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PERFORMANCE SPECIFICATION

CONTROLLED IMAGE BASE (CIB)

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

1. SCOPE

1.1 Scope. This specification defines requirements for the preparation and use of the National Imagery and Mapping agency's (NIMA) Raster Product Format (RPF) Controlled Image Base (CIB) data.

1.2 Purpose. The purpose of this document is to ensure the uniformity of treatment among all elements engaged in a coordinated production program for the CIB.

Beneficial comments (recommendations, additions, deletions) and any data which may be of use in improving this document should be sent to: Director, National Imagery and Mapping Agency, Attn: Doctrine and Force Development/DF, Mail Stop P-37, 12310 Sunrise Valley Drive, Reston, Va. 20191-3449 by using the Standardization Document Improvement Proposal (DD Form 1426) or by letter.

AMSC N/A **AREA MCGT**

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

1.3 Classification. The Controlled Image Base product is currently produced at three levels of detail. The most common levels are ten (10) meter spacing between pixel elements and five (5) meter spacing. CIB can also be produced at a higher level of resolution (two or one meter).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are needed to meet the requirements specified in sections 3, 4, and 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all requirements documents cited in sections 3, 4, and 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 listed in the current Department of Defense Index of Specifications and Standards (DODISS) and the supplement thereto.

DEPARTMENT OF DEFENSE

SPECIFICATIONS

MIL-PRF-89007 - Military Specification, ARC Digitized Raster Graphics

MIL-PRF-89038 - Military Specification, Compressed ARC Digitized Raster Graphics (CADRG), with Amendment 2.

STANDARDS

MIL-STD-2411 – Military Standard, Raster Product Format (RPF)

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

MIL-STD-2411-2 - Incorporation of Raster Product Format (RPF) Data in National Imagery Transmission Format (NITF).

MIL-STD-2414 - Department of Defense Standard Practice, Bar Coding for Mapping, Charting, and Geodesy Products

MIL-STD-2500A – Military Standard, National Imagery Transmission Format (Version 2.0)

(Unless otherwise indicated, copies of federal and military specifications, standards, and instructions are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, 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.

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

b. NIMA Technical Report, NIMA TR 8350.2: Department of Defense World Geodetic System 1984 Technical Report: Parameters, Formulas, and Graphics for the Practical Application of WGS-84.

(Copies of the above publication are available from the National Imagery and Mapping Agency, Dissemination Division, 4600 Sangamore Road, Bethesda, MD 20816-5003.)

d. NIMA Procedural Instruction NI 8955.1 (Draft), Guidelines for Labeling CD-ROMs, Printing and Finishing of Jewel Case Liners/Cardboard Sleeves, and Information Booklets.

(Copies of the above publication is available from the National Imagery and Mapping Agency, Systems Engineering Group (SE), 4600 Sangamore Road, Bethesda, Md. 20816-5003)

(Copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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 following documents that are not listed in the DODISS are the issues of the documents as cited below.

a. Southard, D. A., 1992, “Compression of Digitized Map Images,” Computers and Geosciences, Vol. 18, No. 9, pp. 1213-1253.

b. Markuson, N. J., July 1994, “Analysis of Compression Techniques for Common Mapping Standard (CMS) Raster Data,” ESC Technical Report, MTR-93B0000091.

(Application for ESC Report copies should be addressed to Electronic Systems Center/YV, 5 Eglin St, Hanscom AFB, MA 01731-2123.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), 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 (see 4.2).

3.2 Accuracy and resolution.

3.2.1 Horizontal accuracy.

a. The horizontal accuracy of CIB data depends on the accuracy of the ephemeris data of the satellite capturing the image source from which the CIB was derived and the accuracy of the information used to orthorectify the image. The horizontal accuracy attribute within the CIB frame file defines the accuracy for each frame file or areal extent.

b. Previous experience has shown that accuracies of 25 meters or better are achievable for imagery of 10m or smaller Ground Sample Distance (GSD). At least nine out of any ten randomly chosen points mensurated and computed from CIB will fulfill the horizontal accuracy listed in the attribute section for the particular image source utilized in production. Accuracies shall be determined relative to a 90% Circular Map Accuracy Standard (CMAS) within WGS 84 (NIMA TR 8350.2). The accuracy error attributable to compressing the CIB data contributes insignificantly to the total accuracy of the product.

3.2.2 Vertical accuracy. Vertical accuracy is not applicable to this product specification.

3.2.3 Resolution. The resolution of the CIB data depends on the resolution of the image source from which the CIB is derived and any processing steps which affect the resolution or GSD. MIL-STD-2411-1 lists the registered data series codes for RPF and includes the resolution of all registered CIB products. Note that in this specification, the terms "GSD" and "resolution" are used interchangeably. Initial CIB products will be produced at 5 meter 10 meter nominal resolutions and other resolutions will be produced based on source and customer request

3.3 Datum

3.3.1 Horizontal datum. The horizontal datum for CIB shall e WGS-84, as defined by DMA TM 8358.1.

3.3.2 Vertical datum. The vertical datum is not applicable to this product specification.

3.4 Product description. The CIB product shall conform to MIL-STD-2411. It will be produced directly from source images and reformatted into a CIB frame file structure. CIB files will be physically formatted within the NITF message. CIB images are grayscale (monochromatic), although the input for CIB may be multispectral (i.e., CIB may be derived from a grayscale image, from one band of a multispectral product, or from an arithmetic combination of several multispectral bands). Images will be processed into a CIB product with a specified resolution which will be reflected in the data series code for the product contained in MIL-STD-2411-1. The processing involves projecting the image data into the Equal Arc-second Raster Chart/map (ARC) system, grouping pixels into frames and subframes of constant size and vector quantization image compression, as defined in 3.14.1.

3.4.1 Exchange media and recording formats. The standard CIB data set shall be exchanged on compact disk-read only memory (CD-ROM) media. In addition, CIB may be distributed on the media types specified in MIL-STD 2411. The CIB product will have minimal exploitation software associated or provided.

3.4.2 Source Imagery. Portions of one or more source images are mosaiced together to form each frame file. Source images are othorectified to Mean Sea Level (MSL) using National Imagery and Mapping Agency Digital Terrain Elevation Data (DTED) or other data which provide the required accuracy for the removal of terrain relief and other distortions present within the original source imagery.

3.4.3 Projection system. The CIB product conforms to the ARC projection system, which divides the surface of the earth ellipsoid into 18 latitudinal bands, called zones. Zones 1-9 cover the northern hemisphere, and zones 10-18 (A through J, exclusive of I in CIB) cover the southern hemisphere. Zone 9 and J cover the polar areas in the northern and southern hemispheres, respectively. Each nonpolar zone covers a part of the ellipsoid between two latitude limits and completely encircles the Earth. The nominal zone limits for CIB are listed in MIL-STD-2411-1. The extents of the CIB zone overlaps are defined in the APPENDIX, Section A.5.

3.4.4 Distribution frames. The CIB database is composed of rectangular grids of frames of pixels for each zone and can be distributed with contiguous or non-contiguous coverage. Each frame is represented by a discrete file.

3.4.4.1 Imagery Seams. CIB is designed to be seamless. Seamless is generally interpreted to allow a "shear" of one pixel or less of horizontal displacement. Source images are indistinguishable except where shear and/or shifts in gray scale values occur as a result of inconsistencies in source imagery collection parameters (e.g., gain values set differently, images collected on different dates.) Processing of the source imagery into CIB will include a brightness and/or contrast adjustment in order to minimize such differences; however, it typically will not be possible to eliminate all visual differences between mosaiced images. CIB image data from adjacent frames abut exactly to provide unbroken coverage. However, gaps in coverage may occur as a result of incomplete source image data. In the case where source imagery is extremely dark or light (e.g., contains features that are unrecognizable), data will be enhanced such that contrast will be heightened over large areas and features are recognizable without further enhancement by the user. No artificial seams (i.e., along geocell or frame boundaries) will be introduced to data during processing from source to final CIB product except in the case along the degree boundary where adequate DTED is not available for the adjacent cell. At a minimum, CIB producers should present its approach to both radiometric balancing and contrast enhancement for review before production begins.

3.4.5 Data file organization. CIB data files are arranged in a hierarchical directory/subdirectory structure (see FIGURE 1). The CIB directories and data file, enumerated below, are fully described in 3.12 and 3.13. All names and labels, and the format and structure of directories shall adhere to the conventions specified in MIL-STD-2411.

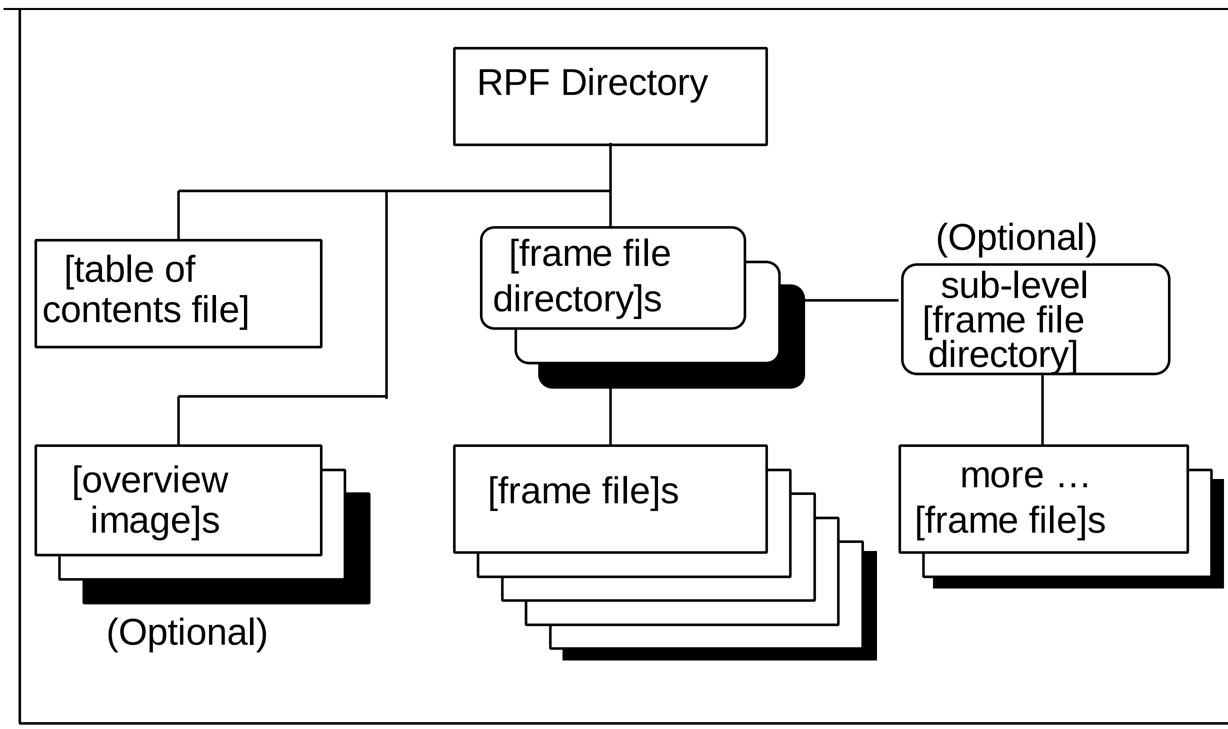

FIGURE 1. CIB Directory/File Structure.

a. CIB "root" Directory: Contains [table of contents file], one or more directories of [frame file]s and one or more [overview image]. The root directory shall be named “RPF”.

b. [table of contents file]: The [table of contents file] provides an overview of the data contents of the distribution media. The [frame file index section] within the [table of contents file] provides path names to each of the [frame file]s on the interchange volume. The path names to the [frame file]s will be used by user applications software to locate the [frame file]s.

c. [frame file directory]s: CIB producers will choose the number of [frame file directory]s in a given volume and convention for assigning [frame file]s to directories. Each of the [frame file directory]s 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.

d. [frame file]s: The [frame file]s contain the tiled image and support data for the geographic frames on a CIB interchange volume. A CIB [frame file] includes all NITF and RPF components. Each [frame file] shall include a [header section], [location section], [coverage section], [compression section], [color/grayscale section], [image section], optional [attribute section], [related images section] and [replace/update section] (only present for replacements and updates). The [frame file] naming convention shall be in accordance with MIL-STD-2411, and is described in the APPENDIX, Section A.3.6.

e. [Overview image]s: (Optional)[overview images] may be provided on CIB interchange media. These indicate graphically where the [frame file]s are located with respect to political and ocean boundaries, similar to the Location Diagram on the jewel-box liner. [Overview image]s will be at the same level on the media as the [table of contents file]. Each [overview image] shall include a [header section], [location section], [compression section], [color grayscale section], and [image section].

f. [Read Me/Metadata File]: NIMA is resolving issues associated with the Executive Order issued on the "Content Standards for Digital Geospatial Metadata". This document is published by the Federal Geographic Data Committee and describes all types and formats of metadata. In conjunction with this metadata file, a READ ME file required by the Defense Information Systems Agency is in work. NIMA will provide amendments to this specification in the form of change pages at a later date to describe the metadata file and the READ ME file.

