

**METRIC**

**MIL-PRF-32283**  
**21 February 2008**

## **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](mailto: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/>.

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## 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

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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://gwq.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>)

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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> )

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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.

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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.**

| <b>Interchange Media</b> | <b>Recording Standard</b> | <b>Volume/File Structure</b> |
|--------------------------|---------------------------|------------------------------|
| 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                     |

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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.**

| <b>Zone Number</b> | <b>Equatorward Latitude</b> | <b>Midpoint Latitude</b> | <b>Poleward Latitude</b> |
|--------------------|-----------------------------|--------------------------|--------------------------|
| 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

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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.

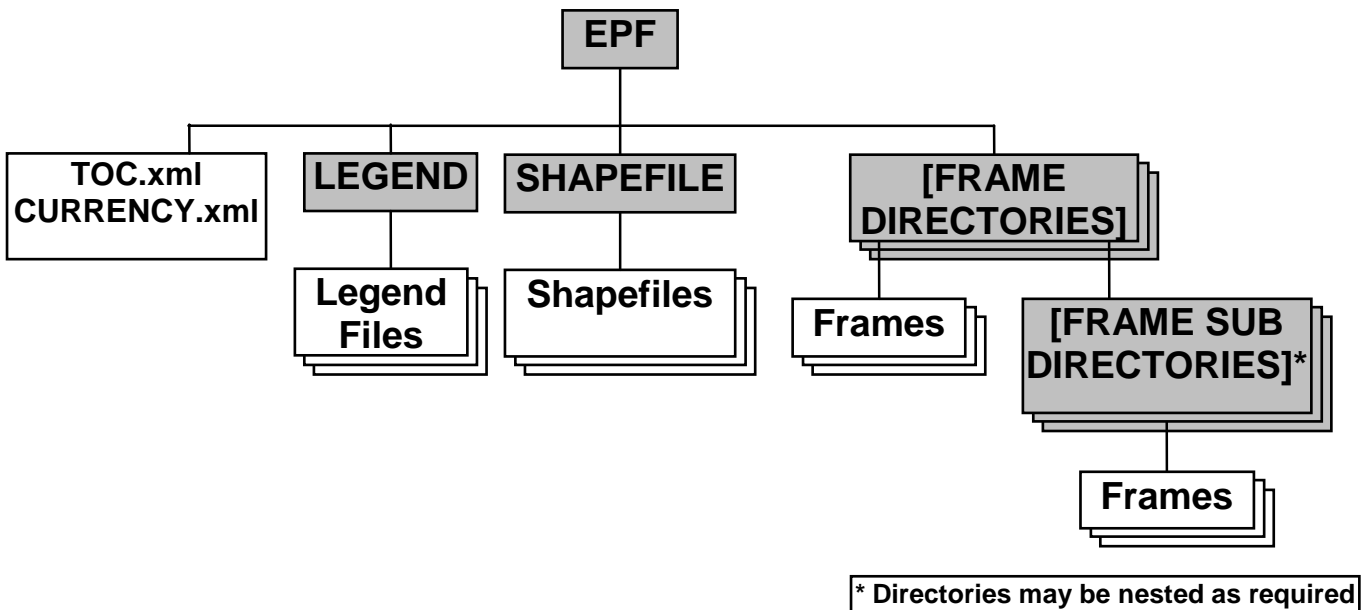
a. Root Directory: Contains [table of contents file], one or more directories of [frame file]s, and possibly a [legend directory]. The root directory shall be named "EPF".

```
(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.**



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**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:

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|                     |   |
|---------------------|---|
| Bytes per pixel:    | 3 bytes per pixel (8 bits per band, RGB)            |
| Color lookup table: | No  |
| Transparency:       | <Not applicable>                                    |
| Compression:        | Uncompressed, LZW (Lossless)<br>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.

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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 ( $\mu$ ) 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.

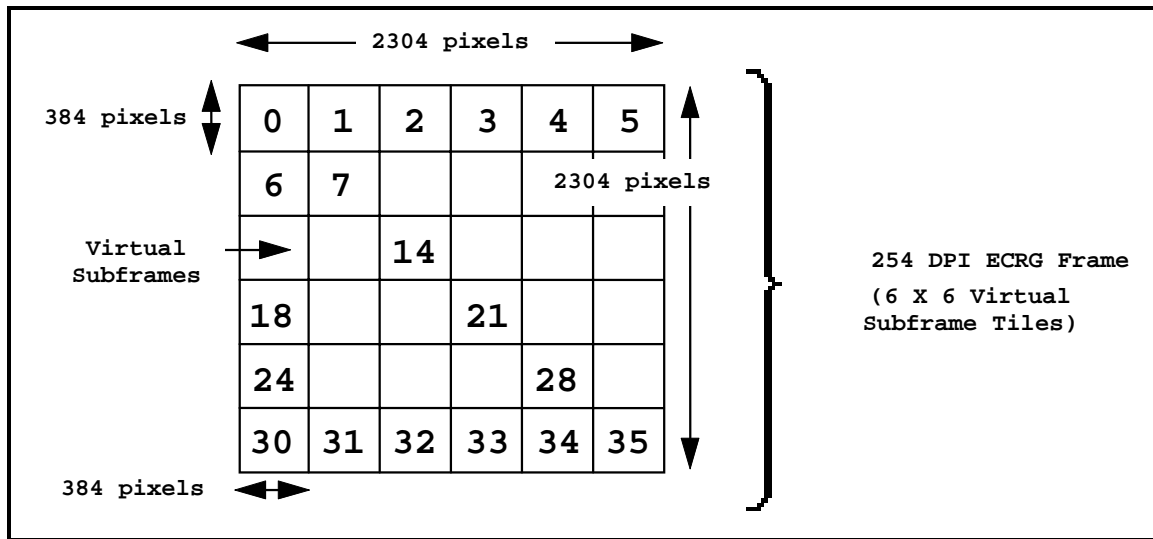
b. All frames and virtual subframes within a zone shall abut in a mutually exclusive manner without any pixel overlap or pixel redundancy. The northern and southern boundaries of a zone generally will not fall exactly on the northern and southern boundaries of a frame or virtual subframe. There shall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

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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

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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.

