The Digital Geographic Information Exchange Standard (DIGEST)

Part 2 - Annex D
IMAGE INTERCHANGE FORMAT (IIF) ENCAPSULATION SPECIFICATION

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Annex D
Image Interchange Format (IIF)
Encapsulation Specification

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D.1 GENERAL DESCRIPTION

Introduction. The Image Interchange Format (IIF) is based on the NATO Secondary Imagery Format (NSIF), version 1.0 referenced as STANAG 4545, Edition 1.

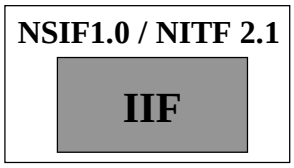

Figure D-1 IIF

Note that NSIF 1.0 is equivalent to the National Imagery Transmission Format (NITF), version 2.1 referenced as MIL-STD-2500B. The Image Interchange Format only implements the parts of NSIF/NITF, which handle Raster (Image) or Matrix data structure. Other data structures such as Graphic data or Text data, which are not described within the DIGEST main body, can be implemented using the NSIF/NITF specifications.

Each IIF File shall be compliant with NSIF 1.0 / NITF 2.1. Hence, while IIF is a restricted profile of NSIF/NITF, each NSIF/NITF File is not necessarily an IIF File.

D.1.1 Format Description

D.1.1.1 Header, Segments and Fields

An IIF File contains an IIF File Header and Segments. A Segment contains a Subheader and a Data Field. All IIF Fields are byte-aligned. The IIF File Header carries information about the identification, classification, structure, content, size of the IIF File as a whole, and the number and size of the major component Segments within the IIF File. For each type of Data Segment supported by the format, there is an associated Subheader and Data Field (as shown in Figure D-2). A Subheader contains information that describes characteristics of the Data Field that contains the actual data.

D.1.1.2 Extension, Conditional Fields

Flexibility to add support for the types of data and data characteristics not explicitly defined in the NSIF/NITF standard is provided within the format. IIF provides a limited support of these extensions. This support is accomplished within IIF by providing for conditional fields in IIF File Header and in each Subheader indicating the presence of Tagged Record Extensions (TREs). The TREs associated with the Headers/Subheaders may contain additional characteristics about the corresponding data.

The only TREs considered by the IIF specifications constitute the Geospatial Support Data Extensions (GeoSDEs) described in appendix D1. All the other TREs are allowed but can be simply ignored, as they are out of the DIGEST scope.

D.1.1.3 Supported Data Types

A single IIF File may comprise different types of Segments. A Segment containing information of a standard data type is called a Standard Data Segment. The IIF specifications are focused on Image Segments (IS). An Image Segment supports the standard image type of data. A special type of Segment called Data Extension Segment (DES) is also used within IIF due to NSIF/NITF implementation constraints.

All the other type of Segments (Graphic and Text Segments for instance) supported by NSIF and NITF are allowed within an IIF File even if they are out of the DIGEST scope. The organization of an IIF file is described below in Figure D-2.

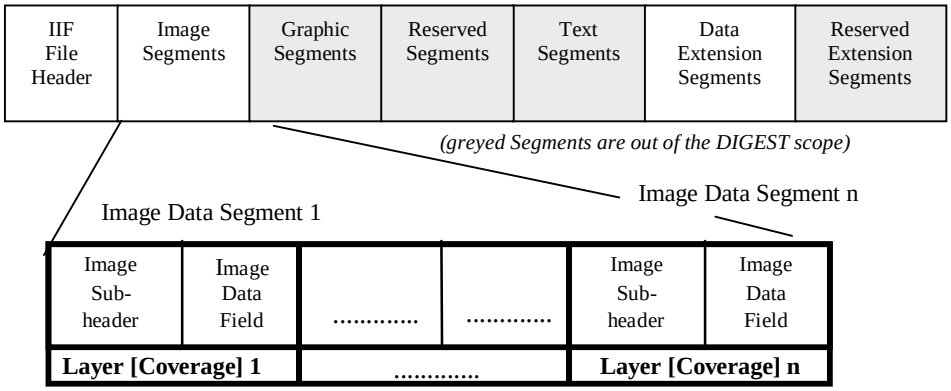

Figure D-2 Organization of an IIF File

D.1.1.4 IIF Application Guidance

An IIF File is composed of one or multiple Image Segments, and may include some other Segments as specified in NSIF. All the Image Segments shall be placed directly after the IIF File Header. They are followed by the Graphic, Reserved, Text, Data Extension and Reserved Extension Segments. The Data Extension Segments include the GeoSDEs (See Appendix 1). The Graphic, Reserved, Text and Reserved Extension can be ignored since they are out of the DIGEST scope.

D.1.1.5 Standard Data Segment Subheaders

Each individual Segment included in an IIF File consists of a Subheader and a Data Field. The first part of the Segment contains the Subheader, the second the corresponding Data Field. This Subheader concerns that particular Data Field. An IIF File includes necessarily one or more Image Segments. The ordering of multiple Data Fields of one type is arbitrary. A diagram of the overall NSIF/NITF File structure is shown on Figure D-2.

D.1.1.6 Header/Subheader/TRE Field Specification

The specification of the fields in the various Headers/Subheaders/TREs found within an IIF File is provided in a series of tables in this Annex. Each table includes:

1) a mnemonic identifier (FIELD) for each field within a Header, Subheader or TRE,

2) the Field's NAME, a description of the valid contents of the field, and any constraints on the field's use,

3) the field SIZE in bytes,

4) the VALUE RANGE it may contain,

5) and an indication of its TYPE (See "D.1.1.8. Field Types") and default values.

The IIF File Header Fields are specified in Table D-3. The Image Segment Subheader Fields are specified in Tables D-4, D-5 and D-6. The Subheader Fields of the Data Extension Segments required by IIF are specified in Table D-7. The GeoSDE Fields are defined in Tables D1-3 to D1-12.

D.1.1.7 Field Structure

The IIF uses byte counts to delimit Header Fields, as opposed to special end-of-field characters or codes or direct addressing. These counts are provided in the tables detailing the IIF Header/Subheader/TRE Field specifications.

The value of a Header/Subheader/TRE Field is an "Unsigned binary integer" or a value represented using one of the following character sets based on the ISO/IEC 646 alphabet (See DIGEST Part 3-5):

1) ECS : The Extended Character Set (ECS) is a subset of the Level 1 Text Repertoire (as described in DIGEST Part 3-5). The range of allowable characters consists of all the whole Level 1 text Repertoire except BackSpace (0x08), Horizontal Tab (0x09) and Vertical Tab (0x0B).

2) ECS-A : It is a subset of the ECS character set comprising character codes range from 0x20 to 0x7E, and 0xA0 to 0xFF. Line Feed (0x0A), Form Feed (0x0C) and Carriage Return (0x0D) are not valid ECS-A characters. As an interim measure, because of inconsistencies between standards, it is strongly advised that character codes ranging from 0xA0 to 0xFF should never be used.

3) BCS-A : The Basic Character Set-Alphanumeric (BCS-A) is a subset of the Level 0 Text Repertoire as defined in DIGEST Part 3-5. The range of allowable characters consists of space (0x20) to tilde (0x7E).

4) BCS-N : It is a subset of the BCS-A character set comprising minus sign to digit 9 (0x2D to 0x39), and plus sign (0x2B).

5) BCS-N integer : It is a subset of the BCS-A character set comprising digits 0 to 9 (0x30 to 0x39), plus sign (0x2B) and minus signs (0x2D).

6) BCS-N positive integer : It is a subset of the BCS-A character set comprising digits 0 to 9 (0x30 to 0x39).

The bit and byte order of the IIF Field values is specified in clause D.1.1.9.

All Header/Subheader/TRE Fields contained in an IIF File shall contain either valid and significant data (that is, data in accordance with the restrictions specified for the contents of the field in this document) or, when allowed, shall be fully filled with ECS/BCS-Spaces.

All data in ECS-A or BCS-A populated field shall be left-justified and padded to the right boundary with BCS Spaces (0x20). BCS-N, BCS-N integer and BCS-N positive integer fields may contain one or more numeric values. Each of these IIF encoded values has a fixed length and position within the field. Each of these values is right justified and padded to the left boundary with leading BCS-Zeros (0x30). However, when the field character set allows a plus sign (0x0B) or minus sign (0x0D), it is the left most character of the numeric value.

When a Field contains a date (date & time), the format of the field is YYYYMMDD (extensively YYYYMMDDhhmmss or YYYYMMDDhhmmss.fff) where YYYY is the year (**0001** to **9999**), MM is the month (**01** to **12**), DD is the day (**01** to **31**), hh is the hour (00 to 23), mm is the minute (**00** to **59**), ss is the second (**00** to **59**) and fff is the millisecond. Within IIF, UTC (Zulu) is assumed to be the time zone designator to express the time of day.

D.1.1.8 Field Types and Default Values

The IIF Header/Subheader/TRE have three types of fields:

C A Conditional Field may or may not be present depending on the value of one or more preceding (required) fields. When present, a Conditional Field shall contain a valid and significant value.

R A Required Field shall be present that is all the characters corresponding to its SIZE are expected. A Required Field of this general type shall contain a valid and significant value.

<R> A Required Field of this type shall be present, but can be filled entirely with ECS/BCS Spaces even if their content is not valid (BCS Spaces are not allowed for numeric fields) nor significant.

When a field is conditional, its description identifies what conditions and which preceding field or fields are used to determine whether or not to include it in the IIF file. When a repetitive set of fields is not necessarily present (the number of repetition may be equal to zero), it is necessary to determine whether a single field within the set is conditional or required. In this case, single fields are all declared conditional, but their condition of presence within the set (R or <R>) is additionally specified between parenthesis.

When the type of the Field is <R>, the default content of the Field (numeric or alphanumeric) is ECS/BCS Spaces. In the other cases, the Field cannot be filled entirely with ECS/BCS Spaces, but a specific default content is proposed in the field description when it makes sense.

D.1.1.9 Logical Recording Formats - Bit and Byte Order

(1) The default method of recording binary numeric data on interchange media shall adhere to the «big endian» convention. The default byte ordering for numeric data fields in a given product shall be documented in its product specification. In big endian format, the most significant byte in each numeric field shall be recorded and read first, and successive bytes recorded and read in order of decreasing significance. That is, if an n-byte field F is stored in memory beginning at address A, then the most significant byte of F shall be stored at A, the next at A+1, and so on. The least significant byte shall be stored at address A+n-1.

(2) ECS/BCS character strings shall be recorded in the order in which the data is generated.

(3) The most significant bit in each byte of every field, regardless of data type, shall be recorded and read first, and successive bits shall be recorded and read in order of decreasing significance.

(4) Pixel arrays shall be recorded in the order specified in the field IMODE.