3.4.6 Data formats. Data recording shall adhere to the conventions for logical data recording formats as specified in section 4.4 of MIL-STD-2411, and formatted within an NITF message conforming to MIL-STD-2411-2.

3.5 Frame and subframe structure.

3.5.1 Scale and Pixel spacing. In the nonpolar zones, pixel spacing is the nominal ground sample distance (GSD) of the source image, at nadir, in both the east-west and north-south directions on the WGS 84 ellipsoid. In the polar zones, pixel spacing is the minimal GSD of the source image at nadir in both X and Y axes of the polar stereographic projection. A nominal scale for CIB can be calculated for comparison to National Imagery and Mapping Agency ARC Digitized Raster Graphics (MIL-PRF-89007) or Compressed ARC Digitized Raster Graphics (CADRG) (MIL-PRF-89038) by using the following equations:

$$\text{CIB scale (Compared to ADRG)} = 100 \times 10^{-6} / \text{GSD} \qquad \textbf{(1)}$$

$$\text{CIB scale (Compared to CADRG)} = 150 \times 10^{-6} / \text{GSD} \qquad \textbf{(2)}$$

a. In the above equations, the "nnn x 10^{-6}" value corresponds to the distance in meters between the pixels that are scanned on the paper map for the ADRG or CADRG product (100 microns and 150 microns, respectively). Dividing this value by the distance in meters between the samples on the ground (GSD) for the CIB product gives the equivalent scale for CIB. As an example, in a 10m CIB product, the equivalent scale as compared to ADRG is $100 \times 10^{-6} / 10$ or 1:100,000.

b. Within a non polar zone, pixel spacing is fixed in units of arc-seconds of latitude per pixel and arc-seconds of longitude per pixel.

c. The numbers of CIB pixels in both latitudinal and longitudinal directions shall be adjusted so that there are integral numbers of subframes per zone. In the polar zone, the number of CIB pixels is adjusted so that there is an even number of subframes across the zone in each dimension.

3.5.2 Frame and subframe tiling.

a. Each frame shall comprise a rectangular array of 1536 by 1536 pixels (2,359,296 pixels). Each frame shall be tiled into a grid of 6 by 6 subframes (i.e., 36 subframes) Each subframe shall comprise a rectangular array of 256 by 256 output pixels. Subframes shall be numbered (0...35) as depicted in FIGURE 2, in accordance with MIL-STD-2411.

b. All frames and subframes within a zone shall abut in a mutually exclusive manner without any pixel overlap or pixel redundancy, except as noted in 3.5.4b. The distance between a pixel that falls on a frame or subframe border and its neighbor in the adjacent frame or subframe shall equal the GSD for the product. The northern and southern boundaries of a zone generally will not fall exactly on the northern and southern boundaries of a frame or subframe. There shall be frame overlap between the zones, as defined in 3.5.5.

c. The APPENDIX, Section A.5, lists the number of frame and subframe rows and columns in each zone for the latitudinal and longitudinal directions, east-west pixel spacing constants (i.e., the number of pixels for 360° longitude), and the north-south pixel spacing constants (i.e., number of pixels contained in 90° from equator to pole) for several example CIB resolutions.

3.5.3 Numbering and origin conventions.

a. The numbering convention shall conform to MIL-STD-2411. All index numbers for pixels within a subframe, subframes within a frame and frames within a zone shall start from 0. Rows and columns of subframes in a frame, pixels, and indices in [frame file] components shall be counted from 0. The origin for the subframe and pixel numbering within frames and subframes shall be from the upper left corner. Subframes and pixels shall be counted in row-major order from the origin. The APPENDIX provides a set of coordinate conversions between row/column coordinate of a pixel within a frame, and the latitude and longitude of the corresponding point, based on the coordinate information provided within the [coverage section] of each [frame file].

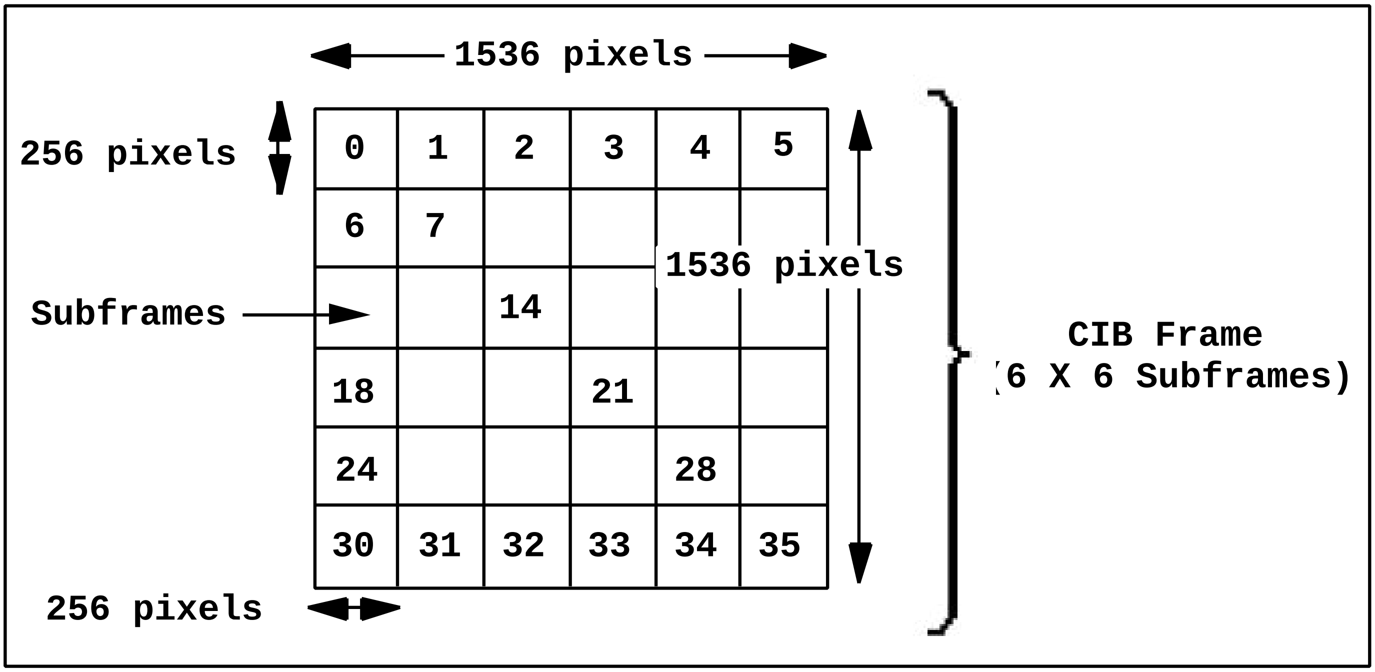

FIGURE 2. CIB Frame/Subframe Structure.

b. In addition, CIB frames may be considered to form conceptual “rows” and “columns” within zones. The APPENDIX, Section A.3.6, uses this concept to define the naming convention of frames for various resolutions by using the resolution and zone specific "frame number." The rows and columns are numbered from 0. The origin for counting nonpolar frame rows and columns 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 is the lower-left corner of the polar zone, with rows and columns numbered from that origin.

3.5.4 Nonpolar 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 nonpolar 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 3). Thus the frames at the top and bottom rows of each zone shall overlap frames of those zones above and below. In each ARC zone, the lower-left pixel in lower-left frame file is edge-aligned with the ARC system origin.

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

a. The north and south polar zones, 9 and J, are depicted in FIGURE 15 and FIGURE 16 in the APPENDIX, Section A.3. These zones are circular with the pole at the center and the radius being the distance from the pole to approximately 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 is the lower-left corner of the zone. Polar CIB frames are not all oriented along the north-south and east-west directions. Further detail on the frame structure and orientation is provided in the APPENDIX, Section A.5.

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 (ϕ, λ) coordinates, as described in the APPENDIX, Section A.3. 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 subframes centered about the poles. There are an odd number of frames with symmetry about the pole. The APPENDIX, Section A.5, provides calculations to compute average frame pixel resolution.

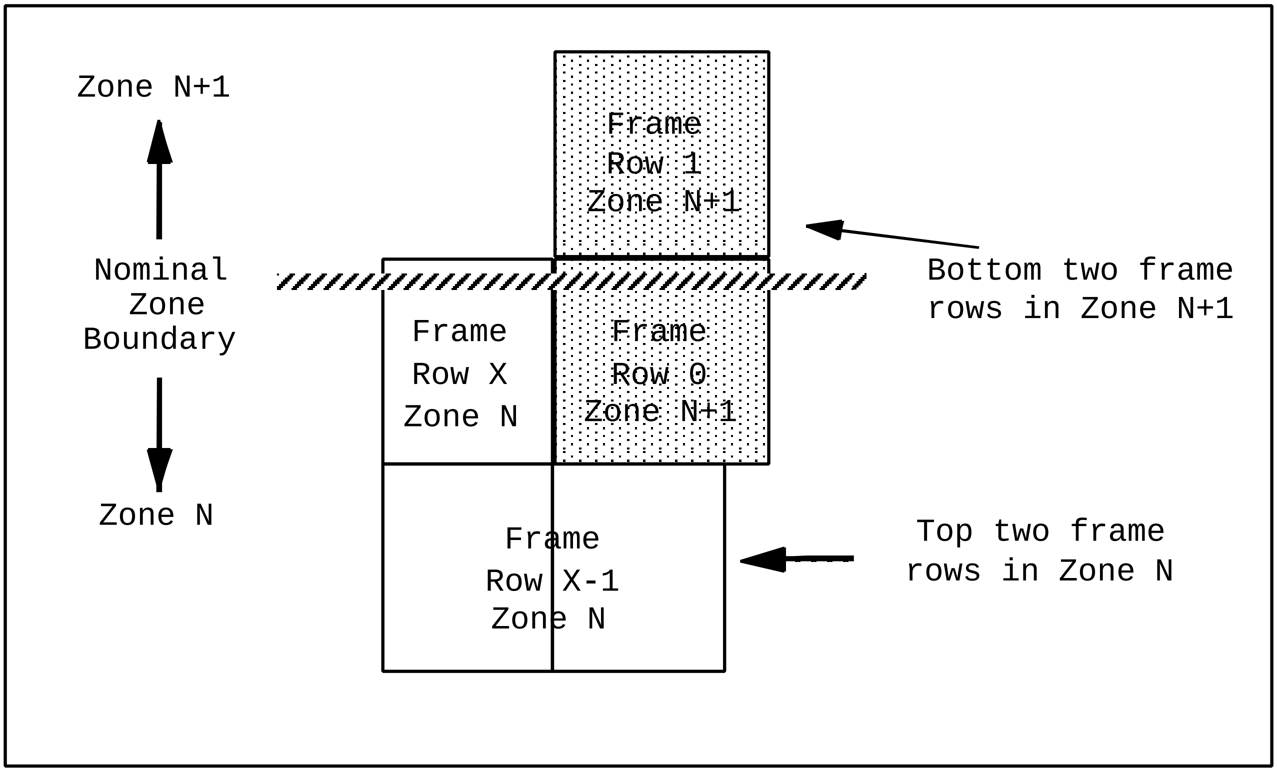

FIGURE 3. CIB Zone Boundary Overlap Structure.

3.5.6 Polar zone overlap. Zones 8 and H extend nominally to 80°. The overlap provided into the polar zones shall consist of the one row of frames that "straddle" the 80° parallel. Polar data will extend to and include the row of frames that straddle the 80° parallel.

