

PERFORMANCE SPECIFICATION

Enhanced Compressed Raster Graphic (ECRG)

This specification is approved for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 Scope. This specification provides requirements for the preparation and use of the Enhanced Compressed Raster Graphic (ECRG). ECRG is a general purpose product, comprising computer-readable digital map and chart images with appropriate attribution, as necessary. It is intended to support various weapons, C3I theater battle management, mission planning, and digital moving map systems. ECRG data is derived directly from digital sources through filtering, compression, and reformatting to the ECRG Specification. ECRG files are physically formatted within a National Imagery Transmission Format 2.1 (NITF 2.1) file.

1.1 Purpose. The purpose of this document is to specify the data format and characteristics of ECRG for producers and users.

Comments, suggestions or questions on this document should be addressed to the National Geospatial-Intelligence Agency, National Center for Geospatial Intelligence Standards (NCGIS), Mail Stop P-106, 12310 Sunrise Valley Drive, Reston, VA 20191-3449, or emailed to ncgis-mail@nga.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <http://assist.daps.dla.mil/>.

2. APPLICABLE DOCUMENTS

2.1. General. The documents listed in this section are specified in Sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in Sections 3, 4, or 5 of this specification whether or not they are listed.

2.2. Government documents.

2.2.1. Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL STANDARDIZATION AGREEMENTS

STANAG 2211, Geoid Datums, Spheroids, Grids, and Cell References.

STANAG 7074, DIGEST, Part 2 - Annex D: IMAGE INTERCHANGE FORMAT (IIF) ENCAPSULATION SPECIFICATION

STANAG 7074 DIGEST, DIGEST 2.1 Part 3 Table 7-1 Units of Measure codes.

STANAG 7074 DIGEST, DIGEST 2.1 Part 3 Table 6-5 Projection Codes and Parameters

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-A-89007 - ARC Digitized Raster Graphics (ADRG)

MIL-PRF-89038 - Compressed ARC Digitized Raster Graphics (CADRG)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-2411 - Raster Product Format (RPF)

MIL-STD-2411-1 - Registered Data Values for Raster Product Format and Addendums

MIL-STD-2414A - Bar Coding for Geospatial Products

MIL-STD-2500C - National Imagery Transmission Format
Version 2.1

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2. Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DMA Technical Manual, DMA TM 8358.1, Defense Mapping Agency: Datums, Ellipsoids, Grids, and Grid Reference Systems, First Edition.

NIMA Technical Report, TR 8350.2: World Geodetic System 84, 2d Edition.

(Copies of these publications are available from the National Geospatial-Intelligence Agency, Geospatial Sciences Division at <http://earth-info.nima.mil/GandG/pubs.html>)

ISO/IEC BIIF Profile for JPEG2000, Version 01.00
(BPJ2K01.00)

(Copies of this publication are available from the National Geospatial-Intelligence Agency, NITF Technical Board at <http://gwg.nga.mil/ntb/index.html>)

Map Projections—A Working Manual, U.S. Geological Survey Professional Paper 1395, First Edition, 1987

(Application for copies of USGS documents should be made to U.S. Geological Survey, 507 National Center, Reston, VA 22092. Copies are also available online at <http://pubs.er.usgs.gov/usgspubs/pp/pp1395>)

ECRG Concept of Operations (CONOPS)

(Copies of this publication is available from the National Geospatial-Intelligence Agency, Geospatial Sciences Division at <http://earth-info.nima.mil/GandG/pubs.html>)

2.3. Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents are those cited in the solicitation or contract.

ANSI/IEEE Std. 754-1985, IEEE Standard for Binary Floating Point Arithmetic.

ANSI/IEEE 1003.1, Portable Operating System Interface for Computer Environments (POSIX)

(Copies of these publications are available from the American National Standards Institute (ANSI) at <http://webstore.ansi.org/ansidocstore>)

ISO 9660-1988, Information Processing - Volume and File Structure of CD-ROM for Information Interchange.

ISO/IEC 10149:1995, Information Technology - Data Interchange on Read-Only 120 mm Optical Data Discs (CD-ROM)

ISO/IEC 16448:2002, Information Technology - 120 mm DVD - Read-only disk

ISO/IEC 13346 Parts 1-5, Volume and File Structure of Write-Once and Rewriteable Media Using Nonsequential Recording (NSR) for Information Interchange

ISO/IEC 15444-1:2004, Information Technology - JPEG 2000 image coding system: core coding system

(Copies of these publications are available from the International Organization for Standardization (ISO) at http://isotc.iso.org/livelink/livelink/fetch/2000/2489/Ittf_Home/PubliclyAvailableStandards.htm and <http://www.iso.org/iso/en/prods-services/ISOstore/store.html>.)

TIFF Revision 6.0 June 03, 1992 - TIFF Specification

(Copies of this publication are available from Adobe at <http://partners.adobe.com/public/developer/en/tiff/TIFF6.pdf>)

ESRI Shapefile Technical Description - An ESRI White Paper - July 1998

(Copies of this publication are available from Adobe at <http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>)

Extensible Markup Language (XML) 1.0 (Third Edition)

(Copies of this publication are available at
<http://www.w3.org/TR/2004/REC-xml-20040204/>)

2.4. Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1. First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2. Accuracy.

3.2.1. Vertical Accuracy. Vertical accuracy is the same as that of the original source graphics.

3.2.2. Horizontal Accuracy.

a. The horizontal accuracy of ECRG is dependent upon the horizontal accuracy of the original map or chart from which source data for ECRG was derived.

b. The source data originate in or have been converted to the World Geodetic System 1984 (WGS-84) datum (see 3.3.2). If an image was converted to WGS-84 from another datum, then the latitude and longitude depicted on the source images (and corresponding ECRG images) may no longer align with the latitude and longitude that the gridlines represent.

3.2.3. Radiometric fidelity. The red, green, and blue (RGB) pixels of the ECRG are representations of the colors in the source map or chart. Color differences among maps and charts are not removed in the process of scanning the charts. The ability of output systems (e.g., printers and displays) to faithfully reproduce colors from ECRG data depends on the resolution and color integrity of the output systems.

3.3. Datum.

3.3.1. Vertical datum. The vertical datum for ECRG is the same as the vertical datum of the source data and its source graphics.

3.3.2. Horizontal datum. The horizontal datum for ECRG shall be WGS-84, as defined by DMA TM 8358.1.

3.4. Product description. The ECRG product shall conform to this specification. It will normally be produced directly from source maps of all scales by processing and reformatting into an ECRG frame file structure. Miscellaneous scale maps and charts or non-NGA maps may be the source for ECRG production. The processing includes JPEG2000 compression. ECRG data is arranged in frames with constant pixel sizes, standardized DPI, and constant overlaps (see 3.5.4).

3.4.1. Exchange media and recording formats. The ECRG shall be normally exchanged on Digital Versatile Disc (DVD) or hard-drive disk drives (drives will use either USB or Firewire interfaces). In addition, ECRG may be distributed on recordable compact discs (CD), the NGA Portal, and NIPRnet, among other current and future media. Many of the current media standards, listed in Table I, and recording format standards for these media are as specified in this document.

Table I. ECRG media standards.

Interchange Media	Recording Standard	Volume/File Structure
CD-ROM		UDF v1.5
DVD		UDF v1.5
Hard-drive		NTFS
NGA Portal		FTP/HTTP
NIPRNet		FTP/HTTP
SIPRNet		FTP/HTTP
JWICS		FTP/HTTP
DREN		FTP/HTTP

3.4.2. Source digitized graphics. ECRG is derived from digital source maps, like ADRG, and other miscellaneous maps/charts or non-NGA maps. The ECRG scales and original source maps and their codes are based on the original ADRG scales and codes located in Section 5.1.4 of the MIL-STD-2411-1. These codes are used within the frame file designator names, as specified in Section A.2.6 of APPENDIX A.

3.4.3. Projection system. The ARC system, as described in MIL-A-89007, divides the surface of the earth ellipsoid into 18 latitudinal bands called zones. Zones 1-9 cover the Northern hemisphere and zones 10-18 (labeled A through J, exclusive of I) cover the Southern hemisphere. One zone in each hemisphere covers the polar areas. Each non-polar zone covers a part of the ellipsoid between two latitude limits and completely encircles the Earth. The nominal zone limits for ECRG are the same as for ADRG, as listed in Table II. The extents of the ECRG zone overlaps are defined in Section D.2.1.5 of APPENDIX D.

Table II. ECRG zone limits.

Zone Number	Equatorward Latitude	Midpoint Latitude	Poleward Latitude
1,A	0°	22.94791772°	32°
2,B	32°	41.12682127°	48°
3,C	48°	52.28859923°	56°
4,D	56°	60.32378942°	64°
5,E	64°	66.09421768°	68°
6,F	68°	70.10896259°	72°
7,G	72°	74.13230145°	76°
8,H	76°	78.17283750°	80°
9,J	80°	—	90°

3.4.4. Distribution frames. The ECRG database is composed of rectangular grids of frames of pixels for each zone. ECRG can be distributed in rectangular or non-rectangular areas, and with contiguous or non-contiguous coverage (i.e., areas separated by large expanses of water, or multiple discrete maps for which no contiguous maps exist). Each frame is represented by a discrete file. The ECRG library is seamless; that is, 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 frame abuts the data of neighboring frames exactly to provide unbroken coverage. Gaps in coverage exist where the source coverage does not exist. The boundaries of the

distribution frames (see 3.5) are not required to coincide with the source map edges.

3.4.5. Data file organization. ECRG data files are arranged in a hierarchical directory/subdirectory structure (see FIGURE 1 and FIGURE 2). The ECRG directories and data files, enumerated below, are fully described in Paragraphs 3.10 through 3.11. All names and labels, and the format and structure of directories are similar to those used in RPF (MIL-STD-2411) with any differences addressed by this specification. Any computer system that can access distribution media conforming to the standards listed in Table I should be able to access ECRG data.

a. Root Directory: Contains [table of contents file], one or more directories of [frame file]s, and possibly a [legend directory]. The root directory shall be named "EPF".

```
(Level 0) EPF [EPF root directory] (unordered)
  (Level 1) TOC.xml [table of contents file]
  (Level 1) CURRENCY.xml [currency file] (optional)
  (Level 1) LEGEND [legend directory]
    (Level 2) [legend file] (0, ... many)
  (Level 1) SHAPEFILES [shapefiles directory]
    (Level 2) [shapefiles] (1, ... many)
  (Level 1) [frame directory] (0, ... many)
    (Level 2) [frame file] (0, ... many)
    (Level 2...m) [subordinate directory] (0,...many)
      (Level 3...n) [frame file] (0, ... many)
```

FIGURE 1. ECRG directory and file structure.

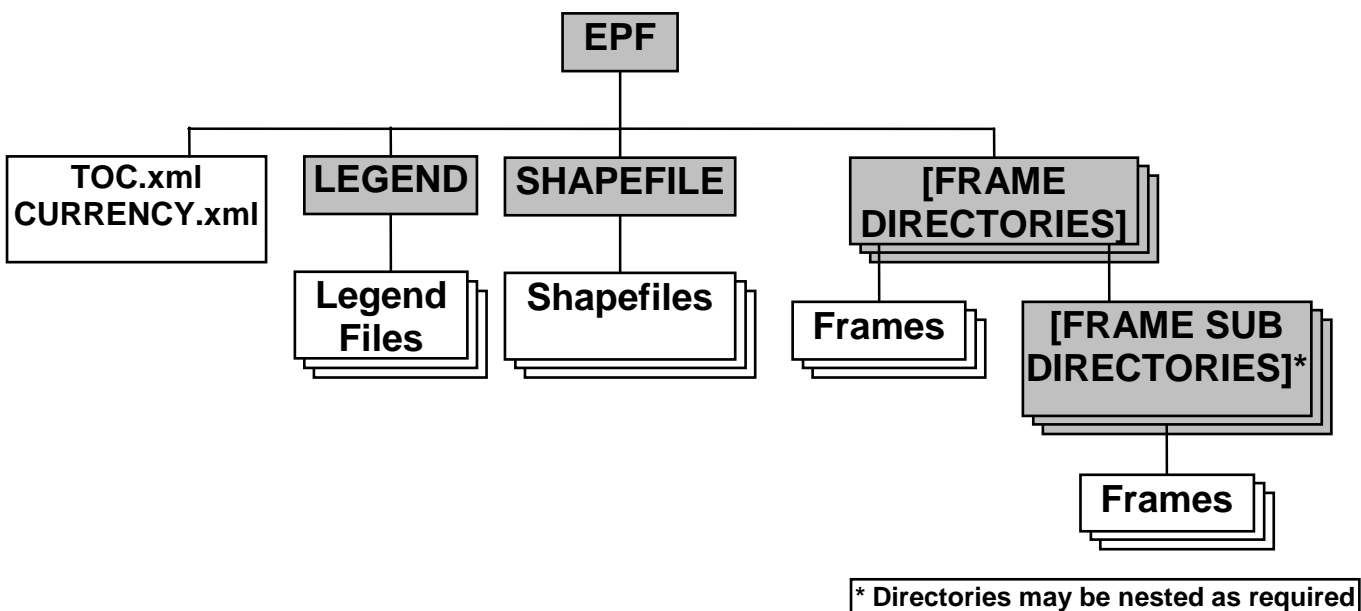


FIGURE 2. Pictorial representation of ECRG directory and file structure.

b. [table of contents file] and [currency file]: The [table of contents file] provides an overview of the data contents of the distribution media. The TOC will be in an XML format and will contain a header specification, registered extension list, frame list by scale, and media metadata. The details of the TOC are provided in Section C.2.3.1. The currency file is not required for all map types, but may be present. For additional details refer to C.2.3.2 and the ECRG CONOPS.

c. [LEGEND directory]: Contains the product specific legends associated with the frames on the media (ICM legends, etc), if available.

d. [Legend files]: Individual legend files, if available, will be referenced in the XML.toc file. The legend files will be stored in a TIFF format with the following parameters:

Bytes per pixel:	3 bytes per pixel (8 bits per band, RGB)
Color lookup table:	No
Transparency:	<Not applicable>
Compression:	Uncompressed, LZW (Lossless) or JPEG DCT (Lossy)
Tiling (Blocking):	None (Untiled)
Overviews:	None
DPI:	254
Maximum rows:	8192
Maximum cols:	8192

There can be zero or more legend files. Multiple legend files can be used as necessary to provide adequate coverage. The actual legend file naming convention will be addressed in the ECRG CONOPS.

e. [SHAPEFILE directory]: Contains the shapefiles pertaining to the products on the media.

f. [Shapefile files]: The shapefiles will include the extents of all included frames with name, date, and scale attribution. The shapefiles will also include the extents of all source used to produce the frames on the media with name, date, and scale attribution. The shapefiles will be provided in standard ESRI shapefile format. Shapefiles for ECRG are described in more detail in APPENDIX C.2.2.3.

g. [frame file directory]s: ECRG producers will choose the number of [frame file directory]s in a given volume and convention for assigning [frame file]s to directories. Each [frame file directory] on a given interchange volume shall be uniquely named in a manner to be determined by an authorized producer. The producers may also assign nested [frame file directory]s as needed to organize the [frame file]s, using a variable hierarchy of arbitrary depth.

h. [frame file]s: The [frame file]s contain the tiled image and support data for the geographic frames on an ECRG interchange volume. Particular details of some of the contents of the frame file are described in Section C.2 of APPENDIX C.2. The [frame file] naming convention shall be in accordance with this specification, and is described in Section A.2.6 of APPENDIX A.

3.5. Frame and virtual subframe structure.

3.5.1. Pixel spacing. Using ADRG as an example and currently the most prominent source for ECRG, the original source graphics are scanned at a 100 micron (μ) pixel resolution (254 pixels per inch) in both East-West and North-South directions, and then warped from the datum of the original paper map or chart to the ARC projection using the WGS-84 ellipsoid. For each map or chart scale, a constant latitudinal (row) and longitudinal (column) pixel interval shall exist in each zone, as defined in APPENDIX D. The numbers of ECRG pixels in the longitudinal direction shall be adjusted so that there are integral numbers of virtual subframes per zone (Refer to Section 3.5.2 for an explanation of virtual subframes). In the polar zone, the number of ECRG pixels is adjusted so that there is an even number of virtual subframes across the zone in each dimension. The minimum resolution of ECRG shall be 254 DPI, but higher resolutions will be allowed.

3.5.2. Frame and virtual subframe tiling.

a. Frames will have a minimum DPI of 254; a 254 DPI frame shall be comprised by a rectangular array of 2304 by 2304 pixels (5,308,416 pixels). For other DPIs, the frame size will need to be calculated with the equations beginning in section D.2.1.1. Unlike RPF frames, ECRG frames will not be tiled into subframes, but a virtual grid of 6 by 6 virtual subframes is used for mathematical purposes in this specification (36 virtual subframes). Each 254 DPI virtual subframe shall comprise a rectangular array of 384 by 384 output pixels (147,456 pixels). For other DPIs, K (virtual subframe size) will need to be calculated with the equations beginning in section D.2.1.1. Virtual subframes shall be numbered as depicted in FIGURE 3. Virtual Subframes are not actual tiles within the image, but are included for frame row and column calculations in APPENDIX D.

b. All frames and virtual subframes within a zone shall abut in a mutually exclusive manner without any pixel overlap or pixel redundancy. The northern and southern boundaries of a zone generally will not fall exactly on the northern and southern boundaries of a frame or virtual subframe. There shall be frame overlap between the zones, as defined in Section 3.5.4.

c. For several scales of source product, APPENDIX D lists the number of frame and virtual subframe rows and columns in each zone for the latitudinal and longitudinal directions, East-

West pixel spacing constants (i.e., the number of pixels for 3D.2° longitude), North-South pixel spacing constants (i.e., number of pixels in 90° from equator to pole), longitudinal pixel sizes (meters) for each zone, and the latitudinal pixel sizes (meters), based on DPI.

d. The midpoint latitude for each zone shall be the same as for the ADRG ARC-zone schematic (see 3.4.3).