D.1.2 The IIF File Header

Each IIF file shall begin with a header, the File Header, whose fields contain identification and origination information, file-level security information, and the number and size of the Segments of each type, e.g., Image Segment(s), contained in the file. Figure D-3 depicts the IIF file header. It depicts the types of information contained in the header and shows the Header's organization as a sequence of groups of related fields. The expansion of the "Image Group" illustrates how the header's overall length and content may expand or contract depending on the number of data segments of each type included in the file. The IIF file header is detailed in table D-3.

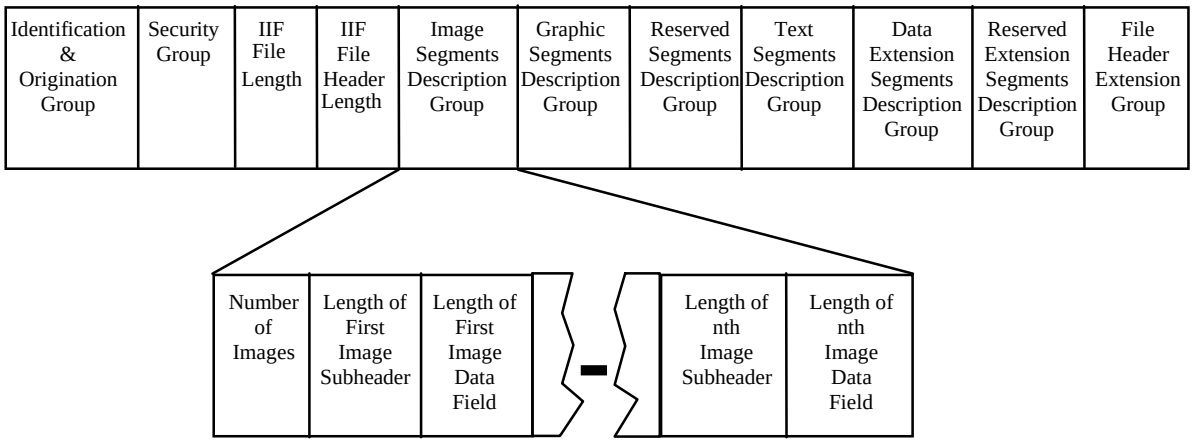

Figure D-3 IIF File Header Structure

D.1.3 Image Data

For the IIF, the image data encompasses multispectral imagery and images intended to be displayed as monochrome (shades of grey), colour-mapped (pseudocolour) or true colour, and may include grid or matrix data intended to provide additional geographic or geo-referencing information.

D.1.3.1 Image Representation (IREP)

The Image Representation (IREP) Field contains a valid indicator for the general kind of image represented by the data. It is an indication of the processing required in order to display an image. IIF valid representation indicators are MONO for monochrome, RGB for (red, green, blue) true colour, RGB/LUT for mapped colour, MULTI for multiband imagery and NODISPLY for an image not intended for display.

Note: NVECTOR, POLAR, VPH and YCbCr601 are not supported within IIF.

Grids or matrix data may include one, two, or several bands of attribute values intended to provide additional geographic or geo-referenced information. The processing required to display each band of the image is indicated in the nth Band Representation (IREPBANDn) Field. Table D-1 shows representative IREP examples and some of its associated fields.

Table D-1 Display Dependent Parameters

IREP	IREPBANDn	NBANDS	PVTYPE	NLUTSn
NODISPLY	BCS Spaces (0x20)	1 to 9, 0	INT, R, C, B, SI	0
MONO	M, LU or BCS Spaces (0x20)	1	INT, R, B	0, 1, 2
RGB	R,G,B	3	INT, R	0
RGB/LUT	LU	1	INT, B	3
MULTI	BCS Spaces (0x20), M, R, G, B, LU	2 to 9, 0	INT, R,C,B	0, 1, 2, 3

Note: If NBANDS field contains 0 then XBANDS field is required where XBANDS > 9

D.1.3.2 Image Category (ICAT)

The specific category of an Image Segment reveals its intended use or the nature of its collector.

IIF valid categories include VIS for visible imagery, SL for side-looking radar, TI for thermal infrared, FL for forward looking infrared, RD for radar, EO for electro-optical, OP for optical, HR for high resolution radar, HS for hyperspectral, CP for colour frame photography, BP for black/white frame photography, SAR for synthetic aperture radar, IR for infrared, MS for multispectral.

Valid categories for geographic products or geo-reference support data are MAP for raster maps, PAT for colour patch, LEG for legends, DTEM for elevation models, MATR for other types of matrix data, and LOCG for location grids.

The possible use of Standard Support Data Extensions (GeoSDEs) to provide geo-referencing data depends on both the intended use of the transmitted image and on its nature as described in Table D-2. The specific significance of each band in the image is indicated in the ISUBCATn field.

Note: SARIQ, FP, MRI, XRAY, CAT, VD, BARO, CURRENT, DEPTH and WIND categories are not supported within IIF.

D.1.3.3 Image Model

The IIF image model is compliant with the DIGEST Raster [Image] model described in DIGEST Part 2 Clauses 5 and 11.

D.1.3.3.1 Display of IIF Images

When an image with R rows and C columns is displayed, a mapping is accomplished from the stored image pixel value array I to a rectangular array S of physical picture elements, for example a Cathode Ray Tube (CRT) display. This mapping will be called the display mapping.

Usually, the resulting display has an identified top, bottom, left and right side. In a particular application, the display mapping may be defined explicitly.

However, lacking this, an image stored in an NSIF file shall be interpreted so that pixel I(0,0) is at the upper left corner, and pixel I(R-1,C-1) is at the lower right corner. The r^{th} row of the image array I shall form the r^{th} row of the display, counting from the top, 0 <= r < R. Within the r^{th} row, the pixels shall appear beginning on the left with I(r,0) and proceeding from left to right with I(r,1), I(r,2), and so on, ending with I(r,C-1).

This mapping of pixel values to physical picture elements is typical of non-interleaved raster pattern of picture elements. The relationship of the pixels I(r,c) in the image array to up, down, left and right implicit in this diagram is used freely in later descriptions to simplify exposition.

Table D-2 Category Dependent Parameters

ICAT	ISUBCATn	NBANDS	PVTYPE	NBPP	ABPP
VIS, OP	User-defined (defaulted to **BCS Spaces (0x20)**)	1	B	1	1
		1, 3	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64
SL, TI, FL, RD, EO, HR, BP	User-defined (defaulted to **BCS Spaces (0x20)**)	1	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64
IR	wavelength (in nanometers) or **BCS Spaces (0x20)**	1	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64

CP, PAT	User-defined (defaulted to **BCS Spaces (0x20)**)	3	INT	8	2 to 8
				32	17 to 32
				64	33 to 64
MAP, LEG	User-defined (defaulted to **BCS Spaces (0x20)**)	1	B	1	1
		1, 3	INT	8	2 to 8
				32	17 to 32
				64	33 to 64
LOCG	**CGX**, **CGY**, **GGX** or **GGY**	2	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			SI	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64
MATR	FACC codes from DIGEST Part 4 - Annex B	1 to 9, 0	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			SI	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64
			C	64	64
MS, HS	wavelength (in nanometers) or **BCS Spaces (0x20)**	2 to 9, 0	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64

SAR	**BCS Spaces (0x20)**, **I**, **Q**, **M** or **P**	1	C	64	64
		1, 2	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64
DTEM	units of length from DIGEST Part 3-7	1	INT	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			SI	8	2 to 8
				12	8 to 12
				16	9 to 16
				32	17 to 32
				64	33 to 64
			R	32	32
				64	64

Note: If NBANDS field contains 0 then XBANDS field is required where XBANDS > 9

D.1.3.3.2 Blocked Images

The concept of blocked images, described in the DIGEST Raster (Image) data model, supports the representation of an image in terms of an orderly set of subimages (or subarrays) called blocks. For large images (e.g., those having more horizontal and vertical pixel values than typical display devices), the performance of an imagery implementation can be potentially improved by «blocking» the image; that is, ordering the pixel values in the IIF file as a series of concatenated pixel arrays. A blocked image may have a block(s) (subarray(s)) comprised of pixel values from the original image and «pad» pixels inserted to meet block boundary conditions.

D.1.3.3.3 Blocked Image Masking

In some instances, a blocked image may have a considerable number of empty blocks (blocks without meaningful pixel values). In this case, it is sometimes useful to not record or transmit empty blocks within an IIF file. However, if empty blocks are not recorded/transmitted, the image loses its logical structure as an image with n*m blocks, where n is the value of the NBPR Field and m is the value of the NBPC Field.

In order to retain logical structure, and to allow the exclusion of empty blocks, an image data mask table identifies the location of non-empty blocks and empty blocks so that the using application can reconstruct the image correctly. The blocked image mask allows one to identify the locations of the recorded image blocks.

Blocked image masks can be used in conjunction with a pad pixel mask, as described below. A blocked image mask may also be used to provide an index for random access within the blocked image data for large images, even if all blocks are recorded in the file.

D.1.3.3.4 Pad Pixel Masking

In addition to empty image blocks, a significant number of pad pixels may be needed to "fill" an image to the nearest block boundary.

(1) If the image is band sequential (the IMODE field contains S), there will be pixel masks that will be arranged in the same order as the image bands, with each mask containing the number of records described by the product of the values of the NBPR field and the NBPC field (NBPR ∗ NBPC).

(2) The output pixel code, which represents Pad Pixels, is identified within the Image Data Mask by the Pad Output Pixel Code (TPXCD) Field. The length in bits of this code is identified in the Pad Output Pixel Code Length (TPXCDLNTH) Field. Although this length is given in bits, the actual TPXCD value is stored in an integral number of bytes. When the number of bits used by the code is less than the number available in the TPXCD field (for example, a 12-bit code stored in two bytes), then the code will be justified in accordance with the Pixel Justification (PJUST) Field in the Image Subheader.

(3) When an application identifies Pad Pixel values, it may replace them with a user-defined value (for example, a light blue background) at the time of presentation except when the value of the TPXCD field is Zero (code 0x00). When the value of the TPXCD field is Zero (code 0x00), the Pad Pixel will be treated as transparent for presentation. The application may choose to ignore Pad Pixels in histogram generation. In any case, Pad Pixels are not valid data, and should not be used for interpretation or exploitation. Consequently, the value used for Pad Pixels shall not appear within the bounds of significant pixels of the image.

D.1.3.4 IIF Image Information

In the IIF, the information describing an image is represented in a series of adjacent fields grouped into the Image Subheader followed by the image data. The field containing the actual image data shall follow immediately the last field of the corresponding Image Subheader with no intervening special characters to designate the beginning of the image. Similarly, the Image Subheader of the first image shall follow immediately the last byte of data of the last field in the IIF File Header, and the Image Subheader of successive images shall follow immediately the last byte of the image of the preceding image.