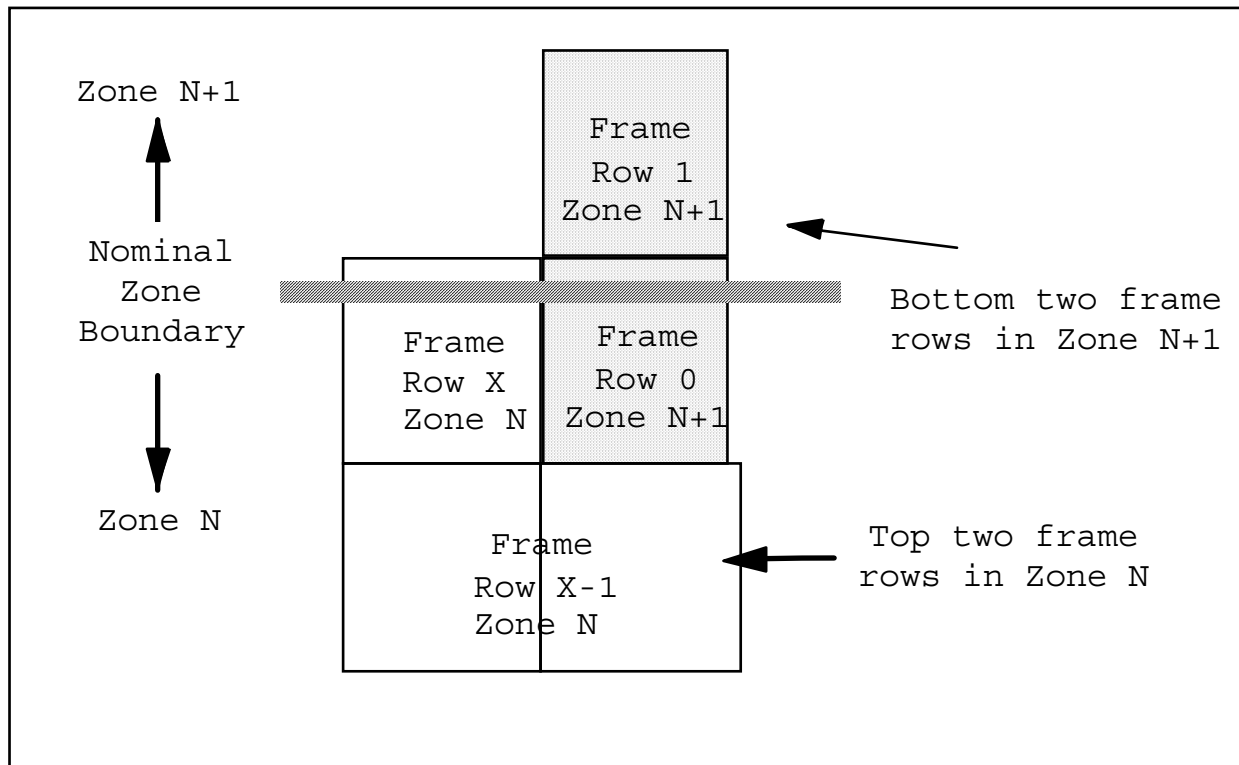
3.5.5. Frame and Virtual subframe structure for polar regions. The ECRG frame and virtual subframe structure is unique in the polar regions, in conjunction with the source products. ECRG shall use a polar stereographic projection, in which meridians (constant longitude) are plotted as radii emanating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

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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.

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**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.

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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.



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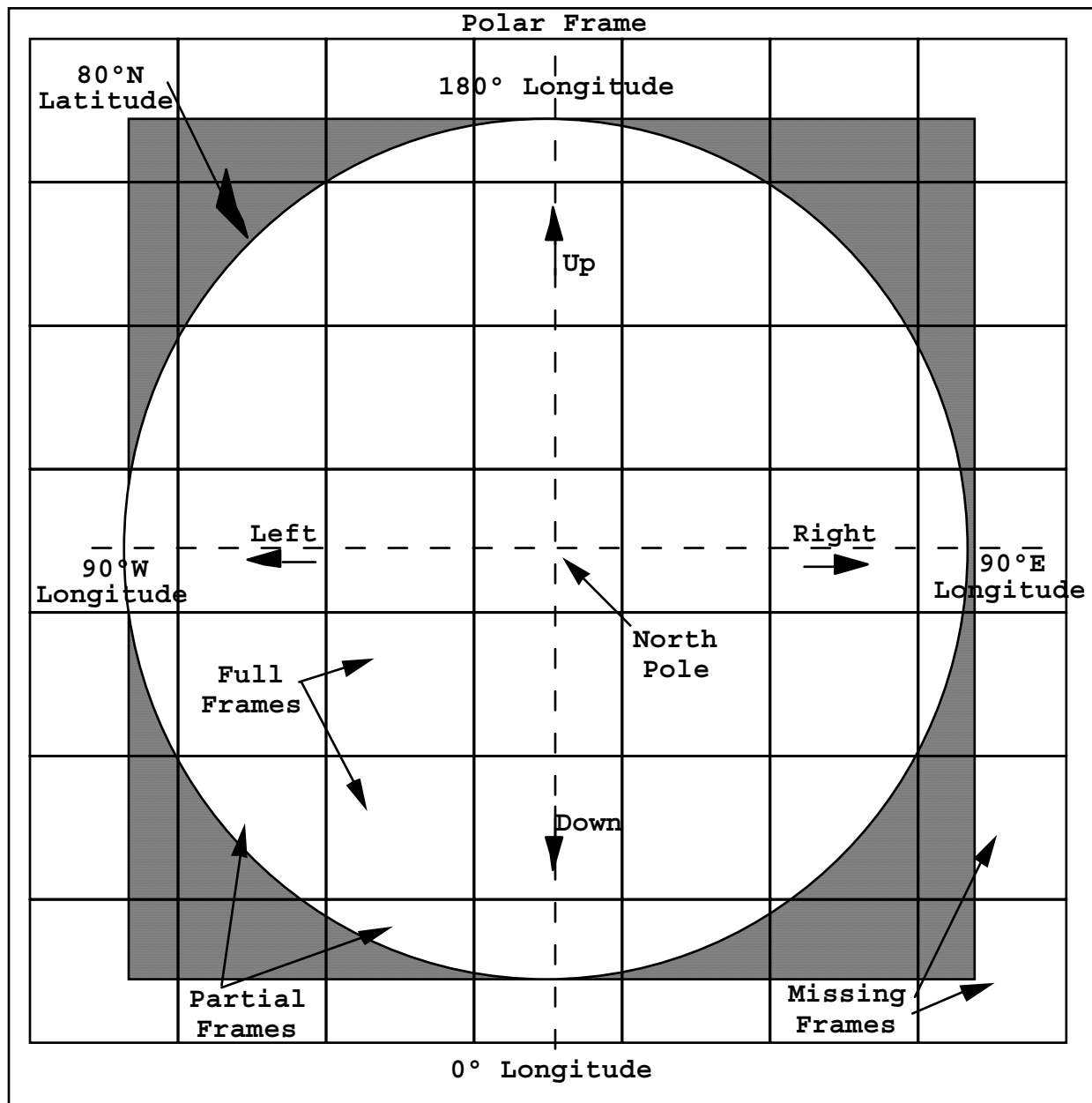


FIGURE 5. Frame orientation for the north polar zone.