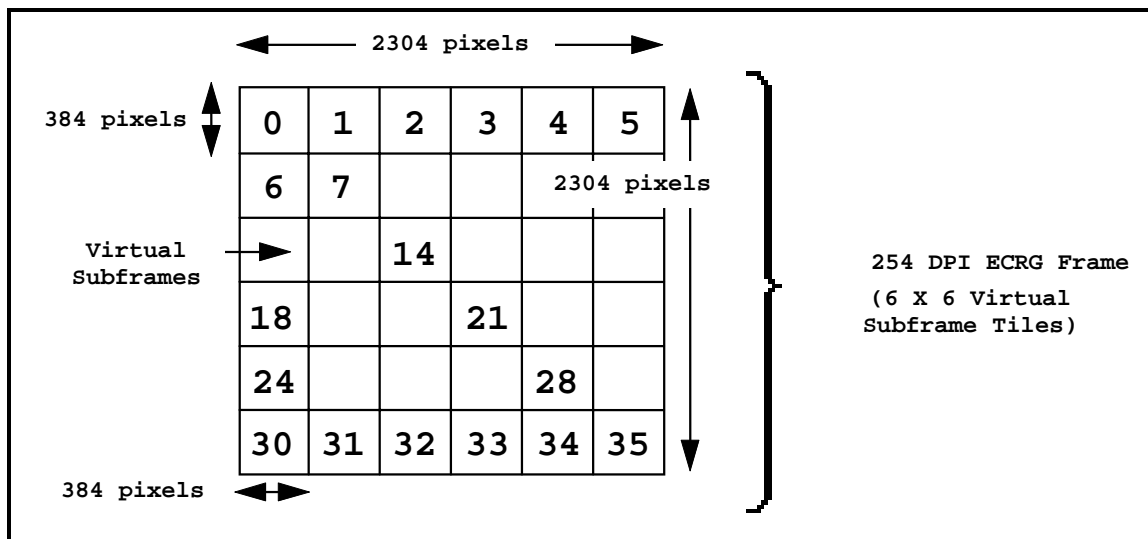


FIGURE 3. ECRG frame/subframe structure.

3.5.3. Numbering and origin conventions.

a. All index numbers shall start from 0. Rows and columns of virtual subframes in a frame, pixels, and indices in frame file sub-entities shall be counted from 0. The origin for the virtual subframe and pixel numbering within frames and virtual subframes shall be from the upper left corner. Virtual Subframes and pixels shall be counted in row-major order from the origin. APPENDIX A provides a set of coordinate conversions between pixel rows and columns within frames, and the latitude and longitude of a point within a frame based upon the coordinate information provided within each frame file.

b. In addition, ECRG frames may be considered to form conceptual "rows" and "columns" within zones. Section A.2.6 of APPENDIX A. uses this concept to define the naming convention of frames for various scales by using the scale and zone specific "frame number." The rows and columns are numbered from 0. The

origin for counting non-polar frame rows and columns in both the northern and southern hemispheres is the southernmost latitude of the zone, and 180° west longitude, with columns counted in an easterly direction from that origin. The origin for counting polar frames (see 3.5.5) is the lower-left corner of the polar zone, with rows and columns numbered from that origin. Section A.2 of APPENDIX A provides the coordinate conversions for points within a frame file.

3.5.4. Non-polar frame overlap.

a. The longitudinal and latitudinal extents of the zones in the southern hemisphere are identical to those in the northern hemisphere.

b. Rows of frames from different zones do not have the same longitudinal extent since the longitudinal pixel intervals differ.

c. For each non-polar zone N, the top-most frame row of that zone corresponds in latitude with the bottom-most frame row of zone N+1 (as depicted in FIGURE 4). Thus the frames at the top and bottom rows of each zone shall overlap frames of those zones above and below. The zone overlap shall be a full frame.

3.5.5. Frame and Virtual subframe structure for polar regions. The ECRG frame and virtual subframe structure is unique in the polar regions, in conjunction with the source products. ECRG shall use a polar stereographic projection, in which meridians (constant longitude) are plotted as radii emanating from the poles, and parallels (constant latitude) are plotted as concentric circles that are centered at the poles.

a. The north and south polar zones, 9 and J, are depicted in FIGURE 5 and FIGURE 6, respectively. These zones are circular with the pole at the center and the radius being the distance from the pole to 80° (north or south) latitude. The polar frame structure is square. The center frame is positioned with the pole in the exact center of that frame and the sides of the frame making right angles with the 0°, 90°E, 180°W, and 90°W meridians. The origin for polar zone frame rows and columns (see 3.5.3.b) is the lower-left corner of the zone. Polar ECRG frames are not all oriented along the north-south and east-west directions. Further detail on the frame structure and orientation is provided in APPENDIX D.

b. The pixel coordinate system for polar zones is centered at the pole. Polar zone pixels are transformed from (<X>, <Y>) pixel row and column coordinates to latitude and longitude coordinates in degrees, as described in Section A.2 of APPENDIX A. Pixel resolutions and sizes are not constant in a left-right or up-down direction. The number of pixels in the polar zone is adjusted so that there are an even number of virtual subframes centered about the poles. There are an odd number of frames with symmetry about the pole. APPENDIX D provides calculations to compute average frame pixel resolution.

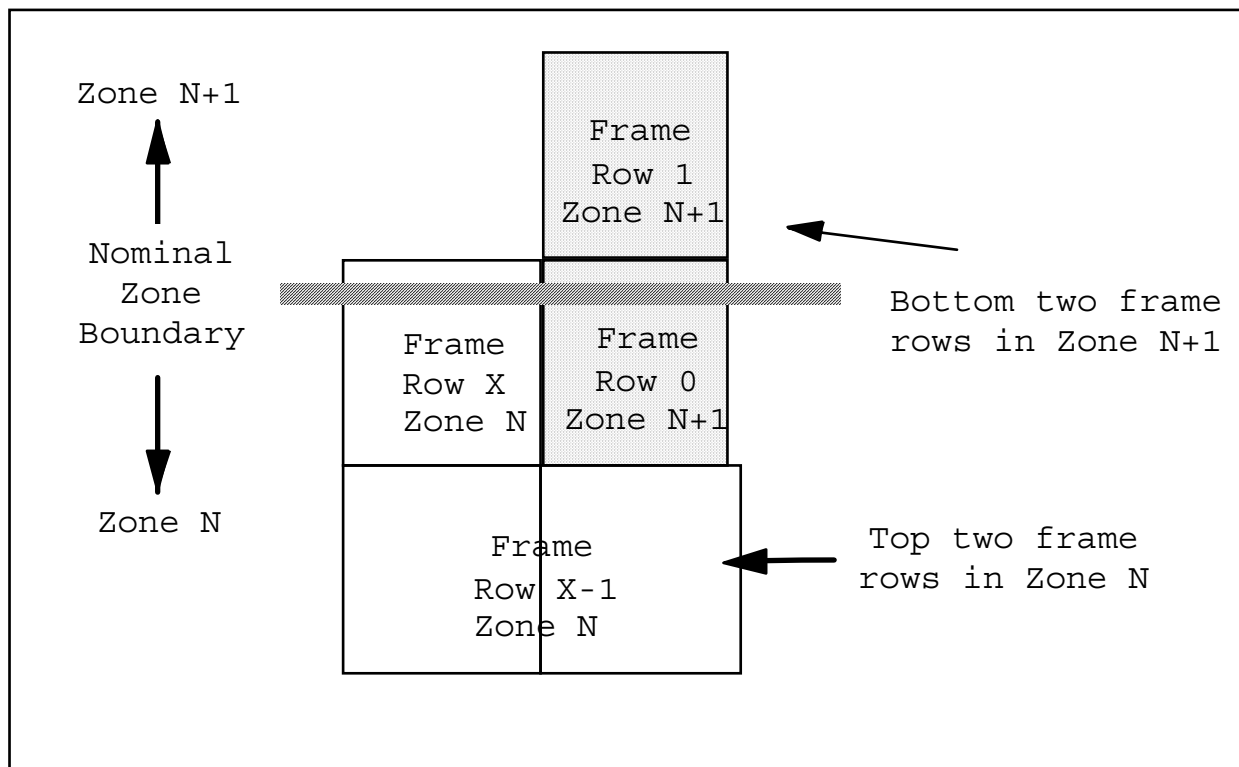


FIGURE 4. ECRG zone boundary overlap structure.

3.5.6. Polar zone overlap. Polar zone overlap is limited by the source data. Polar frames are defined in polar stereographic projection and non-polar frames are in the ARC projection. Based on ADRG polar overlap characteristics, which often does not provide any overlap (below 80 degrees) in the polar zones, the overlap in zones 8 and H are limited to 1024 pixels in 254 DPI ECRG. Thus, all "overlap" between zones 8 and H and the associated polar zones will be contained in zones 8 and H. Polar data will not be transformed to the ARC projection to provide a full 2304 pixels (at 254 DPI) of overlap.

3.6. Coordinate reference systems.

3.6.1. Non-polar coordinates. Coordinates for row and column pixels in the non-polar zones are proportional to WGS-84 latitude and longitude of map features under the Equirectangular projection (as defined in *Map Projections—A Working Manual*, page 90). The coordinate conversions for the non-polar case are in Sections A.2.2 and A.2.3 of APPENDIX A.

3.6.2. Polar coordinates. Pixel coordinates in the polar zones are proportional to rectangular coordinates of the Azimuthal Equidistant projection, polar aspect, spherical form (as defined in *Map Projections—A Working Manual*, page 191). The coordinate conversions for the polar case are provided in Sections A.2.4 and A.2.5 of APPENDIX A.

3.6.3. WGS-84 coordinates. The WGS-84 coordinates for longitude and latitude in ECRG are signed values in the range $-180^\circ \leq \text{longitude} \leq +180^\circ$ and $-90^\circ \leq \text{latitude} \leq +90^\circ$.

3.7. Projection distortion.

3.7.1. Non-polar distortion. For the non-polar zones, some visual distortion is present due to a stretch (at the poleward latitude) and shrink (at equatorward latitude) in the East-West direction. There is no distortion (i.e., the nominal pixel interval is true) along a selected parallel at the mid-latitude (see Table II) of each zone. The maximum stretch or shrink at the zone boundaries is the same as found in source. Since an entire [frame file] of overlap is included between zones, there can be noticeable visual distortion in the overlap area for the very small scale maps (e.g. GNC, JNC).

3.7.2. Polar distortion. Distortion in the polar zones is less than 10% for most scales.

3.8. Image formats. Each ECRG interchange volume contains compressed, transformed images from multiple source maps. The contents of many source map sheets are contained on a single ECRG Media; this number varies with map series, media size, and specific publication requirement. These are recorded in [frame file]s (see 3.11). A compressed JPEG2000 image segment exists for each ECRG frame. In cases where map source does not exist, blank areas of frames shall be padded with black pixels (in RGB as 0,0,0) in order to fully populate the frame extent. The source polygons stored in the SOURCB TRE may also be used to determine exact areas without source.

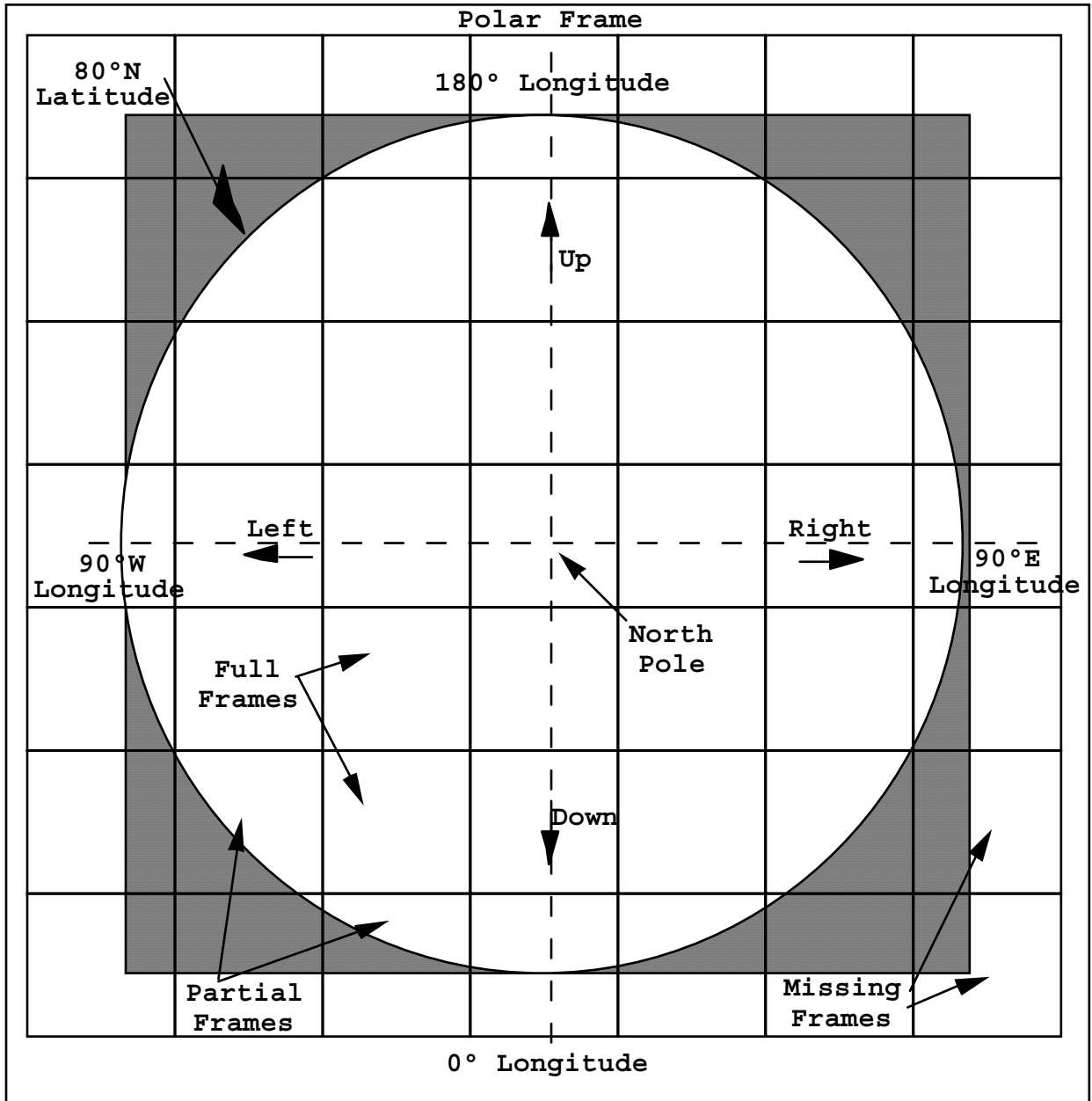


FIGURE 5. Frame orientation for the north polar zone.

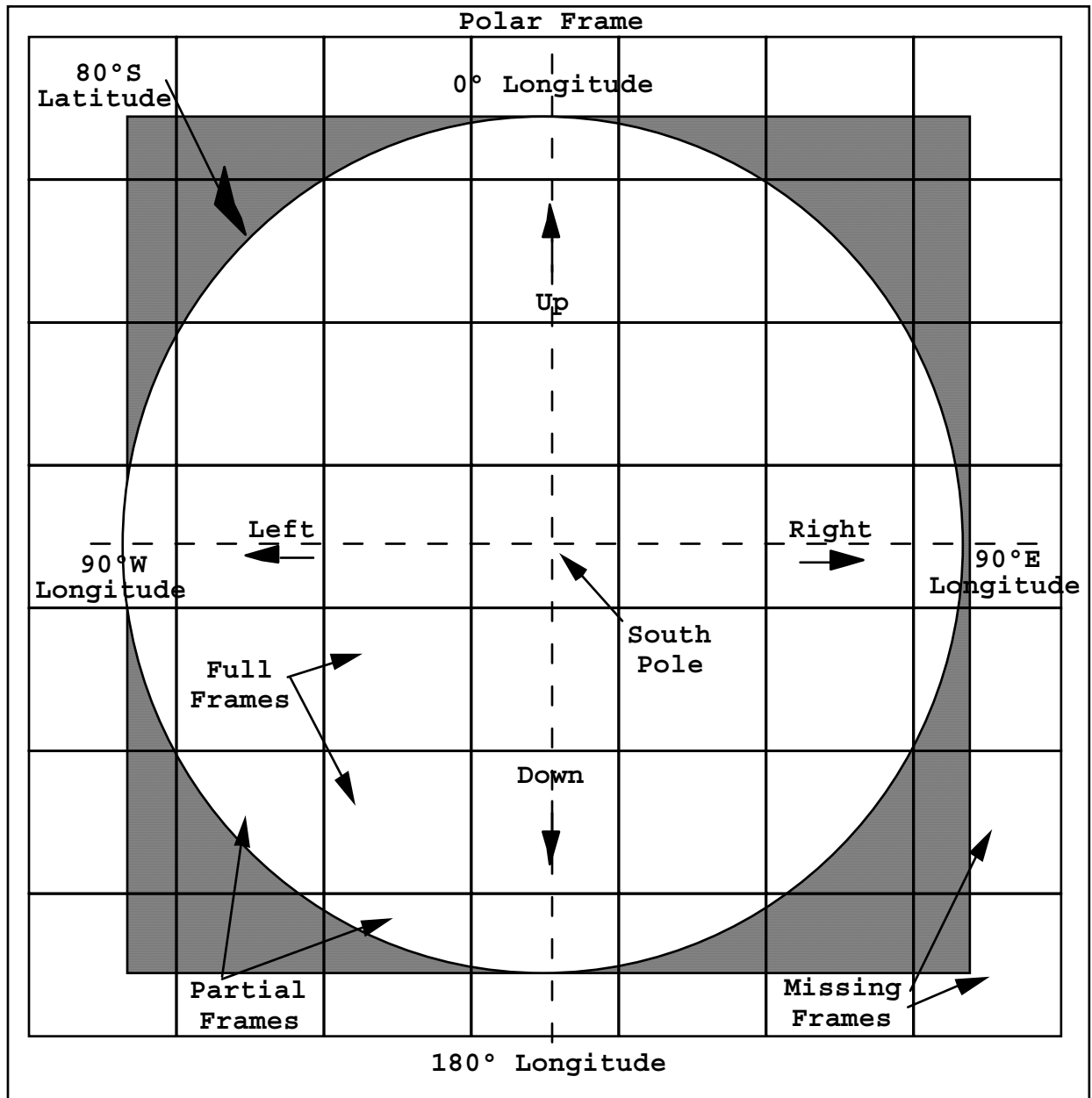


FIGURE 6. Frame orientation for the south polar zone.