D.1.3.4.1 Image Subheader

The Image Subheader Fields (except LUTDnm) contain only characters from the ECS/BCS-A character sets and subsets. They provide information about the image source, its identification, and characteristics needed to display and interpret it properly.

The Image Subheader Field definitions are detailed in Table D-4.

D.1.3.4.2 Image Data Mask

The Image Data Mask Table is a conditional data structure included in the Image Data Field for masked images when so indicated by the Image Compression (IC) Field value (NM, M1, M3, M4, M5, M6 or M7). The Image Data Mask Table is not recorded for non-masked images (IC values NC, C1, C3, C4, C5, C6, C7, and I1).

The Image Data Field of a masked image is identical to that of non-masked images except for the following: the first byte of the image data is offset from the beginning of the Image Data Field by the length of the Image Data Mask Table(s); and empty image blocks are not recorded/transmitted in the image data area.

If the image is band sequential (the IMODE field contains S), there will be multiple Blocked Image and/or Pad Pixel Masks (one for each band). All Blocked Image Masks will be recorded first, followed by all Pad Pixel Masks. Since the Image Data Mask Tables are in the image data area, the data recorded/transmitted there are binary.

The structure of the Image Data Mask Table is defined in detail in Table D-5.

D.1.3.4.3 Image Data Format

Image data may be stored in an IIF file in either uncompressed or compressed form.

(1) **Uncompressed image data format**. The order in which pixel values of a single band image are stored is fixed. When an image has more than one band, several options are available for the order in which pixel values are stored. The option used is indicated by the IMODE field in the Image Subheader. The following subclauses describe the possibilities within this format. In describing the encoding of image data, the IIF display convention is invoked freely for ease of expression. Let the image to be encoded be denoted by I, and assume I has R rows and C columns. Let I have n bands; that is, each pixel is an n-vector, the i^{th} value of which is the value for that pixel location of the i^{th} band of the image. Let N denote the Number of Bits per Pixel per Band (NBPP). Thus, there are $n * N$ bits-per-pixel. Let I be blocked with H blocks per row and V blocks per column. Note that special cases such as single band images and single block images are included in this general image by setting $n = 1$, and $H = V = 1$, respectively.

(2) **Compressed image data format**. The format of the image data after compression is provided with the description of the NSIF/IIF image compression algorithms in ITU-T RECMN T.4 AMD2, ISO/IEC 10918-1, ISO/IEC 10918-3, and ISO/IEC 12087-5. Also found in these references are the conditions the data must meet before a given compression method can be applied.

D.1.3.4.4 Grey Scale Look-Up Tables (LUTs)

Grey scale Look-Up Tables are out of the DIGEST scope. They are not allowed within IIF. Every Image Segment of an IIF File using Grey Scale Look-Up Tables shall be ignored.

D.1.3.4.5 Colour Look-Up Tables (LUTs)

Colour images are represented using the RGB colour system notation. For colour images, each LUT entry shall be composed of the output colour components red, green, and blue, appearing in the IIF File in that order. There shall be a LUT entry for each pixel value in a particular band of an IIF image (the entries index of the LUT will range from 0 to 2^{NBPP} - 1). The LUT entries shall appear in the IIF File in increasing index order beginning with index 0.

The display colour of an Image Pixel shall be determined by using the pixel value as an index into each LUT (red, green, blue). The corresponding values for red, green, and blue shall determine the displayed colour in a manner specific to the display device. The colour component values may be any of the 256 pixel values associated with the band. The presence of colour LUTs is optional for 24-bit per pixel (true colour) images. Pseudo-colour (e.g., 8-bit per pixel colour images) shall contain a LUT to correlate each pixel value with a designated true colour value. Pixels larger than 16 bits may not be mapped with an IIF LUT and IIF LUT values can be no larger than 8 bits.

D.1.3.5 DIGEST Metadata

The NSIF Standard Geospatial Support Data Extensions (GeoSDEs) are used within IIF to convey the DIGEST metadata such as geographic reference description, source description and quality description. Those Standard Extensions are composed of the following set of TREs, which are controlled by the NSIF custodian:

GEOPS for geo-referencing parameters including datums, ellipsoids;

PRJPS for geo-referencing parameters defining projections;

GEOLO for image, raster, or matrix data rectified consistently with geographic (lat/long) coordinate systems;

MAPLO for image, raster, or matrix data rectified consistently with cartographic (E,N) coordinate systems;

REGPT for registration points in either geographic or cartographic systems;

GRDPS for non-rectified image, raster, or matrix data that is positioned using a location grid;

BNDPL for an accurate geographic location of the significant part of the image.

ACCPO for horizontal and vertical accuracy over regions for which the definitions are constant;

ACCHZ for horizontal accuracy when the vertical accuracy varies across the region for which horizontal accuracy is constant;

ACCVT for vertical accuracy when the horizontal accuracy varies across the region for which vertical accuracy is constant;

SNSPS for sensor parameters;

SOURC for map source information;

FACCB for Attribute FACC Code definition.

The categories of image and extensively digital geographic information, to which the Standard GeoSDEs apply, are shown in Table D1-1.

D.1.4 Data Extension

This subclause describes the Data Extension mechanism of NSIF/NITF used by IIF to support the inclusion of GeoSDEs. The GeoSDE TREs may be associated with other kind of TREs. Some of these TREs may be placed in parts of the IIF File that are not described here. The full Data Extension mechanism of NSIF is described within the STANAG 4545, Edition 1.

D.1.4.1 Data Extension Segment (DES)

An IIF File may include different types of DES. The general specification of a DES can be found in STANAG 4545, Edition 1. The Unique DES Type Identifier (DESID) Field defines the type of a given DES.

D.1.4.2 DES Structure

A DES shall consist of a DES Subheader and a DES User-Defined Data (DESDATA) Field (similar to the way a Standard Data Segment has a Subheader and an adjacent associated Data Field).

The IIF File Header includes Fields defining the number of DES in the IIF File, the length (size) of each DES Subheader, and the length (size) of the DESDATA Field. The IIF File Header accommodates up to 999 DES. The field size specifications in the IIF File Header allow each DES to be just less than one gigabyte in length.

D.1.4.3 TRE Overflow DES

A specific type of DES is used for encapsulating a series of TRE in a DES as overflow from the IIF File Header or any Segment Subheader. The value of the DESID Field of this specific DES type is TRE_OVERFLOW. A separate TRE_OVERFLOW DES is used for each IIF File Header or Subheader field that overflows. Which IIF File Header or Subheader field overflowed is indicated in the DES Overflowed Header Type (DESOFLOW) Field and DES Data Segment Overflowed (DESITEM) Field contents. The TRE Overflow DES Subheader shall contain the fields defined in Table D-7.

D.1.4.4 GeoSDEs Placement

A sequence of TREs including GeoSDEs can appear in the IIF File Extended Header Data (XHD) Field, in any Image Extended Subheader Data (IXSHD) Field and in a Data Extension Segment (DES) that is designated to contain TRE Overflow (TRE_OVERFLOW). When GeoSDE TREs carry data associated with the IIF File and sufficient room is available, they should appear in the XHD Field of the IIF File Header. When the GeoSDE TREs carry data associated with an Image Segment and sufficient room is available in the Segment's Subheader, they should appear in the IXSHD Field. When sufficient room is not available in the IIF File Header (or the Segment Subheader), the GeoSDE TREs may be placed in a TRE_OVERFLOW DES. The entire TRE shall be included within the NSIF File Header, Subheader, or DES that has been selected to contain it.

All the GeoSDEs corresponding to a given image (DIGEST Layer) appear necessarily in an IXSHD Field of the image's subheader (or in the corresponding TRE_OVERFLOW DES), except the geo-referencing parameters (GEOPS and optionally PRJPS) which shall be placed in the XHD Field of the File Header (or in the corresponding TRE_OVERFLOW DES).

D.2 IIF FILE HEADER DETAILED REQUIREMENTS

Table D-3 describes the detailed requirements for the IIF File Header.

If IIF encapsulated then the DIGEST Information Package Metadata Subset and part of the Dataset Metadata Subset are transmitted within the IIF File Header. Otherwise (mixed encapsulations), the standard ASCII table of content (SATOC, See Part 2 - Annex E) indicates the encapsulation used for the DIGEST Metadata elements. The value of these elements serves as the default value of the corresponding IIF File Header Fields. An IIF File could have been produced by a different body than the originator of a mixed DIGEST Information Package. In this case, many of the File Header Fields could have a different value than the Metadata element to which they are associated. Note that, in all cases, an IIF File contains information from a single dataset of the DIGEST Information Package.

The relationship between the DIGEST information and the IIF encapsulation is given in clause 12.2.4. A precise reference is given for each field corresponding to any information of the DIGEST Information Package Metadata Subset.

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
FHDR	File Profile Name. IIF is a profile of NSIF 1.0 and NITF 2.1.	4	BCS-A **NSIF** or **NITF**	R
FVER	File Version. FHDR and FVER Fields define the DIGEST Specification. When the FHDR and FVER field values are respectively **NSIF** (or **NITF**) and **01.00** (respectively 02.10), the corresponding DIGEST Specification is DIGEST 2.0, second amendment, dated TBD (See clause 12.2.4.1 of DIGEST Part 2).	5	BCS-A **01.00** or **02.10**	R
CLEVEL	Complexity Level. This field is out of the DIGEST scope. The application that creates the file shall conform to the NSIF format. Valid entries are integer values assigned in accordance with complexity requirements established in STANAG 4545, Edition 1 - Annex E.	2	BCS-N positive integer **01** to **99**	R
STYPE	Standard Type. This field is out of the DIGEST scope. **BF01** indicates that NSIF is intended to be registered as a profile of ISO/IEC IS 12087-5.	4	BCS-A **BF01**	R