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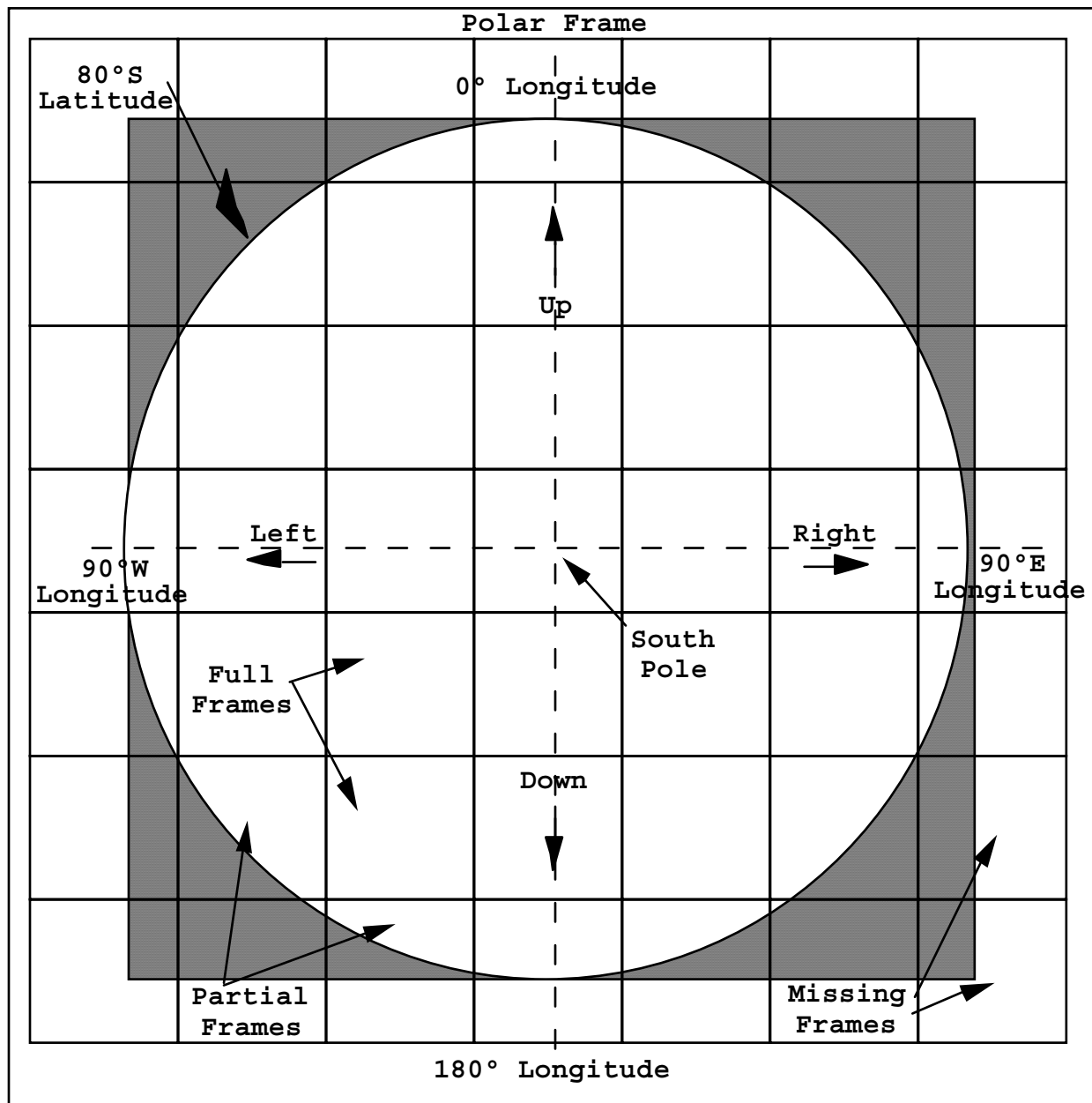


FIGURE 6. Frame orientation for the south polar zone.

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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.

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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.

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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.

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## 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.

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## 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.

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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<br>NGA       |
| ECRG        | Enhanced Compressed Raster Graphic                             |
| FIPS<br>PUB | Federal Information Processing Standard<br>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<br>System          |
| LFC         | Low Flying Chart (UK)  |
| NGA         | National Geospatial-Intelligence Agency                        |
| NIPRNet     | Unclassified but Sensitive Internet Protocol<br>Router Network |
|             | 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

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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.  |
| $(\Phi, \lambda)$        | Latitude, longitude of point in WGS-84 coordinates.   |
| $(\Phi_F, \lambda_F)$    | Latitude, longitude of frame origin for non-polar.  |
| $(\Phi_{sz}, \lambda_z)$ | 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 <sub>F</sub> , c <sub>Fz</sub> )  | Row and column number of a ECRG frame in a polar zone    |
| (r <sub>PF</sub> , c <sub>PF</sub> ) | Row and column number of a pixel within a frame.         |
| ( $\Phi$ , $\lambda$ )               | Latitude and longitude of a point in WGS-84 coordinates. |
| (<X>, <Y>)                           | Projection coordinates of a pixel with respect to pole.  |
| C <sub>S</sub>                       | Polar Pixel Constant for scale 1:S divided by 360°.      |
| P <sub>F</sub>                       | 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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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 ( $\Phi$ ) and longitude ( $\lambda$ ) 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 ( $\Phi_F$ ,  $\lambda_F$ ) 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,

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

and then the latitude of the frame origin ( $\Phi_F$ , 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,

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

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

and then the longitude of the frame origin ( $\lambda_F$ , 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  $0^\circ \leq \text{ACOS} \left[ \frac{\langle Y \rangle}{\sqrt{\langle X \rangle^2 + \langle Y \rangle^2}} \right] \leq 180^\circ$ .

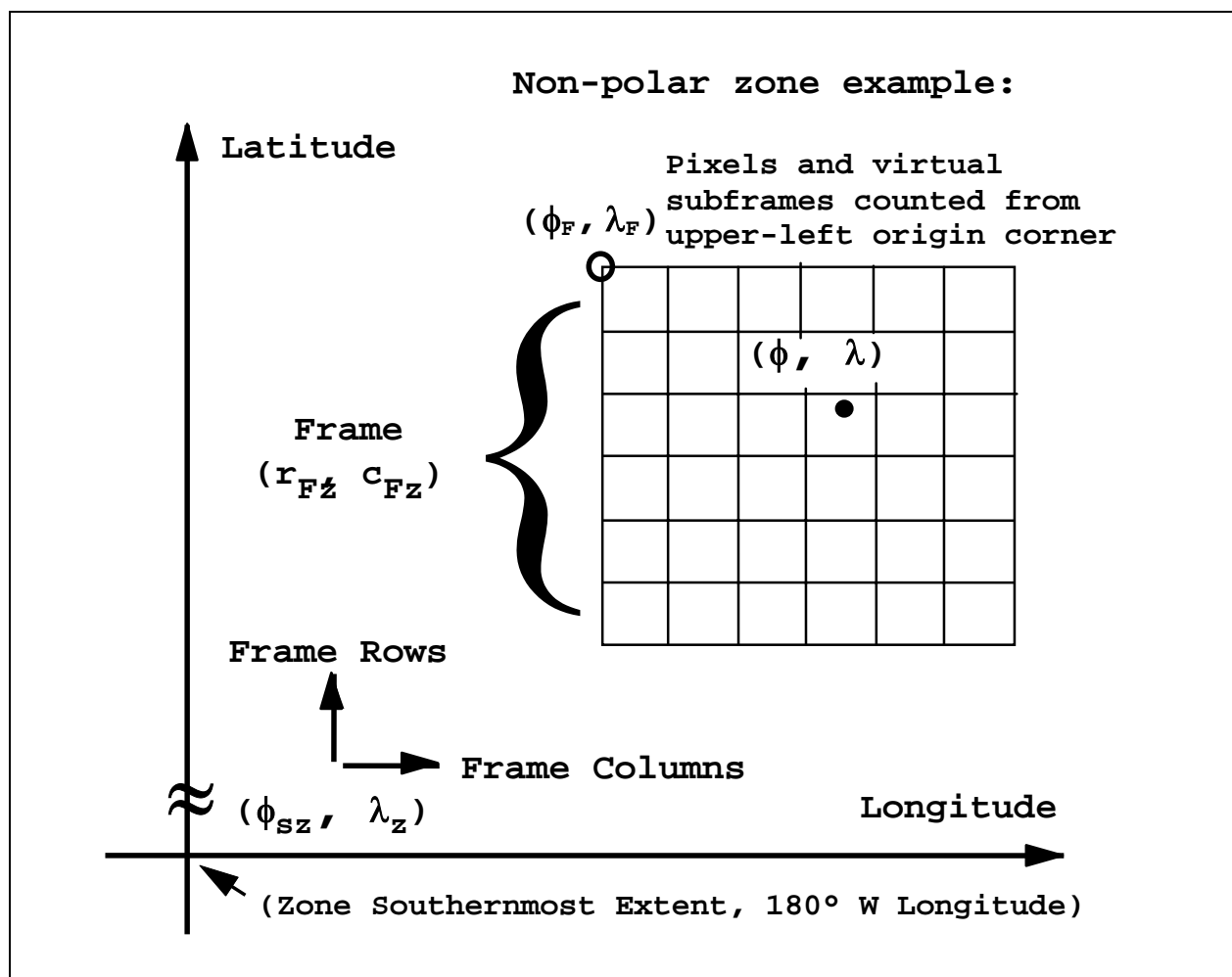


Figure A-1. Coordinate transformation in non-polar zones.