3.9. Preparation of source material.

3.9.1. Source data. The source data for ECRG production is digital map data, like ADRG, or other maps and charts. Any map information that is included in these data sources at the time of ECRG production may be included for distribution. ECRG updates will be incorporated concurrently with updates to the source data. It will be possible to directly update ECRG digital image data with digital map updates.

3.9.2. Spatial reduction/filtering. There will be no designated spatial reduction in ECRG. 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 (specifically ADRG source at 254 DPI). A specific algorithm may be recommended or required in the future for ECRG production.

3.9.3. Color reduction. An ECRG frame will use 24 bit color (approximately 16.7 million colors). As long as the source images are 24 bit color or less, no color reduction will be performed.

3.9.4. Compression algorithm. Spatial compression shall be performed using JPEG 2000 with a standard compression ratio of 20:1. The 9-7I Wavelet Transform with Irreversible Component Transform (ICT) shall be used to compress the source image. No internal tiling will occur, so the tile size shall be equal to the frame size. Five (5) Decomposition layers will be used to allow for six (6) viewing resolutions. JPEG2000 details are provided in Section C.2.2 and NITF 2.1 details are provided in Section C.2.1.

3.10. ECRG volume support data. Each ECRG volume shall contain support information for the [frame file]s contained therein. This information shall consist of:

- An XML TOC File
- An XML Currency File
- Shapefiles containing source and frame extents on the volume

These files correspond to ECRG media, not to individual frames. In other words, there won't be a TOC or XML for each frame file. Details about the above volume support data are provided in Section C.2.3. Additional details regarding the Currency File are located in the ECRG CONOPS.

3.11. The frame file. The data for each ECRG frame is provided in separate frame files. ECRG frames shall be formatted within a NITF 2.1 file. ECRG frames contain the JPEG2000 compressed image and a variety of metadata about the frame. Details are provided in Sections C.2.1 and C.2.2.

3.12. Storage requirements. Including overhead, the ECRG image data is approximately 20:1 compressed with respect to the source image data. The storage requirements for these items are discussed in APPENDIX B. Multiple volumes and/or storage on other distribution media will be appropriate to the data capacity of that media.

3.13. ECRG decompression. All information required for decompression of an ECRG frame file is contained within the file itself. Most importantly, software shall be written to support variable resolution (DPI).

3.14. ECRG Frame Revision History. The ECRG Frame Revision History will be stored in the first NITF Text Segment. The ECRG Frame Revision history is based on Section 5.1.6 of MIL-STD-2411. The reference/update table described in 5.1.6 of MIL-STD-2411 will use the ECRG naming conventions and is stored as ASCII text within the NITF Text segment.

3.15. ECRG Frame Description. The ECRG Frame Description will be stored in the second NITF Text segment. The Frame Description is intended to be a placeholder for storing additional metadata about ECRG frames. Specific production requirements for the ECRG frame description will be specified in the ECRG CONOPS.

3.15.1. Media labeling. ECRG Media will be labeled as specified in the ECRG CONOPS.

3.15.2. Catalog indexing. Each Media in the ECRG library shall be indexed to facilitate configuration management, including updates, additions, and replacements. The exact format for ECRG Catalog number shall be specified in the ECRG CONOPS, but the first five positions shall always be "ECRGX".

3.16. Distribution. Interchange volumes may include any reasonable combination of the ECRG and other data on the same volume. In addition, ECRG data from multiple scales may be included on a volume.

3.16.1. Standard distribution. Standard packaging of ECRG by NGA will be as follows:

a. In support of aeronautical combat operations, aeronautical charts of ECRG will be packaged in three distinct groupings: GNC and JNC, ONC and TPC, and JOG.

b. Other ECRG products (TLM datasets, nautical charts, classified materials, etc.) will be packaged by type and may be either uniform or mixed in scale.

c. ECRG of non-NGA charts will generally be packaged in a manner corresponding to their NGA counterparts. For example, UK LFC and TFC would be packaged as if they were TPC and JOG.

3.16.2. Non-standard distribution. In support of crisis, special, and/or reoccurring broad-based user requirements, ECRG will be geopackaged vertically (all scales) and with other products covering discrete geographic regions. For example, data sets can be identified for test ranges, major training centers, crisis areas, or by other common thematic content where integrated datasets with mixed data types and scales are needed by large numbers of users.

4. QUALITY ASSURANCE PROVISIONS

4.1. Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2).
- b. Quality conformance inspection (see 4.3).

4.2. First article inspection. When a first article inspection is required (see 3.1 and 6.3), it shall be examined for defects and tested as specified in 4.3.1.

4.3. Quality conformance inspection. The ECRG frame files shall be examined for defects and errors as specified in 4.3.1. Required corrections shall be made to all files before being sent to the next production stage. Defects detected during the inspection of the frame files shall be evaluated by NGA for criticality a suitable corrective action.

4.3.1. Tests. The following classes of defects and errors will be tested for:

a. Horizontal Accuracy. Frame files will be inspected to ensure that a horizontal accuracy of plus or minus one-half pixel with respect to the source used to create the ECRG frame is maintained.

b. Visual Appearance. Each frame file will be inspected for overall color appearance. Each frame file will be inspected for feature loss due to color appearance.

c. Attribute Data. Frame files will be inspected to ensure the accuracy of textual attribute data.

d. Standards Compliance. Each frame file will be inspected to ensure compliance with ISO 9660 (as necessary) and this specification.

5. PACKAGING

5.1. Packaging. For acquisitions purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military service's system Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1. Intended use. ECRG data is military-unique because it is designed to support various weapons, C3I theater battle management, mission planning, and digital moving map systems for military aircraft.

a. ECRG image data is of appropriate size and quality for use in military command and control systems, ground-based force to unit-level mission planning systems, and aircraft cockpit "moving map" displays. ECRG is intended to satisfy the needs of a broad range of users in its compression ratio, display and print quality and displayed screen size.

b. The image compression of ECRG compared to source ADRG and other source offers distinct operational, logistical, and supportability benefits to many users of digitized map/chart and imagery data. It permits the same datasets to be used for both ground-based and aircraft cockpit displays, offers significant savings in media storage/transportation and peripheral costs, results in faster data loading times and requires less frequent reloading of hard disks from media. It also allows multiple scale and product types to be placed on interchange media for geographic areas of interest.

6.2. Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.2.2).
- c. When a first article is required (see 3.1, 4.2, and 6.3).

6.3. First article. When a first article is required, it shall be inspected and approved under appropriate provisions of the production contract. The contracting officer shall specify the appropriate type of first article and the number of units to be furnished. The contracting officer shall also include specific instructions in acquisition documents regarding arrangements for selection, inspection, and approval of the first article.

6.4. Subject term (key word) listing.

a. Key Words

ADRG
ARC
CADRG
DVD
ECRG
JPEG2000
NITF
Pixel

b. Acronyms

ADRG	ARC Digitized Raster Graphics
ANSI	American National Standards Institute
ARC	Equal Arc-Second Raster Chart
ATC	Air Target Chart
CADRG	Compressed Arc Digitized Raster Graphic
CD-R	Compact Disc - Recordable
CD-ROM	Compact Disc - Read Only Memory
DVD	Digital Versatile Disc (or Digital Video Disc)

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DIS	Draft International Standard
DMA	Defense Mapping Agency, the predecessor agency to NGA
ECRG	Enhanced Compressed Raster Graphic
FIPS PUB	Federal Information Processing Standard Publication
GNC	Global Navigation Chart
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFS	Independent File System
ISO	International Standards Organization
JNC	Jet Navigation Chart
JOG	Joint Operations Graphic
JOG-A	Joint Operations Graphic – Air
JWICS	Joint Worldwide Intelligence Communications System
LFC	Low Flying Chart (UK)
NGA	National Geospatial-Intelligence Agency Unclassified but Sensitive Internet Protocol Router Network
NIPRNet	Non-Classified Internet Protocol Router Network Non-Classified Internet Protocol Router Network
ONC	Operational Navigation Chart
RGB	Red-Green-Blue
SIPRNet	Secret Internet Protocol Router Network
TFC	Transit Flying Chart (UK)
TLM	Topographic Line Map
TPC	Tactical Pilotage Chart
WGS-84	World Geodetic System – 1984

6.5. International standardization agreements. Certain provisions of this specification may be subject to international standardization agreements. When amendment, revision, or

cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.5.1. NATO Standardization Agreements (STANAGs).

STANAG 2211, "Geodetic Datums, Spheroids, Grids, and Cell References."

STANAG 7074, DIGEST, Part 2 - Annex D: IMAGE INTERCHANGE FORMAT (IIF) ENCAPSULATION SPECIFICATION

6.6 NGA operational help desk. For questions concerning this or other NGA products, services, or specifications, please telephone the NGA Operational Help Desk at 1-800-455-0899, Commercial 314-263-4864, or DSN 693-4864.

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APPENDIX A
COORDINATE TRANSFORMATION RELATIONSHIPS

A. COORDINATE TRANSFORMATION RELATIONSHIPS

A.1 SCOPE

A.1.1 Scope. This appendix provides the coordinate transformation relationships between the latitude and longitude of points and the rows and columns of virtual subframes and pixels within a [frame file]. It also defines a conceptual grid of [frame file]s that can be used by producers and receivers to configuration manage datasets, and it provides a naming convention to be used for many scales of maps. This appendix is a mandatory part of the specification.

A.2 COORDINATE TRANSFORMATIONS

A.2.1 References for the ARC system projection. Non-polar zone equations are based on the Equirectangular projection. Polar zone equations are based on the Azimuthal Equidistant projection, polar aspect, and spherical form. Coordinate values are in the range $-180^\circ \leq \text{longitude } (\lambda) \leq +180^\circ$ and $-90^\circ \leq \text{latitude } (\Phi) \leq +90^\circ$. West longitudes are negative; East longitudes are positive; South latitudes are negative; North latitudes are positive. Table A-I and Table A-II list the parameters used, respectively, for the non-polar and polar coordinate computations.

a. For the polar case, the relationship between the pixel locations, and geodetic latitude and longitude shall adhere to the convention defined in MIL-A-89007 (Sections 30.4.1 and 30.4.2 of that document). Specifically, pixels in the polar region are mapped into a pixel coordinate system that is centered at the pole itself, to facilitate the transformations from pixel coordinates to latitude and longitude.

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Table A-I. Non-polar coordinate conversion parameters.

Parameter	Description
(r_{Fz} , c_{Fz})	Row and column number of a ECRG frame in zone z for scale s.
(R, C)	Maximum number of rows and columns within contiguous grid for zone z and scale s.
n_{sz}	Cumulative frame number at scale s (1:S) within zone z .
(r_{PF} , c_{PF})	Row and column number of a pixel within a frame.
(Φ , λ)	Latitude, longitude of point in WGS-84 coordinates.
(Φ_F , λ_F)	Latitude, longitude of frame origin for non-polar.
(Φ_{sz} , λ_z)	Latitude, longitude of ARC non-polar origin of scale s and zone z ($\lambda_z = -180^\circ$).
A_{sdz}	East-West Pixel Constant for scale 1:S, DPI d, and zone z.
B_{sd}	North-South Pixel Constant for scale 1:S, DPI d, in all zones.
P_F	Number of pixels in each dimension of a frame ::>=2304.

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Table A-II. Polar coordinate conversion parameters.

Parameter	Description
(r _F , c _{Fz})	Row and column number of a ECRG frame in a polar zone
(r _{PF} , c _{PF})	Row and column number of a pixel within a frame.
(Φ, λ)	Latitude and longitude of a point in WGS-84 coordinates.
(<X>, <Y>)	Projection coordinates of a pixel with respect to pole.
C _S	Polar Pixel Constant for scale 1:S divided by 360°.
P _F	Number of pixels in each dimension of a frame ::>=2304.
R	Number of pixels from a pole to side of frame structure

b. For very large scale maps or charts (e.g., greater than 1:2000) discrete [frame file]s will be produced as appropriate. Note that the ECRG naming convention can handle scales as large as ~1:2 (per Section A.2.6). A theoretical gridding of contiguous frames shall be defined by the producers for each scale and zone. Some frames within these contiguous grids will never be produced (for example, if no source map or chart exists that includes the predefined area of the entire frame) and some frames will be only partially filled (for example, if the source map or chart exists for only a portion of the predefined area of the frame). This contiguous grid is for configuration management of the [frame file]s and the frame naming convention (see Section A.2.6). Within each zone grid, an absolute frame numbering is defined within each zone at each scale. The frame numbers start from 0 at the left, southernmost corner of each zone, increase in row-major order left to right for each row, and end at the right, northernmost corner of the zone.

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COORDINATE TRANSFORMATION RELATIONSHIPS

c. The numbers of frame and virtual subframe rows and columns, the pixel constants, and the exact latitudinal zone extents (adjusted for DPI) are provided in APPENDIX D (in TABLE D-I through TABLE D-IX).

A.2.2 Non-polar latitude and longitude of an ECRG frame pixel. The following equations may be used to obtain the latitude (Φ) and longitude (λ) of a pixel. The latitude of a pixel is a function of the frame row number (see 3.5.3.b) and pixel row number within the frame. The longitude of a pixel is a function of the frame column number (see 3.5.3.b) for its zone, and pixel column number within the frame (see Figure A-1). The latitude and longitude of a pixel can be determined relative to the origin (Φ_F , λ_F) of a frame (i.e., upper-left corner latitude and longitude) as provided in the frame metadata. The latitudes and longitudes used in the conversion equations are signed real numbers with a negative number signifying southern or western hemisphere, respectively.

A.2.2.1 Pixel row coordinate to latitude coordinate equation.

$$\phi = \phi_F - \frac{90^\circ}{B_S} * r_{PF} \quad (1)$$

A.2.2.2 Pixel column coordinate to longitude coordinate equation.

$$\lambda = \lambda_F + \frac{360^\circ}{A_{SZ}} * c_{PF} \quad (2)$$

A.2.3 Non-polar frame pixel coordinates of a geographic point. The following equations can be used to obtain the frame and pixel row and column numbers (r_{Fz} , c_{Fz} , r_{FP} and c_{FP}) of a point, given the latitude and longitude of the point (see Figure A-1). The zone of the point is determined by zone extents with overlap (APPENDIX D, TABLE D-I through TABLE D-IX).

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A.2.3.1 Latitude equations. Calculate the frame row within the zone,

$$r_{FZ} = \text{INT} \left\{ \frac{\phi - \phi_Z * \frac{B_s}{P_F}}{90^\circ} \right\} \quad (3)$$

and then the latitude of the frame origin (ϕ_F , the latitude of the northwest corner of the frame),

$$\phi_F = \frac{90^\circ}{B_s} * P_F * (r_{FZ} + 1) + \phi_Z \quad (4)$$

and finally the pixel row with respect to the frame origin,

$$r_{PF} = \frac{\phi_F - \phi}{90^\circ} * B_s \quad (5)$$

A.2.3.2 Longitude equations. Calculate the frame column within the zone,

$$c_{FZ} = \text{INT} \left\{ \frac{\lambda - \lambda_Z * \frac{A_{SZ}}{P_F}}{360^\circ} \right\} \quad (6)$$

where: $90^\circ/B_s$::= <latitude/vertical interval> for pixels
 $360^\circ/A_{SZ}$::= <longitude/horizontal interval> for pixels
and ϕ_F ::= <northwest/upper left latitude> of frame
 λ_F ::= <northwest/upper left longitude> of frame

and then the longitude of the frame origin (λ_F , the longitude of the northwest corner of the frame),

$$\lambda_F = \frac{360^\circ}{A_{SZ}} * P_F * (c_{FZ} + \lambda_Z) \quad (7)$$

and finally the pixel column with respect to the frame origin,

$$c_{PF} = \frac{\lambda - \lambda_F}{360^\circ} * A_{SZ} \quad (8)$$

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A.2.4 Polar latitude and longitude of an ECRG frame pixel.

A.2.4.1 North polar region. Given the projection coordinates of a point ($\langle X \rangle$, $\langle Y \rangle$) with respect to the north pole, its latitude and longitude in degrees shall be computed as follows (see Figure A-2):

$$\phi = 90^\circ - \left[\frac{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}}{C_s} \right] \quad (9)$$

$$\lambda = \text{ACOS} \left[\frac{-\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \quad \text{for } X > 0 \quad (10)$$

$$\lambda = -\text{ACOS} \left[\frac{-\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \quad \text{for } X < 0 \quad (11)$$

where: $\lambda = 180^\circ$ for [$\langle X \rangle = 0$ and $\langle Y \rangle > 0$];
and $\lambda = 0^\circ$ for [$\langle X \rangle = 0$ and $\langle Y \rangle \leq 0$];
and $0^\circ \leq \text{ACOS} \left[\frac{-\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \leq 180^\circ$

A.2.4.2 South polar region. Given the projection coordinates of a point ($\langle X \rangle$, $\langle Y \rangle$) with respect to the south pole, its latitude and longitude in degrees shall be computed as follows (see Figure A-3):

$$\phi = -90^\circ + \left[\frac{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}}{C_s} \right] \quad (12)$$

$$\lambda = \text{ACOS} \left[\frac{\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \quad \text{for } \langle X \rangle > 0 \quad (13)$$

$$\lambda = -\text{ACOS} \left[\frac{\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \quad \text{for } \langle X \rangle < 0 \quad (14)$$

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where: $\lambda = 0^\circ$ for [$\langle X \rangle = 0$ and $\langle Y \rangle \geq 0$];
 and $\lambda = 180^\circ$ for [$\langle X \rangle = 0$ and $\langle Y \rangle < 0$];
 and $0^\circ \leq \text{ACOS} \left[\frac{\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \leq 180^\circ$.