3.6 Coordinate reference systems.

3.6.1 Nonpolar coordinates. Coordinates for row and column pixels in the nonpolar zones are proportional to WGS-84 latitude and longitude of features under the Equirectangular projection (as defined in *Map Projections—A Working Manual*, page 90). The coordinate conversions for the nonpolar case are in the APPENDIX, Section A.3, subsections A.3.2 and A.3.3.

3.6.2 Polar coordinates. Pixel coordinates in the polar zones are proportional to rectangular coordinates of the Azimuthal Equidistant projection, polar aspect, and spherical form (as defined in *Map Projections—A Working Manual*, page 191). The coordinate conversions for the polar case are provided in the APPENDIX, Section A.3, subsections A.3.4 and A.3.5.

3.6.3 WGS-84 coordinates. The WGS-84 coordinates for longitude and latitude in CIB are signed values in the range -180° = longitude = +180° and -90° = latitude = +90°.

3.7 Projection distortion. A nominal GSD is given for the various CIB products. In order to view the earth ellipsoid as a flat surface, it must be projected to a flat plane. This can be accomplished using a projection which uses localized values in which frames could not be seamlessly joined. In CIB, the ARC projection was chosen for use for several reasons including (1) it provides a way to project the earth such that it is seamless within zones, (2) the ARC system is used by ADRG and CADRG data, which allows applications to more easily utilize the data types, and (3) the ARC projection system retains a high accuracy and causes minimal visual distortion.

3.7.1 Nonpolar distortion. For the nonpolar zones, some minor 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 the parallel at the mid-latitude of each zone.

3.7.2 Polar distortion. Some distortion occurs in the polar zones as a result of the projection of the image pixels into the polar stereographic projection. The amount of the distortion and the resulting change in accuracy is minimal.

3.8 Image formats. Each CIB interchange volume contains compressed, transformed images from multiple source images. A single, worldwide grayscale table exists for CIB data and each [frame file] includes this worldwide grayscale table in the [color/grayscale section]. The frame files also include an image decompression codebook. Each codebook is defined in the [compression section] of the [frame file]. Each partial subframe shall be padded with “transparent” pixel kernels (see 3.14.1.2) to form a fully populated 256 x 256 matrix of pixels. Empty subframes will not be recorded.

3.9 Source support data. Each CIB interchange volume contains the following source support data:

a. Header data within the [table of contents file] and [frame file]s that contain the critical configuration control information needed by software applications.

b. The [table of contents file] that describes the geographic boundaries and locations of actual data, and pathnames to the [frame file]s and their locations.

c. Configuration management data in the [replace/update section] which provides the replace/update history of successive versions or updates to the CIB image data within each frame. This section is always present with the exception of the first edition of a [frame file].

d. Attribute data in the [attribute section] that gives important information about the source image(s) such as accuracy and date of collection.

e. If graphic overview files are present, they provide a depiction of the extent and locations of the [frame file]s on the interchange media.

3.10 Preparation of source material.

3.10.1 Source data. The source data for CIB production are normally digital satellite images which can be processed to one of the data series listed in MIL-STD-2411-1. Applicable ancillary information (e.g., image source, accuracy) included with the source image at the time of CIB production are included in the attribute section of the [frame file]. Source imagery data that are more recent than the current version of a frame file or contain data that are of higher quality (e.g., less cloud cover) are candidates for CIB update data.

3.10.2 Color/grayscale reduction. During compression, the available grayscale values in the source data shall be quantized to a maximum 216 global colors in the CIB [frame file]s. (This allows 8-bit systems to have 40 colors reserved for overlays generated by applications software.) In addition, a 217th entry with a color table value of zero is included in all CIB frame files where transparent pixels occur. Thus the CIB color table contains either 216 or 217 entries depending on whether transparent pixels are included in the frame file.(see 3.14.1.2). A further reduced color table may be available, wherein each of the 217 grayscale values in the primary color table is mapped to a grayscale value in the reduced color/grayscale table through use of a color/grayscale conversion table, as defined in MIL-STD-2411 and MIL-STD-2411-1.

3.10.3 Compression algorithm. For the initial CIB product, image compression shall be performed using a Vector Quantization (VQ) algorithm that employs a 4 x 4 compression kernel size with 4096 codebook entries. One method for the VQ process is described in the Southard (1992) and Markuson (1994) references. Future CIB products will allow for additional optional compression algorithms (eg. JPEG). CIB data imported from CIB co-producers shall be uncompressed.

3.11 CIB volume support data. Each CIB volume contains support information for the [frame files] contained therein. This information shall consist of a [table of contents file] and may also include [overview image]s.

3.11.1 The [table of contents file]. The structure and data types for the [table of contents file] are completely defined in MIL-STD-2411 and MIL-STD-2411-1.

3.11.2 The [overview image]. The [overview image] or [overview image]s are graphics which portray the coverage of the contents of the CIB volume. The structure of the [overview image] is identical to the CIB [frame file], except that it does not include a [coverage section], [attribute section], [related image section], or [replace/update section]. The naming convention for the [overview image]s shall be NNNNNNNN.OVR, where NNNNNNNN represents a file name that is unique for each [overview image] on a given volume; [overview image]s on different volumes may have the same file name. CIB data may contain two types of overview images. One [overview image] type will consist of downsampled versions of the data on the media. The data will be downsampled such that large and/or distinctive features in the data can be identified and thus located in the CIB [frame files]s. The second type of overview image is a location diagram consisting of a map containing, at a minimum, the political boundaries of the area surrounding the CIB coverage on the media. A box defining the area of CIB coverage on the media will be included on the map.

3.12 The [frame file]. The data for each CIB frame is provided in a distinct [frame file]. Each [frame file] comprises the logical sections described below, per MIL-STD-2411, and includes all RPF and NITF components. Starting addresses for each section component within the [frame file] are designated with location pointers from the start of the [frame file]. CIB components are physically distributed within the NITF message, as described in MIL-STD-2411-2. Registered data values for RPF fields are as specified in MIL-STD-2411-1.

3.12.1 The [header section]. The [header section] contains critical configuration control information. The structure and data types for the [header section] are defined in MIL-STD-2411. Values that have specific meaning for CIB data are defined below.

a. The <little/big endian indicator> for CIB shall be (00)H, denoting big endian encoding for all distribution media.

b. The encoded <governing specification number> and <governing specification date> shall refer to editions of this CIB specification, i.e., MIL-PRF-89041A.

c. Volume Identification *(ID)* is required on all disks and must be identical to the ISO 9660 eleven character volume label written in the header of the disk. The Volume ID must be unique to satisfy the requirement for the mounting of discs in CD-ROM Jukeboxes and on network systems. The Volume ID *(CBrrvvvvssE)* for standard CIB products will consist of the following information:

(1) The first four characters are "CBrr", where "CB" indicates CIB, and "rr" represents the image pixel resolution of the data set. ("10" for 10-meter data, "05" for 5-meter, etc.)

(2) The next four characters are "vvvv" and identifies the JOG Area Identification Block for the area.

(3) The next two characters are "ss" and represent the subvolume levels of resolution. For 10-meter data the only option is "00" which covers an entire JOG block. For 5-meter

data, the number set "00, 01, 02, and 03" with each section covering one-fourth of the area covered by the 10-meter data. For 1-meter data, the number set includes "00" through "99" with each section covering 1/100 of the area covered by the 10-meter data. Character eleven, "E" is the edition number, for editions "1" through "9" of standard data sets.

d. Other fields are identified by the producer as defined in MIL-STD-2411 or by registered values listed in MIL-STD-2411-1.

3.12.2 The [location section]. The [location section] designates the beginning byte addresses relative to the beginning of the file for the sections/components in an RPF file. Its structure and data types shall be as defined in MIL-STD-2411. The <component id>s are defined within the MIL-STD-2411-1. Producers and software developers should use the addresses recorded within the [location section] and not “hard-code” them because the address of a given component may vary from one NITF message to another. Note: The component locations (byte addresses) given in the [location section] are always relative to the beginning of the file. For CIB data, this is the beginning of the NITF message.

3.12.3 The [coverage section]. The [coverage section] defines the geographic extent of the frame. The structure and data types for the [coverage section] in the CIB product shall be as defined in MIL-STD-2411. This section includes four sets of latitude and longitude vertices that shall define the geographic extent of the [frame file]. The APPENDIX, Section A.5, subsection A.5.1, defines the four parameters that define the pixel resolutions and their intervals.

3.12.4 The [compression section]. The [compression section] is applicable for compressed data only.

3.12.4.1 VQ CIB compression. This section shall provide tables of pixel vector codebook values necessary to decode the compressed image for the vector quantization algorithm used for CIB; they will be used by the application software to decompress the image data. The method for reconstructing images from vector codebook tables and image grayscale values from color/grayscale lookup tables is outlined in 3.13.1.1 below. The structure and data types for the [compression section] shall be as defined in MIL-STD-2411. The last /compression lookup value/ (i.e., index 4095) is used for the transparent kernel (see 3.13.1.2). Values within the [compression section] that have specific meaning for CIB data are defined below.

a. The <number of compression lookup offset records> shall be 4, as each row of the compression kernel is stored in a separate table. Likewise, four [compression lookup tables] are present in the compression section of each CIB [frame file].

b. The <number of compression parameter offset records>

shall be 0, as no other parameters are required for CIB compression.

c. Other fields are identified by the producer as defined in MIL-STD-2411 or by registered values listed in MIL-STD-2411-1.

3.12.5 The [color/grayscale section]. The [color/grayscale table] contains 216 instances of grayscale values that are pointed to by the indices in the [compression section]. They define the grayscale value of a pixel for display or printing purposes. The CIB product uses a worldwide color/grayscale table, which is included within each [frame file]. The structure and data types for the [color/grayscale section] in the CIB product shall be as defined in MIL-STD-2411. Because there is, by default, only one "band" in CIB imagery, the number of spectral bands for CIB is defined as one. Values within the [color/grayscale section] that have specific meaning for CIB data are defined below.

a. The <number of color/grayscale offset records> shall be at least one; thus, there is at least one [color/grayscale table] and one associated [histogram table] in a [frame file]. However, additional [color/grayscale table]s and associated [histogram table]s may be included to provide alternative [color/grayscale table]s for any application that requires it. The user application software will select the color table that it will utilize. The mapping between the primary color/grayscale table and the alternative color/grayscale table will be provided in a color/grayscale conversion table, as defined in MIL-STD-2411 and MIL-STD-2411-1. The color/grayscale conversion table is contained within the [color conversion subsection] as defined in MIL-STD-2411. The conversion table will be identified by its <color converter table id>. For CIB, the primary color table has 216 grayscale values (217 values when transparent pixels are present) and its <color/grayscale id> ::= 3. The 217th entry is used in situations where [frame file]s contain transparent pixels, and is defined as the default transparent pixel entry.

b. A [histogram subsection] shall be provided in each [frame file] with a [histogram table] containing 216 (indices 0 to 215) [histogram record]s, to define the absolute number of occurrences of each grayscale value in the output pixel file for the [frame file].

3.12.6 The [image section].

a. For compressed data, the [image section] contains indices of VQ compression kernels in the [compression section], that in turn, specify grayscale indices in the primary color table within the [color/grayscale table section]. The structure and data types for the [image section] in CIB shall be as defined in MIL-STD-2411. The [subframe mask table] and [transparency mask table] are described in MIL-STD-2411. A mask subsection will always be present, and a null value in the subframe mask table offset will indicate that all subframes are present. Null values of (FFFF)H in these tables indicate, respectively, the subframes that contain no data and subframes that do not have transparent pixels. Transparent kernels (see 3.13.1.2) may be used on the edges of the image. Values within the [image section] that have specific meaning for compressed CIB data are defined in TABLE 1.

b. For uncompressed data, the [image section] contains grayscale indices in the primary color table. Values within the [image section] that have specific meaning for uncompressed CIB data are defined in TABLE 2.

3.12.7 The [attribute section]. The [attribute section] will define ancillary or qualifying data about the overall frame image or areal subsets of the image. The structure and data types for the [attribute section] shall be as defined in MIL-STD-2411.

a. Pointers to attributes and one or more parameters for those attributes are enumerated for each areal extent in the [offset record]s. The <parameter offset>s in these records point to the actual values or codes for the parameters in the [attribute record]s.