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
OSTAID	Originating Station ID. This field is out of the DIGEST scope. The application that creates the file shall ensure that this field contains a code identifying the originating organization. The IIF default value is **DIGEST/IIF**.	10	BCS-A (default is **DIGEST/IIF**)	R
FDT	File Date & Time. If the DIGEST Information Package Metadata Subset is IIF encapsulated, this field conveys the "exchange date" of the DIGEST information package (See clause 12.2.4.1 of DIGEST Part 2). If (the DIGEST information package and) the Dataset Metadata Subset(s) is (are) IIF encapsulated, this field conveys (also) the "creation date" of the dataset (See clause 12.2.4.6 of DIGEST Part 2). In all the other cases, the FDT default value is the "creation date" of the dataset. If the time of day is not defined, the values for hh, mm and ss can be defaulted to **00**.	14	BCS-N positive integer YYYYMMDDhhmmss	R
FTITLE	File Title. If the Dataset Metadata Subset is IIF encapsulated, this field contains the value of the "dataset type" (See clause 12.2.4.1 and 12.2.4.2 of DIGEST Part 2) or **ECS Spaces** (when the "dataset type" is not present). Else, the default value is the value of the "dataset type" (truncated to 80 characters, if needed) if defined or **ECS Spaces**.	80	ECS-A	<R>
FSCLAS	File Security Classification. If the DIGEST Information Package Metadata Subset is IIF encapsulated, this field contains the value of the DIGEST information package "security classification" (See clause 12.2.4.1 of DIGEST Part 2). Else, the default value is the DIGEST information package "security classification". A less restrictive classification (especially **U**) is also acceptable if it corresponds to the Security Classification required by the content of the IIF File (if the content is unclassified).	1	ECS-A **T**, **S**, **C**, **R**, or **U**	R
FSCLSY	File Security Classification System. This field is out of the DIGEST scope. A valid code is expected when the value of the FSDCTP Field is not ECS Spaces or when the FSCLAS is T, S, C or R. The IIF default code is **NS**. The default value is **ECS Spaces (0x20)**.	2	ECS-A **NS** and other codes allowed by NSIF (default is **ECS Spaces (0x20)**)	<R>

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
FSCODE, FSCTLH, FSREL	NSIF unused Fields These fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces (0x20)**.	33	ECS-A (default is **ECS Spaces (0x20)**)	<R>
FSDCTP	File Declassification Type. If the DIGEST Information Package Metadata Subset is IIF encapsulated, the value of this field is **O** when and only when the originator's permission for "downgrading" is required for the DIGEST information package (See clause 12.2.4.1 of DIGEST Part 2). Else, the value **O** is acceptable if and only if the originator's permission for "downgrading" is required for the DIGEST information package (information conveyed by the encapsulation of the DIGEST Information Package Metadata Subset). The value of the field is **DD** when and only when the FSDCDT Field contains a valid "downgrading date". Note that DIGEST does not allow to specify a "downgrading date" when the originator's permission for "downgrading" is required. The default value is **ECS Spaces (0x20)**. Any NSIF codes are acceptable with respect of the preceding constraints but may be ignored (no originator's permission required for "downgrading") since they are out of the DIGEST scope.	2	ECS-A **O, DD** and other codes allowed by NSIF (default is **ECS Spaces (0x20)**)	<R>
FSDCDT	File Declassification Date If the DIGEST Information Package Metadata Subset is IIF encapsulated, this field contains the value of the DIGEST information package "downgrading date" (See clause 12.2.4.1 of DIGEST Part 2) or **ECS Spaces** (when the DIGEST information package is not candidate for downgrading). Else, the default value is the DIGEST information package "downgrading date" or **ECS Spaces** if not defined.	8	ECS-A YYYYMMDD (default is **ECS Spaces (0x20)**)	<R>
FSDCXM, FSDG, FSDGDT	NSIF unused Fields These fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces (0x20)**.	13	ECS-A (default is **ECS Spaces (0x20)**)	<R>

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
FSCLTX	File Classification Text. If the DIGEST Information Package Metadata Subset is IIF encapsulated, this field contains the value of the DIGEST information package "releasibility" (See clause 12.2.4.1 of DIGEST Part 2) or **ECS Spaces** if the DIGEST information package "releasibility" is UNRESTRICTED). If (the DIGEST Information Package and) the Dataset Metadata Subset(s) is (are) IIF encapsulated, this field conveys (also) the "releasibility" of the dataset (See clause 12.2.4.6 of DIGEST Part 2) or **ECS Spaces** if the dataset "releasibility" is UNRESTRICTED. If the DIGEST Information Package and the Dataset Metadata Subsets are not IIF encapsulated, the default value is the dataset "releasibility" (truncated to 43 characters if needed) or **ECS Spaces** when UNRESTRICTED.	43	ECS-A user-defined values (default is **ECS Spaces (0x20)**)	<R>
FSCATP, FSCAUT, FSCRSN, FSSRDT, FSCTLN	NSIF unused Fields These fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces (0x20)**.	65	ECS-A (default is **ECS Spaces (0x20)**)	<R>
FSCOP	File Copy Number. This field is out of the DIGEST scope. Its value can be defaulted to **BCS zeros (0x30)**.	5	BCS-N positive integer (default is **BCS zeros (0x30)**)	R
FSCPYS	File Number of Copies. This field is out of the DIGEST scope. Its value can be defaulted to **BCS zeros (0x30)**.	5	BCS-N positive integer (default is **BCS zeros (0x30)**)	R
ENCRYP	Encryption This field is out of the DIGEST scope. Its value can be defaulted to **BCS zero (0x30)**.	1	BCS-N positive integer (default is **BCS zeros (0x30)**)	R
FBKGC	File Background Colour. This field is out of the DIGEST scope. It shall contain the three components of the File Background Colour in the order Red, Green, Blue. The default background colour is Black that is the value **0x00** for each component.	3	Unsigned binary integer (default is **0x000000**)	<R>

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ONAME	Originator's Name. DIGEST defines the originator title and address of the DIGEST information package "originator" as a single free text. A back slash (0x5C) is used as a separator between the title of "originator" and the different part of its address. If the DIGEST Information Package Metadata Subset is IIF encapsulated, the ONAME value is the title of the DIGEST information package "originator" (See clause 12.2.4.1 of DIGEST Part 2) or **ECS Spaces (0x20)** when the exchange context (and so the "originator") of the DIGEST information package is not defined. Else, the default value is the title of the DIGEST information package "originator" (eventually truncated to 24 characters). Note that the size of the ONAME Field is not sufficient to convey the address of the DIGEST information package "originator" within IIF.	24	ECS-A	<R>
OPHONE	Originator's Phone Number. This field is out of the DIGEST scope. Its value can be defaulted to **ECS Spaces (0x20)**.	18	ECS-A (default is **ECS Spaces (0x20)**)	<R>
FL	File Length. This field ensures the physical integrity of the IIF encapsulation. It shall contain the length in bytes of the entire IIF File including all Headers, Subheaders, and data. Note: The largest file is limited to **999999999998**. The value **999999999999** is reserved for NSIF-specific use and is not allowed within IIF.	12	BCS-N positive integer **000000000388** to **999999999998**	R
HL	NSIF File Header Length. This field ensures the physical integrity of the IIF encapsulation. It shall contain a valid length in bytes of the IIF File Header. It's also the offset between the beginning of the file and the first Image Segment.	6	BCS-N positive integer **000388** to **999999**	R
NUMI	Number of Image Segments. This field ensures the physical integrity of the IIF encapsulation. It shall contain the number of separate Image Segments included in the IIF File. There is one Image Segment per layer (from the Geo Data Subset or the Supporting Data Subset) of the dataset.	3	BCS-N positive integer **001** to **999**	R
. . . .	Start for each Image Segment LISHn, LIn.			
NOTE:	LISHn and LIn fields repeat in pairs as follows LISH001, LI001; LISH002, LI002; ..... LISHn, LIn. LISHn and LIn fields correspond to the n^{th} Image Segment, counting from the first Image Segment (n=001) in order of the Image Segments' appearance in the IIF File.			

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
LISHn	Length of nth Image Subheader. This field ensures the physical integrity of the IIF encapsulation. It shall contain a valid length in bytes for the nth Image Segment Subheader. Note: The largest Image Subheader is limited to **999998** bytes. The value **999999** is reserved for NSIF-specific use and is not allowed within IIF.	6	BCS-N positive integer **000439** to **999998**	R
LIn	Length of nth Image Segments. This field ensures the physical integrity of the IIF encapsulation. It shall contain a valid length in bytes of the nth Image Segment. If the Image is compressed, its length after compression shall be used. Note: The largest Image Segment is limited to **9999999998** bytes. The value **9999999999** is reserved for NSIF-specific use and is not allowed within IIF.	10	BCS-N positive integer **0000000001** to **9999999998**	R
End for each Image Segment LISHn, LIn; the number of loop repetitions is the value specified in the NUMI field.				
NUMS	Number of Graphic Segments. This field ensures the physical integrity of the IIF encapsulation. It shall contain the number of separate Graphic Segments included in the IIF File. These Segments are out of the DIGEST scope. Therefore, the default value is **000** indicating there is no Graphic Segment in the File.	3	BCS-N positive integer **000** to **999** (default is **BCS zeros (0x30)**)	R
Start for each Graphic Segment LSSHn, LSn.				
NOTE: LSSHn and LSn fields repeat in pairs as follows LSSH001, LS001; LSSH002, LS002; ..... LSSHn, LSn. LSSHn and LSn fields correspond to the nth Graphic Segment, counting from the first Graphic Segment (n=001) in order of the Graphic Segments' appearance in the IIF File.				
LSSHn	Length of nth Graphic Subheader. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMS Field contains BCS zeros. Proper use of this Field is described in STANAG 4545, Edition 1.	4	BCS-N positive integer **0258** to **9998**	C
LSn	Length of nth Graphic Segments. This field ensures the physical integrity of the IIF encapsulation. It contains the length in bytes of the nth Graphic Segment. This Field is conditional and is omitted if the NUMS Field contains BCS zeros. When an IIF File contains Graphic Segment, this Field can be used for accessing the DESs.	6	BCS-N positive integer **000001** to **999998**	C
End for each Graphic Segment LSSHn, LSn; the number of loop repetitions is the value specified in the NUMS field.				
NUMX	Reserved for Future Use. This field shall be filled with BCS zeros (0x30)	3	BCS-N positive integer **000**	R

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
NUMT	Number of Text Segment. This field ensures the physical integrity of the IIF encapsulation. It shall contain the number of separate Text Segments included in the IIF File. These Segments are out of the DIGEST scope. So, the default value is **000** indicating there is no Text Segment in the File	3	BCS-N positive integer **000** to **999** (default is **BCS zeros (0x30)**)	R
Start for each Text Segment LTSHn, LTn.				
NOTE: LTSHn and LTn fields repeat in pairs as follows LTSH001, LT001; LTSH002, LT002; ..... LTSHn, LTn. LTSHn and LTn fields correspond to the nth Text Segment, counting from the first Text Segment (n=001) in order of the Text Segments' appearance in the IIF File.				
LTSHn	Length of nth Text Subheader. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMT Field contains BCS zeros. Proper use of this Field is described in STANAG 4545, Edition 1.	4	BCS-N positive integer **0282** to **9998**	C
LTn	Length of nth Text Segment. This field ensures the physical integrity of the IIF encapsulation. It contains the length in bytes of the nth Text Segment. This Field is conditional and is omitted if the NUMT Field contains BCS zeros. When an IIF File contains Text Segment, this Field can be used for accessing the DESs.	5	BCS-N positive integer **00001** to **99998**	C
End for each Text Segment LTSHn, LTn; the number of loop repetitions is the value specified in the NUMT field.				
NUMDES	Number of Data Extension Segments. This field ensures the physical integrity of the IIF encapsulation. It shall contain the number of separate Data Extension Segments included in the IIF File.	3	BCS-N positive integer **000** to **999** (default is **BCS zeros (0x30)**)	R
Start for each Data Extension Segment LDSHn, LDn.				
NOTE: LDSHn and LDn fields repeat in pairs as follows LDSH001, LD001; LDSH002, LD002; ..... LDSHn, LDn. LDSHn and LDn fields correspond to the nth Data Extension Segment, counting from the first Data Extension Segment (n=001) in order of the Data Extension Segments' appearance in the IIF File.				
LDSHn	Length of nth Data Extension Subheader. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMDES Field contains BCS zeros. When present, it shall contain a valid length in bytes for the nth Data Extension Segment Subheader. Note: The largest Data Extension Subheader is limited to **9998** bytes. The value **9999** is reserved for NSIF-specific use and is not allowed within IIF.	4	BCS-N positive integer **0200** to **9998**	C