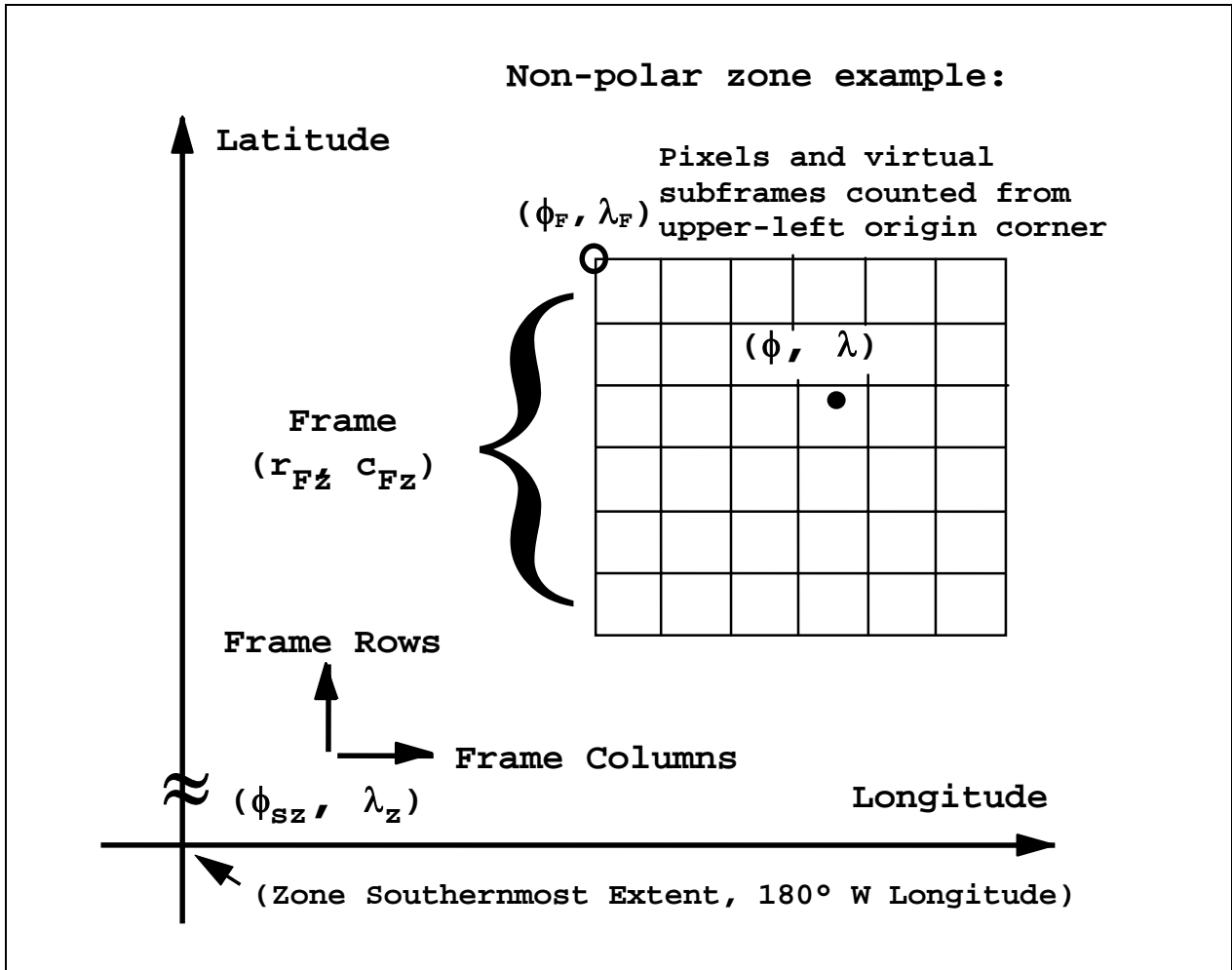


Figure A-1. Coordinate transformation in non-polar zones.

A.2.5 Polar frame pixel coordinates of a geographic point.

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A.2.5.1 North polar region. Given the latitude and longitude of point (Φ, λ) , its projection coordinates $(\langle X \rangle, \langle Y \rangle)$ shall be computed as follows (see Figure A-2):

$$\langle X \rangle = C_s * (90^\circ - \phi) * \text{SIN}(\lambda) \quad (15)$$

$$\langle Y \rangle = -C_s * (90^\circ - \phi) * \text{COS}(\lambda) \quad (16)$$

The coordinates $\langle X \rangle$ and $\langle Y \rangle$ are given with respect to the north pole as an origin of a rectangular coordinate system. It is useful to translate the coordinates of the point to the ECRG frame structure. The frame structure has its origin in its lower left corner. The expressions for the frame row and column, the subframe row and column, and the pixel position with respect to the lower left corner of the frame structure are computed as follows:

$$r_F = \text{INT} \left\{ \frac{\langle Y \rangle + R}{P_F} \right\} \quad (17)$$

$$c_F = \text{INT} \left\{ \frac{\langle X \rangle + R}{P_F} \right\} \quad (18)$$

$$r_{PF} = [P_F - 1] - \text{INT} \left\{ \left[\left(\frac{\langle Y \rangle + R}{P_F} \right) - r_F \right] * P_F \right\} \quad (19)$$

$$c_{PF} = \text{INT} \left\{ \left[\left(\frac{\langle X \rangle + R}{P_F} \right) - c_F \right] * P_F \right\} \quad (20)$$

The constant R is calculated by finding the number of frames on a side of the frame structure (see D.2.2.3), dividing by two and multiplying by the number of pixels per frame side.

A.2.5.2 South polar region. Given the latitude and longitude of point (Φ, λ) , its projection coordinates $(\langle X \rangle, \langle Y \rangle)$ shall be computed as follows (see Figure A-3):

$$\langle X \rangle = C_s * (90 + \phi) * \text{SIN}(\lambda) \quad (21)$$

$$\langle Y \rangle = C_s * (90 + \phi) * \text{COS}(\lambda) \quad (22)$$

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The coordinates <X> and <Y> are given with respect to the south pole as an origin of a rectangular coordinate system. Since the frame coordinate system has its origin in the lower left corner in an identical scheme as the north polar region, all frame, subframe and pixel calculations are identical to the north polar calculations.

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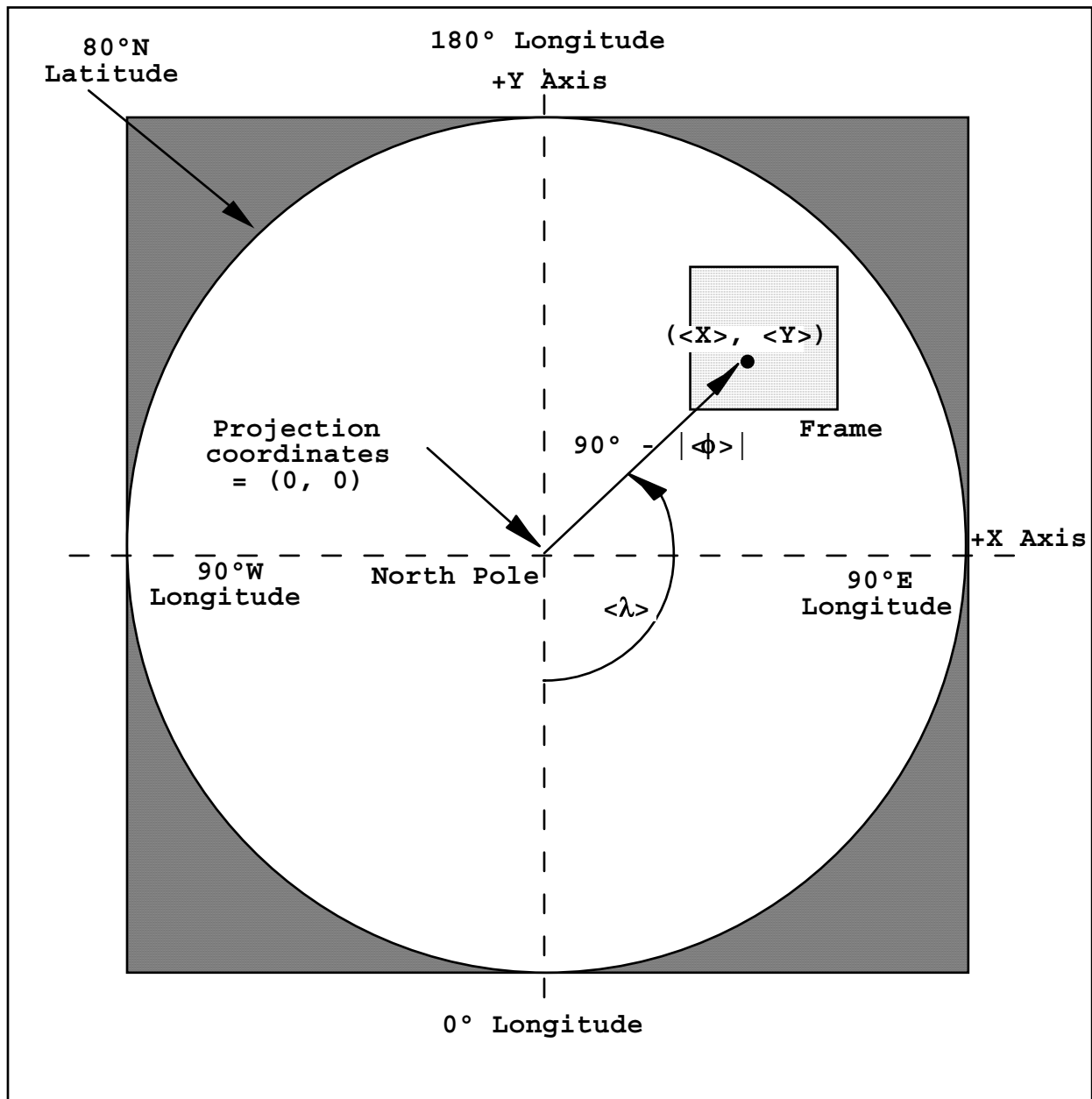


Figure A-2. Coordinate transformation in north polar region.

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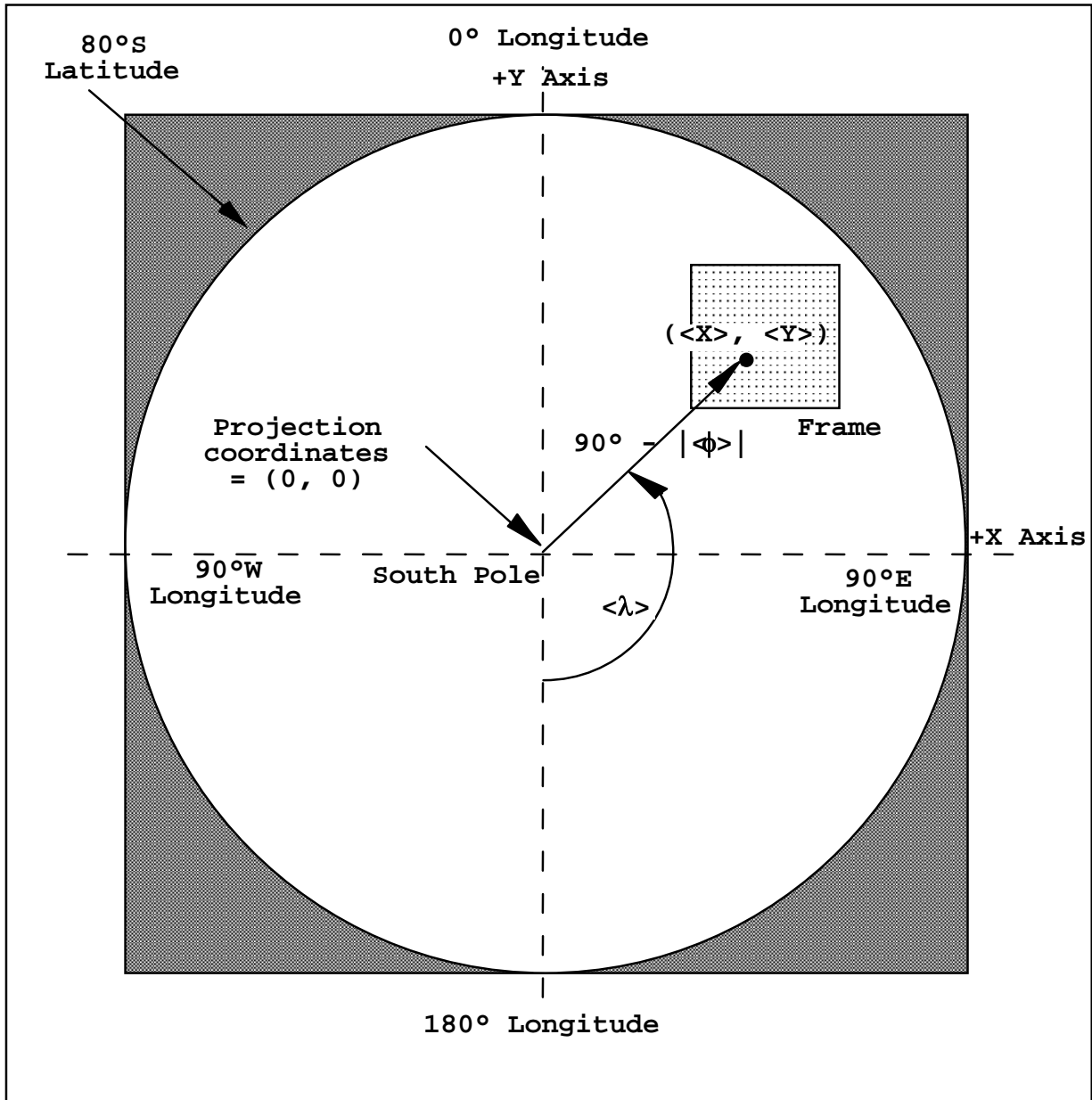


Figure A-3. Coordinate transformation in south polar region.

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A.2.6 Frame naming convention. The frame naming convention for non-standard miscellaneous large-scale maps and charts shall conform to this specification, and be assigned by the producer. The naming convention for all standard small-scale maps and charts, where it is intended for producers to provide contiguous [frame file] coverage (see Section A.2.1 of APPENDIX A) shall conform to this specification, and further restrict the ECRG [frame file] names to conform to the form "fffffffffvvp.ccz." (The contiguous frame grid concept is depicted in Figure A-4. The "ffffffff" portion of the name shall be a ten-digit radix 34 value that encodes the unique cumulative frame number within a zone in base 34. n_{sz} (see equations below), with the right-most digit being the least significant position. For example, the "ffffffff" portion of the names would start with "0000000000," and proceed through "0000000009." The next value would be "000000000A" and the values would proceed through "000000000Z," "0000000010," and so forth until "ZZZZZZZZZZ." The radix 34 value incorporates the numbers 0 through 9 and letters A through Z exclusive of the letters "I" and "O" as they are easily confused with the numbers "1" and "0". This allows 2,064,377,754,059,776 unique [frame file] names; a contiguous grid of frame names down to ~1:2 scale could be defined.) The "vvv" portion of the name shall be a radix 34 value that encodes the successive version number. The "p" portion of the name shall be a radix 34 value that designates the producer code ID. The "cc" and "z" portions of the name extension shall encode the map or chart type and the zone, respectively. The ECRG producers are responsible to ensure that [frame files] for all map types, scales, zones, and revisions, have unique names.

A.2.6.1 The number of rows and columns for several scales are provided in TABLE D-I through TABLE D-IX. The relationships between frame row and column numbers, and the cumulative count of frames within a zone are expressed in the equations below:

$$n_{sz} = c_{Fz} + (r_{Fz} * C_z) \tag{23}$$

$$n_{sz} \text{ (maximum)} = (R_z * C_z) - 1 \tag{24}$$

$$r_{Fz} = \text{INT} \left\{ \frac{n_{sz}}{C_z} \right\} \tag{25}$$

$$c_{Fz} = n_{sz} - (r_{Fz} * C_z) \tag{26}$$

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where C_z is the number of columns in the zone and R_z is the number of rows in the zone. The frame number of the frame denoted by the frame row r_{Fz} and frame column c_{Fz} is n_{sz} .

A.2.6.2 DPI will have no effect on the number of frames and virtual subframes found in any specified scale. Only the pixel constant and pixel size for each zone at each scale are functions of the DPI. Refer to APPENDIX D for further information.