<number of spectral groups> =	1
<number of subframe tables> =	36
<number of spectral band tables> =	1
<number of spectral band lines per image row> =	1
<number of subframes in east-west or left-right direction> =	6
<number of subframes in north-south or up-down direction> =	6
<number of output columns per subframe> =	256
<number of output rows per subframe> =	256
<number of image rows> =	64
<number of image codes per row> =	64
<image code bit length> =	12
<transparent output pixel code length> =	8
/transparent output pixel code/ =	216

TABLE 1. Defined Frame Descriptor Values for Compressed CIB Data

<number of spectral groups> =	1
<number of subframe tables> =	36
<number of spectral band tables> =	1

<number of spectral band lines per image row> =	1
<number of subframes in east-west or left-right direction> =	6
<number of subframes in north-south or up-down direction> =	6
<number of output columns per subframe> =	256
<number of output rows per subframe> =	256
<number of image rows> =	256
<number of image codes per row> =	256
<image code bit length> =	8
<transparent output pixel code length> =	8
/transparent output pixel code/ =	216

TABLE 2. Defined Frame Descriptor Values for Uncompressed CIB Data.

b. The attribute descriptions and their identifiers and parameter descriptions and identifiers for CIB are listed in the APPENDIX, Section A.4. The actual values/codes used for <parameter value>s in [attribute record]s shall be as defined in MIL-STD-2411-1.

c. If the areal extent of the values is an entire frame, then the <areal coverage sequence number>s shall be set to zero. Otherwise, they shall point to an [explicit areal coverage record] which contains three or more latitude/longitude vertices of the areal extent for the attribute parameters; the areal extent may be irregularly shaped.

3.12.8 The [replace/update section]. The [replace/update section] will provide the genealogy of the [frame file] through successive replacements and updates. It is included for all replacement and update [frame file]s. The structure and data types for the [replace/update section] in the CIB product shall be as defined in section 5.1.6 of MIL-STD-2411.

3.13 Decompression.

3.13.1 VQ compressed storage requirements. Including overhead, the CIB image data is 8.15:1 compressed with respect to the source image data.

3.13.1.1 VQ CIB decompression. All information required for decompression of a CIB [frame file] is contained within the file itself. Software for the decompression of CIB data should be written so that offset values and file structures can change without needing to modify the application software. This section describes the specific parameters required for the decompression of CIB data.

3.13.1.1.1 Overview. CIB decompression involves replacing codes in the compressed image with pixel values for use in display or exploitation of the data. This decompression is done in a two-step process as shown in FIGURES 4 and 5. A compressed subframe consists of a 64 x 64 array of 12-bit codes. Each of these codes, during spatial decompression is converted to a 4 x 4 block of decompressed pixels. Each pixel in this 4 x 4 block is an index into the color/grayscale table containing a grayscale value. When decompressed, the output subframe is 256 x 256 pixels in size. The first 4 x 4 block is in the upper left hand corner of the subframe. The decompression continues across the first row through the first 64 codes. The 65th 12-bit code (/image code/, number 64) is used to decompress the first 4 x 4 block on the second row of the subframe. Decompression continues in this “row major” fashion until the entire subframe has been spatially decompressed.

a. The output from the spatial decompression process described above is a 256 x 256 array consisting of indices to a color/grayscale table. The number of entries in the color/grayscale table is 216 in cases where no transparent pixels are present and 217 in cases where transparent pixels are present. The last entry (index 216) represents “transparent” pixels in frame files with transparent pixels. The final decompression step involves decompressing the subframe indices into their monochromatic (M) pixel values. Each of the 216 entries in the CIB color/grayscale table contains a grayscale value that is in the range 0-255. Section 3.13.1.1.2 and 3.13.1.1.3 describe the steps of the decompression process in detail.

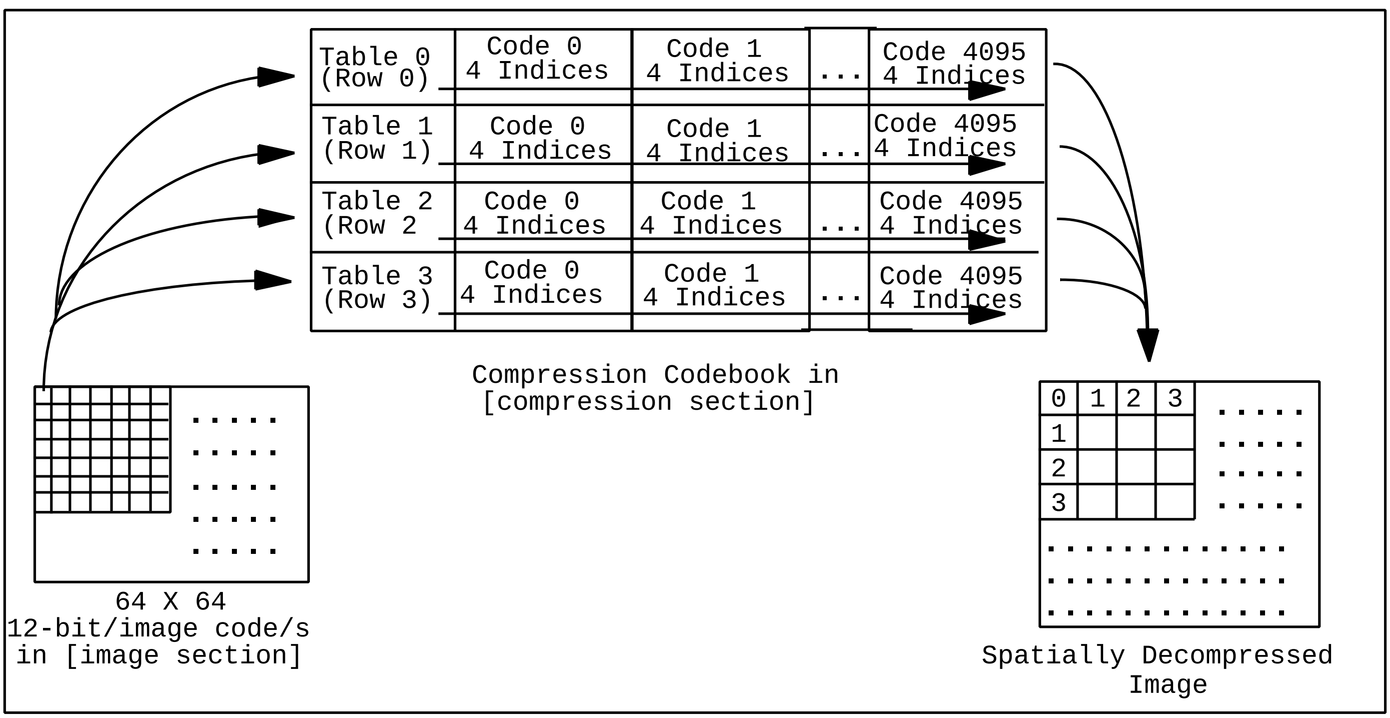

FIGURE 4. Process Flow for CIB Spatial Decompression.

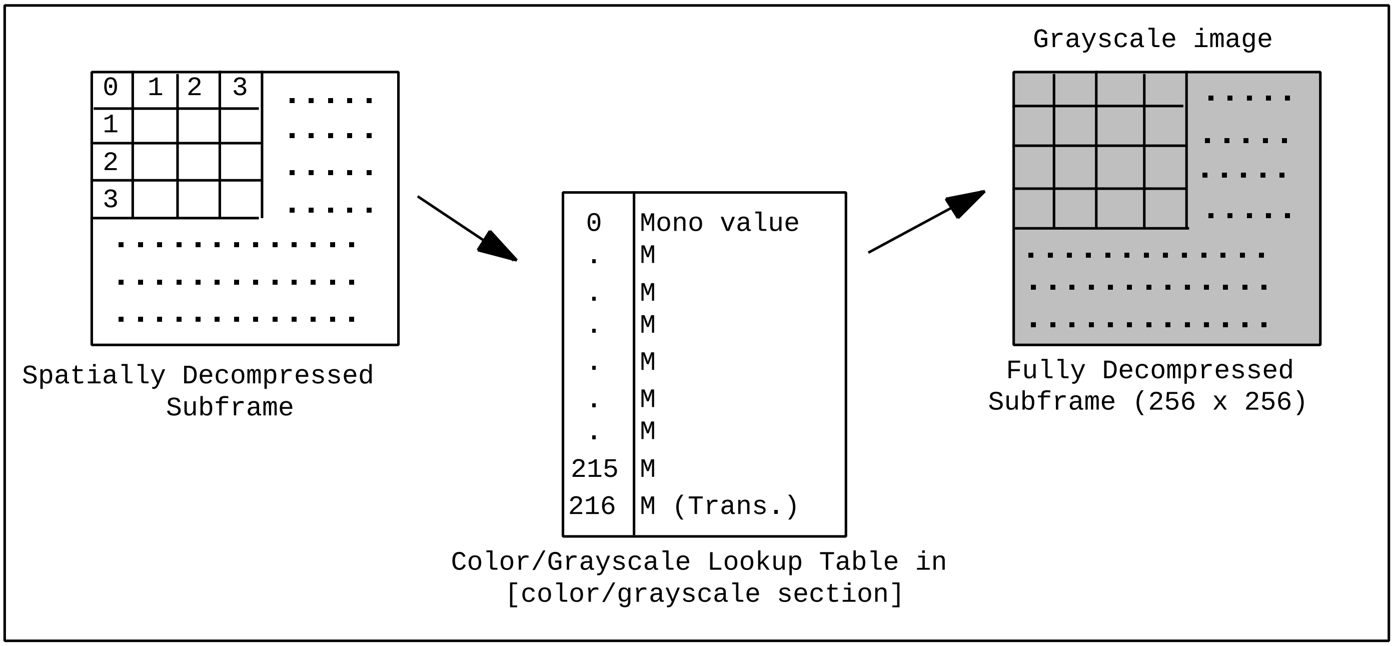

FIGURE 5. Process Flow for CIB Color Decompression.

3.13.1.1.2 Image decompression. The CIB compression section contains four [compression lookup table]s. Each table contains the decompressed pixel values for one row of the compression vector. For a particular /image code/, *n*, there is an entry in each of the four tables. The resulting decompressed pixels from the four compression tables can be combined to form a single 4 x 4 block. A description of the logical steps to spatially decompress a 4 x 4 block is provided below.

a. Each /image code/ has a value ranging from 0 to 4095, representing a particular code word. The /image code/ is used as an index into each of the 4 [compression lookup table]s. Each record of a [compression lookup table] contains 4 /compression lookup value/s. Therefore, the /image code/ indexes a 4 x 4 block of /compression lookup value/s (4 per row with 4 rows). As shown in FIGURE 6, each row of the compression codebook contains 4096 /compression lookup value/s for each row position. Each of these index values ranges from 0 to 216 and represents an index into the [color/grayscale table].

b. If a compressed /image code/ in the [image section] contains the value, *n*, then the 4 x 4 color/grayscale table indices, represented as /compression lookup value/s in the [compression section], can be found first by using the [location section] to determine the starting byte of the [compression section]. If we let the offset to the start of the first compression table be represented by A_1, then the location of the first 4 /compression lookup value/s for *n* would be located at the following byte positions within the [compression section]:

Location for value 0, row 0 = $A_1 + (4 \times n)$ **(3)**

Location for value 1, row 0 = A_1 + (4 x n) + 1
Location for value 2, row 0 = A_1 + (4 x n) + 2
Location for value 3, row 0 = A_1 + (4 x n) + 3

c. The location of the next row of color/grayscale indices (/compression lookup value/s) would be offset 16,384 (4 x 4096) bytes from the start of the first row of values. If its offset was A_2 then the location of the second 4 values for n (the second row of 4 color/grayscale table index values) would be at the following byte positions within the [compression section]:

Location for value 0, row 1 = A_2 + (4 x n) **(4)**
Location for value 1, row 1 = A_2 + (4 x n) + 1
Location for value 2, row 1 = A_2 + (4 x n) + 2
Location for value 3, row 1 = A_2 + (4 x n) + 3

d. The location of the color/grayscale table indices (/compression lookup value/s) for rows three and four would be similarly offset by 32,768 bytes and 49,152 bytes, respectively. It should be noted that the offset values for each of the [compression lookup table]s is included in the [compression lookup subsection]. Programmers should always examine the offset values to determine the starting location for each table.

e. To decompress the first 16 pixels of the image frame file (4 x 4 section of the image located in the upper-left corner), the first 12-bit /image code/ (/image code/, number 0) would be used as an index to the 4 rows of 4 color/grayscale table indices (/compression lookup value/s) in the [compression section]. These 16 indices would be used as lookup values for the [color/grayscale table], and the 4 rows of 4 grayscale values would be placed in the upper-left corner of the decompressed image. The decompression process continues across the columns and down the rows. In all, 4096 (64 x 64) groups of 4 x 4 pixels are placed into the output decompressed image for each subframe.

f. Although the description provided above can be used to decompress the image by sequentially decompressing the 4096 (64 x 64) compression vectors, the order of the decompression steps may be modified. For example, some applications may choose to decompress an entire row of the subframe at a time. This approach is made possible by the four separate compression tables for each image row.