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  $(\Phi, \lambda)$ , its projection coordinates  $(\langle X \rangle, \langle Y \rangle)$  shall be computed as follows (see Figure A-2):

$$\langle X \rangle = C_s * (90^\circ - \phi) * \sin(\lambda) \quad (15)$$

$$\langle Y \rangle = -C_s * (90^\circ - \phi) * \cos(\lambda) \quad (16)$$

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  $(\Phi, \lambda)$ , its projection coordinates  $(\langle X \rangle, \langle Y \rangle)$  shall be computed as follows (see Figure A-3):

$$\langle X \rangle = C_s * (90 + \phi) * \sin(\lambda) \quad (21)$$

$$\langle Y \rangle = C_s * (90 + \phi) * \cos(\lambda) \quad (22)$$

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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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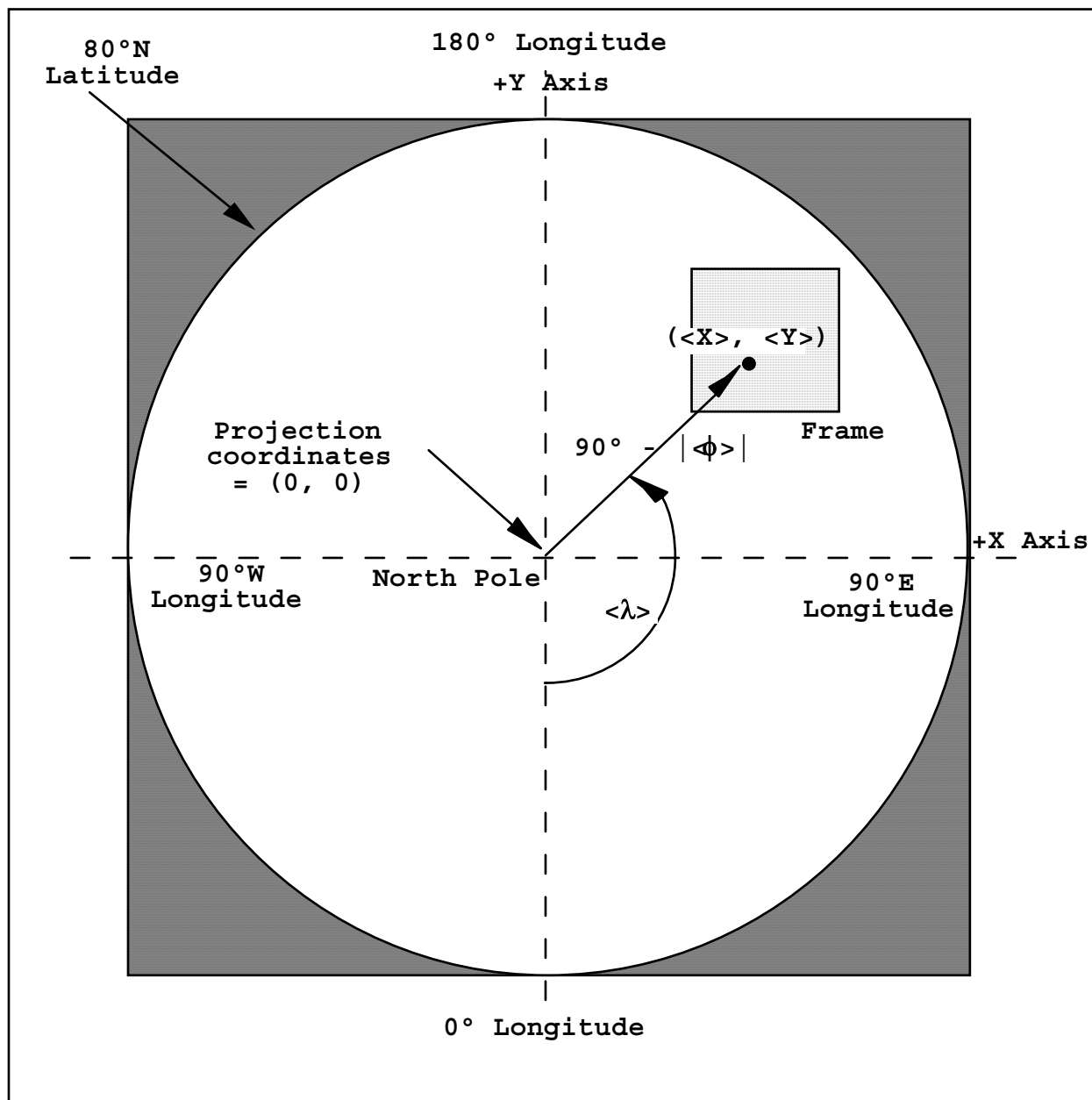


Figure A-2. Coordinate transformation in north polar region.