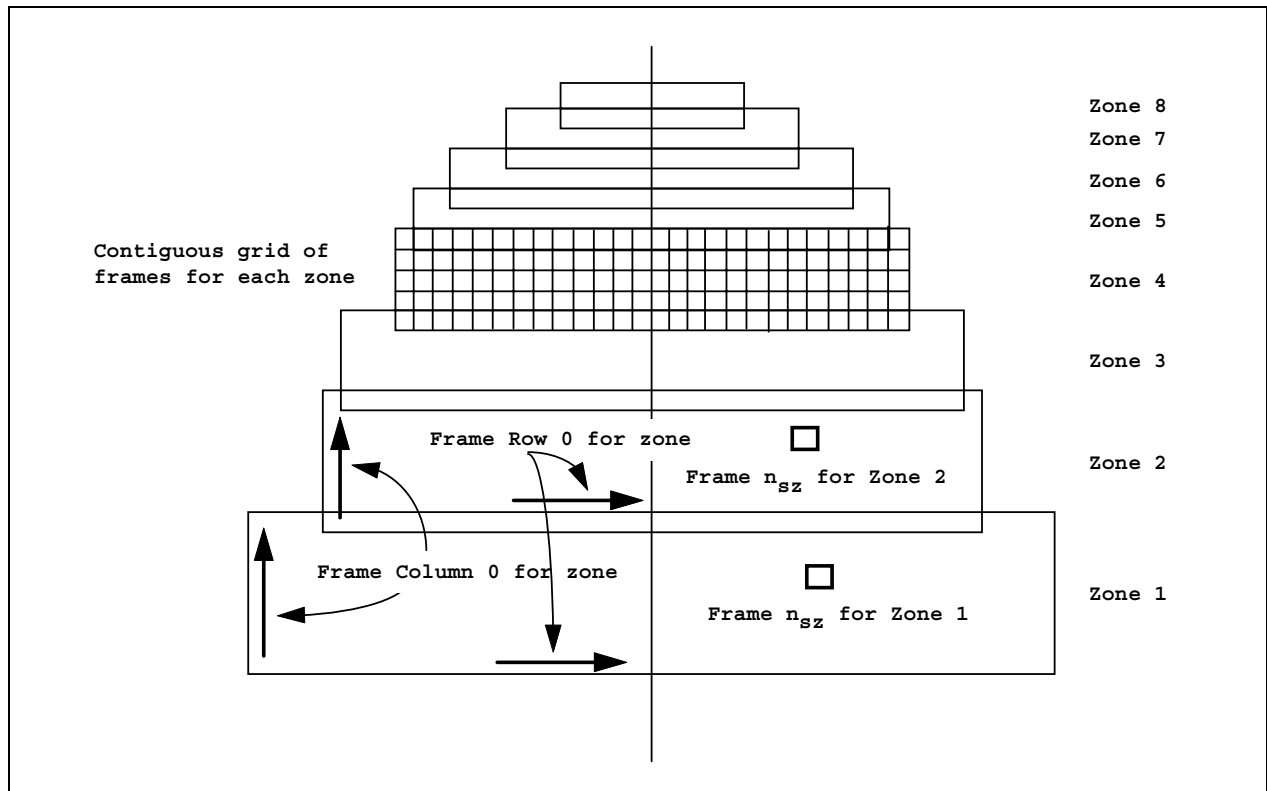


Figure A-4. Contiguous frame numbering convention for zones.

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 APPENDIX B
 STORAGE REQUIREMENTS

B. STORAGE REQUIREMENTS

B.1 SCOPE

B.1.1 Scope. This appendix provides information about the sizes of the sections of a frame file and provides a typical example with binary and decimal or logical values for that example. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

B.2 Computation of frame file size. TABLE B-I provides the sizes of the logical sections in an ECRG frame file. TABLE B-II provides typical sizes, based on assumptions about the nature of the data. These assumptions are not mandatory. The percent of total size for the typical section sizes are also provided in TABLE B-II.

TABLE B-I. ECRG [frame file] size computations.

Section Name	Computation of Size
<i>NITF Header</i>	<i>425 (fixed fields) + GEOPS (454)= 879 bytes</i>
Image Segment Sub-Header	852 (fixed fields) + J2KLRA (82) + GEOLOB (59) + BNDPLB (165) + Length of ACCPOB + Length of SOURCB = 1158 + ACCPOB + SOURCB
Image Segment	Length of Compressed Image Segment
Text Segment 1 Sub-Header	282
Text Segment 1	Length of Text Segment 1
Text Segment 2 Sub-Header	282
Text Segment 2	Length of Text Segment 2

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TABLE B-II. ECRG [frame file] typical sizes.

Section Name	Full 254 DPI Frame Example Bytes (% of Total)	
<i>NITF Header</i>	879	(0.11 %)
Image Segment Sub-Header	2,732	(0.34 %)
Image Segment (Approximate Size)	800,000	(99.38%)
Text Segment 1 Sub-Header	282	(0.03 %)
Text Segment 1	400	(0.05 %)
Text Segment 2 Sub-Header	282	(0.03 %)
Text Segment 2	400	(0.05 %)
Total	804,975	

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

C. ECRG DATA CONTENT SPECIFICS

C.1 SCOPE

C.1.1 Scope. This appendix lists ECRG file content specifics, attributes, and data types. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

C.2 ECRG NITF 2.1 FILE STRUCTURE

C.2.1 ECRG File structure. An ECRG frame file is a NITF 2.1 that must contain:

- NITF 2.1 File Header
 - File Header
 - GEOPSB (DIGEST - Georeferencing Information)
- One (1) Image Segment
 - Image Sub-header
 - J2KLRA TRE(BPJ2K01.00)
 - GEOLOB (DIGEST - Geographic Coordinate Information)
 - BNDPLB (DIGEST - Bounding Polygon of Frame)
 - ACCPOB (DIGEST - Accuracy Information)
 - SOURCB (DIGEST - Map Source Information)
 - Image Data Field (JPEG2000 compressed) [See Section 5 for JPEG2000 Specifics]
- Two (2) Text Segments
 - Text Segment 1 - Revision History of Frame
 - Text Segment 2 - Frame Description

In the future, there will be an optional Data Extension Segment for storing GML data:

- One (1) Data Extension Segment
 - Future GML/Vector capabilities

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 ECRG DATA CONTENT SPECIFICS

C.2.1.2 ECRG NITF File Header.

TABLE C-I. ECRG NITF 2.1 file.

ECRG NITF 2.1 File						
NITF File Header	Image Segments			Text Segments		
File Header with GEOPSB TRE	Image Sub-header with J2KLRA, GEOLOB, BNDPLB, ACCPOB, and SOURB TREs	JPEG2000 Compressed Image Segment	Text segment Sub-header 1	Text Segment 1 (Frame Revision History)	Text Segment Sub-header 2	Text Segment 2 (Frame Description)

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ECRG DATA CONTENT SPECIFICS

TABLE C-II. ECRG NITF file header contents.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
FHDR	File Profile Name	4	"NITF"	Required
FVER	File Version	5	"02.10"	Required
CLEVEL	Complexity Level	2	Calculated based on the width and height of the frame. Valid values are "05", "06", "07", or "09".	Required, depends on DPI of frames
STYPE	Standard Type	4	"BF01"	Required
OSTAID	Originating Station ID	10	<i>Producer Code</i>	Required
FDT	File Data and Time	14		Required
FTITLE	File Title	80	<i>Frame File Name</i>	Required
FSCLAS	File Security Classification	1	T, S, C, R, or U	Required
FSCLSY	File Security Classification System	2		Required
FSCODE	File Codewords	11		Required
FSCTLH	File Control and Handling	2		Required
FSREL	File Releasing Instructions	20		Required
FSDCTP	File Declassification Type	2		Required
FSDCDT	File Declassification Date	8		Required
FSDCXM	File Declassification Exemption	4		Required
FSDG	File Downgrade	1		Required
FSDGDT	File Downgrade Date	8		Required
FSCLTX	File Classification Text	43		Required
FSCATP	File Classification Authority Type	1		Required
FSCAUT	File Classification Authority	40		Required

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

TABLE C-II. ECRG NITF file header contents. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
FSCRSN	File Classification Reason	1		Required
FSSRDT	File Security Source Date	8		Required
FSCTLN	File Security Control Number	15		Required
FSCOP	File Copy Number	5	"00000"	Required
FSCPYS	File Number of Copies	5	"00000"	Required
ENCRYP	Encryption	1	"0"	Required
FBKGC	File Background Color	3	0x000000 - Black	Required
ONAME	Originator's Name	24	<i>Producer Code</i>	Required
OPHONE	Originator's Phone Number	18	Blank	Required
FL	File Length	12		Required
HL	NITF File Header Length	6	"000879"	Required
NUMI	Number of Image Segments	3	"001"	Required
LISH ₁	Length of nth Image Sub-header	6		Required
LI ₁	Length of nth Image Segment	10		Required
NUMS	Number of Graphic Segments	3	"000"	Required
NUMX	Reserved for Future Use	3	"000"	Required
NUMT	Number of Text Segments	3	"002"	Required
LTSH ₁	Length of 1 st text sub-header	4	"0282"	Required
LT ₁	Length of 1 st text segment	5		Required
LTSH ₂	Length of 2 nd text sub-header	4	"0282"	Required
LT ₂	Length of 2 nd text segment	5		Required
NUMDES	Number of Data Extension Segments	3	"000"	Required

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 ECRG DATA CONTENT SPECIFICS

TABLE C-II. ECRG NITF file header contents. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
NUMRES	Number of Reserved Extension Segments	3	"000"	Required
UDHDL	User Defined Header Data Length	5	"00000"	Required
XHDL	Extended Header Data Length	5	"00457"	Required
XHDLOFL	Extended Header Data Overflow	3	"000"	Required
XHD	Extended Header Data	XHDL - 3	GEOPSB TRE (see table below)	Required

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ECRG DATA CONTENT SPECIFICS

GEOPS (DIGEST - Georeferencing Information) stored in NITF
Header XHD

TABLE C-III. DIGEST georeferencing information.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"GEOPSB"	Required
CEL	Length of Data to Follow	5	"00443"	Required
TYP	Coordinate System Type	3	"GEO"	Required
UNI	Coordinate Units	3	"DEG"	Required
DAG	Geodetic Datum Name	80	"World Geodetic System 1984"	Required
DCD	Geodetic Datum Code	4	"WGE"	Required
ELL	Ellipsoid Name	80	"World Geodetic System 1984"	Required
ELC	Ellipsoid Code	3	"WE "	Required
DVR	Vertical Datum Reference	80	"Geodetic"	Required
VDCDVR	Code (Category) of Vertical Reference	4	"GEOD"	Required
SDA	Sounding Datum Name	80	"Mean Sea"	Required
VDCSDA	Code for Sounding Datum	4	"MSL"	Required
ZOR	Z values False Origin	15	<i>Z Values False Origin for ECRG frame</i>	Required
GRD	Grid Code	3	<i>Grid Code for ECRG frame</i>	Required
GRN	Grid Description	80	<i>Grid Description for ECRG frame</i>	Required
ZNA	Grid Zone Number	4	<i>Grid Zone Number for ECRG frame</i>	Required

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C.2.1.3 ECRG Image Segment Sub-Header.

TABLE C-IV. ECRG image segment subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
IM	File Part Type	2	"IM"	Required
IID1	Image Identifier 1	10	"ECRG "	Required
IDATIM	Image Date and Time	14	<i>CCYYMMDDhhmmss</i>	Required; Oldest Source Significant Date
TGTID	Target Identifier	17	Blank	Required
IID2	Image Identifier 2	80	<i>Frame File Name</i>	Required
ISCLAS	Image Security Classification	1	T,S,C,R, or U	Required
ISCLSY	Image Security Classification System	2		Required
ISCODE	Image Codewords	11		Required
ISCTLH	Image Control and Handling	2		Required
ISREL	Image Releasing Instructions	20		Required
ISDCTP	Image Declassification Type	2		Required
ISDCDT	Image Declassification Date	8		Required
ISDCXM	Image Declassification Exemption	4		Required
ISDG	Image Downgrade	1		Required
ISDGDT	Image Downgrade Date	8		Required
ISCLTX	Image Classification Text	43		Required
ISCATP	Image Classification Authority Type	1		Required
ISCAUT	Image Classification Authority	40		Required

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TABLE C-IV. ECRG image segment subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
ISCRSN	Image Classification Reason	1		Required
ISSRDT	Image Security Source Date	8		Required
ISCTLN	Image Security Control Number	15		Required
ENCRYP	Encryption	1	"0"	Required
ISORCE	Image Source	42		Required; Source Type: ADRG, EPODS, etc
NROWS	Number of Significant Rows in Image	8	>= 2304, NROWS = NCOLS	Required
NCOLS	Number of Significant Columns in Image	8	>= 2304, NROWS = NCOLS	Required
PVTYPE	Pixel Value Type	3	"INT"	Required
IREP	Image Representation	8	"RGB "	Required, The YcbCr601 transform will be done internal to the J2K compressed data stream; expected output from decoders is RGB.
ICAT	Image Category	8	"MAP"	Required
ABPP	Actual Bits-Per-Pixel Per Band	2	"08"	Required
PJUST	Pixel Justification	1	"R"	Required
ICORDS	Image Coordinate Representation	1	"G"	Required

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TABLE C-IV. ECRG image segment subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
IGEOLO	Image Geographic Location	60		Required, for cataloging, not for georeferencing
NICOM	Number of Image Comments	1	"4"	Required
ICOM ₁	Image Comment 1	80		Required, Current Edition Frame Production Date
ICOM ₂	Image Comment 2	80		Required, Frame DPI
ICOM ₃	Image Comment 3	80		Required, Frame Producer Description
ICOM ₄	Image Comment 4	80	<number> <Units of Measure>	Required, Frame Contour Interval
IC	Image Compression	2	"C8"	Required
COMRAT	Compression Rate Code	4	"0040"	Required, 20:1 compression, 8/20 = 0.4 (per band) so COMRAT = 0040
NBANDS	Number of Bands	1	"3"	Required
IREPBAND ₁	Nth Band Representation	2	"R "	Required
ISUBCAT ₁	Nth Band Subcategory	6	Blank	Required
IFC ₁	Nth Band Image Filter Condition	1	"N"	Required
IMFLT ₁	Nth Band Standard Image Filter Code	3	Blank	Required
NLUTS ₁	Number of LUTS for the nth Image Band	1	"0"	Required
IREPBAND ₂	Nth Band Representation	2	"G "	Required
ISUBCAT ₂	Nth Band Subcategory	6	Blank	Required
IFC ₂	Nth Band Image Filter Condition	1	"N"	Required

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TABLE C-IV. ECRG image segment subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
IMFLT ₂	Nth Band Standard Image Filter Code	3	Blank	Required
NLUTS ₂	Number of LUTS	1	"0"	Required
IREPBAND ₃	Nth Band Representation	2	"B "	Required
ISUBCAT ₃	Nth Band Subcategory	6	Blank	Required
IFC ₃	Nth Band Image Filter Condition	1	"N"	Required
IMFLT ₃	Nth Band Standard Image Filter Code	3	Blank	Required
NLUTS ₃	Number of LUTS	1	"0"	Required
ISYNC	Image Sync code	1	"0"	Required
IMODE	Image Mode	1	"B"	Required
NBPR	Number of Blocks Per Row	4	"0001"	Required, No Tiling
NBPC	Number of Blocks Per Column	4	"0001"	Required, No Tiling
NPPBH	Number of Pixels Per Block Horizontal	4	IF NCOLS <=8192, NPPBH = NCOLS IF NCOLS > 8192, NPPBH = "0000" AND CLEVEL = "09"	Required
NPPBV	Number of Pixels Per Block Vertical	4	IF NROWS <=8192, NPPBV = NROWS IF NROWS > 8192, NPPBV = "0000" AND CLEVEL = "09"	Required
NBPP	Number of Bits Per Pixel per Band	2	"08"	Required
IDLVL	Image Display Level	3	"001"	Required
IALVL	Attachment Level	3	"000"	Required
ILOC	Image Location	10	"0000000000"	Required

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TABLE C-IV. ECRG image segment subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
IMAG	Image Magnification	4	"1.00"	Required
UDIDL	User Defined Image Data Length	5	"00000"	Required
IXSHDL	Image Extended Sub-header Data Length	5	82 (J2KLRA) + 59 (GEOLOB) + 165 (BNDPLB) + Length of ACCPOB + Length of SOURCB + 3	Required
IXSOFL	Image Extended Sub-header Overflow	3	"000"	Required
IXSHD	Image Extended Sub-header Data	IXSHDL -3	J2KLRA, GEOLOB , BNDPLB, ACCPOB, SOURCB (See tables below)	Required

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

J2KLRA TRE (BPJ2K01.00) stored in Image Segment Sub-header
(IXSHD)

TABLE C-V. J2KLRA TRE subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"J2KLRA"	Required
CEL	Length of User-Defined Data	5	"00071"	Required
ORIG	Original Compressed Data	1	"8"	Required
NLEVELS_0	Number of Wavelet levels in original image	2	"05"	Required
NBANDS_0	Number of bands in original image	5	"00003"	Required
NLAYERS_0	Number of Layers in original image	3	"005"	Required
LAYER ID ₀	Layer ID Number	3	"000"	Required
BITRATE ₀	Bit-rate	9	"00.031250"	Required; 256:1 Compression
LAYER ID ₁	Layer ID Number	3	"001"	Required
BITRATE ₁	Bit-rate	9	"00.062500"	Required; 128:1 Compression
LAYER ID ₂	Layer ID Number	3	"002"	Required
BITRATE ₂	Bit-rate	9	"00.125000"	Required; 64:1 Compression
LAYER ID ₃	Layer ID Number	3	"003"	Required
BITRATE ₃	Bit-rate	9	"00.250000"	Required; 32:1 Compression
LAYER ID ₄	Layer ID Number	3	"004"	Required
BITRATE ₄	Bit-rate	9	"00.400000"	Required; 20:1 Compression

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GEOLOB (DIGEST - Geographic Coordinate Information) stored in Image Segment Sub-header (IXSHD)

TABLE C-VI. DIGEST geographic coordinate information subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"GEOLOB"	Required
CEL	Length of Data to Follow	5	"00048"	Required
ARV	Longitude Density	9		Required
BRV	Latitude Density	9		Required
LSO	Longitude of Reference Origin	15		Required
PSO	Latitude of Reference Origin	15		Required

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ECRG DATA CONTENT SPECIFICS

BNDPLB (DIGEST - Bounding Polygon of Frame) stored in Image Segment Sub-header (IXSHD)

TABLE C-VII. DIGEST bounding polygon subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"BNDPLB"	Required
CEL	Length of Data to follow	5	"00154"	Required
NUM_PTS	Number of points in bounding polygon	4	"0005"	Required, 4 points and the required repeat of the first point
LON ₀	Longitude/Easting	15	NW LON	Required
LAT ₀	Latitude/Northing	15	NW LAT	Required
LON ₁	Longitude/Easting	15	NE LON	Required
LAT ₁	Latitude/Northing	15	NE LAT	Required
LON ₂	Longitude/Easting	15	SE LON	Required
LAT ₂	Latitude/Northing	15	SE LAT	Required
LON ₃	Longitude/Easting	15	SW LON	Required
LAT ₃	Latitude/Northing	15	SW LAT	Required
LON ₄	Longitude/Easting	15	NW_LON	Required, must repeat first point (NW)
LAT ₄	Latitude/Northing	15	NW_LAT	Required, must repeat first point (NW)