Compression Algorithm ID,
Table Offsets, and Record Count Information

[compression lookup table]

Byte	Field Description	
A1	Row 0, Code 0,	Indices 0,1,2,3
A1+1	Row 0, Code 1,	Indices 0,1,2,3
A1+2	Row 0, Code 2,	Indices 0,1,2,3
A1+3	Row 0, Code 3,	Indices 0,1,2,3
..	....	
..	....	
A1+16380	Row 0, Code 4095,	Indices 0,1,2,3
A2	Row 1, Code 0,	Indices 4,5,6,7
A2+1	Row 1, Code 1,	Indices 4,5,6,7
A2+2	Row 1, Code 2,	Indices 4,5,6,7
A2+3	Row 1, Code 3,	Indices 4,5,6,7
..	....	
..	....	
A2+16380	Row 1, Code 4095,	Indices 4,5,6,7
A3	Row 2, Code 0,	Indices 8,9,10,11
A3+1	Row 2, Code 1,	Indices 8,9,10,11
A3+2	Row 2, Code 2,	Indices 8,9,10,11
A3+3	Row 2, Code 3,	Indices 8,9,10,11
..	....	
..	....	
A3+16380	Row 2, Code 4095,	Indices 8,9,10,11
A4	Row 3, Code 0,	Indices 12,13,14,15
A4+1	Row 3, Code 1,	Indices 12,13,14,15
A4+2	Row 3, Code 2,	Indices 12,13,14,15
A4+3	Row 3, Code 3,	Indices 12,13,14,15
..	....	
..	....	
A4+16380	Row 3,Code 4095,	Indices 12,13,14,15

FIGURE 6. Example File Layout of [compression section].

3.13.1.1.3 Color/grayscale decompression. The [color/grayscale table] in the [color/grayscale section] consists of 216 entries, (217 when transparent pixels are present), each containing a 1-byte value representing a monochrome (grayscale) intensity level or transparent pixel value.

a. Each byte that resulted from the spatial decompression process is used as an index into the color/grayscale table. Each byte in the spatially decompressed matrix will be an integer in the range 0-216. The values are used as lookup values into the color/grayscale table. The 216/217 entries in the color/grayscale table contain monochrome values in the range 0 - 255, arranged as shown in FIGURE 7. Entry 217 (index 216) is reserved for “transparent” pixels, for cases where the data is missing or not available at the given geographic location. The grayscale value in the CIB color/grayscale table for entry 217 (index 216, for transparent pixels) is 0.

c. A value of *m* in the spatially decompressed subframe can be used to determine the values of a pixel in the output image first by using the [location section] to determine the starting byte of the [color/grayscale section]. If we let *B* represent the offset to the [color/grayscale section], then the location of the monochromatic value for *m* would be located at byte position *B*+*m* within the [color/grayscale section].

d. To reconstruct the image, each 1-byte element from the spatially decompressed matrix is replaced by the monochromatic value that was derived during color/grayscale decompression. The grayscale matrix obtained from this step becomes the decompressed CIB subframe.

3.13.1.2 Transparent pixels. Subframes that are partially filled by the image coverage area are padded with transparent pixels whose index values are set to 0 during data production. A 4 x 4 kernel in a subframe that contains at least one transparent pixel is replaced by the 12-bit /image code/, represented by index 4095. This entry represents a transparent kernel in any frame that contains transparent pixels. If no transparent pixels are present then index 4095 will be used for grayscale values. The last <color/grayscale element> in frames containing transparent pixels (index 216 in the [color/grayscale table]) is set to 0 (black) to represent a transparent pixel. If application software encounters index 4095 in a frame containing transparent pixels, it may decompress to display black, or remap the transparent kernel to a system-specific transparent color.

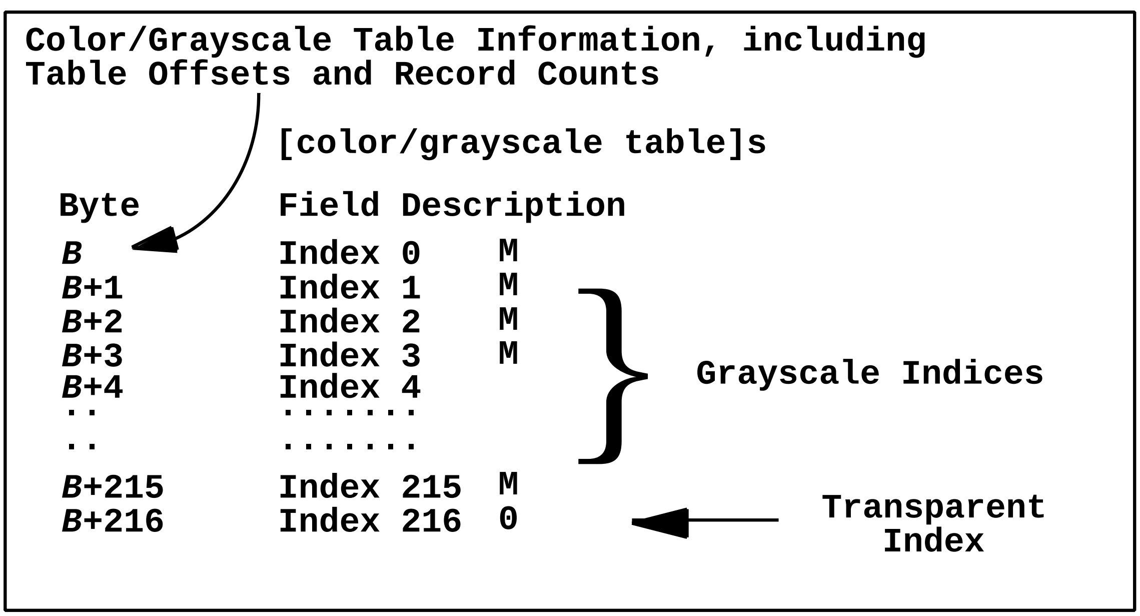

FIGURE 7. Example File Layout of [color/grayscale section].

3.14 CD ROM labeling and packaging. CD ROM labeling, and labeling on the cardboard sleeve, or jewel case liner/information booklet, as applicable, shall be in accordance with NIMA Instruction NI 8955.1 (DRAFT), Guidelines for Labeling the National Imagery and Mapping Agency's CD-ROMs, Printing and Finishing of Jewel Case Liners/Cardboard Sleeves, and Information Booklets. Method of packaging (cardboard sleeve or jewel case) shall be as specified in the contract (see 5.1).

3.14.1 CD labeling. Labeling of CIB CDs shall be in accordance with NIMA Instruction NI 8955.1 (DRAFT).

3.14.1.1 Product specific items. CIB specific examples are shown in NIMA Instruction NI 8955.1 (DRAFT)

3.14.1.1.1 Catalog indexing. Each CD-ROM in the CIB library shall be indexed to facilitate configuration management, including updates, additions, and replacements. The format convention of the alphanumeric value of a bar-coded NIMA reference number for standard CIB distribution is a fifteen character identifier according to the following description:

a. The first five positions are "CBrrX" or "CBrrS", where "CB" indicates this is CIB, "rr" is the image pixel resolution ("10" for 10 meter data, "05" for 5 meter, etc.), and the final character is either an "X" indicating this is a standard production set or an "S" if it a special production set.

b. The remaining ten characters are "aannss <blank> <blank> <blank> <blank>" and identify the specific data set. The data set identifier for 10-, 5-, and 1-meter data resolution sets is alphanumeric designator "aannss". The first two characters "aa" of the designator are alphabetic, begin with either the letter "S" or "N" (for northern or southern hemisphere) and end with the letter "A" through "U" (which represents a 4 degree latitudinal band (or row) starting with band "A" at the equator and proceeding northward or southward in bands of four degrees). The next two characters of the alphanumeric designator "nn" are numeric and refer to the 6 degree longitudinal dimension (or column) of the JOG block, beginning at 180 degrees longitude (block 01) and proceeding eastward in 6 degree increments. The next two numbers of the designator "ss" are numeric and represent the data sections of CIB data. For 10-meter data the only option is "00" which covers an entire JOG section. For 5-meter data, the number set includes "00, 01, 02, and 03", with each section covering one-fourth of the area covered by the 10-meter data. For 1-meter data, the numbers are from "00" through "99" with each section covering 1/100 of the area covered by the 10-meter data.

3.14.1.2 Volume identifier. This should be identical to the eleven characters of the Volume Identifier (first eleven characters of the ISO 9660 Volume Identifier (32 characters available) written on the header of the disk (see MIL-HDBK-9660).

3.14.2. Information booklet. Information booklets shall be provided for each CIB CD. Labeling of the CIB information booklet covers shall be in accordance with NIMA Instruction NI 8955.1. When used in conjunction with the jewel case, the front cover of the information booklet also serves as the front cover of the case.

4. VERIFICATION

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

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. When a first article inspection is required (see 3.1 and 6.2), it shall be examined as specified in 4.3.1, and tested as specified in 4.3.2.

4.3 Conformance inspection. Quality conformance inspection shall include the examination of 4.3.1 and the tests of 4.3.2.

4.3.1 Examination. The database shall be examined for compliance with the requirements specified in section 3. Unless a waiver has been granted non compliance with any of the specified requirements shall constitute cause for rejection.

4.3.2. Tests A CD-ROM sample determined by the contracting officer shall be tested for compliance in the following areas:

a. Data verification on a byte-for-byte basis of disc master from original (raw, prepared, or premastered) data.

b. Data verification on a sector-by-sector basis of each disc master or son against a pressed surrogate using error-correction coding.

c. ISO 9660 and ISO 10149 compliance.

d. Any other quality control procedures defined by the contracting officer.

4.4 Government Furnished Material. The contractor shall not duplicate, copy, or otherwise reproduce the MC&G property for the purposes other than those necessary for the performance of the contract.

4.5 Government property surplus. At the completion of the contract, the contractor, as directed by the contracting officer, shall either destroy or return to the government all government-furnished MC&G property not consumed in the performance of the contract.

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 personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's Systems 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. This specification is intended to provide guidelines for the preparation and use of CIB data to support various military weapons, C3I theater battle management, mission planning, and digital moving map systems. CIB data is not a commercial product and is releasable only to DoD and its' associated contractors.

a. CIB 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 displays. CIB is intended to satisfy the needs of a broad range of military users in its compression ratio and file format.

b. The 8:1 reduction in the size of CIB files compared to source imagery and the reformatting of the data into RPF offers distinct operational, logistical, and supportability benefits to the many military users of digital imagery data. It permits the same data sets to be used for both ground-based and aircraft cockpit displays, offers significant savings in media storage/transportation and peripherals (i.e., hard disk) costs, results in faster data loading times and requires less frequent reloading of hard disks from media. The compression of CIB data results in no perceptible loss of image quality.

c. CIB [frame file]s are physically formatted within a NITF message.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification

b. Issue of the DODISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced.

c. When a first article is required (see 3.1 and 4.2).

d. Levels of packaging (see 5.1).

6.3 Supersession. This specification supersedes the Military Specification for Controlled Image Base (CIB), MIL-C-89041, dated 15 May 1995.

6.4 Acronyms.

ADRG	ARC Digitized Raster Graphics
ANSI	American National Standards Institute
ARC	Equal Arc-Second Raster Chart
CADRG	Compressed ADRG
CD-R	Compact Disk - Recordable
CD-ROM	Compact Disk – Read Only Memory
CIB	Controlled Image Base
DMA	Defense Mapping Agency
FIPS PUB	Federal Information Processing Standard Publication
GSD	Ground Sample Distance
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Standards Organization
JPEG	Joint Photograph Experts Group
LUT	Look Up Table
M	Monochromatic
MSL	Mean Sea Level
NITF	National Imagery Transmission Format
NIMA	National Imagery and Mapping Agency
RPF	Raster Product Format
VQ	Vector Quantization
WGS-84	World Geodetic System – 1984

6.5 International standardization agreements. Certain provisions of this specification may be subject to STANAG 2211, “Geodetic Datums, Spheroids, Grids, and Cell References.” and to STANAG 7099, “Controlled Image Base”. When amendment, revision, or cancellation of this specification is proposed that will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.6 Subject term (key word) listing.