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
LDn	Length of nth Data Extension Segments. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMDES Field contains BCS zeros. When present, it shall contain a valid length in bytes of the nth Data Extension Segment. Note: The largest Data Extension Segment is limited to **999999998** bytes. The value **999999999** is reserved for NSIF-specific use and is not allowed within IIF.	9	BCS-N positive integer **000000001** to **999999998**	C
End for each Data Extension Segment LDSHn, LDn; the number of loop repetitions is the value specified in the NUMDES field.				
NUMRES	Number of Reserved Extension Segment. This field ensures the physical integrity of the IIF encapsulation. It shall contain the number of separate Reserved Extension Segments included in the IIF File. These Segments are out of the DIGEST scope. Therefore, the default value is **000** indicating there is no Reserved Extension Segment in the File.	3	BCS-N positive integer **000** to **999** (default is **BCS zeros (0x30)**)	R
Start for each Reserved Extension Segment LRESHn, LREn.				
NOTE: LRESHn and LREn fields repeat in pairs as follows LRSH001, LR001; LRSH002, LR002; ..... LRESHn, LREn. LRESHn and LREn fields correspond to the nth Reserved Extension Segment, counting from the first Reserved Extension Segment (n=001) in order of the Reserved Extension Segments' appearance in the IIF File.				
LRESHn	Length of nth Reserved Extension Subheader. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMRES Field contains BCS zeros. Proper use of this Field is described in STANAG 4545, Edition 1.	4	BCS-N positive integer **0200** to **9998**	C
LREn	Length of nth Reserved Extension Segment. This field ensures the physical integrity of the IIF encapsulation. This Field is conditional and is omitted if the NUMRES Field contains BCS zeros. Proper use of this Field is described in STANAG 4545, Edition 1.	7	BCS-N positive integer **0000001** to 9**99998**	C
End for each Reserved Extension Segment LRESHn, LREn; the number of loop repetitions is the value specified in the NUMRES field.				
UDHDL	User-Defined Data Length This Field ensures the physical integrity of the IIF encapsulation. When its value is not 0000, it is followed by UDHDL bytes to skip.	5	BCS-N positive integer **00000**, **00003** to **99999** (default is **BCS zeros (0x30)**)	R
UDHODFL, UDHD	NSIF unused Fields These fields are out of the DIGEST scope. They can be omitted. In this case, the value of the UDHDL Field shall be **00000**.	As specified in UDHDL	User-defined	C

Table D-3 IIF File Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
XHDL	Extended Header Data Length. The field shall contain the sum of the length of all the TREs appearing in the XHD field plus 3 (size of XHDLOFL field) in bytes. All the Standard GeoSDEs needed shall be present. Other extensions are allowed. If a sequence of TRE is too long to fit in the XHD Field, it shall be put in a TRE_OVERFLOW DES.	5	BCS-N positive integer **00000** or **00003** to **99999** (default **is BCS zeros (0x30)**)	R
XHDLOFL	Extended Header Data Overflow. This Field shall contain BCS zeros (code 0x30) if the TREs in the XHD Field do not overflow into a DES, or shall contain the sequence number of the DES into which they do overflow. This Field shall be omitted if the XHDL Field contains BCS zeros (0x30).	3	BCS-N positive integer **000** to **999** (default **is BCS zeros (0x30)**)	C
XHD	Image Extended Subheader Data. This field may contain some GeoSDEs and extra TREs. TREs in this field shall contain information pertaining specifically to the whole file. TREs shall appear one after the other in this field with no intervening bytes. The first byte of this field shall be the first byte of the first TRE appearing in the field. The last byte of this field shall be the last byte of the last TRE to appear in the field.	As specified in XHDL minus 3	TREs	C

D.3 IIF IMAGE DATA DETAILED REQUIREMENTS

D.3.1 IIF Image Subheader Field Definitions

Table D-4 describes the detailed requirements for the IIF File Image Subheader.

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
IM	File Part Type. This field shall contain the value **IM** to identify the Subheader as an Image Subheader.	2	BCS-A **IM**	R
IID1	Image Identifier 1. This field shall contain a unique designation of the DIGEST layer corresponding to the Image Segment (See DIGEST Part 2, clauses 12.2.4.2 and 12.2.4.7).	10	BCS-A	R
IDATIM	Image Date and Time. This field is out of the DIGEST scope. Its default value is the value of the FDT Field.	14	BCS-N positive integer YYYYMMDDhhmmss	R
TGTID	Target Identifier. This field is out of the DIGEST scope. Its value can be defaulted to **BCS Spaces**.	17	BCS-A (default is **BCS Spaces (0x20)**)	<R>
IID2	Image Identifier 2. This field shall contain a unique description of the DIGEST layer corresponding to the Image Segment (See DIGEST Part 2, clauses 12.2.4.2 and 12.2.4.7) or **ECS Spaces** when the description of the layer is not available.	80	ECS-A	<R>
ISCLAS	Image Security Classification. If the Dataset Metadata Subset is IIF encapsulated, the "security classification" of the dataset (See DIGEST Part 2, clause 12.2.4.6) is equal to the highest Image Security Classification of the IIF File. A valid value representing the classification level of the Segment is expected.	1	ECS-A **T**, **S**, **C**, **R**, or **U**	R
ISCLSY	Image Security Classification System. This field is out of the DIGEST scope. A valid code is expected when the value of the ISDCTP Field is not ECS Spaces or when the value of the ISCLAS Field is not U. The IIF default code is **NS**. The default value is **ECS Spaces (0x20)**.	2	ECS-A **NS** and other codes allowed by NSIF (default is **ECS Spaces (0x20)**)	<R>
ISCODE, ISCTLH, ISREL	NSIF unused Fields These fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces (0x20)**.	33	ECS-A (default is **ECS Spaces (0x20)**)	<R>

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ISDCTP	Image Declassification Type. If the Dataset Metadata Subset is IIF encapsulated, the originator's permission for "downgrading" is required for the dataset (See DIGEST Part 2, clause 12.2.4.6) when the ISDCTP Field value is **O** for at least one of the Image Segment within the IIF File. The default value is **ECS Spaces**. The **DD** value is expected if the ISDCDT Field contains a valid "downgrading date". The **O** value is expected if the originator's permission for "downgrading" is required for the Image Segment. All the other values allowed by NSIF are acceptable but are out of the DIGEST scope.	2	ECS-A **O**, **DD** and other codes allowed by NSIF. (default is **ECS Spaces (0x20)**)	<R>
ISDCDT	Image Declassification Date. This field contains the downgrading date of the layer corresponding to the Image Subheader. This information is not directly a DIGEST Metadata element but shall be used to compute the "downgrading date" of the dataset (See DIGEST Part 2, clause 12.2.4.6) when the Dataset Metadata Subset is IIF encapsulated. A "downgrading date" can be defined for the dataset when the dataset is classified (See ISCLAS), the originator's permission for "downgrading" is not required (See ISDCDT) and a Declassification Date is defined for at least one of the Image Segments. In this case, the "downgrading date" of the dataset is the latest Declassification Date defined for the Image Segments of the File.	8	ECS-A YYYYMMDD (default is **ECS Spaces (0x20)**)	<R>
ISDCXM, ISDG, ISDGDT, ISCLTX, ISCATP, ISCAUT, ISCRSN, ISSRDT, ISCTLN	NSIF unused Fields These fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces (0x20)**.	121	ECS-A (default is **ECS Spaces (0x20)**)	<R>
ENCRYP	Encryption This field is out of the DIGEST scope. Its value can be defaulted to **BCS Zero (0x30)**.	1	BCS-N positive integer (default is **BCS zero (0x30)**)	R
ISORCE	NSIF unused Fields This field is out of the DIGEST scope. Its value can be defaulted to **ECS Spaces (0x20)**.	42	ECS-A (default is **ECS Spaces (0x20)**)	<R>