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ACCPOB (DIGEST - Accuracy Information) stored in Image Segment Sub-header (IXSHD)

TABLE C-VIII. DIGEST accuracy information subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"ACCPOB"	Required
CEL	Length of Data to Follow	5		Required
NUM_ACPO	Number of positional accuracy regions	2		Required, There will be a region for each source that went into the frame
Start for each region of positional accuracy				
UNIAAH _n	Unit of Measure for AAH _n	3		Required
AAH _n	Absolute Horizontal Accuracy	5		Required
UNIAAV _n	Unit of Measure for AAV _n	3		Required
AAV _n	Absolute Vertical Accuracy	5		Required
UNIAPH _n	Unit of Measure for APH _n	3		Required
APH _n	Point-to-Point Horizontal Accuracy	5		Required
UNIAPV _n	Unit of Measure for APV _n	3		Required
APV _n	Point-to-Point Vertical Accuracy	5		Required
NUM_PTS _n	Number of Points in Bounding Polygon	3		Required, The last point must be a repeat of the first point
... Start for each bounding polygon point (coordinate pair)				
Lon _{nm}	Longitude/Easting	15		Required
Lat _{nm}	Latitude/Northing	15		Required
... End for each bounding polygon point (coordinate pair)				
... End for each region of positional accuracy				

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ECRG DATA CONTENT SPECIFICS

SOURCB (DIGEST - Map Source Information) stored in Image Segment Sub-header (IXSHD)

TABLE C-IX. DIGEST map source information subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
CETAG	Unique Extension Identifier	6	"SOURCB"	Required
CEL	Length of Data to Follow	5		Required
IS_SCA	Image Segment Reciprocal Scale	9		Required
CPATCH	Color Patch Id	10	Blank	Required
NUM_SOUR	Number of Source Descriptions	2		Required
... Start for each source description				
NUM_BP _n	Number of Bounding Polygons	2		Required
... Start for each bounding polygon of the nth original scene				
NUM_PTS _{np}	Number of Points in the p th Bounding Polygon	3		Required, The last point must be a repeat of the first point
... Start for each point (coordinate pair) of the p th bounding polygon				
LON _{npm}	Longitude/Easting	15		Required
LAT _{npm}	Latitude/Northing	15		Required
... End for each point (coordinate pair) of the p th bounding polygon				
... End for each bounding polygon of the nth original scene				
PRT _n	Series	10		Required
URF _n	Source Identification	20		Required, 3 character country code, immediately followed by chart producer
EDN _n	Edition	7		Required

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TABLE C-IX. DIGEST map source information subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
NAM _n	Name	20		Required
CDP _n	Type of Significant Date	3	"029"	Required, CDV _n is the significant date
CDV _n	Significant Date	8		Required
CDV27 _n	Perishable Date	8		Required
SRN _n	Source Reference Number	80		Required
SCA _n	Reciprocal Scale	9		Required
UNISQU _n	Unit of Measure for Coverage	3		Required, Use values from DIGEST 2.1 Part 3 Table 7-1 Units of Measure. Valid values are one of: M2 KM2 HA
SQU _n	Coverage	10		Required
UNIPCI _n	Unit of Measure for Contour Interval	3		Required
PCI _n	Contour Interval	4	May be blank	Required
WPC _n	Water Coverage	3	May be blank	Required
NST _n	Navigation System Type	3	May be blank	Required
UNIHKE _n	Units of HKE	3	May be blank	Required
HKE _n	Highest Known Elevation	6	May be blank	Required
LONHKE _n	Longitude/Easting of HKE	15	May be blank	Required
LATHKE _n	Latitude/Northing of HKE	15	May be blank	Required
QSS _n	Security Classification of Source	1	T, S, C, R, U	Required
QOD _n	Downgrading	1		Required
CDV10 _n	Downgrading Date	8		Required

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TABLE C-IX. DIGEST map source information subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
QLE _n	Releasability	80		Required
CPY _n	Copyright Statement	80		Required
NMI _n	Number of Magnetic Information	2	May be blank	Required
... Start for each set of magnetic information				
CDV30 _{np}	Date of Magnetic Information	8	May be blank	Required
UNIRAT _{np}	Units for Annual Rate of Change	3	May be blank	Required
RAT _{np}	Annual Rate of Change	8	May be blank	Required
UNIGM _{np}	Units of GMA _{np}	3	May be blank	Required
GMA _{np}	G-M Angle	8	May be blank	Required
LONGMA _{np}	Longitude/Easting of GMA _{np} Reference Point	15	May be blank	Required
LATGMA _{np}	Latitude/Northing of GMA _{np} Reference Point	15	May be blank	Required
UNIGC _{np}	Units of GCA _{np}	3	May be blank	Required
GCA _{np}	Grid Convergence Angle	8	May be blank	Required
... End for each set of magnetic information				
NLI _n	Number of Legend Images	2	"00"	Required
DAG _n	Geodetic Datum Name	80		Required
DCD _n	Geodetic Datum Code	4		Required
ELL _n	Ellipsoid Name	80		Required
ELC _n	Ellipsoid Code	3		Required
DVR _n	Vertical Datum Reference	80		Required
VDCDVR _n	Code (Category) of Vertical Reference	4		Required
SDA _n	Sounding Datum Name	80		Required
VDCSDA _n	Code for Sounding Datum	4		Required

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TABLE C-IX. DIGEST map source information subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
PRN _n	Projection Name	80		Required, Use codes from DIGEST 2.1 Part 3 Table 6-5
PCO _n	Projection Code	2		Required, Use codes from DIGEST 2.1 Part 3 Table 6-5
NUM_PRJ _n	Number of Projection Parameters	1		Required
... Start for each projection parameter				
PRJ _{np}	Projection Parameter	15		Required, Use codes from DIGEST 2.1 Part 3 Table 6-5
... End for each projection parameter				
XOR _n	Projection False X (Easting) Origin	15		Required
YOR _n	Projection False Y (Northing)	15		Required
GRD _n	Grid Code	3		Required
GRN _n	Grid Description	80		Required
ZNA _n	Grid Zone number	4		Required
NIN _n	Number of Insets	2	"00"	Required
... End for each source description				

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APPENDIX C
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ECRG Text Sub-header Segment 1 (Frame Revision History) Sub-Header

TABLE C-X. Frame revision history subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
TE	File Part Type	2	"TE"	Required
TEXTID	Text Identifier	7	"FRMREVI"	Required
TXTALVL	Text Attachment Level	3	"000"	Required
TXTDT	Text Date and Time	14		Required
TXTITL	Text Title	80	"Frame Revision History" + 58 spaces	Required
TSCLAS	Text Security Classification	1	T, S, C, R, U	Required
TSCLSY	Text Security Classification System	2		Required
TSCODE	Text Codewords	11		Required
TSCTLH	Text Control and Handling	2		Required
TSREL	Text Releasing Instructions	20		Required
TSDCTP	Text Declassification Type	2		Required
TSDCDT	Text Declassification Date	8		Required
TSDCXM	Text Declassification Exemption	4		Required
TSDG	Text Downgrade	1		Required
TS DGDT	Text Downgrade Date	8		Required
TSCLTX	Text Classification Text	43		Required
TSCATP	Text Classification Authority Type	1		Required
TSCAUT	Text Classification Authority	40		Required

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TABLE C-X. Frame revision history subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
TSCRSN	Text Classification Reason	1		Required
TSSRDT	Text Security Source Date	8		Required
TSCTLN	Text Security Control Number	15		Required
ENCRYP	Encryption	1	"0"	Required
TXTFMT	Text Format	3	"STA"	Required
TXSHDL	Text Extended Sub-header Data Length	5	"00000"	Required

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ECRG Text Sub-header Segment 2 (Frame Description) Sub-Header

TABLE C-XI. Frame description subheader.

FIELD	NAME	SIZE	ECRG VALUE	NOTES
TE	File Part Type	2	"TE"	Required
TEXTID	Text Identifier	7	"FRMDESC"	Required
TX TALVL	Text Attachment Level	3	"000"	Required
TX TDT	Text Date and Time	14		Required
TX TITL	Text Title	80	"Frame Description" + 63 spaces	Required
TS CLAS	Text Security Classification	1	T, S, C, R, U	Required
TS CLSY	Text Security Classification System	2		Required
TS CODE	Text Codewords	11		Required
TS CTLH	Text Control and Handling	2		Required
TS REL	Text Releasing Instructions	20		Required
TS DCTP	Text Declassification Type	2		Required
TS DCDT	Text Declassification Date	8		Required
TS DCXM	Text Declassification Exemption	4		Required
TS DG	Text Downgrade	1		Required
TS DGDT	Text Downgrade Date	8		Required
TS CLTX	Text Classification Text	43		Required
TS CATP	Text Classification Authority Type	1		Required
TS CAUT	Text Classification Authority	40		Required
TS CRSN	Text Classification Reason	1		Required

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TABLE C-XI. Frame description subheader. (Cont'd)

FIELD	NAME	SIZE	ECRG VALUE	NOTES
TSSRDT	Text Security Source Date	8		Required
TSCTLN	Text Security Control Number	15		Required
ENCRYP	Encryption	1	"0"	Required
TXTFMT	Text Format	3	"STA"	Required
TXSHDL	Text Extended Sub-header Data Length	5	"00000"	Required

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

C.2.2 JPEG 2000 DETAILS

C.2.2.1 JPEG 2000 References

- ISO/IEC 15444-1
- BPJ2K01.00 (BPJ2K01.00 Sections 7, 8.4.7, 9).
- Note, the ECRG JPEG2000 is not NPJE/EPJE constrained and therefore Section 8 of BPJ2K01.00 does not apply to this product except for Section 8.4.7.

C.2.2.2 JPEG2000 File Format within NITF/NISF.

- JPC Compressed Data Stream Only
 - Minimal JPEG2000 file that gives only the information required to decode the data.
 - This is the recommended approach for use of JPEG 2000 within NITF/NSIF from BPJ2K01.00
 - The JPC Compressed Data Stream is entirely contained within the NITF 2.1 Image Segment described by the Image Segment Sub-header in Section 0.
- JPEG 2000 ECRG Details
 - JPEG2000 Part 1 Profile 1 Compliant
 - 20:1 Compression (0.4 bit-per-pixel-per band)
 - RPCL (Resolution Precinct Component Layer)
 - Precinct Size of 256x256.
 - 9-7I Irreversible wavelet Transformation
 - Implements ICT (Irreversible Component Transform)
 - Code-Block Size of 64x64
 - No Tiling
 - Tile Size will equal Frame Size, i.e. No tiles within an image
 - 5 (five) Decomposition Layers will allow for 6 (six) viewing resolutions
 - PLT Marker for the single tile-part
 - 5 (five) Quality Layers (0.03125, 0.0625, 0.125, 0.25, 0.4 bpppb)

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C.2.2.3 Specifics in addition to BPJ2K01.00 Section 7

- $XT_{SIZ} = X_{SIZ} = YT_{SIZ} = Y_{SIZ}$ [Single Tile for entire image]
- Progression Order = 0000 0010 [RPCL]
- Scod = 0000 0111 [Entropy Coder, with precincts defined in Precinct Size, EPH Marker shall be used, SOP marker segments may be used]
- SPcod/SPcoc Precinct Size Field = 1000 1000 [256 x 256 Precincts]
- Lqcd in QCD and/or QCC = 35 [9-7i wavelet]
- Sqcd in QCD and/or QCC = 0100 0010 [9-7 Irreversible Filter, 2 Guard Bits, and Scalar Expounded Quantization]
- XO_{SIZ} and $YO_{SIZ} = 0$ [No offset from origin of reference grid]
- XTO_{SIZ} and $YTO_{SIZ} = 0$ [No offset from origin to edge of first tile]
- Multiple Component Transform = 0000 0001 [Component Transform Used]
- SPcod/SPcoc $N_{LEVELS} = 5$
- SPcod/SPcoc Transformation = 0000 0000 [9-7 Irreversible Wavelet Filter]

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C.2.3 Volume metadata files.

C.2.3.1 TOC.

The XML schema below defines the XSD for the ECRG TOC file. Immediately below the schema is a human readable table with field definitions and examples.

```
<?xml version="1.0"?>
<!DOCTYPE Table_of_Contents [
<ELEMENT Table_of_Contents (file_header, product+, shapefile_list?, extension_list)>
<ELEMENT file_header (file_name, media_metadata?)>
<!ATTLIST file_header file_status (new|replacement|update) "new">
<ELEMENT file_name (#PCDATA)>
<ELEMENT product (disc+)>
<!ATTLIST product product_title ID #REQUIRED>
<ELEMENT disc (frame_list)>
<!ATTLIST disc id ID #REQUIRED>
<ELEMENT frame_list (scale+)>
<!ATTLIST frame_list number_of_frames CDATA #REQUIRED>
<ELEMENT scale (frame+)>
<!ATTLIST scale size CDATA #REQUIRED>
<ELEMENT frame (frame_path, frame_version, frame_chart_type, frame_zone, security?, source_list) >
<!ATTLIST frame name CDATA #REQUIRED>
<ELEMENT frame_path (#PCDATA)>
<ELEMENT frame_version (#PCDATA)>
<ELEMENT frame_chart_type (#PCDATA)>
<ELEMENT frame_zone (#PCDATA)>
<ELEMENT source_list (source+)>
<!ATTLIST source_list number_of_sources CDATA #REQUIRED>
<ELEMENT source (#PCDATA)>
<ELEMENT extension_list (extension+)>
<ELEMENT extension (chart_code, chart_type, chart_scale, chart_description)>
<!ATTLIST extension code CDATA #REQUIRED>
<ELEMENT chart_code (#PCDATA)>
<ELEMENT chart_type (#PCDATA)>
<ELEMENT chart_scale (#PCDATA)>
<ELEMENT chart_description (#PCDATA)>
<ELEMENT media_metadata (media_title, government_producer, number_of_volumes,
volume_sequence_number, stock_number, media_edition, media_production_date, bounding_rectangle,
security?, governing_standard?, number_of_frames?, media_size, media_producer?, media_description?,
archive_list?, legend_list?)>
<ELEMENT media_title (#PCDATA)>
<ELEMENT number_of_volumes (#PCDATA)>
<ELEMENT volume_sequence_number (#PCDATA)>
<ELEMENT stock_number (#PCDATA)>
<ELEMENT media_edition (#PCDATA)>
<ELEMENT media_production_date (#PCDATA)>
<ELEMENT number_of_frames (#PCDATA)>
<ELEMENT media_size (#PCDATA)>
<ELEMENT government_producer (producer_name, producer_address, producer_information*) >
<ELEMENT producer_name (#PCDATA)>
<ELEMENT producer_address (#PCDATA)>
<ELEMENT producer_information (#PCDATA)>
<ELEMENT governing_standard (standard_name, standard_number, standard_date) >
<ELEMENT standard_name (#PCDATA)>
<ELEMENT standard_number (#PCDATA)>
<ELEMENT standard_date (#PCDATA)>
<ELEMENT security ( classification, (country_code|international_code)?, release_marking?) >
<ELEMENT classification (#PCDATA)>
<ELEMENT country_code (#PCDATA)>
<ELEMENT international_code (#PCDATA)>
<ELEMENT release_marking (#PCDATA)>
<ELEMENT bounding_rectangle (lat_lon)+ >
```