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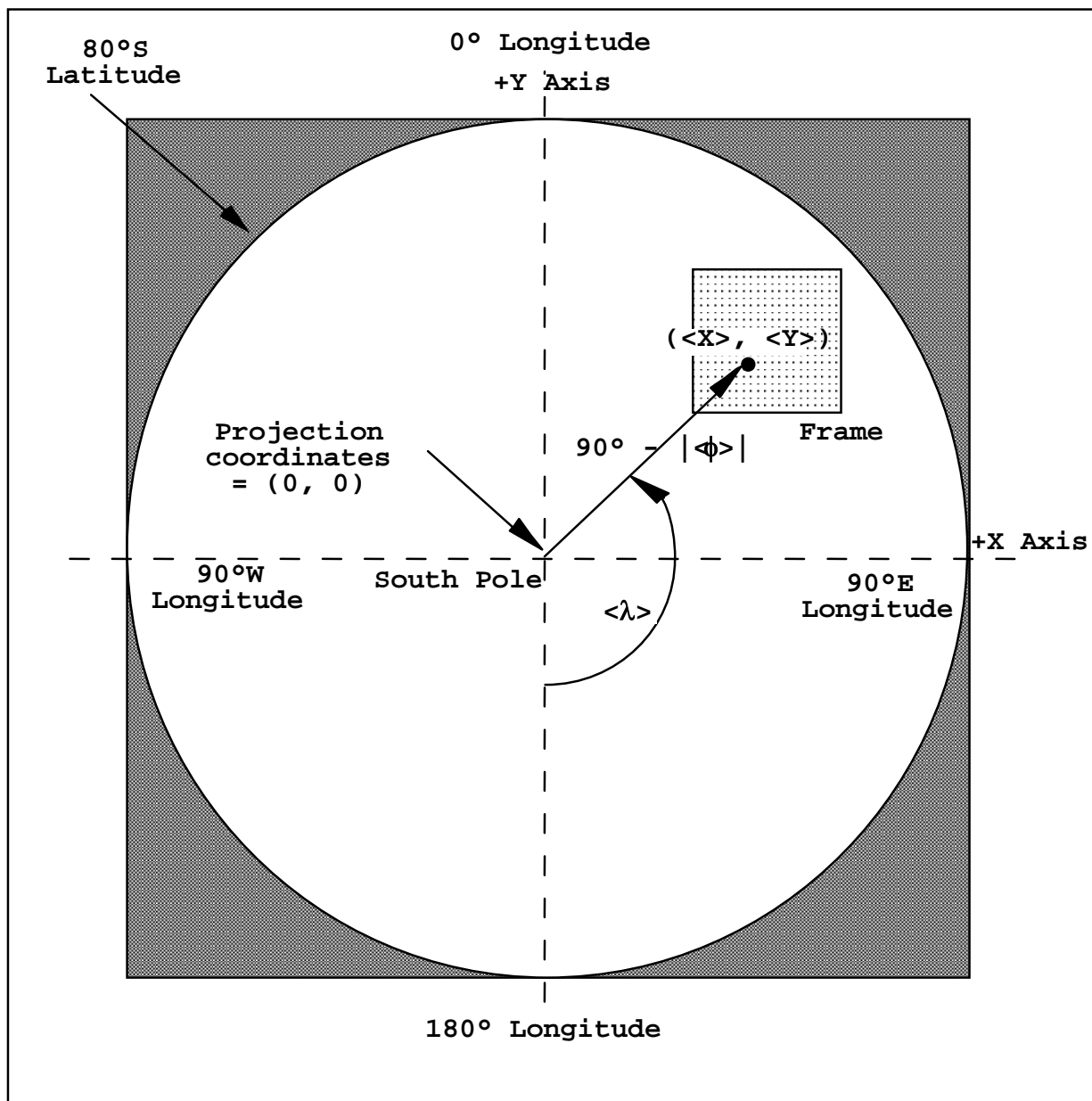


Figure A-3. Coordinate transformation in south polar region.

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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:

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

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

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

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

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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.

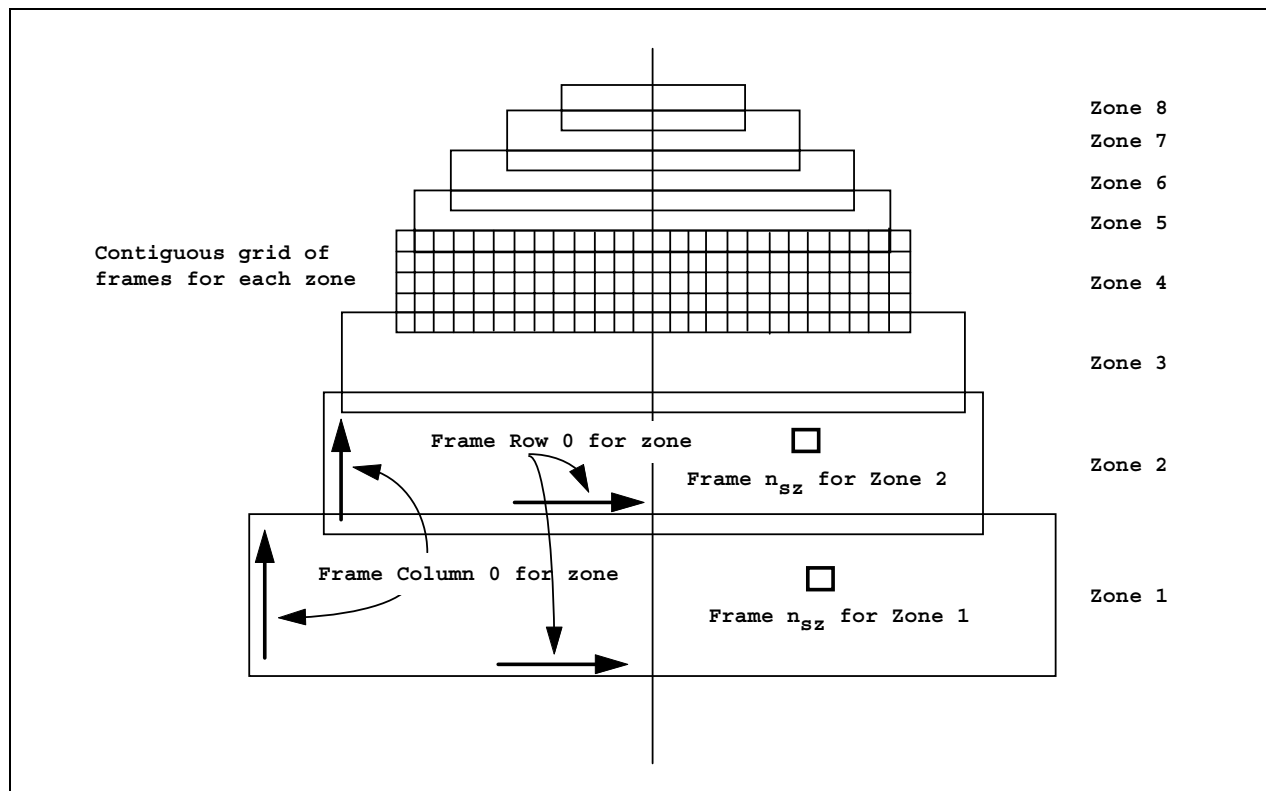


Figure A-4. Contiguous frame numbering convention for zones.