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
NROWS	Number of Significant Rows in Image. This field shall contain the "number of significant rows" of the image (See DIGEST Part 2, clause 12.2.4.7). Note that the "row of upper right corner" and the "row of lower left corner" (See DIGEST Part 2, clause 12.2.4.7) are respectively equal to 0 and NROWS - 1.	8	BCS-N positive integer **00000002** to **99999999**	R
NCOLS	Number of Significant Columns in Image. This field shall contain the "number of significant columns" of the image (See DIGEST Part 2, clause 12.2.4.7). Note that the "column of lower left corner" and the " column of upper right corner " (See DIGEST Part 2, clause 12.2.4.7) are respectively equal to 0 and NCOLS - 1.	8	BCS-N positive integer **00000002** to **99999999**	R
PVTYPE	Pixel Value Type. This field shall contain the "value type" of the image pixels (See DIGEST Part 2, clause 12.2.4.7).	3	BCS-A **INT**, **B**, **SI**, **R**, **C**	R
IREP	Image Representation. This field shall contain a valid indicator of the processing required in order to display an image. IIF supports the following indicators: • MONO for monochrome, • RGB for red, green, or blue true colour, • RGB/LUT for mapped colour, • MULTI for multiband imagery, • NODISPLY for an image not intended for display. This field should be used in conjunction with the IREPBANDn field to interpret the processing required to display each band of the image. The value of the IREP Field depends on the "structure" of the layer corresponding to the Image Segment. If the "structure" value is 1 or 2 (Matrix), the IREP Field value is NODISPLY. If the "structure" value is 3, the IREP Field value is RGB/LUT. If the "structure" value is 4, the IREP Field value can be MONO (if the NBANDS Field value is 1), RGB (if the NBANDS Field value is 3 and the IREPBANDn values are R, G and B) or MULTI (in all the other cases).	8	BCS-A **MONO**, **RGB**, **RGB/LUT**, **MULTI**, **NODISPLY** (See Table D-1)	R
ICAT	Image Category. This field shall contain a valid indicator of the specific category of image, raster, or grid data. The specific category of an Image Segment reveals its intended use or the nature of its collector. IIF	8	BCS-A **VIS**, **SL**, **TI**, **FL**, **RD**, **EO**, **OP**, **HR**, **HS**, **CP**, **BP**, **SAR**, **IR**, **MAP**, **MS**, **PAT**, **LEG**,	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
	supports the following indicators: • VIS for visible imagery, • SL for side-looking radar, • TI for thermal infrared, • FL for forward looking infrared, • RD for radar, • EO for electro-optical, • OP for optical, • HR for high resolution radar, • HS for hyperspectral, • CP for colour frame photography, • BP for black/white frame photography, • SAR for synthetic aperture radar, • IR for infrared, • MS for multispectral, • MAP for raster maps, • PAT for colour patch, • LEG for legends, • DTEM for elevation models, • MATR for other types of matrix data, • LOCG for location grids. This field should be used in conjunction with the ISUBCATn, field to interpret the significance of each band of the image.		**DTEM**, **MATR**, **LOCG** (See Table D-2)	
ABPP	Actual Bits-per-Pixel per Band. This field is out of the DIGEST scope. Its value can be defaulted to the NBPP Field value.	2	BCS-N positive integer **01** to **96**	R
PJUST	Pixel Justification. This field is out of the DIGEST scope. Its value can be defaulted to **R**. Note that if the value of ABPP Field is not the same than the value of the NBPP Field, the value of the PVTYPE shall be considered in order to interpret correctly the pixel samples.	1	BCS-A **L** or **R**	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ICORDS	Image Coordinate Representation. This field shall contain a valid code indicating the type of coordinate representation used for providing an approximate location of the image in the IGEOLO field. The valid values for this field are: **U** for UTM expressed in Military Grid Reference System (MGRS) form, **N** for UTM (Northern hemisphere), **S** for UTM (Southern hemisphere), **G** for Geographic, **D** for Decimal Degrees. Choice between N and S is based on hemisphere of northernmost point. The default Geodetic reference system is WGS84.	1	BCS-A **U**, **G**, **N**, **S** or **D**	<R>

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
IGEOLO	Image Geographic Location This field shall contain an approximate geographic location of the image corners. The locations of the four corners of the (significant) image data shall be given in image coordinate order: (0,0), (0,NCOLS-1), (NROWS-1,NCOLS-1), (NROWS-1,0). The format of the coordinates depends on the ICORDS Field value: **U** zzBJKeeeeennnnn where zzBJK represents the zone, band and 100 km square within the zone and eeeee, nnnnn represents residuals of Easting and Northing. **N** zzeeeeeennnnnnn where zz represents the UTM zone number, and eeeeee, nnnnnnn represents Easting and Northing. **S** same format than N. **G** ddmmssXdddmmssY where ddmmssX represents degrees, minutes, and seconds of latitude with X representing North (N) or South (S) and dddmmssY represents degrees, minutes, and seconds of longitude with Y representing East (E) or West (W). **D** ±dd.ddd±ddd.ddd where ±dd.ddd equals latitude (+ represents the northern hemisphere, - represents the southern hemisphere) and ±ddd.ddd equals longitude (+ represents the eastern hemisphere, - represents the western hemisphere). In order to conform the NSIF Format, the IGEOLO coordinates shall be computed using the elements defining the "LOCAL COORDINATE SYSTEM" (See clause 12.2.4.7 of DIGEST Part 2) and not the "WGS84 MBR". This field can be used to compute the "WGS84 MBR", the "column sequence" and the "row sequence" of the layer (See clauses 12.2.4.2 and 12.2.4.7 of DIGEST Part 2). The value of the "column sequence" is 0 if the first or the fourth corner is the westernmost corner (1 in all the other cases). The value of the "row sequence" is 0 if the first and second corner is the southernmost corner (1 in all the other cases). If the ICORDS Field value is U, N or S, a geodetic conversion is needed in order to define the Westernmost/Easternmost longitudes and the outhernmost/Northernmost latitudes of the "WGS84 MBR".	60	BCS-A ±dd.ddd±ddd.ddd (four times) or ddmmssXdddmmssY (four times) or zzBJKeeeeennnnn (four times) or zzeeeeeennnnnnn (four times)	C

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
NICOM	Number of Image Comments. This field is out of the DIGEST scope. Its value can be defaulted to **0**.	1	BCS-N positive integer **0** to **9** (default is **BCS zero (0x30)**)	R
. . . . .	Start for each Image Comment ICOMn (if the value of the NICOM field is not equal to zero).			
ICOMn	Image Comment n. This field is out of the DIGEST scope. It shall not be present if the value of NICOM is 0. The repeated ICOMn Fields shall be ignored if present.	80	ECS-A	C
. . . . .	End for each ICOMn field; the number of loop repetitions is the value specified in the NICOMn field.			
IC	Image Compression. This field contains the "compression code" of the layer (See clause 12.2.4.7 of DIGEST Part 2). Valid values for this field are, C1 to represent bi-level, C3 to represent JPEG, C4 to represent Vector Quantization, C5 to represent lossless JPEG, I1 to represent downsampled JPEG and NC to represent the image is not compressed. Also valid are M1, M3, M4, and M5 for compressed images, and NM for uncompressed images indicating an image that contains a Block Mask and/or a Pad Pixel Mask that is when and only when the value of the "tile index map flag" is Y (See clause 12.2.4.7 of DIGEST Part 2). C6 and M6 are reserved values that will represent a future correlated multicomponent compression algorithm. C7 and M7 are reserved values that will represent a future complex SAR compression. C8 and M8 are reserved values that will represent the future ISO standard compression JPEG 2000. The format of a mask image is identical to the format of its corresponding non-masked image, except for the presence of an Image Data Mask at the beginning of the image data area. The format of the Image Data Mask is described in Table D-5. The definitions of the compression schemes associated with codes C1/M1, C3/M3, C4/M4, C5/M5, and I1 are given, respectively, in ITU-T T.4 AMD2, MIL-STD-188-198A profile of ISO/IEC 10918-1, ISO/IEC DIS 10918-3, ISO/IEC IS 12087-5, and NIMA N0106-98. C1 is found in ITU-T T.4 AMD2, C3 is found in MIL-STD-188-198A profile of ISO/IEC 10918-1 and ISO/IEC DIS 10918-3, C4 is found in ISO/IEC IS 12087-5, and C5 and I1 are found in NIMA N0106-98.	2	BCS-A **NC**, **NM**, **C1**, **C3**, **C4**, **C5**, **C6**, **I1**, **M1**, **M3**, **M4**, **M5**, **M6**	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
COMRAT	Compression Rate Code. This field shall contain If the IC field contains C1, C3, C4, C5, M1, M3, M4, M5, or I1 this field shall be present and contain a code indicating the "compression ratio" of the layer (See DIGEST Part 2, clause 12.2.4.7). If the value of the IC field is C1 or M1, the valid codes are 1D, 2DS, and 2DH, where: 1D implies One-dimensional Coding 2DS implies Two-dimensional Coding Standard Vertical Resolution (K=2) 2DH implies Two-dimensional Coding High Vertical Resolution (K=4) Explanation of these codes can be found in ITU-T T.4 AMD2. If the value of the IC field is C3, M3, C5, M5 or I1, the value of the field shall identify the embedded quantization table(s) used by the JPEG compression algorithm. In this case, the format of this field is XX.Y where XX is the image data type (00 represents General Purpose, 01, represents VIS, 02 represents IR, 03 represents SAR and 04 represents Downsample JPEG), and Y represents the quality level 1 to 5. The value of Y shall be 0 if customized tables are used. Explanation of embedded tables can be found in MIL-STD-188-198A, which is a profile of ISO/IEC 10918-1, defined in accordance with AC 224(AG/4)D-67 and NIMA N0106-97. If the value of the IC field is C4 or M4, this field shall contain a value given in the form n.nn representing the number of bits-per-pixel for the compressed image. Explanation of the compression rate for Vector Quantization can be found in ISO/IEC IS 12087-5. This field is omitted if the value of the IC field is NC or NM.	4	BCS-A	C
NBANDS	Number of Bands. This field shall contain the "number of bands" of the layer (See DIGEST Part 2, clause 12.2.4.7) or **0** if the "number of bands" exceeds **9**.	1	BCS-A **0** to **9**	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
XBANDS	Number of Multispectral Bands. This field shall contain the "number of bands" of the layer (See DIGEST Part 2, clause 12.2.4.7) if it exceeds **9**. It shall be omitted in the other cases.	5	BCS-N positive integer **00010** to **99999**	C
. . . . . Start for each IREPBANDn to LUTDnm fields.				
NOTE: The IREPBANDn to LUTDnm fields repeat the number of times indicated in the NBANDS field or the XBANDS field.				
IREPBANDn	n^{th} Band Representation. This field is out of the DIGEST scope except when the value of the IREP Field is RGB. In this case, it contains the "band designation" of a band of the image (See clause 12.2.4.7 of DIGEST Part 2) and the value are **R**, **G**, **B** respectively for the band corresponding to the Red, Green, Blue colour. The default values are **M** when IREP contains MONO or MULTI, **BCS Spaces** when IREP contains NODISPLY and **LU** when IREP contains RGB/LUT.	2	BCS-A **LU**, **R**, **G**, **B**, **M** and all the other codes allowed by NSIF.	R
ISUBCATn	n^{th} Band Subcategory. This field contains the "band designation" of a band of the image (See clause 12.2.4.7 of DIGEST Part 2) except when IREP contains RGB (See IREPBANDn) or when ISUBCATn contains BCS Spaces (in this case the band designation is BANDn where n is the number of the band). The following NSIF constraints shall to be consider when defining the value of the "band designation" using IIF. When ICAT contains MS, HS or IR, ISUBCATn contains the wavelength (in nanometers) corresponding to the band or is defaulted to BCS Spaces. For location grids, the number of bands is strictly equal to 2; consequently, there are only 2 fields, the ISUBCAT1 field and the ISUBCAT2 field. Standard values of these fields of location grids are either CGX and CGY for the cartographic X (Easting) and Y (Northing) bands, or GGX and GGY with the geographic X representing the longitude band and Y representing the latitude band. Standard values for the matrix (ICAT contains MATR) are FACC codes from DIGEST Part 4 - Annex B. Standard values for Digital Terrain Elevation Model (ICAT contains DTEM) are units of length from DIGEST Part 3-7.	6	BCS-A	<R>
IFCn	n^{th} Band Image Filter Condition. This field is out of the DIGEST scope. Its value can be defaulted to **N**.	1	BCS-A (default is **N**)	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
IMFLTn	n^{th} Band Standard Image Filter Code. This field is out of the DIGEST scope. It can be filled with BCS Spaces.	3	BCS-A	<R>
NLUTSn	Number of LUTs for the n^{th} Image Band. The only IIF allowed values are **3** when IREP contains RGB/LUT and **0** in all the other cases. Note that an IIF LUT is attached to a single band while a DIGEST LUT applies to the whole image. Within IIF, this difference is not a problem as LUTs are only allowed when IREP contains RGB/LUT and so when the image contains only one band.	1	BCS-N positive integer **0** or **3**	R
NELUTn	Number of LUT Entries for the n^{th} Image Band. This field shall contain the number of entries in each of the LUTs for the n^{th} image band, that is the number of times the "COLOUR CODE IDENTIFIER" occurs (See clause 12.2.4.7 of DIGEST Part 2). This field shall be omitted if the value of the NLUTSn contains BCS Zero (code 0x30).	5	BCS-N positive integer 00001 to 65536	C
. . . . . Start for each LUT LUTDnm.				
LUTDnm	n^{th} Image Band, m^{th} LUT. This field shall be omitted if the Number of LUTs (NLUTSn) is BCS Zero (code 0x30). Otherwise, this field shall contain the data defining the m^{th} LUT for the n^{th} image band. Each entry in the LUT is composed of one byte, ordered from MSB to LSB, representing a binary value from zero (0x00) to 255 (0xFF). To use the LUT, for each integer k, $0 \le k \le$ (value of the NELUTn field) - 1, the pixel value k in the n^{th} image band shall be mapped to the value of the k^{th} byte of this field (the LUT). NOTE: This is a repeating field based on the value of the NLUTSn field. When there are more than one LUT (value of the NLUTSn field is greater than 1), the net effect is to have the LUT ordered in band sequential fashion, all the "red values" followed by the "green values" followed by the "blue values" (See clause 12.2.4.7 of DIGEST Part 2).	As specified in NELUTn	Unsigned binary integer LUT Values	C
. . . . . End for each LUTDnm field; the number of loop repetitions is the value specified in the NLUTSn field.				
. . . . . End for each IREPBANDn to LUTDnm fields; the number of loop repetitions is the value specified in the NBANDS field or the XBANDS field.				
ISYNC	Image Sync Code. This field is out of the DIGEST scope. Its value can be defaulted to **0**.	1	BCS-N positive integer (default is **BCS zero (0x30)**)	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
IMODE	Image Mode. The values **B**, **S** and **R** correspond respectively to the values 0, 2 and 4 of the layer "pixel or element order" (See clause 12.2.4.7 of DIGEST Part 2). There is no Image Mode corresponding to the value 1, 3 and 5 of the layer "pixel or element order". The presence of B, (P,) or S implies specific ordering of data within the JPEG image data representation. For this case, the interpretation of the various values of the IMODE field is specified in the MIL-STD-188-198A profile of ISO/IEC 10918-1 and ISO/IEC DIS 10918-3. When the value of the IC field is I1, C1, M1, C4 or M4 the value of the IMODE field is B.	1	BCS-A **B**, **P**, **R** or **S**	R
NBPR	Number of Blocks Per Row. This field contains the "horizontal block number" of the layer (See clause 12.2.4.7 of DIGEST Part 2).	4	BCS-N positive integer **0001** to **9999**	R
NBPC	Number of Blocks Per Column. This field contains the "vertical block number" of the layer (See clause 12.2.4.7 of DIGEST Part 2).	4	BCS-N positive integer **0001** to **9999**	R
NPPBH	Number of Pixels Per Block Horizontal. This field contains the "horizontal pixel number" of the layer (See clause 12.2.4.7 of DIGEST Part 2).	4	BCS-N positive integer **0001** to **8192**	R
NPPBV	Number of Pixels Per Block Vertical. This field contains the "vertical pixel number" of the layer (See clause 12.2.4.7 of DIGEST Part 2).	4	BCS-N positive integer **0001** to **8192**	R
NBPP	Number of Bits Per Pixel Per Band. This field contains the "value length" of image samples (See clause 12.2.4.7 of DIGEST Part 2).	2	BCS-N positive integer **01** to **96**	R
IDLVL	Image Display Level. This field is out of the DIGEST scope. Its value can be defaulted to **001** for the first segment, **002** for the second segment, …, etc.	3	BCS-N positive integer (default is **001**)	R
IALVL	Image Attachment Level. This field is out of the DIGEST scope. Its value can be defaulted to **000**.	3	BCS-N positive integer (default is **000**)	R
ILOC	Image Location. This field is out of the DIGEST scope. Its value can be defaulted to **0000000000**.	10	BCS-N positive integer (default is **0000000000**)	R
IMAG	Image Magnification. This field is out of the DIGEST scope. Its value can be defaulted to **1.0**.	4	BCS-A (default is **1.0**)	R