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```

<!ELEMENT lat_lon (#PCDATA)>
<!ELEMENT media_producer (producer_name, producer_information*) >
<!ELEMENT media_description (#PCDATA)>
<!ELEMENT archive_list (prior_edition*) >
<!ATTLIST archive_list number_of_archives CDATA #REQUIRED>
<!ELEMENT prior_edition (previous_title, previous_edition, previous_production_date?)>
<!ATTLIST prior_edition edition CDATA #REQUIRED>
<!ELEMENT previous_title (#PCDATA)>
<!ELEMENT previous_edition (#PCDATA)>
<!ELEMENT previous_production_date (#PCDATA)>
<!ELEMENT legend_list (legend*) >
<!ATTLIST legend_list number_of_legends CDATA #REQUIRED>
<!ATTLIST legend_list legend_directory CDATA #REQUIRED>
<!ELEMENT legend (legend_name, legend_type, legend_source*) >
<!ELEMENT legend_name (#PCDATA)>
<!ELEMENT legend_type (#PCDATA)>
<!ELEMENT legend_source (#PCDATA)>
<!ELEMENT shapefile_list (shapefile+)>
<!ATTLIST shapefile_list number_of_shapefiles CDATA #REQUIRED>
<!ELEMENT shapefile (file_name, shape_scale, bounding_rectangle)>
<!ELEMENT shape_scale (#PCDATA)>
}

```

TABLE C-XII. The XML table of contents (TOC) layout.

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
				(default value is bold)		
Table of Contents						
<u>File Header</u>				Attribute: file_status - new or <i>update</i> or <i>replacement</i>	Required	This header describes the actual TOC file, including production dates, included charts, overlays, and associated metadata.
	File Name			<u>TOC.xml</u>	Required	The TOC file name
	Media Metadata			--	<i>Optional</i> - may or may not be present.	The metadata associated with the media containing the set of frames.
		Media Title		(text)	<i>If included</i> - Required	The title (full name) of the media set of frames.
		Government Producer		--	<i>If included</i> - Required	The designation of the official government producer of this media data set (NGA).
			Producer Name	<u>National Geospatial-Intelligence Agency (NGA)</u>	<i>If included</i> - Required	The official government sponsor of the production of this media set.
			Producer Address	<u>3200 S. Second St. St. Louis, Missouri U.S.A. 63118</u>	<i>If included</i> - Required	The address of the government producer

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TABLE C-XII. The XML table of contents (TOC) layout. (Cont'd)

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
			Producer Information	<u>Property of the US Government</u>	<i>Optional</i> - possibly 0, 1, or many occurrences	An optional list of pertinent information concerning the government producer.
		Number Of Volumes		<u>01-xx</u>	<i>If included</i> - Required	The number of media volumes for this particular set of frames.
		Volume Sequence Number		<u>01-xx</u>	<i>If included</i> - Required	The current volume number for this media, out of the entire set of media volumes.
		Stock Number		(text)	<i>If included</i> - Required	The NGA Stock Number under which this media is officially categorized.
		Media Edition		<u>01-xx</u>	<i>If included</i> - Required	The official edition number of this media release (assuming similar if not same set of frames).
		Media Production Date		In <u>YYYYMMDD</u> format	<i>If included</i> - Required	The date the media was officially published by NGA (or one of their producers).
		Bounding Rectangle		--	<i>If included</i> - Required	A list of latitude/longitude points that describe the outer-most bounding rectangle. Good practice would include the NW, NE, SE, SW corner coordinates, and then repeat the NW coordinate for a total of 5 pairs or coordinates.
			Latitude/ Longitude	(comma separated numeric pairs)	Required (recommend a list of 5 pairs)	Each Latitude/Longitude entry
		Security		--	<i>If included</i> - <i>Optional</i> - may or may not be present.	The highest level of security associated with the entire volume of media.
			Classification	<u>U</u>	<i>If included</i> - Required	The highest classification of each of the frames on the media.
			Country Code	<u>US</u>	<i>If included</i> - <i>Optional</i> - if there is a classification country code available.	The country code of the country specifying the classification.

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ECRG DATA CONTENT SPECIFICS

TABLE C-XII. The XML table of contents (TOC) layout. (Cont'd)

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
			Release Marking	<u>PS</u>	<i>If included - Optional - if there is a releasability constraint specified</i>	Any release caveats or other markings associated with the classification.
		Governing Standard		--	<i>If included - Optional - may or may not be present.</i>	The official standard on which the ECRG product is created.
			Standard Name	<u>Enhanced Compressed Raster Graphics (ECRG)</u>	<i>If included - Required</i>	The official title of the specification
			Standard Number	<u>MIL-PRF-32283</u>	<i>If included - Required</i>	The official specification number assigned.
			Standard Date	<u>21 FEB 2008</u>	<i>If included - Required</i>	The official date the specification was approved.
		Number Of Frames		1 - ∞	<i>Optional - may or may not be present.</i>	The number of frames for associated with this media set.
		Media Size		(number of bytes)	<i>If included - Required</i>	The size of all of the contents across all of the media set.
		Media Producer		--	<i>Optional - may or may not be present.</i>	The critical information regarding the actual producer of the media set of frames. This information should correspond to the Producer Code designation located in the naming convention schema (see Section A.2.6)
			Producer Name	(text)	<i>If included - Required</i>	The name of the actual producer of this media set.
			Producer Information	(free-from text)	<i>if included - Optional - possibly 0, 1, or many occurrences</i>	An optional list of pertinent information concerning the media producer.
		Media Description		(free-from text)	<i>Optional - may or may not be present.</i>	The free-form text description of the contents of the media. May contain location-based, scale-based, or source/chart-based information or other information, as deemed necessary.

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TABLE C-XII. The XML table of contents (TOC) layout. (Cont'd)

Heading	Subheader	Subheader Contents	Subheader Content Details	Value	Frequency	Description
		Archive List		Attribute - number of archives listed.	<i>Optional</i> - may or may not be present.	This is a list of previous editions corresponding media set (assuming similar if not same set of frames).
			Prior Edition	Attribute - edition number	<i>If included</i> - Required	For each of the previous editions listed in the history archive.
			(previous title)	(text)	<i>If included</i> - Required	The title of a previous edition
			(previous edition)	(textual numeric value)	<i>If included</i> - Required	The edition number of the previous edition
			(previous production date)	In <u>YYYYMMDD</u> format	<i>If included</i> - <i>Optional</i> - if there is an available production date	The production date, if available, of the previous edition.
		Legend List		Attribute - number of legends listed. Attribute - relative path to LEGEND directory	<i>Optional</i> - may or may not be present.	The list of legend files located (if relevant and necessary) located on this media.
			Legend	--	<i>If included</i> - Required	For each of the legends listed in the legend list.
			(Legend Name)	(text)	<i>If included</i> - Required	The actual name of the legend included.
			(Legend Type)	(text)	<i>If included</i> - Required	The descriptive text or abbreviation of the type of legend.
			(Legend Source)	(text)	<i>if included</i> - <i>Optional</i> - possibly 0, 1, or many occurrences	An optional descriptive field on which chart(s) or chart types this legend applies.
<u>Product</u>				Attribute: Product Title	Required	This section lists each of the products on this media (typically only one).
	Disc			Attribute: Disc Number	Required	This subsection lists all of the discs (media) that span the media set.
	(Frame List)			Attribute: Number of Frames in this frame list	Required	The subsection lists each frame on this media as part of this media set.
		Scale		Attribute: Scale Size	Required	This subsection segregates each listed frame by scale.
			Frame	Attribute: Frame Name (using naming convention specified in Section A.2.6)	Required	This section describes the included frame
			(Frame Path)	(text)	<i>Required</i>	This section identifies the relative path location from the root directory

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ECRG DATA CONTENT SPECIFICS

TABLE C-XII. The XML table of contents (TOC) layout. (Cont'd)

Heading	Subheader	Subheader Contents	Subheader Content Details	Value	Frequency	Description
			(Frame Version)	(textual numeric version)	<i>Optional</i> - may or may not be present.	The frame version. Can be parsed from the frame name.
			(Frame Chart Type)	(text)	Required	The chart type represented on the frame. This value can be parsed from the frame name.
			(Frame Zone)	(textual numeric zone)	Required	The zone in which the frame occupies. This value can be parsed from the frame name.
			(Security)	uses same <i>Classification/ Country Code/Release Marking</i> description as above.	<i>Optional</i> - may or may not be present.	The highest classification of each of the source charts in the frame.
			(Source List)	Attribute: Number of Sources in this list	<i>Required</i>	The list of sources that contributed to this frame
			(Source)	Name of the Source	<i>Required</i>	The name of the source
<u>Shapefile List</u>				Attribute: Number of Shapefiles in this list	<i>Optional</i> - may or may not be present.	The list of included Shapefiles that can be used to show primarily bounding rectangles of the individual frame groups.
	Shape File				<i>If included - Required</i>	This section describe each Shapefile.
		File Name			<i>If included - Required</i>	The Shapefile file name
		Shape Scale			<i>If included - Required</i>	The scale associated with the Shapefile that outlines the designated set of frames (at the same scale) and source chart types.
		Bounding Rectangle		--	<i>If included - Required</i>	The overall bounding rectangle of the specified Shapefile, otherwise uses the same criteria as the Bounding Rectangle specified above.
			Latitude/Longitude	(comma separated numeric pairs)	<i>If included - Required</i>	the list of latitudes and longitudes that comprise the bounding rectangle.
<u>Extension List</u>					Required	
	Extension			Attribute: The two-letter code that designates a chart type.	Required	This section will describe the meaning of a particular extension code (used in the frame name) determining chart type and scale, and based on standard chart types.
		Chart Code			Required	The two-letter designation that will be used in as the first two letters in a frame's name extension
		Chart Type			Required	The chart type designation of the two-letter code.
		Chart Scale			Required	The appropriate scale of the designated chart type.
		Chart Description			Required	A full name or description of the chart type.

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

C.2.3.2 Currency File.

The XML schema below defines the XSD for the ECRG currency file. Immediately below the schema is a human readable table with field definitions and examples.