ADRI
arc
compression
NIMA
frames
GSD
imagery
JPEG
NITF
nonpolar zones
pixel
polar zones
resolution
RPF
VQ
WGS 84
Y2K (Year 2000)

6.7 Viewing Software CIB can be viewed using NIMA MUSE Version 1.1 or higher. NIMA MUSE 1.1 or higher contains the Raster Importer that will allow CIB data to be imported for viewing. NIMA MUSE 1.1 or higher also contains the CIB Browser which can be used to point data locations.

6.8 Changes from previous issue. There are no notations in the margins of this new version of the specification. The changes were too extensive and the document should be reviewed in its' entirety. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content, irrespective of any relationship to the last previous issue.

6.9 Y2K Century Logic. Implementers of this product should base their century logic on the basis that the first data set for this product was produced in June 1995.

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

APPENDIX A

COORDINATES TRANSFORMATIONS

A.1. SCOPE

A.1.1 Scope. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance. Section A.3. provides the coordinate transformation relationship between the latitude and longitude of points and the rows and columns of 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 manage datasets, and it provides a naming convention to be used for CIB data of various resolutions. Section A.4. lists CIB attributes and data types. The possible data codes for the attributes are defined in MIL-STD-2411-1. Section A.5. describes the method of determining the possible number of frames and subframes per zone at each resolution, and provides tables of these values for three resolutions.

A.2. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

A.3. COORDINATE TRANSFORMATIONS

A.3.1 References for the ARC system projection. Nonpolar 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° = longitude (l) = +180° and -90° = latitude (f) = +90°. TABLES 3 and 4 list the parameters used, respectively, for the nonpolar 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 A.3.3.3 and A.3.3.4). 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.

Parameter	**Description**
(r_{Fz}, c_{Fz})	Row and column number of a CIB frame in zone z and resolution *r*
(R, C)	Maximum number of rows and columns within contiguous grid for zone z and resolution *r*.
n_{rz}	Cumulative frame number within zone z at resolution *r*.
(r_{PF}, c_{PF})	Row and column number of a pixel within a frame.
(ϕ, λ)	Latitude, longitude of point in WGS-84 coordinates.
(ϕ_F, λ_F)	Latitude, longitude of frame origin for nonpolar.
(ϕ_{rz}, λ_z)	Latitude, longitude of ARC nonpolar origin of zone z and resolution *r* (λ_z = -180°).
A_{rz}	east-west pixel constant for resolution *r* and zone z. Equals the number of pixels of resolution r around the midpoint latitude of zone z representing a full circle.
B_r	north-south pixel constant for resolution *r* in all zones. Equals the number of pixels of resolution r representing an arc of 90°.
P_F	Number of pixels in each dimension of a frame ::=1536.

TABLE 3. Nonpolar Coordinate Conversion Parameters.

Parameter	**Description**
(r_F, c_{Fz})	Row and column number of a CIB frame in a polar zone
(r_{PF}, c_{PF})	Row and column number of a pixel within a frame.
(ϕ, λ)	Latitude and longitude of a point in WGS-84 coordinates.
(<X>, <Y>)	Projection coordinates of a pixel with respect to pole.
C_r	Polar Pixel Constant for resolution *r* divided by 90°.
P_F	Number of pixels in each dimension of a frame ::=1536.
R	Number of pixels from a pole to side of frame structure

TABLE 4. Polar Coordinate Conversion Parameters.

b. For all broad area CIB image products, a theoretical grid of contiguous frames shall be defined by the producers for each resolution and zone. Some frames within these grids will never be produced (i.e., if no source image is collected that includes the predefined area of the entire frame), and some frames will be only partially filled (i.e., if the source image exists for only a portion of the predefined area of the frame). The grids are defined to facilitate configuration management of the [frame file]s and to provide a framework for the frame naming convention (see section A.3.6). Within each zone grid, an absolute frame numbering scheme is defined within each zone at each resolution. The frame numbers start from 0 at the southwest (bottom-left) corner of each zone, increase in row-major order left to right for each row, and end at the northeast (upper-right) corner of the zone.

c. The numbers of frame and subframe rows and columns, the pixel constants, and the latitudinal zone extents for three example CIB resolutions are provided in section A.5. (TABLES 7 and 8 and 9).

A.3.2 Nonpolar latitude and longitude of a CIB frame pixel. The following equations may be used to obtain the latitude (ϕ)

and longitude (λ) of a pixel. The latitude of a pixel is a function of the frame row number and pixel row number within the frame. The longitude of a pixel is a function of the frame column number for its zone and pixel column number within the frame (see FIGURE 14). The latitude and longitude of a pixel can be determined relative to the origin (ϕ_F, λ_F) of a frame (i.e., upper-left corner latitude and longitude) as provided in the [coverage section]. The latitudes and longitudes used in the conversion equations are signed real numbers with a negative number signifying southern or western hemisphere, respectively.

A.3.2.1 Pixel row coordinate to latitude coordinate equation.

$$f = f_F - \left[\frac{90°}{B_r} * (r_{PF} + 0.5) \right] \qquad \textbf{(5)}$$

A.3.2.2 Pixel column coordinate to longitude coordinate equation.

$$l = l_F + \left[\frac{360°}{A_{rz}} * (c_{PF} + 0.5) \right] \qquad \textbf{(6)}$$

where: $90°/B_r$ ::= <latitude/vertical interval> for pixels
$360°/A_{rz}$ ::= <longitude/horizontal interval> for pixels

and ϕ_F ::= <northwest/upper left latitude> of frame
λ_F ::= <northwest/upper left longitude> of frame

A.3.3 Nonpolar 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 14). The zone of the point is determined by zone extents with overlap (APPENDIX section A.5., TABLES 7, 8, and 9 give examples for 10m, 5m and 1m CIB resolutions).

A.3.3.1 Latitude equations. The following equation can be used to calculate the frame row within the zone:

$$r_{FZ} = \text{INT} \left\{ \frac{\phi - \phi r_Z}{90°} * \frac{B_r}{P_F} \right\} : \qquad \textbf{(7)}$$

The latitude of the frame origin (ϕ_F, the latitude of the northwest corner of the frame) is calculated as follows:

$$\phi_F = \frac{90°}{B_r} * P_F * (r_{FZ} + 1) + \phi_{rZ} \quad \textbf{(8)}$$

The pixel row (with respect to the frame origin) is calculated using the following equation:

$$r_{PF} = INT\left[\frac{f_F - f}{90°} * B_r \right] \quad \textbf{(9)}$$

A.3.3.2 Longitude equations. The following equation can be used to calculate the frame column within the zone:

$$c_{FZ} = INT \left\{ \frac{\lambda - \lambda_Z}{360°} * \frac{A_{rZ}}{P_F} \right\} \quad \textbf{(10)}$$

The longitude of the frame origin (λ_F, the longitude of the northwest corner of the frame), can be calculated as follows:

$$\lambda_F = \frac{360°}{A_{rZ}} * P_F * (c_{FZ}) + \lambda_Z \quad \textbf{(11)}$$

The pixel column with respect to the frame origin can be calculated using the following equation:

$$c_{PF} = INT\left[\frac{l - l_F}{360°} * A_{rz} \right] \quad \textbf{(12)}$$

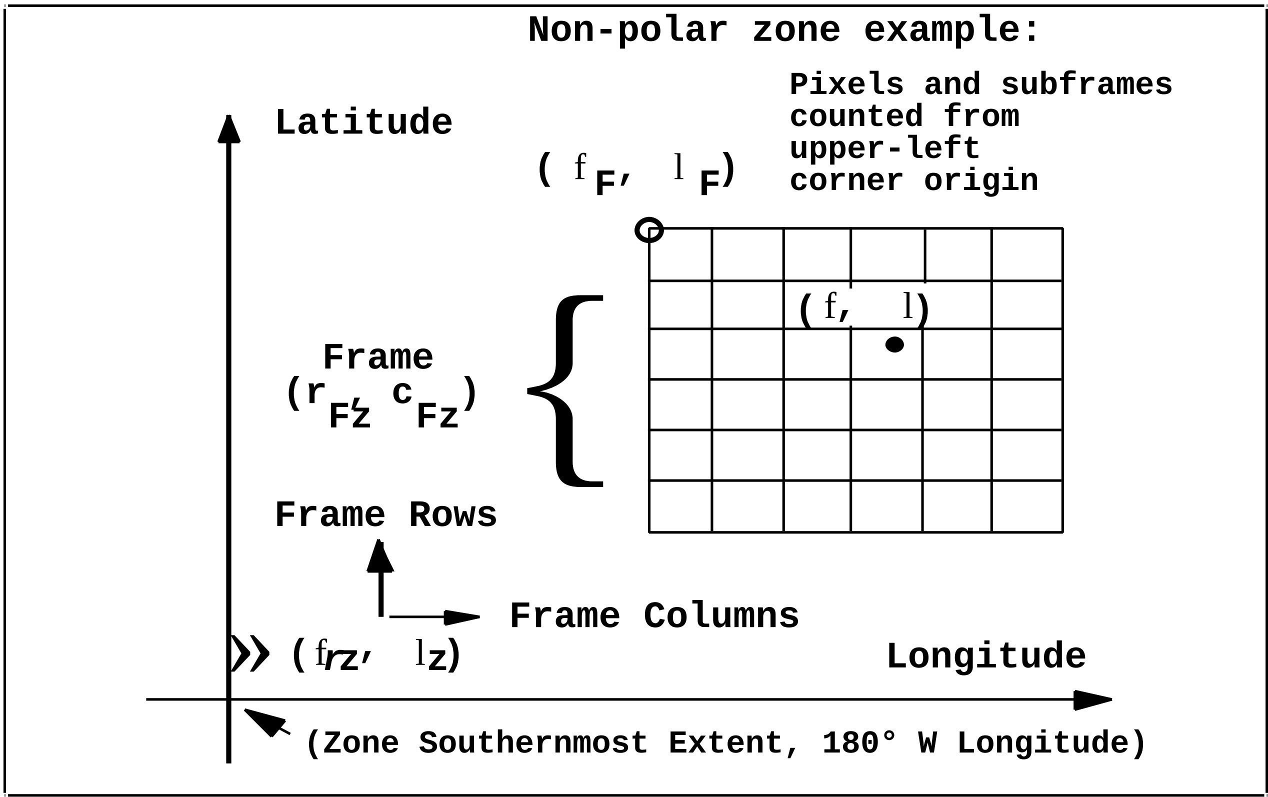

FIGURE 14. Coordinate Transformation in Non-Polar Zones.

A.3.4 Polar latitude and longitude of a CIB frame pixel.

A.3.4.1 North polar region. Given the projection coordinates of a point (<X>, <Y>) with respect to the north pole, its latitude and longitude in degrees shall be computed as follows (see FIGURE 15):

$$\phi = 90° - \left[\frac{\sqrt{<X>^2 + <Y>^2}}{C_r}\right] \quad \textbf{(13)}$$

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

$$\lambda = -\text{ACOS}\left[\frac{-<Y>}{\sqrt{<X>^2 + <Y>^2}}\right] \quad \text{for } <X> < 0 \quad \textbf{(15)}$$

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

A.3.4.2 South polar region. Given the projection coordinates of a point (<X>, <Y>) with respect to the south pole, its latitude and longitude in degrees shall be computed as follows (see FIGURE 16):

$$\phi = -90° + \left[\frac{\sqrt{\langle X\rangle^2 + \langle Y\rangle^2}}{C_r}\right] \tag{16}$$

$$\lambda = \mathrm{ACOS}\left[\frac{\langle Y\rangle}{\sqrt{\langle X\rangle^2 + \langle Y\rangle^2}}\right] \quad \text{for } \langle X\rangle > 0 \tag{17}$$

$$\lambda = -\mathrm{ACOS}\left[\frac{\langle Y\rangle}{\sqrt{\langle X\rangle^2 + \langle Y\rangle^2}}\right] \quad \text{for } \langle X\rangle < 0 \tag{18}$$

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

A.3.5 Polar frame pixel coordinates of a geographic point.