Table D-4 IIF File Image Subheader

FIELD	NAME	SIZE	VALUE RANGE	TYPE
UDIDL	User-defined Image Data Length. This Field ensures the physical integrity of the IIF encapsulation. When UDIDL is not **00000**, this field is followed by UDIDL bytes to skip.	5	BCS-N positive integer **00000**, **00003** to **99999** (default is **BCS zeros (0x30)**)	R
UDOFL, UDID	NSIF unused Fields These fields are out of the DIGEST scope. They can be omitted. In this case, the value of the UDIDL Field shall be **00000**.	As specified in UDIDL	User-defined	C
IXSHDL	Image Extended Subheader Data Length. The field shall contain the sum of the length of all the TREs appearing in the IXSHD field plus 3 (size of IXSOFL field) in bytes. All the Standard GeoSDEs needed shall be present. Other extensions are allowed but the total length of IXSHD can not exceed 99996 bytes. If necessary, refer to NSIF and its UDID Field and overflow mechanism.	5	BCS-N positive integer **00004** to **99999**	R
IXSOFL	Extended Subheader Overflow. This Field shall contain BCS zeros (code 0x30) if the TREs in the IXSHD Field do not overflow into a DES, or shall contain the sequence number of the DES into which they do overflow. This Field shall be omitted if the IXSHDL Field contains BCS zeros (0x30).	3	BCS-N positive integer **000** to **999**	R
IXSHD	Image Extended Subheader Data. This field may contain GeoSDEs and extra TREs. TREs in this field for an image shall contain information pertaining specifically to the image. TREs shall appear one after the other in this field with no intervening bytes. The first byte of this field shall be the first byte of the first TRE appearing in the field. The last byte of this field shall be the last byte of the last TRE to appear in the field.	As specified in IXSHDL minus 3	TREs	R

D.3.2 IIF Image Mask Definition

Table D-5 defines the IIF Image Mask. The set of fields constituting the Image Data Mask is included if the value of the IC Field is NM, M1, M3, M4 or M5.

Table D-5 IIF Image Data Mask

FIELD	NAME	SIZE	VALUE RANGE	TYPE
IMDATOFF	Blocked Image Data Offset. This field identifies the offset from the beginning of the Image Data Mask to the first byte of the blocked image data. This offset, when used in combination with the offsets provided in the BMRnBND fields, can provide random access to any recorded image block in any image band.	4	Unsigned binary integer; range of values: 0 to 2^{32} -1	C
BMRLNTH	Block Mask Record Length. This field identifies the length of each Block Mask Record in bytes. When present, the length of each Block Mask Record is 4 bytes. The total length of all the Block Mask Records is equal to BMRLNTH ∗ NBPR ∗ NBPC ∗ NBANDS (one 4-byte record for each block of each band in the image). If all of the image blocks are recorded, this value may be set to 0x0000, and the conditional BMRnBNDm fields are not recorded/transmitted. Otherwise, the value may be set to 0x0004, and the conditional BMRnBNDm fields are recorded/transmitted and can be used as an offset index for each image block in each band of the image. If this field is present, but coded as 0x0000, then only a Pad Pixel Mask is included.	2	Unsigned binary integer; 0x0000 represents no Block Mask Record; 0x0004 represents Block Mask Records (4 bytes each) are present	C

Table D-5 IIF Image Data Mask

FIELD	NAME	SIZE	VALUE RANGE	TYPE
TMRLNTH	Pad Pixel Mask Record Length. This field identifies the length of each Pad Pixel Mask Record in bytes. When present, the length of each Pad Pixel Mask Record is 4 bytes. The total length of the Pad Pixel Mask Records is equal to TMRLNTH * NBPR * NBPC * NBANDS (one 4-byte record for each block for each band in the image). If none of the image blocks contain Pad Pixels, this value is set to 0x0000, and the conditional TMRnBNDm fields are not recorded/transmitted. If the value of the IC field is M3, the value shall be set to 0x0000. If this field is present, but coded as 0x0000, then a Block Mask is included.	2	Unsigned binary integer; 0x0000 represents no Pad Pixel Mask Records; 0x0004 represents Pad Pixel Mask Records (4 bytes each) are present	C
TPXCDLNTH	Pad Output Pixel Code Length. This field identifies the length in bits of the Pad Output Pixel Code. If coded as 0x0000, no Pad Pixels are present, and the TPXCD field is not recorded. If the value of the IC field is M3, the value shall be set to zeros (0x0000).	2	Binary unsigned; 0x0000 represents no Pad Pixels; or Pad Pixel Code length in bits (Length must be as specified in NBPP)	C
TPXCD	Pad Output Pixel Code. This field is included if the value of the IC field is NM, M1, M3, M4, or M5 and the value of the TPXCDLNTH is not zeros (0x0000). It contains the Output Pixel Code that represents a Pad Pixel in the image. This value is unique within the image, and allows the user to identify Pad Pixels. The Pad Pixel Output Code length is determined by the value of the TPXCDLNTH field. If the number of bits used by the TPXCD field is less than the number of bits available for storage, the value shall be justified in accordance the value contained by the PJUST field in the Image Subheader (L for left-justified, R for right-justified).	The length (size) of the TPXCD field is the next highest number of bytes that can contain the number of bits identified in the TPXCDLNTH field. For example, a TPXCDLNTH value of 12 (bits) would be stored in a TPXCD field with the size of 2 (bytes).	Unsigned binary integer; range of values: 0 to 2^n -1 where n is the value contained by the TPXCDLNTH field	C
..... Start for each BMRnBNDm and TMRnBNDm record.				
NOTE: The BMRnBNDm record repeats, one 4-byte record for each block of each band in the image.				