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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.**

| <b>Section Name</b>       | <b>Computation of Size</b>   |
|---------------------------|--|
| <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.**

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

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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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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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**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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**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 <sub>1</sub> | Length of nth Image Sub-header            | 6    |                      | Required |
| LI <sub>1</sub>   | 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 <sub>1</sub> | Length of 1 <sup>st</sup> text sub-header | 4    | "0282"               | Required |
| LT <sub>1</sub>   | Length of 1 <sup>st</sup> text segment    | 5    |                      | Required |
| LTSH <sub>2</sub> | Length of 2 <sup>nd</sup> text sub-header | 4    | "0282"               | Required |
| LT <sub>2</sub>   | Length of 2 <sup>nd</sup> text segment    | 5    |                      | Required |
| NUMDES            | Number of Data Extension Segments         | 3    | "000"                | Required |

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**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<br>- 3 | GEOPSB TRE (see table below) | Required |

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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   | CCYYMMDDhhmmss  | Required;<br>Oldest<br>Source<br>Significant<br>Date |
| TGTID  | Target Identifier                          | 17   | Blank           | Required   |
| IID2   | Image Identifier 2                         | 80   | Frame File Name | Required   |
| ISCLAS | Image Security<br>Classification           | 1    | T,S,C,R, or U   | Required   |
| ISCLSY | Image Security<br>Classification<br>System | 2    |                 | Required   |
| ISCODE | Image Codewords                            | 11   |                 | Required   |
| ISCTLH | Image Control and<br>Handling              | 2    |                 | Required   |
| ISREL  | Image Releasing<br>Instructions            | 20   |                 | Required   |
| ISDCTP | Image<br>Declassification<br>Type          | 2    |                 | Required   |
| ISDCDT | Image<br>Declassification<br>Date          | 8    |                 | Required   |
| ISDCXM | Image<br>Declassification<br>Exemption     | 4    |                 | Required   |
| ISDG   | Image Downgrade                            | 1    |                 | Required   |
| ISDGD  | Image Downgrade Date                       | 8    |                 | Required   |
| ISCLTX | Image Classification<br>Text               | 43   |                 | Required   |
| ISCATP | Image Classification<br>Authority Type     | 1    |                 | Required   |
| ISCAUT | Image Classification<br>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;<br>Source Type:<br>ADRG, EPODS,<br>etc  |
| NROWS  | Number of Significant Rows in Image    | 8    | >= 2304, NROWS<br>= NCOLS | Required  |
| NCOLS  | Number of Significant Columns in Image | 8    | >= 2304, NROWS<br>= NCOLS | Required  |
| PVTYPE | Pixel Value Type                       | 3    | "INT"                     | Required  |
| IREF   | 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 <sub>1</sub>     | Image Comment 1                       | 80   |                                | Required, Current Edition Frame Production Date                      |
| ICOM <sub>2</sub>     | Image Comment 2                       | 80   |                                | Required, Frame DPI  |
| ICOM <sub>3</sub>     | Image Comment 3                       | 80   |                                | Required, Frame Producer Description                                 |
| ICOM <sub>4</sub>     | Image Comment 4                       | 80   | <number><br><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 <sub>1</sub> | Nth Band Representation               | 2    | "R "                           | Required   |
| ISUBCAT <sub>1</sub>  | Nth Band Subcategory                  | 6    | Blank                          | Required   |
| IFC <sub>1</sub>      | Nth Band Image Filter Condition       | 1    | "N"                            | Required   |
| IMFLT <sub>1</sub>    | Nth Band Standard Image Filter Code   | 3    | Blank                          | Required   |
| NLUTS <sub>1</sub>    | Number of LUTS for the nth Image Band | 1    | "0"                            | Required   |
| IREPBAND <sub>2</sub> | Nth Band Representation               | 2    | "G "                           | Required   |
| ISUBCAT <sub>2</sub>  | Nth Band Subcategory                  | 6    | Blank                          | Required   |
| IFC <sub>2</sub>      | 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 <sub>2</sub>    | Nth Band Standard Image Filter Code   | 3    | Blank   | Required            |
| NLUTS <sub>2</sub>    | Number of LUTS                        | 1    | "0"   | Required            |
| IREPBAND <sub>3</sub> | Nth Band Representation               | 2    | "B "  | Required            |
| ISUBCAT <sub>3</sub>  | Nth Band Subcategory                  | 6    | Blank   | Required            |
| IFC <sub>3</sub>      | Nth Band Image Filter Condition       | 1    | "N"   | Required            |
| IMFLT <sub>3</sub>    | Nth Band Standard Image Filter Code   | 3    | Blank   | Required            |
| NLUTS <sub>3</sub>    | 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<br>IF NCOLS > 8192,<br>NPPBH = "0000"<br>AND CLEVEL = "09" | Required            |
| NPPBV                 | Number of Pixels Per Block Vertical   | 4    | IF NROWS <=8192, NPPBV = NROWS<br>IF NROWS > 8192,<br>NPPBV = "0000"<br>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) +<br>59 (GEOLOB) +<br>165 (BNDPLB) +<br>Length of<br>ACCP0B +<br>Length of<br>SOURCB + 3 | Required |
| IXSOFL | Image Extended Sub-header Overflow    | 3            | "000"  | Required |
| IXSHD  | Image Extended Sub-header Data        | IXSHDL<br>-3 | J2KLRA, GEOLOB<br>, BNDPLB,<br>ACCP0B, SOURCB<br>(See tables<br>below)                               | Required |

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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_O             | Number of Wavelet levels in original image | 2    | "05"        | Required                          |
| NBANDS_O              | Number of bands in original image          | 5    | "00003"     | Required                          |
| NLAYERS_O             | Number of Layers in original image         | 3    | "005"       | Required                          |
| LAYER ID <sub>0</sub> | Layer ID Number                            | 3    | "000"       | Required                          |
| BITRATE <sub>0</sub>  | Bit-rate                                   | 9    | "00.031250" | Required;<br>256:1<br>Compression |
| LAYER ID <sub>1</sub> | Layer ID Number                            | 3    | "001"       | Required                          |
| BITRATE <sub>1</sub>  | Bit-rate                                   | 9    | "00.062500" | Required;<br>128:1<br>Compression |
| LAYER ID <sub>2</sub> | Layer ID Number                            | 3    | "002"       | Required                          |
| BITRATE <sub>2</sub>  | Bit-rate                                   | 9    | "00.125000" | Required;<br>64:1<br>Compression  |
| LAYER ID <sub>3</sub> | Layer ID Number                            | 3    | "003"       | Required                          |
| BITRATE <sub>3</sub>  | Bit-rate                                   | 9    | "00.250000" | Required;<br>32:1<br>Compression  |
| LAYER ID <sub>4</sub> | Layer ID Number                            | 3    | "004"       | Required                          |
| BITRATE <sub>4</sub>  | Bit-rate                                   | 9    | "00.400000" | Required;<br>20:1<br>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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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 <sub>0</sub> | Longitude/Easting                    | 15   | NW LON     | Required  |
| LAT <sub>0</sub> | Latitude/Northing                    | 15   | NW LAT     | Required  |
| LON <sub>1</sub> | Longitude/Easting                    | 15   | NE LON     | Required  |
| LAT <sub>1</sub> | Latitude/Northing                    | 15   | NE LAT     | Required  |
| LON <sub>2</sub> | Longitude/Easting                    | 15   | SE LON     | Required  |
| LAT <sub>2</sub> | Latitude/Northing                    | 15   | SE LAT     | Required  |
| LON <sub>3</sub> | Longitude/Easting                    | 15   | SW LON     | Required  |
| LAT <sub>3</sub> | Latitude/Northing                    | 15   | SW LAT     | Required  |
| LON <sub>4</sub> | Longitude/Easting                    | 15   | NW_LON     | Required, must repeat first point (NW)                        |
| LAT <sub>4</sub> | 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 <sub>n</sub>   | Unit of Measure for AAH <sub>n</sub>  | 3    |            | Required  |
| AAH <sub>n</sub>  | Absolute Horizontal Accuracy          | 5    |            | Required  |
| UNIAAV <sub>n</sub>   | Unit of Measure for AAV <sub>n</sub>  | 3    |            | Required  |
| AAV <sub>n</sub>  | Absolute Vertical Accuracy            | 5    |            | Required  |
| UNIAPH <sub>n</sub>   | Unit of Measure for APH <sub>n</sub>  | 3    |            | Required  |
| APH <sub>n</sub>  | Point-to-Point Horizontal Accuracy    | 5    |            | Required  |
| UNIAPV <sub>n</sub>   | Unit of Measure for APV <sub>n</sub>  | 3    |            | Required  |
| APV <sub>n</sub>  | Point-to-Point Vertical Accuracy      | 5    |            | Required  |
| NUM_PTS <sub>n</sub>  | 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 <sub>nm</sub>   | Longitude/Easting                     | 15   |            | Required  |
| Lat <sub>nm</sub>   | Latitude/Northing                     | 15   |            | Required  |
| ... End for each bounding polygon point (coordinate pair)   |                                       |      |            |   |
| ... End for each region of positional accuracy              |                                       |      |            |   |