A.3.5.1 North polar region. Given the latitude and longitude of point (ϕ, λ), its projection coordinates (<X>, <Y>) shall be computed as follows (see FIGURE 15):

$$\langle X\rangle = C_r * (90° - \phi) * \mathrm{SIN}(\lambda) \tag{19}$$

$$\langle Y\rangle = -C_r * (90° - \phi) * \mathrm{COS}(\lambda) \tag{20}$$

The coordinates <X> and <Y> 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 CIB 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:

$$r_F = \mathrm{INT}\left\{\frac{\langle Y\rangle + R}{P_F}\right\} \tag{21}$$

$$c_F = \mathrm{INT}\left\{\frac{\langle X\rangle + R}{P_F}\right\} \tag{22}$$

$$r_{PF} = [P_F] - \mathrm{INT}\left\{\left[\left(\frac{\langle Y\rangle + R}{P_F}\right) - r_F\right] * P_F\right\} \tag{23}$$

$$c_{PF} = \mathrm{INT}\left\{\left[\left(\frac{\langle X\rangle + R}{P_F}\right) - c_F\right] * P_F\right\} \tag{24}$$

The constant R is calculated by finding the number of frames on a side of the frame structure, dividing by two and multiplying by the number of pixels (1536) per frame side.

$$R = FS/2 * 1536$$

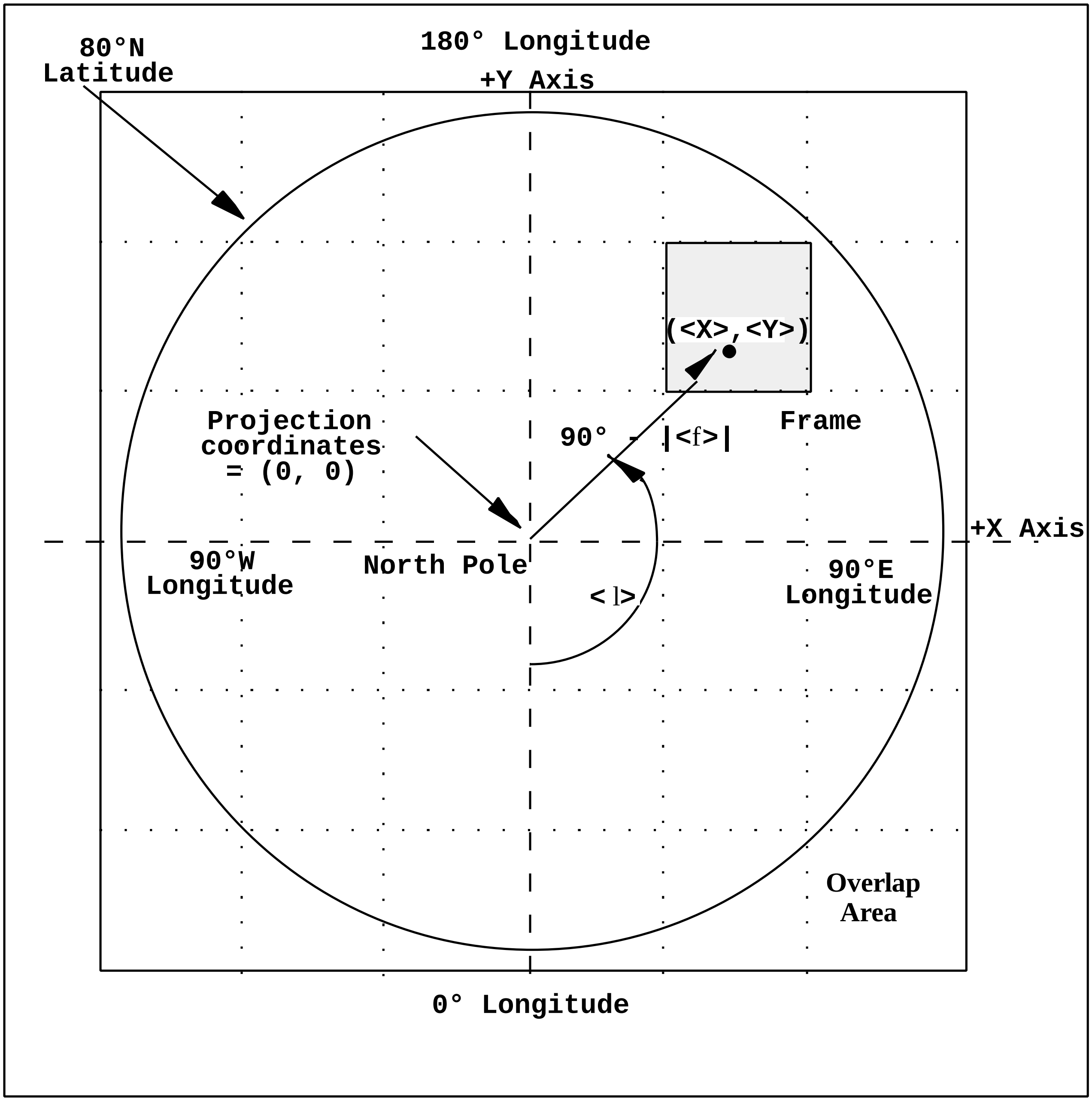

FIGURE 15. Coordinate Transformation in North Polar Region.

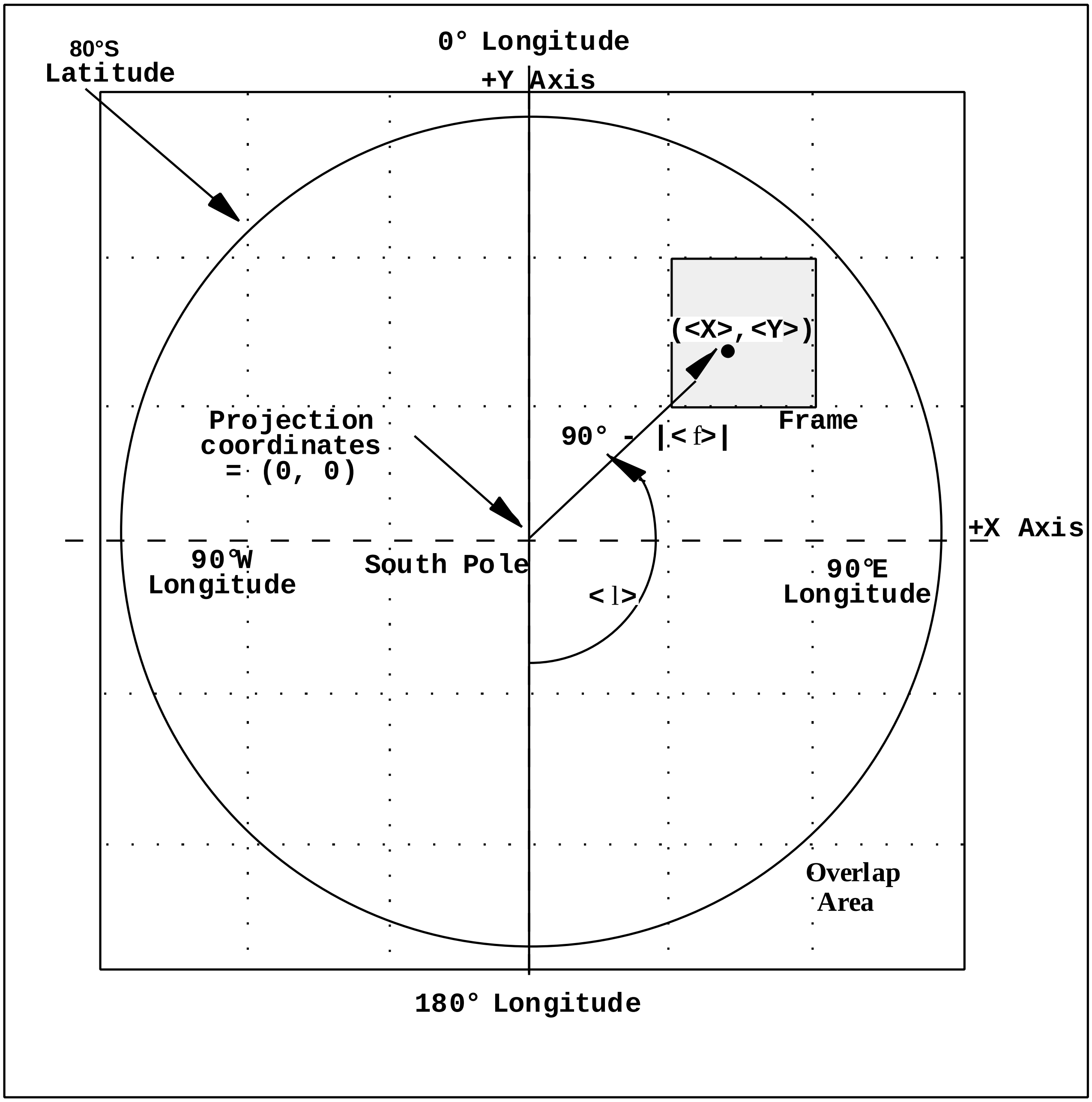

FIGURE 16. Coordinate Transformation in South Polar Region.

A.3.5.2 South polar region. Given the latitude and longitude of point (ϕ, λ), its projection coordinates (<X>, <Y>) shall be computed as follows (see FIGURE 16):

$$<X> = C_r * (90 + \phi) * SIN(\lambda) \quad \textbf{(25)}$$

$$<Y> = C_r * (90 + \phi) * COS(\lambda) \quad \textbf{(26)}$$

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.

A.3.6 Frame naming convention. The naming convention for all resolutions of images registered in MIL-STD-2411-1(Section 5.1.4), where it is intended for producers to provide contiguous [frame file] coverage, shall conform to MIL-STD-2411. In addition, the CIB [frame file] names are further restricted to conform to the form “ffffffvp.ccz.” (The contiguous frame grid concept is depicted in FIGURE 17.) The “ffffff” portion of the name shall be a radix 34 value that encodes the unique cumulative frame number within a zone in base 34, n_{rz} (see equations below), with the right-most digit being the least significant position. 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". For example, the “ffffff” portion of the names would start with “000000,” proceed through “000009,” “00000Z,” “000010,” and so forth until “ZZZZZZ.” This allows 1,544,804,416 unique [frame file] names; a contiguous grid of frame names down to a resolution of 0.2 meters (approximately 8 inches) can be defined. The “v” 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, as defined in MIL-STD-2411-1. The “cc” and “z” portions of the name extension shall encode the data series code and the zone, respectively, as defined in MIL-STD-2411-1. The CIB producers are responsible to ensure that [frame files] for all image resolutions, zones, and revisions, have unique names.

The number of rows and columns for three resolutions are provided in TABLES 7, 8 and 9. The relationship between frame row and column numbers and the cumulative count of frames within a zone are expressed in the equations below:

$$n_{rz} = c_{Fz} + (r_{Fz} * C_z) \quad \textbf{(27)}$$

$$n_{rz}\ (\text{maximum}) = (R_z * C_z) - 1 \quad \textbf{(28)}$$

$$r_{Fz} = INT\left\{ \frac{n_{rz}}{C_z} \right\} \quad \textbf{(29)}$$

$$c_{Fz} = n_{rz} - (r_{Fz} * C_z) \tag{30}$$

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_{rz}.