```
<?xml version="1.0"?>
<!DOCTYPE Frame_Currency_List [
<!ELEMENT Frame_Currency_List (file_header, frame_list, extension_list?)>
<!ELEMENT file_header (file_name, file_metadata?)>
<!ATTLIST file_header file_updated CDATA #REQUIRED>
<!ELEMENT file_name (#PCDATA)>
<!ELEMENT file_metadata (file_description?, number_of_frames?, security?, government_producer,
governing_standard?, file_producer?)>
<!ELEMENT file_description (#PCDATA)>
<!ELEMENT number_of_frames (#PCDATA)>
<!ELEMENT security ( classification, (country_code|international_code)?, release_marking?) >
<!ELEMENT classification (#PCDATA)>
<!ELEMENT country_code (#PCDATA)>
<!ELEMENT international_code (#PCDATA)>
<!ELEMENT release_marking (#PCDATA)>
<!ELEMENT government_producer (producer_name, producer_address, producer_information*) >
<!ELEMENT producer_name (#PCDATA)>
<!ELEMENT producer_address (#PCDATA)>
<!ELEMENT producer_information (#PCDATA)>
<!ELEMENT governing_standard (standard_name, standard_number, standard_date) >
<!ELEMENT standard_name (#PCDATA)>
<!ELEMENT standard_number (#PCDATA)>
<!ELEMENT standard_date (#PCDATA)>
<!ELEMENT file_producer (producer_name, producer_information*) >
<!ELEMENT frame_list (scale+)>
<!ATTLIST frame_list number_of_frames CDATA #REQUIRED>
<!ELEMENT scale (frame+)>
<!ATTLIST scale size CDATA #REQUIRED>
<!ELEMENT frame (frame_version?, frame_chart_type, frame_zone, security?, located_on_product*) >
<!ATTLIST frame name CDATA #REQUIRED>
<!ELEMENT frame_version (#PCDATA)>
<!ELEMENT frame_chart_type (#PCDATA)>
<!ELEMENT frame_zone (#PCDATA)>
<!ELEMENT located_on_product (product_title, product_edition, product_date)>
<!ATTLIST located_on_product title CDATA #REQUIRED>
<!ELEMENT product_title (#PCDATA)>
<!ELEMENT product_edition (#PCDATA)>
<!ELEMENT production_date (#PCDATA)>
<!ELEMENT extension_list (extension+)>
<!ELEMENT extension (chart_code, chart_type, chart_scale, chart_description)>
<!ATTLIST extension code CDATA #REQUIRED>
<!ELEMENT chart_code (#PCDATA)>
<!ELEMENT chart_type (#PCDATA)>
<!ELEMENT chart_scale (#PCDATA)>
<!ELEMENT chart_description (#PCDATA)>
]>
```

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

TABLE C-XIII. The XML currency file layout.

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
				(default value is <i>bold</i>)		
Currency File						
<u>File Header</u>				Attribute: Date of Currency File (in YYYYMMDD format)	Required	This header describes the actual Currency file, including production dates, most recent versions of all published frames and associated metadata.
	File Name			<u>FrameCurrency.xml</u>	Required	The Currency File file name
	File Metadata			--	<i>Optional</i> - may or may not be present.	The metadata associated with this file listing all published frames.
		Media Description		(free-from text)	<i>If included - Optional</i> - may or may not be present.	The free-form text description of the contents of this file. May also contain location-based, scale-based, or source/chart-based information or other information, as deemed necessary.
		Number Of Frames		1 - ∞	<i>If included - Optional</i> - may or may not be present.	The number of official frames published, and thus included in this file.
		Security		--	<i>If included - Optional</i> - may or may not be present.	The highest level of security associated with this file.
			Classification	<u>U</u>	<i>If included - Required</i>	The highest classification of this file.
			Country Code	<u>US</u>	<i>If included - Optional</i> - if there is a classification country code available.	The country code of the country specifying the classification.
			Release Marking	<u>PS</u>	<i>If included - Optional</i> - if there is a releasability constraint specified	Any release caveats or other markings associated with the classification.
		Government Producer		--	<i>If included - Required</i>	The designation of the official government producer of this media data set (NGA).
			Producer Name	<u>National Geospatial-Intelligence Agency (NGA)</u>	<i>If included - Required</i>	The official government sponsor of the production of this media set.
			Producer Address	<u>3200 S. Second St., St. Louis, Missouri U.S.A. 63118</u>	<i>If included - Required</i>	The address of the government producer

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

TABLE C-XIII The XML currency file layout. (Cont'd)

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
			Producer Information	<u>Property of the US Government</u>	<i>Optional</i> - possibly 0, 1, or many occurrences	An optional list of pertinent information concerning the government producer.
		Governing Standard		--	<i>If included - Optional</i> - may or may not be present.	The official standard on which the ECRG product is created.
			Standard Name	<u>Enhanced Compressed Raster Graphics (ECRG)</u>	<i>If included - Required</i>	The official title of the specification
			Standard Number	<u>MIL-PRF-32283</u>	<i>If included - Required</i>	The official specification number assigned.
			Standard Date	<u>21 FEB 2008</u>	<i>If included - Required</i>	The official date the specification was approved.
		File Producer		--	<i>Optional</i> - may or may not be present.	The critical information regarding the actual producer of the Currency File.
			Producer Name	(text)	<i>If included - Required</i>	The name of the actual producer of this file.
			Producer Information	(free-from text)	<i>if included - Optional</i> - possibly 0, 1, or many occurrences	An optional list of pertinent information concerning the file's producer.
Frame List				Attribute: Number of Frames in this frame list	Required	The subsection lists each frame on this media as part of this media set.
	Scale			Attribute: Scale Size	Required	This subsection segregates each listed frame by scale.
		Frame		Attribute: Frame Name (using naming convention specified in Section 0)	Required	This section describes the included frame
			Frame Version	(textual numeric version)	<i>Optional</i> - may or may not be present.	The frame version. Can be parsed from the frame name.
			Frame Chart Type	(text)	Required	The chart type represented on the frame. This value can be parsed from the frame name.

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ECRG DATA CONTENT SPECIFICS

TABLE C-XIII The XML currency file layout. (Cont'd)

<u>Heading</u>	<u>Subheader</u>	<u>Subheader Contents</u>	<u>Subheader Content Details</u>	<u>Value</u>	<u>Frequency</u>	<u>Description</u>
			Frame Zone	(textual numeric zone)	Required	The zone in which the frame occupies. This value can be parsed from the frame name.
			Security	uses same <i>Classification/Country Code/Release Marking</i> description as above.	<i>Optional</i> - may or may not be present.	The highest classification of each of the source charts in the frame.
			Located on Product	Attribute:: The associated product title (or stock number)	Required	The section will list as many products as this particular frame resides.
			(Product Title)	(text)	Required	This is the title of the official product which this frames resides.
			(Product Edition)	(textual numeric value)	Required	The edition (or version) of the specified product.
			(Product Date)	In <u>YYYYMMDD</u> format	Required	The publication date of the specified product
<u>Extension List</u>				--	Required	
	Extension			Attribute: The two-letter code that designates a chart type.	Required	This section will describe the meaning of a particular extension code (used in the frame name) determining chart type and scale, and based on standard chart types.
		Chart Code		XX	Required	The two-letter designation that will be used in as the first two letters in a frame's name extension
		Chart Type		(text)	Required	The chart type designation of the two-letter code.
		Chart Scale		(textual numeric value)	Required	The appropriate scale of the designated chart type.
		Chart Description		(free-from text)	Required	A full name or description of the chart type.

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APPENDIX C
ECRG DATA CONTENT SPECIFICS

C.2.3.3 Shapefiles

- o Frame Extent Shapefile (for all frames on a media)
 - Each frame included shall be represented by a polygon representing the geographic extent of the frame
 - Each polygon feature will named with its ECRG frame name except that the "." character before the extension should be replaced with an "_"
 - The Shapefiles (.shp, .dbf, and shx files) shall be named by zone, so that users and software have a way to distinguish between frames in the polar and non-polar zones. Before the extension, shapefiles shall have a *<zonenumber>* in the filename. For example, a shapefile containing frames from zone 2 would have a _2 before the file extension.
 - Each frame polygon will have the following associated metadata:
 - Frame_Name - Text Field of 18 characters
 - Sig_Date - Text Field of 8 characters in YYYYMMDD format
 - Scale - Text Field of 20 characters (1:XXXXXXXXXXXXXXXXXXXX)
- o Source Extent Shapefile (for all frames on a media)
 - Each source used to create the frames on the media shall be represented by a polygon representing the geographic extent of the source.
 - Each polygon feature will be named with the source's name.
 - Each source polygon will have the following associated metadata:
 - Source_Nam - Text Field of 50 characters
 - Sig_Date - Text Field of 8 characters in YYYYMMDD format
 - Scale - Text Field Text Field of 20 characters (1:XXXXXXXXXXXXXXXXXXXX)
- o The projection of the shapefile for a given zone will be the same as the projection of the frames within that zone.

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APPENDIX D
FRAME AND VIRTUAL SUBFRAME STRUCTURE

D. FRAME AND VIRTUAL SUBFRAME STRUCTURE

D.1 SCOPE

D.1.1 Scope. This appendix describes the method of determining the possible number of frames and virtual subframes per zone at each scale, and provides tables of these values for a number of scales. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

D.2 Frame and subframe structure.

D.2.1 Method of computation for non-polar zones. This appendix describes the method of computation of the non-polar latitudinal and longitudinal pixel constants and pixel sizes, the number of frames and virtual subframes in each zone for the latitudinal and longitudinal directions, the rules of zone overlaps and the zonal extents based on DPI. Non-polar ECRG frames shall be north-up. The pixel resolution values (degrees) for the latitudinal and longitudinal directions shall be based, respectively, on the North-South and East-West Pixel Constants. The pixel size and interval data may be used to define frame files containing image data for non-contiguous maps/charts at miscellaneous scales. The ECRG pixel constant calculations involve the calculation of CADRG pixel constants. The CADRG pixel constants are used to scale the number of ECRG virtual subframes to ensure that a frame in ECRG will always occupy the same geographic space as its corresponding frame in CADRG.

D.2.1.1 North-south. pixel constant and Frame Width/Height. The North-South pixel constant is the number of pixels stretching latitudinally from the equator to a pole (90°). The ECRG North-South pixel constant value (B_{SD}) is a function of scale and DPI. The Frame Width and Height (P_F) is a function of DPI.

a. For Scale S , calculate the CADRG North-South pixel constant ($B_{S-CADRG}$) per Appendix 60.1.1 of MIL-C-89038. This result should be saved as an integer value with long precision.

b. Compute μ_{ECRG} in microns for the desired DPI. This value should be saved with double precision.

$$\mu_{ECRG} = \frac{25,400}{DPI}$$

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 APPENDIX D
 FRAME AND VIRTUAL SUBFRAME STRUCTURE

c. Calculate the number of CADRG Subframes that stretch from the equator to a pole (0° to 90°). This result should be saved as an integer value with long precision.

$$N_{CSF-NS} = B_{S-CADRG} / K_{CADRG}$$

where: $K_{CADRG} = 256$ pixels (The size of a CADRG subframe)

d. Compute the ECRG Virtual Subframe Size. This result should be saved as an integer value with long precision.

$$K_{ECRG} = ROUND \left(K_{CADRG} * \mu_{CADRG} / \mu_{ECRG} \right)$$

e. Compute the ECRG North-South Pixel Constant. This value should be saved with long precision.

$$B_{SD} = K_{ECRG} * N_{CSF-NS}$$

f. Compute the width and height of the ECRG Frame. This result should be saved as an integer value with long precision.

$$P_F = K_{ECRG} * 6$$

D.2.1.2 East-west pixel constant. The East-West pixel constant is the number of pixels longitudinally from the 180° west longitude meridian going 360° in an easterly direction along the zone midpoint. The ECRG values (A_{SZD}) are a function of Zone, Scale, and DPI.

a. For Scale S and Zone Z, calculate the CADRG East-West pixel constant (A_{CADRG}) per Appendix 60.1.2 of MIL-C-89038. This result should be saved as an integer value with long precision.

b. Compute the total number of CADRG east-west sub-frames (N_{CSF-EW}). This result should be saved as an integer value with long precision.

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APPENDIX D
FRAME AND VIRTUAL SUBFRAME STRUCTURE

$$N_{CSF-EW} = A_{CADRG} / K_{CADRG}$$

c. Compute the ECRG East-West Pixel Constant (A_{SZD}). This result should be saved as an integer value with long precision.

$$A_{SZD} = K_{ECRG} * N_{CSF-EW}$$

D.2.1.3 North-south. pixel size. The latitudinal pixel size (meters) is derived from the ADRG parameter value at a scale 1:S. The corresponding ADRG value, listed in APPENDIX 70, TABLE III of MIL-A-89007, is derived by dividing the value for the 1:1,000,000 scale by the scale factor (1,000,000/S, for 1:S scale maps). The value for ECRG is derived by multiplying the ADRG (or source) pixel size by the ADRG North-South Pixel Constant (B_S), and dividing by 4 times the ECRG North-South Pixel Constant (B_{SD}).

D.2.1.4 East-west. pixel size. The longitudinal pixel sizes (meters) for each zone are derived from the ADRG parameter values at a scale 1:S. The corresponding ADRG values, listed in APPENDIX 70, TABLE III of MIL-A-89007, are derived by dividing values for the 1:1,000,000 scale by a scale factor (1,000,000/S). The values for ECRG are derived by multiplying ADRG pixel sizes by the ratio of ADRG to ECRG East-West Pixel Constants.

D.2.1.5 Equatorward and poleward zone extents.

a. The poleward and equatorward extents of a zone are not exactly equal to the nominal zone extents defined in Table A-II. Frames overlapping the nominal zone boundaries are filled with data. For the northern hemisphere, the exact poleward zone extent is defined as latitude of the top of the frame overlapping the poleward nominal zone extent. The exact equatorward zone extent is defined as the latitude of the bottom of the frame overlapping the equatorward nominal zone extent. In the case of the southern hemisphere, the top of the overlapping frame defines the equatorward extent, and the bottom defines the poleward extent.

b. To calculate the exact poleward zone extent for a given scale, first calculate the number of pixels in a degree of latitude for the scale. This number is the N-S pixel constant divided by 90° . The number of frames needed to reach the nominal

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zone boundary is the number of pixels per degree of latitude multiplied by the nominal zone boundary (in degrees), divided by P_F (the number of pixel rows in a frame) and rounded up to the nearest integer. The exact zone extent is calculated by multiplying the number of frames by P_F and dividing by the number of pixels in a degree of latitude.

c. To calculate the exact equatorward zone extent for a given scale, again calculate the number of frames needed to reach the nominal zone boundary (the equatorward boundary in this case) by using the same method described in the previous paragraph. For the equatorward case, round the number of frames down to the nearest integer. Again, the exact zone extent is calculated by multiplying the number of frames by P_F and dividing by the number of pixels in a degree of latitude.

d. The maximum stretch or shrink of frame pixels within a zone may be computed as the difference between the cosine of the resulting zonal extents latitude and the midpoint latitude, and then dividing by the cosine of the midpoint latitude.

D.2.1.6 Latitudinal frames and subframes. The number of latitudinal frames and subframes in a zone for a given scale can be computed by using the exact poleward and equatorward zone extents and the number of pixels per degree of latitude (as calculated in Section D.2.1.5). The number of latitudinal frames is the difference (in degrees) between the exact poleward zone extent and exact equatorward zone extent, multiplied by number of pixels per degree, divided by P_F , and rounded to the nearest integer. Multiplying the number of frame rows by 6 will yield the number of subframes for that scale and zone.

D.2.1.7 Longitudinal frames and subframes. The number of longitudinal frames and subframes is computed by determining the number of subframes to reach around the earth along a parallel at the zone midpoint. The East-West pixel constant is divided by K pixels to determine the number of virtual subframes. The results are divided by 6 and rounded up to obtain the number of frame columns.

D.2.2 Additional computations for the polar zones. The computations for the polar zones are described in the following sections.

D.2.2.1 Polar pixel constant. The Polar pixel constant is the number of pixels 360° around a prime meridian. The ECRG

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value is a function of scale and DPI. It is important in ECRG that the number of polar pixels be a multiple of two virtual subframes. This is so the number of virtual subframes about the pole can be equal in each direction.

a. For Scale S, calculate the CADRG Polar pixel constant (A_{C-POL}) per Appendix 60.2.1 of MIL-C-89038. This result should be saved as an integer value with long precision.

b. Compute the total number of CADRG Polar sub-frames (N_{CSF-P}). This result should be saved as an integer value with long precision.

$$N_{CSF-POL} = A_{C-POL} * (20/360) / K_{CADRG}$$

c. Compute the ECRG Polar Pixel Constant (A_{POL}). This result should be saved as an integer value with long precision.

$$A_{POL} = K_{ECRG} * (360/20) * N_{CSF-POL}$$

D.2.2.2 Polar pixel size. The nominal pixel size (meters) for the polar zone is derived from the ADRG parameter values at a scale 1:S. The corresponding ADRG value, listed in APPENDIX 70, TABLE III of MIL-A-89007, is derived by dividing values for the 1:1,000,000 scale by a scale factor (1,000,000/S). The values for ECRG are derived by multiplying ADRG pixel sizes by the ratio of ADRG to ECRG Polar Pixel Constants.

D.2.2.3 Polar frames and subframes. The number of the polar subframes in each dimension (symmetric) is computed by multiplying the ECRG Polar Pixel Constant by the ratio $20^\circ/360^\circ$, and then dividing by K pixels. The number of frames is determined by dividing by 6 virtual subframes per frame, but rounding up to the next odd number of frames. (This ensures that a symmetric number of frames can be centered at the pole.)

D.2.3 Tabular data for frame and subframe structure. Results of computations defined above for the latitudinal and longitudinal data are enumerated in TABLE D-I through TABLE D-IX for various scales of ECRG source data. Equivalent values can be computed for any arbitrary scale map or chart, using the methodology outlined above in D.2.1 and D.2.2. This would allow developing ECRG [frame file]s for maps/charts of any scale.

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TABLE D-I. Frame/subframe sizes for 1:5,000,000 Global Navigation Chart (GNC) (254 DPI).

N-S Pixel Constant	N-S Pixel Size (m)
19968	502.7

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	24	4	0°	41.5384615
2,B	12	2	31.1538462	51.9230769
3,C	12	2	41.5384615	62.3076923
4,D	12	2	51.9230769	72.6923077
5,E *	6	1	62.3076923	72.6923077
6,F *	6	1	62.3076923	72.6923077
7,G	12	2	62.3076923	83.0769231
8,H *	6	1	72.6923077	83.0769231

9,J	—	—	80°	90°
-----	---	---	-----	-----

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	193	33	74112	500.36
2,B	159	27	61056	498.45
3,C	128	22	49152	500
4,D	104	18	39936	499.5
5,E *	85	15	32640	500.45
6,F *	72	12	27648	498.5
7,G	57	10	21888	501.92
8,H *	44	8	16896	500

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	12	3	82944	484.08

* Not produced due to full frame-level redundancy.

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TABLE D-II. Frame/subframe sizes for 1:2,000,000 Jet Navigation Chart (JNC) (254 DPI).

			N-S Pixel Constant	N-S Pixel Size (m)
			49920	200.31

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	48	8	0	33.2307692
2,B	30	5	29.0769231	49.8461538
3,C	18	3	45.6923077	58.1538462
4,D	18	3	54.0000000	66.4615385
5,E	12	2	62.3076923	70.6153846
6,F	12	2	66.4615385	74.7692308
7,G	12	2	70.6153846	78.9230769
8,H	12	2	74.7692308	83.0769231
9,J	—	—	80°	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	481	81	184704	199.94
2,B	395	66	151680	199.63
3,C	320	54	122880	200
4,D	260	44	99840	199.8
5,E	213	36	81792	199.71
6,F	179	30	68736	199.03
7,G	144	24	55296	199.6
8,H	108	18	41472	200

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	28	5	193536	206.67

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TABLE D-III. Frame/subframe sizes for 1:1,000,000 Operational Navigation Chart (ONC) (254 DPI).

			N-S Pixel Constant	N-S Pixel Size (m)
			100224	99.77

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	96	16	0	33.1034483
2,B	54	9	31.0344828	49.6551724
3,C	30	5	47.5862069	57.9310345
4,D	24	4	55.8620690	64.1379310
5,E	18	3	62.0689655	68.2758621
6,F	18	3	66.2068966	72.4137931
7,G	18	3	70.3448276	76.5517241
8,H	18	3	74.4827586	80.6896552
9,J	—	—	80°	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size(m)
1,A	963	161	369792	99.87
2,B	788	132	302592	99.9
3,C	640	107	245760	100
4,D	519	87	199296	99.84
5,E	425	71	163200	99.78
6,F	357	60	137088	99.79
7,G	287	48	110208	99.68
8,H	215	36	82560	99.84

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	58	11	400896	99.77

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TABLE D-IV. Frame/subframe sizes for 1:500,000 Tactical Pilotage Chart (TPC) (254 DPI).

N-S Pixel Constant	N-S Pixel Size (m)
200064	49.98

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	186	31	0	32.1305182
2,B	102	17	31.0940499	48.7140115
3,C	54	9	47.6775432	57.0057582
4,D	48	8	55.9692898	64.2610365
5,E	30	5	63.2245681	68.4069098
6,F	30	5	67.3704415	72.5527831
7,G	30	5	71.5163148	76.6986564
8,H	30	5	75.6621881	80.8445298

9,J	—	—	80°	90°
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Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	1925	321	739200	49.96
2,B	1576	263	605184	49.95
3,C	1280	214	491520	50
4,D	1037	173	398208	49.97
5,E	851	142	326784	49.83
6,F	715	120	274560	49.83
7,G	573	96	220032	49.93
8,H	429	72	164736	50.04

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	116	21	801792	49.89

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TABLE D-V. Frame/subframe sizes for 1:250,000 Joint Operations Graphic (JOG) (254 DPI).

N-S Pixel Constant	N-S Pixel Size (m)
400512	24.97

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	372	62	0	32.0997124
2,B	192	32	31.5819751	48.1495686
3,C	102	17	47.6318313	56.4333653
4,D	96	16	55.9156280	64.1994247
5,E	54	9	63.6816874	68.3413231
6,F	54	9	67.8235858	72.4832215
7,G	48	8	71.9654842	76.1073826
8,H	54	9	75.5896453	80.2492809

9,J	—	—	80°	90°
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Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	3851	642	1478784	24.97
2,B	3152	526	1210368	24.98
3,C	2560	427	983040	25
4,D	2075	346	796800	24.97
5,E	1701	284	653184	24.93
6,F	1429	239	548736	24.93
7,G	1147	192	440448	24.94
8,H	859	144	329856	24.99

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	232	39	1603584	24.94

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TABLE D-VI. Frame/subframe sizes for 1:100,000 Topographic Line Map (TLM) (254 DPI).

			N-S Pixel Constant	N-S Pixel Size (m)
			1001088	9.99

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	930	155	0	32.1058688
2,B	468	78	31.8987342	48.0552359
3,C	240	40	47.8481013	56.1334868
4,D	234	39	55.9263521	64.0046030
5,E	126	21	63.7974684	68.1472957
6,F	120	20	67.9401611	72.0828539
7,G	120	20	71.8757192	76.0184120
8,H	126	21	75.8112773	80.1611047
9,J	—	—	80°	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	9627	1605	3696768	9.99
2,B	7880	1314	3025920	9.99
3,C	6400	1067	2457600	10.00
4,D	5187	865	1991808	9.99
5,E	4253	709	1633152	9.97
6,F	3573	596	1372032	9.97
7,G	2867	478	1100928	9.98
8,H	2147	358	824448	10.00

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	580	97	4008960	9.98

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TABLE D-VII. Frame/subframe sizes for 1:50,000 Topographic Line Map (TLM) (254 DPI).

		N-S Pixel Constant	N-S Pixel Size (m)
		2001792	5.00

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	1854	309	0	32.0084404
2,B	936	156	31.9048533	48.0644542
3,C	468	78	47.9608671	56.0406676
4,D	468	78	55.9370804	64.0168809
5,E	240	40	63.9132937	68.0567811
6,F	240	40	67.9531939	72.0966814
7,G	234	39	71.9930942	76.0329944
8,H	240	40	75.9294073	80.0728947
9,J	—	—	80°	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1,A	19253	3209	7393152	5.00
2,B	15760	2627	6051840	5.00
3,C	12800	2134	4915200	5.00
4,D	10373	1729	3983232	5.00
5,E	8507	1418	3266688	4.98
6,F	7147	1192	2744448	4.98
7,G	5733	956	2201472	4.99
8,H	4293	716	1648512	5.00

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9,J	1158	193	8004096	5.00

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TABLE D-VIII. Frame/subframe sizes for 1:1,000,000 Operational Navigation Chart (ONC) (300 DPI - 2724 x 2724 pixels).

N-S pixel Constant	N-S Pixel Size (m)
118494	84.39

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1, A	96	16	0	33.1034483
2, B	54	9	31.0344828	49.6551724
3, C	30	5	47.5862069	57.9310345
4, D	24	4	55.8620690	64.1379310
5, E	18	3	62.0689655	68.2758621
6, F	18	3	66.2068966	72.4137931
7, G	18	3	70.3448276	76.5517241
8, H	18	3	74.4827586	80.6896552
9, J	----	----	80	90
Zone Number	Subframes (Columns) Latitudinal	Frame (Columns) Latitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1, A	963	161	437202	84.47
2, B	788	132	357752	84.50
3, C	640	107	290560	84.58
4, D	519	87	235626	84.44
5, E	425	71	192950	84.39
6, F	357	60	162078	84.41
7, G	287	48	130298	84.31
8, H	215	36	97610	84.45

Zone Number	Polar (X-Y) Subframes	Polar (X-Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9, J	58	11	473976	84.39

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TABLE D-IX. Frame/subframe sizes for 1:1,000,000 Operational Navigation Chart (ONC) (600 DPI - 5442 x 5442 pixels).

N-S pixel Constant	N-S Pixel Size (m)
236727	42.24

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1, A	96	16	0	33.1034483
2, B	54	9	31.0344828	49.6551724
3, C	30	5	47.5862069	57.9310345
4, D	24	4	55.8620690	64.1379310
5, E	18	3	62.0689655	68.2758621
6, F	18	3	66.2068966	72.4137931
7, G	18	3	70.3448276	76.5517241
8, H	18	3	74.4827586	80.6896552
9, J	----	----	80	90
Zone Number	Subframes (Columns) Latitudinal	Frame (Columns) Latitudinal	E-W Pixel Constant	E-W Pixel Size (m)
1, A	963	161	873441	42.28
2, B	788	132	714716	42.30
3, C	640	107	580480	42.34
4, D	519	87	470733	42.27
5, E	425	71	385475	42.24
6, F	357	60	323799	42.25
7, G	287	48	260309	42.20
8, H	215	36	195005	42.27

Zone Number	Polar (X-Y) Subframes	Polar (X-Y) Frames	POL Pixel Constant	POL Pixel Size (m)
9, J	58	11	946908	42.24

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TABLE D-X. Example Data Series Codes.

Refer to Paragraph 5.1.4 of MIL-STD-2411-1 Notice 1 for a complete list of data series codes.

Additional data series codes may be added to the ECRG TOC.xml file as they are approved by NGA.

[frame directory]		8
[frame file]		8
[rpf root directory]		8
[subordinate directory]		8
Accuracy		
Horizontal	3.2.2	5
Vertical	3.2.1	5
<u>Accuracy</u>	3.2	5
ARC	3.4.3	7
ARC	3.5.1	11
ARC	3.5.6	15
ARC	A.2.1	27
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CONCLUDING MATERIAL

Custodians:
Air Force: 09
Army: TI
Navy: NO

Preparing Activity:
NGA - MP

Project GINT-2006-005

Review Activities:
Air Force: 33, 99
Army: AV, CE2
Coast Guard: CG
DISA: DC2
DCMA: CM
DIA: DI
DMSO: DMS
Marine Corps: MC
NSA: NS
USNORTHCOM: US
USSOCOM

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above by using the ASSIST Online database at <http://assist.daps.dla.mil/>.