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SOURCEB (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    | "SOURCEB"  | 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 <sub>n</sub>  | Number of Bounding Polygons                              | 2    |            | Required   |
| ... Start for each bounding polygon of the nth original scene                      |  |      |            |  |
| NUM_PTS <sub>np</sub>  | Number of Points in the p <sup>th</sup> Bounding Polygon | 3    |            | Required, The last point must be a repeat of the first point               |
| ... Start for each point (coordinate pair) of the p <sup>th</sup> bounding polygon |  |      |            |  |
| LON <sub>npm</sub>   | Longitude/Easting  | 15   |            | Required   |
| LAT <sub>npm</sub>   | Latitude/Northing  | 15   |            | Required   |
| ... End for each point (coordinate pair) of the p <sup>th</sup> bounding polygon   |  |      |            |  |
| ... End for each bounding polygon of the nth original scene                        |  |      |            |  |
| PRT <sub>n</sub>   | Series   | 10   |            | Required   |
| URF <sub>n</sub>   | Source Identification                                    | 20   |            | Required, 3 character country code, immediately followed by chart producer |
| EDN <sub>n</sub>   | Edition  | 7    |            | Required   |

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

| FIELD               | NAME                                 | SIZE | ECRG VALUE    | NOTES   |
|---------------------|--------------------------------------|------|---------------|---|
| NAM <sub>n</sub>    | Name                                 | 20   |               | Required  |
| CDP <sub>n</sub>    | Type of Significant Date             | 3    | "029"         | Required, CDV <sub>n</sub> is the significant date  |
| CDV <sub>n</sub>    | Significant Date                     | 8    |               | Required  |
| CDV27 <sub>n</sub>  | Perishable Date                      | 8    |               | Required  |
| SRN <sub>n</sub>    | Source Reference Number              | 80   |               | Required  |
| SCA <sub>n</sub>    | Reciprocal Scale                     | 9    |               | Required  |
| UNISQU <sub>n</sub> | 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:<br>M2<br>KM2<br>HA |
| SQU <sub>n</sub>    | Coverage                             | 10   |               | Required  |
| UNIPCI <sub>n</sub> | Unit of Measure for Contour Interval | 3    |               | Required  |
| PCI <sub>n</sub>    | Contour Interval                     | 4    | May be blank  | Required  |
| WPC <sub>n</sub>    | Water Coverage                       | 3    | May be blank  | Required  |
| NST <sub>n</sub>    | Navigation System Type               | 3    | May be blank  | Required  |
| UNIHKE <sub>n</sub> | Units of HKE                         | 3    | May be blank  | Required  |
| HKE <sub>n</sub>    | Highest Known Elevation              | 6    | May be blank  | Required  |
| LONHKE <sub>n</sub> | Longitude/Easting of HKE             | 15   | May be blank  | Required  |
| LATHKE <sub>n</sub> | Latitude/Northing of HKE             | 15   | May be blank  | Required  |
| QSS <sub>n</sub>    | Security Classification of Source    | 1    | T, S, C, R, U | Required  |
| QOD <sub>n</sub>    | Downgrading                          | 1    |               | Required  |
| CDV10 <sub>n</sub>  | 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 <sub>n</sub>                               | Releasability  | 80   |              | Required |
| CPY <sub>n</sub>                               | Copyright Statement                                    | 80   |              | Required |
| NMI <sub>n</sub>                               | Number of Magnetic Information                         | 2    | May be blank | Required |
| ... Start for each set of magnetic information |  |      |              |          |
| CDV30 <sub>np</sub>                            | Date of Magnetic Information                           | 8    | May be blank | Required |
| UNIRAT <sub>np</sub>                           | Units for Annual Rate of Change                        | 3    | May be blank | Required |
| RAT <sub>np</sub>                              | Annual Rate of Change                                  | 8    | May be blank | Required |
| UNIGM <sub>np</sub>                            | Units of GMA <sub>np</sub>                             | 3    | May be blank | Required |
| GMA <sub>np</sub>                              | G-M Angle  | 8    | May be blank | Required |
| LONGMA <sub>np</sub>                           | Longitude/Easting of GMA <sub>np</sub> Reference Point | 15   | May be blank | Required |
| LATGMA <sub>np</sub>                           | Latitude/Northing of GMA <sub>np</sub> Reference Point | 15   | May be blank | Required |
| UNIGC <sub>np</sub>                            | Units of GCA <sub>np</sub>                             | 3    | May be blank | Required |
| GCA <sub>np</sub>                              | Grid Convergence Angle                                 | 8    | May be blank | Required |
| ... End for each set of magnetic information   |  |      |              |          |
| NLI <sub>n</sub>                               | Number of Legend Images                                | 2    | "00"         | Required |
| DAG <sub>n</sub>                               | Geodetic Datum Name                                    | 80   |              | Required |
| DCD <sub>n</sub>                               | Geodetic Datum Code                                    | 4    |              | Required |
| ELL <sub>n</sub>                               | Ellipsoid Name   | 80   |              | Required |
| ELC <sub>n</sub>                               | Ellipsoid Code   | 3    |              | Required |
| DVR <sub>n</sub>                               | Vertical Datum Reference                               | 80   |              | Required |
| VDCDVR <sub>n</sub>                            | Code (Category) of Vertical Reference                  | 4    |              | Required |
| SDA <sub>n</sub>                               | Sounding Datum Name                                    | 80   |              | Required |
| VDCSDA <sub>n</sub>                            | 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 <sub>n</sub>                        | Projection Name                        | 80   |            | Required,<br>Use codes<br>from DIGEST<br>2.1 Part 3<br>Table 6-5 |
| PCO <sub>n</sub>                        | Projection Code                        | 2    |            | Required,<br>Use codes<br>from DIGEST<br>2.1 Part 3<br>Table 6-5 |
| NUM_PRJ <sub>n</sub>                    | Number of Projection<br>Parameters     | 1    |            | Required   |
| ... Start for each projection parameter |  |      |            |  |
| PRJ <sub>np</sub>                       | Projection Parameter                   | 15   |            | Required,<br>Use codes<br>from DIGEST<br>2.1 Part 3<br>Table 6-5 |
| ... End for each projection parameter   |  |      |            |  |
| XOR <sub>n</sub>                        | Projection False X<br>(Easting) Origin | 15   |            | Required   |
| YOR <sub>n</sub>                        | Projection False Y<br>(Northing)       | 15   |            | Required   |
| GRD <sub>n</sub>                        | Grid Code                              | 3    |            | Required   |
| GRN <sub>n</sub>                        | Grid Description                       | 80   |            | Required   |
| ZNA <sub>n</sub>                        | Grid Zone number                       | 4    |            | Required   |
| NIN <sub>n</sub>                        | Number of Insets                       | 2    | "00"       | Required   |
| ... End for each source description     |  |      |            |  |
|   |  |      |            |  |

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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 |
| TSDBG   | Text Downgrade                      | 1    |                                      | Required |
| TSDBGDT | 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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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 <b><i>bold</i></b> )  |  |  |
| Table of Contents  |                  |                           |                                  |   |  |  |
|                    |                  |                           |                                  |   |  |  |
| <u>File Header</u> |                  |                           |                                  | Attribute: file_status - <b><i>new</i></b> 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        |                           |                                  | <b><i>TOC.xml</i></b>   | 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                    | <b><i>National Geospatial-Intelligence Agency (NGA)</i></b>                       | <i>If included</i> - Required                | The official government sponsor of the production of this media set.   |
|                    |                  |                           | Producer Address                 | <b><i>3200 S. Second St., St. Louis, Missouri U.S.A. 63118</i></b>                | <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             | <b><u>Property of the US Government</u></b> | <i>Optional - possibly 0, 1, or many occurrences</i>                                 | An optional list of pertinent information concerning the government producer.  |
|                |                  | Number Of Volumes         |                                  | <b><u>01-xx</u></b>                         | <i>If included - Required</i>  | The number of media volumes for this particular set of frames.   |
|                |                  | Volume Sequence Number    |                                  | <b><u>01-xx</u></b>                         | <i>If included - Required</i>  | The current volume number for this media, out of the entire set of media volumes.  |
|                |                  | Stock Number              |                                  | ( text )                                    | <i>If included - Required</i>  | The NGA Stock Number under which this media is officially categorized.   |
|                |                  | Media Edition             |                                  | <b><u>01-xx</u></b>                         | <i>If included - Required</i>  | The official edition number of this media release (assuming similar if not same set of frames).  |