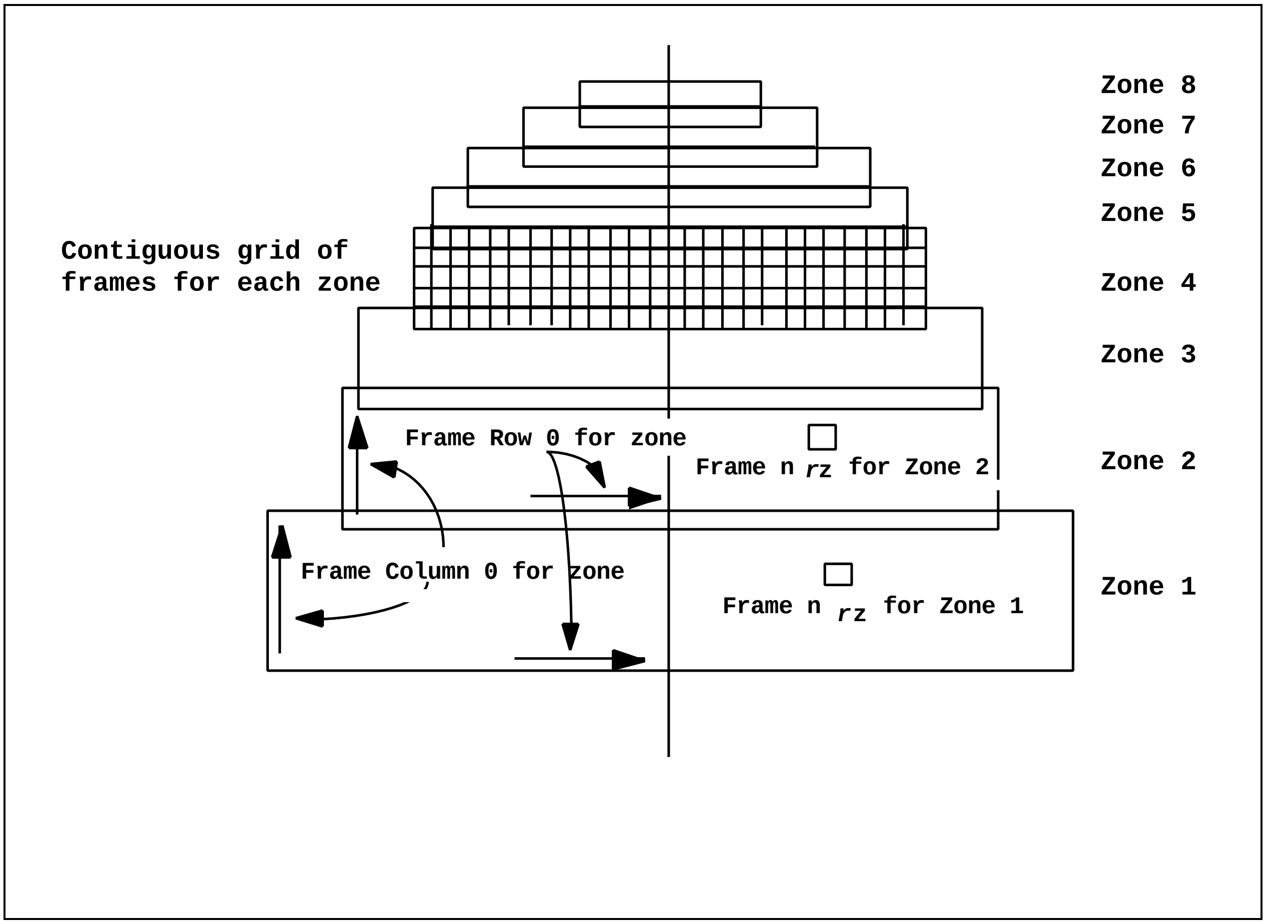

FIGURE 17. Contiguous Frame Numbering Convention for Zones.

A.4. CIB ATTRIBUTE DATA

A.4.1 CIB attribute and parameter table. TABLE 5 lists examples of the attributes and parameters (i.e., subattributes) that are included with the CIB data. Use of parameters facilitates a grouping of related attributes that users would normally need as a group. A full listing of <attribute id> and <parameter id> values are defined in MIL-STD-2411-1.

TABLE 5. Example CIB Attributes and Parameters.

Attribute Description	**Attr ID**	**Parameter Description**	**Parm ID**	**Data Type**
Currency Date	1	Currency Date	1	asci:8
Production Date	2	Production Date	1	asci:8
Significant Date	3	Significant Date	1	asci:8
Horizontal Absolute Accuracy	9	Horizontal Absolute Accuracy	1	uint:4
	9	Accuracy Units of Measure	2	uint:2
Horizontal Relative Accuracy	11	Horizontal Relative Accuracy	1	uint:4
	11	Accuracy Units of Measure	2	uint:2
Image Source	22	Image Source	1	asci:12
	22	Ground Sample Distance	2	uint:4

A.5. FRAME AND SUBFRAME STRUCTURE

A.5.1 Method of computation for nonpolar zones. This appendix describes the method of computation of the nonpolar latitudinal and longitudinal pixel constants and pixel sizes, the number of frames and subframes in each zone for the latitudinal and longitudinal directions, the rules of zone overlaps and the zonal extents. Nonpolar CIB frames shall be north-up. The pixel size and interval data may be used to define [frame file]s containing image data for non-contiguous areas at various resolutions.

A.5.1.1 Calculating Pixel constant. The north-south or latitudinal pixel constant is the number of pixels latitudinally from the equator to a pole (90°). The east-west pixel constant is the number of pixels longitudinally from the 180° west longitude meridian going 360° in an easterly direction along the zone midpoint. The latitudinal and longitudinal pixel constants for various resolutions of CIB are derived by using the pixel spacing constants given for the 1:1,000,000 scale charts in MIL-A-89007 and adjusting for a particular image resolution. To determine the north-south pixel constant, the "B" parameter in Table III, Section 70 of MIL-A-89007 is multiplied by a scale factor (1,000,000*S), where "S" is the scale corresponding the resolution of the image. S is equal to (100×10^{-6} / GSD). This value is rounded up to the next highest multiple of 512 pixels (This value is the pixel constant for a corresponding scale of ADRG data). The CIB pixel constant is calculated by dividing this value by 4 to represent 90° instead of 360° and rounding to the nearest multiple of 256 pixels (the size of a subframe). The east-west pixel constant is calculated in a similar way, using the "A" constant which represents the number of pixels required to circle the earth at the midpoint latitudes of each zone. The calculation for the east-west pixel constant does not include division by 4 because the longitudinal or east-west pixel constant encircles the earth (360°) at each midpoint latitude.

Table 6 lists the east-west pixel constants for three image resolutions, 1 meter, 5 meter and 10 meter, for the nonpolar zones. The last row ("lat") shows the north-south pixel constant for the three resolutions. The north-south pixel constant is the same for all nonpolar zones for a given resolution.

Table 6. Three Example CIB Resolution east-west pixel constants

Zone	Pixel constant (10 meter product)	Pixel constant (5 meter product)	Pixel constant (1 meter product)
1,A	3696640	7393280	36966400
2,B	3025920	6051840	30259200
3,C	2457600	4915200	24576000
4,D	1991680	3983360	19916800
5,E	1633280	3266560	16332800
6,F	1372160	2744320	13721600
7,G	1100800	2201600	11008000
8,H	824320	1648640	8243200
Lat	1000960	2001920	10009600

b. The <latitude/vertical interval> in the [coverage section] shall be 90° divided by the north-south pixel constant for the resolution of the data. The <longitude/horizontal interval> in the [coverage section] shall be 360° divided by the east-west pixel constant for the zone of the frame and the resolution of the data.

A.5.1.2 Calculating 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 MIL-STD-2411-1, because 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 resolution, first calculate the number of pixels in a degree of latitude for the resolution. This number is the N-S pixel constant divided by 90° (this number is the inverse of the <latitude/vertical interval> described in A.5.1.1). The number of frames needed to reach the nominal zone boundary is the number of pixels per degree of latitude multiplied by the nominal zone boundary (in degrees), divided by 1536, the number of pixels rows in a frame, and rounded up to the nearest integer. The exact zone extent is calculated by multiplying the number of frames by 1536 and dividing by the number of pixels in a degree of latitude.

c. To calculate the exact equatorward zone extentfor a given resolution, 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 1536 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 cosine of the midpoint latitude, and then dividing by the cosine of the midpoint latitude.

A.5.1.3 Calculating Latitudinal frames and subframes. The number of latitudinal frames and subframes in a zone for a given resolution can be computed by using the exact poleward and equatorward zone extents and the number of pixels per degree of latitude (as calculated in A.5.1.2). 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, and divided by 1536, the number of pixel rows per frame. Multiplying the number of frame rows by 6 will yield the number of subframes for that resolution and zone.

A.5.1.4 Calculating 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 256 pixels to determine the number of subframes. The results are divided by 6 and rounded up to obtain the number of frame columns.

A.5.2 Additional computations for the polar zones. The computations for the polar zones are described in the following sections.

A.5.2.1 Polar pixel constant. For CIB, the polar pixel constant is derived from the N-S pixel constant for a particular resolution product. The CIB value for the polar pixel constant is calculated by multiplying the N-S pixel constant for the resolution by the ratio 20/90 (degrees), rounding to the nearest multiple of 512 (to insure that the number of subframes about the pole can be equal in each direction), then multiplying by the ratio 90/20 (degrees).

A.5.2.2 Polar frames and subframes. The number of the polar subframes in each dimension (symmetric) is computed by multiplying the polar pixel constant by the ratio 20°/90°, dividing by 256 pixels per subframe, and then adding four subframes to the result. The four subframes are added to allow for overlap all around the earth. The number of frames is determined by dividing this value by 6 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.) All polar frames are fully populated provided that data exists in the areas.

A.5.2.3 Polar zone extents. The poleward extent of the polar zones is exactly 90°. The equatorward extent of the polar regions is less than 80° (i.e., it overlaps the data from zones 8 and H) but the exact extent varies. This is because the frames are not aligned with the latitudinal bands around the earth (see FIGURES 15 an 16).

A.5.3 Tabular data for frame and subframe structure. Results of computations defined above for the latitudinal and longitudinal data are enumerated in TABLES 7, 8 and 9 for three resolutions of CIB source data. The same values can be computed for any arbitrary resolution image, using the methodology outlined above in A.5.1 and A.5.2. This would allow developing CIB [frame file]s for various resolution, non-contiguous images.

**TABLE 7. Frame/Subframe Sizes for Source Image GSD of 10 Meters.

N-S Pixel Constant
1,000,960

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	1392	232	0°	32.0409207
2,B	702	117	31.9028133	48.0613811
3,C	354	59	47.9232737	56.0716113
4,D	354	59	55.9335038	64.0818414
5,E	180	30	63.9437340	68.0869565
6,F	180	30	67.9488491	72.0920716
7,G	180	30	71.9539642	76.0971867
8,H	180	30	75.9590793	80.1023018
9,J	———	———	varies	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant
1,A	14440	2407	3696640
2,B	11820	1970	3025920
3,C	9600	1600	2457600
4,D	7780	1297	1991680
5,E	6380	1064	1633280
6,F	5360	894	1372160
7,G	4300	717	1100800
8,H	3220	537	824320

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant
9,J	872	147	999,936

** NEW CHANGE ON "4,D"

TABLE 8. Frame/Subframe Sizes for Source Image GSD of 5 Meters.

N-S Pixel Constant
2,001,920

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	2784	464	0°	32.0409207
2,B	1398	233	31.9718670	48.0613811
3,C	696	116	47.9923274	56.0025575
4,D	702	117	55.9335038	64.0127877
5,E	354	59	63.9437340	68.0179028
6,F	354	59	67.9488491	72.0230179
7,G	354	59	71.9539642	76.0281330
8,H	354	59	75.9590793	80.0332481
9,J	———	———	varies	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant
1,A	28880	4814	7393280
2,B	23640	3940	6051840
3,C	19200	3200	4915200
4,D	15560	2594	3983360
5,E	12760	2127	3266560
6,F	10720	1787	2744320
7,G	8600	1434	2201600
8,H	6440	1074	1648640

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant
9,J	1742	291	2,002,176

**TABLE 9. Frame/Subframe Sizes for Source Image GSD of 1 Meter.

N-S Pixel Constant

10,009,600

Zone Number	Subframes in Zone (Rows) Latitudinal	Frame Rows in Zone Latitudinal	Equatorward Zone Extent with Overlap	Poleward Zone Extent with Overlap
1,A	13908	2318	0°	32.0132992
2,B	6954	1159	31.9994885	48.0061381
3,C	3480	580	47.9923274	56.0025575
4,D	3486	581	55.9887468	64.0127877
5,E	1740	290	63.998977	68.0040921
6,F	1746	291	67.9902813	72.0092072
7,G	1740	290	71.9953964	76.0005115
8,H	1746	291	75.9867008	80.0056266
9,J	———	———	79.9918159	90°

Zone Number	Subframes (Columns) Longitudinal	Frames (Columns) Longitudinal	E-W Pixel Constant
1,A	144400	24067	36966400
2,B	118200	19700	30259200
3,C	96000	16000	24576000
4,D	77800	12967	19916800
5,E	63800	10634	16332800
6,F	53600	8934	13721600
7,G	43000	7167	11008000
8,H	32200	5367	8243200

Zone Number	Polar (X - Y) Subframes	Polar (X - Y) Frames	POL Pixel Constant
9,J	8692	1449	10008576

** NEW TABLE

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