|                |                  | Media Production Date     |                                  | In <b><u>YYYYMMDD</u></b> format            | <i>If included - Required</i>  | The date the media was officially published by NGA (or one of their producers).  |
|                |                  | Bounding Rectangle        |                                  | --  | <i>If included - Required</i>  | 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 - Optional - may or may not be present.</i>                           | The highest level of security associated with the entire volume of media.  |
|                |                  |                           | Classification                   | <b><u>U</u></b>                             | <i>If included - Required</i>  | The highest classification of each of the frames on the media.   |
|                |                  |                           | Country Code                     | <b><u>US</u></b>                            | <i>If included - Optional - if there is a classification country code available.</i> | The country code of the country specifying the classification.   |

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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>   |
|----------------|------------------|---------------------------|----------------------------------|--|--|--|
|                |                  |                           | Release Marking                  | <b><u>PS</u></b>   | <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                    | <b><u>Enhanced Compressed Raster Graphics (ECRG)</u></b> | <i>If included - Required</i>  | The official title of the specification  |
|                |                  |                           | Standard Number                  | <b><u>MIL-PRF-32283</u></b>                              | <i>If included - Required</i>  | The official specification number assigned.  |
|                |                  |                           | Standard Date                    | <b><u>21 FEB 2008</u></b>                                | <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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**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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### 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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**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 <b><u>bold</u></b> )                             |  |   |
| 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        |                           |                                  | <b><u>FrameCurrency.xml</u></b>                                    | 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-form 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                   | <b><u>U</u></b>  | <i>If included - Required</i>  | The highest classification of this file.  |
|                    |                  |                           | Country Code                     | <b><u>US</u></b>   | <i>If included - Optional</i> - if there is a classification country code available. | The country code of the country specifying the classification.  |
|                    |                  |                           | Release Marking                  | <b><u>PS</u></b>   | <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                    | <b><u>National Geospatial-Intelligence Agency (NGA)</u></b>        | <i>If included - Required</i>  | The official government sponsor of the production of this media set.  |
|                    |                  |                           | Producer Address                 | <b><u>3200 S. Second St., St. Louis, Missouri U.S.A. 63118</u></b> | <i>If included - Required</i>  | The address of the government producer  |

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**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><b>Property of the US Government</b></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><b>Enhanced Compressed Raster Graphics (ECRG)</b></u>               | <i>If included - Required</i>                                      | The official title of the specification  |
|                |                  |                           | Standard Number                  | <u><b>MIL-PRF-32283</b></u>  | <i>If included - Required</i>                                      | The official specification number assigned.  |
|                |                  |                           | Standard Date                    | <u><b>21 FEB 2008</b></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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**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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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:XXXXXXXXXXXXXXXXXXXXX)
- 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:XXXXXXXXXXXXXXXXXXXXX)
- 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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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  $\mu_{ECRG}$  in microns for the desired DPI. This value should be saved with double precision.

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

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c. Calculate the number of CADRG Subframes that stretch from the equator to a pole ( $0^\circ$  to  $90^\circ$ ). 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  $180^\circ$  west longitude meridian going  $360^\circ$  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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$$N_{CSF-EW} = A_{CADRG} / K_{CADRG}$$

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  $90^\circ$ . 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  $360^\circ$  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 CADRГ 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 CADRГ 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 ECRГ 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 ADRГ parameter values at a scale 1:S. The corresponding ADRГ 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 ECRГ are derived by multiplying ADRГ pixel sizes by the ratio of ADRГ to ECRГ 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 ECRГ 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 ECRГ 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 ECRГ [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                        |
| <del>5, E</del> * | 6                                    | 1                              | 62.3076923                           | 72.6923077                        |
| <del>6, F</del> * | 6                                    | 1                              | 62.3076923                           | 72.6923077                        |
| 7, G              | 12                                   | 2                              | 62.3076923                           | 83.0769231                        |
| <del>8, H</del> * | 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                             |
| <del>5, E</del> * | 85                                   | 15                             | 32640                                | 500.45                            |
| <del>6, F</del> * | 72                                   | 12                             | 27648                                | 498.5                             |
| 7, G              | 57                                   | 10                             | 21888                                | 501.92                            |
| <del>8, H</del> * | 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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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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°                               |

| 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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FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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°                               |
| 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).**

|  |  |  | <b>N-S Pixel Constant</b> | <b>N-S Pixel Size (m)</b> |
|--|--|--|---------------------------|---------------------------|
|  |  |  | 1001088                   | 9.99                      |

| <b>Zone Number</b> | <b>Subframes in Zone (Rows) Latitudinal</b> | <b>Frame Rows in Zone Latitudinal</b> | <b>Equatorward Zone Extent with Overlap</b> | <b>Poleward Zone Extent with Overlap</b> |
|--------------------|---|---------------------------------------|---|--|
| 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°                                      |

| <b>Zone Number</b> | <b>Subframes (Columns) Longitudinal</b> | <b>Frames (Columns) Longitudinal</b> | <b>E-W Pixel Constant</b> | <b>E-W Pixel Size (m)</b> |
|--------------------|---|--------------------------------------|---------------------------|---------------------------|
| 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                     |

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



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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

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

|  |  |  | <b>N-S Pixel Constant</b> | <b>N-S Pixel Size (m)</b> |
|--|--|--|---------------------------|---------------------------|
|  |  |  | 2001792                   | 5.00                      |

| <b>Zone Number</b> | <b>Subframes in Zone (Rows) Latitudinal</b> | <b>Frame Rows in Zone Latitudinal</b> | <b>Equatorward Zone Extent with Overlap</b> | <b>Poleward Zone Extent with Overlap</b> |
|--------------------|---|---------------------------------------|---|--|
| 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°                                      |

| <b>Zone Number</b> | <b>Subframes (Columns) Longitudinal</b> | <b>Frames (Columns) Longitudinal</b> | <b>E-W Pixel Constant</b> | <b>E-W Pixel Size (m)</b> |
|--------------------|---|--------------------------------------|---------------------------|---------------------------|
| 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                      |

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

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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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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APPENDIX D  
FRAME AND VIRTUAL SUBFRAME STRUCTURE

**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.

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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/>.