Table D-5 IIF Image Data Mask

FIELD	NAME	SIZE	VALUE RANGE	TYPE
BMRnBNDm	Block n, Band m Offset. This field shall contain the n^{th} Block Mask Record of band m. It is recorded/transmitted only if the BMRLNTH field does not contain zeros (0x0000). The field shall contain an offset in bytes from the beginning of the blocked image data to the first byte of block n of band m. If block n of the image data of band m is not recorded/transmitted, the offset value is defaulted to 0xFFFFFFFF. If the value of the IMODE field is S, the offsets for all blocks in band 1 are recorded followed by block offsets for band 2, etc. (band sequential). The number of BMR for each band is NBPR ∗ NBPC. This field corresponds to a single value of the "TILE INDEX MAP" of the layer (See clause 12.2.4.7 of DIGEST Part 2). Do be careful that BMRnBNDm defines an offset from the beginning of the blocked image.	4	Unsigned binary integer Increment n prior to m 0 <= n <= NBPR ∗ NBPC - 1 0 <= m <= max(NBANDS,XBANDS) (Default is 0xFFFFFFFF if the block is not recorded)	C
. . . .				
NOTE: The TMRnBNDm record repeats, one 4-byte record for each block of each band in the image. This results in a table containing an offset value (or 0xFFFFFFFF) for each block of each band of the image.				
TMRnBNDm	Pad Pixel n, Band m. This field shall contain the n^{th} Pad Pixel for band m. It is recorded/transmitted only if the TMRLNTH field does not contain zeros (0x0000). The field shall contain an offset in bytes from the beginning of the blocked image data to the first byte of block n of the image data of band m if block n contains Pad Pixels, or the default value 0xFFFFFFFF to indicate that this block does not contain Pad Pixels. The offsets for all blocks in band 1 are recorded followed by block offsets for band 2, etc. (band sequential). The number of TMR for each band is NBPR ∗ NBPC.	4	Unsigned binary integer Increment n prior to m 0 <= n <= NBPR ∗ NBPC - 1 0 <= m <= max(NBANDS,XBANDS) (Default is 0xFFFFFFFF if the block is not recorded)	C

D.3.3 VQ Compressed Images

Detailed information about the VQ compression and its NSIF/NITF/IIF encoding can be found either in:

- MIL-STD-188-199, Notice 1 dated 27 June 1996, Vector Quantization for the NITF Standard ;
- ISO/IEC 12087 – Part 5 dated 1 December 1998, Basic Interchange Format (BIIF).

An Image Segment contains a VQ compressed image when the value of the IC Field is C4 or M4.

D.3.3.1 Structure of an IIF VQ Compressed Image

The data Field of an IIF VQ compressed Image Segment is composed of three parts:

- An optional IIF Image Data Mask (as described in subclause D.3.2) which is required when the value of the IC Field is equal to M4;
- A mandatory VQ Header; and
- The compressed Image Data.

The VQ compressed Image Structure is shown in Figure D-4. The following fields are applicable to the compressed image data and define its organization: NBANDS, XBANDS, IMODE, NBPR and NBPC. The number of VQ codes per block; their size and much other information related to the compressed image are defined in the VQ Header.

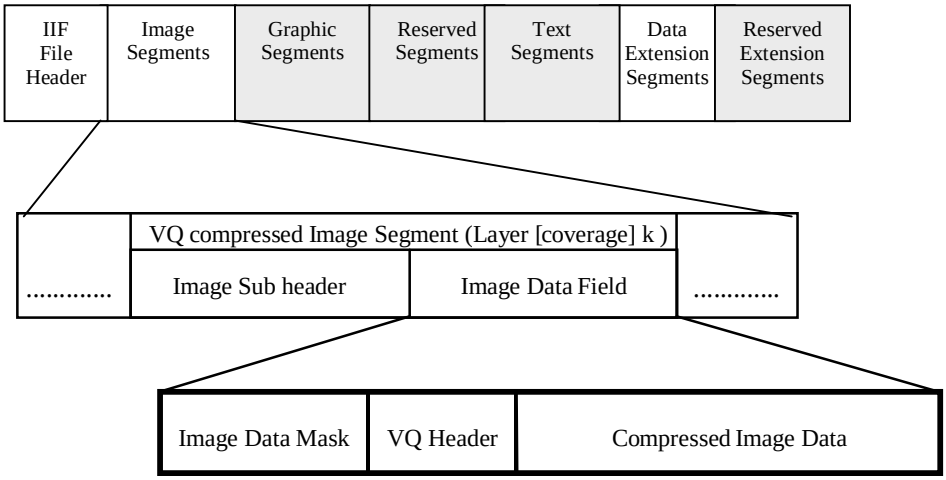

Figure D-4 VQ Compressed Image Structure

D.3.3.2 VQ Header Definition

Table D-6 describes the detailed requirements for the VQ Header of a VQ compressed image.

Table D-6 VQ Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
1. Image Display Parameter Subheader				
NIR	Number of image rows. This Field shall contain the total number of rows, that is the value of the "Compression Parameter" for which the "Id" is equal to 100 (See DIGEST part 2, clause 12.2.4.7).	4	Unsigned binary integer **1** (0x00000001) to **2^{32}-1** (0xFFFFFFFF)	R
NICR	Number of image codes per row. This Field shall contain the total number of image codes per row, that is the value of the "Compression Parameter" for which the "Id" is equal to 101 (See DIGEST part 2, clause 12.2.4.7).	4	Unsigned binary integer **1** (0x00000001) to **2^{32}-1** (0xFFFFFFFF)	R
ICBL	Image Code Bit Length. This Field shall contain the length in bits of each image code, that is the value of the "Compression Parameter" for which the "Id" is equal to 102 (See DIGEST part 2, clause 12.2.4.7).	1	Unsigned binary integer **1** (0x01) to **255** (0xFF)	R
2. Compression Section Subheader				
CAI	Compression Algorithm Id. This field defines the algorithm used for the image data. This field is reserved for future use. The default value is **1** (0x00000001) and indicates that the image data is vector quantized.	2	Unsigned binary integer **1** (0x0001)	R
NCLT	Number of Compression Lookup Tables This Field shall contain the number of "Compression Lookup Tables". Valid entries are **1** (0x0001) and **4** (0x0004).	2	Unsigned binary integer **1** (0x0001) or **4** (0x0004)	R
NCPOR	Number of Compression Parameter Offset Records This Field is reserved for future use. The default value is **0** (0x0000).	2	Unsigned binary integer **0** (0x0000)	R
3. Compression Lookup Subsection				
CLOTO	Compression Lookup Offset Table Offset This Field indicates the displacement, measured in bytes, between the beginning of the Compression Lookup Subsection (this Field) and the first byte of the first "Compression Lookup Table Description" (counting the first byte of this Field as 0). The default value is **6** (0x0000).	4	Unsigned binary integer (default is **6** (0x0006))	R
CLTDL	Compression Lookup Table Description Length This Field indicates the number of bytes of each "Compression Lookup Table Description". The default value is **14** (0x000E).	2	Unsigned binary integer (default is **14** (0x000E))	R

Table D-6 VQ Header

FIELD	NAME	SIZE	VALUE RANGE	TYPE
. . . Start for each Compression Lookup Table Description (occurs NCLT times)				
CLTIn	Compression Lookup Table Id This Field shall contain the "Compression Look up Table Id" of the nth Compression Lookup Table (See DIGEST Part 2, clause 12.2.4.7). The allowed values are : • 1 (0x0001) : Row 0 of a 4x4 kernel ; • 2 (0x0002) : Row 1 of a 4x4 kernel ; • 3 (0x0003) : Row 2 of a 4x4 kernel ; • 4 (0x0004) : Row 3 of a 4x4 kernel ; • 5 (0x0005) : a 16-element of a 4x4 kernel ; • 6 (0x0006) : a 4-element of a 2x2 kernel. When the NCLT Field contains 1 (0x0001), there is a single "Compression Lookup Table". Its CLTIn value is 5 or 6 depending on the kernel size. When the NCLT Field contains 4 (0x0004), there shall be 4 Compression Lookup Table uniquely identified. Their CLTIn value is respectively 1, 2, 3 and 4.	2	Unsigned binary integer **1** (0x0001) to **6** (0x0006)	R
NCLRn	Number of Compression LUT Rows This Field defines the "Number of Compression LUT Rows" of the nth Compression Lookup Table (See DIGEST Part 2, clause 12.2.4.7).	4	Unsigned binary integer **1** (0x00000001) to **2^{32}-1** (0xFFFFFFFF)	R
NVCLRn	Number of Values per Compression LUT Row This Field defines the "Number of Values per Compression LUT Row" of the nth Compression Lookup Table (See DIGEST Part 2, clause 12.2.4.7).	2	Unsigned binary integer **1** (0x0001) to **2^{16}-1** (0xFFFF)	R
CLVBLn	Compression LUT Value Bit Length This Field defines the length in bits of each CLVnmp Field of the nth Compression Lookup Table (See DIGEST Part 2, clause 12.2.4.7).	2	Unsigned binary integer **1** (0x0001) to **2^{16}-1** (0xFFFF)	R
CLTOn	Compression Lookup Table Offset This Field defines the displacement, measured in bytes, between the beginning of the Compression Lookup Subsection (CLOTO Field) and the first byte of the nth Compression Lookup table (counting the first byte of the CLOTO Field as 0)	4	Unsigned binary integer **1** (0x00000001) to **2^{32}-1** (0xFFFFFFFF)	R
. . . End for each Compression Lookup Table Description				
. . . Start for each Compression Lookup Table (occurs NCLT times)				
. . . Start for each Compression LUT Row (occurs NCLRn times)				
. . . Start for each Compression Lookup Value (occurs NVCLRn times)				
CLVnmp	Compression Lookup Value This Field contains the pth value of the mth Compression LUT Row of the nth Compression Lookup Table.	As specified by CLVBLn (in bits)	Unsigned binary integer	R
. . . End for each Compression Lookup Value				
. . . End for each Compression LUT Row				
. . . End for each Compression Lookup Table				

D.3.4 TRE_OVERFLOW DES Definition

Table D-7 describes the detailed requirements for the TRE_OVERFLOW DES.

Table D-7 TRE_OVERFLOW DES

FIELD	NAME	SIZE	VALUE RANGE	TYPE
DE	Data Extension Subheader. This field shall contain the characters **DE** to identify the subheader as a data extension.	2	BCS-A **DE**	R
DESID	Unique DES Type Identifier. This field shall contain **TRE_OVERFLOW**	25	BCS-A **TRE_OVERFLOW**	R
DESVER	Version of the Data Definition. This field shall contain the alphanumeric version number of the use of the Tag.	2	BCS-N positive integer **01**	R
DECLAS	Data Extension File Security Classification. This field shall contain a valid value representing the classification level of the Segment. The value can be defaulted to the value of the Security Classification Field of the Header (FSCLAS) or Image Subheader (ISCLAS) which overflows.	1	ECS-A **T**, **S**, **C**, **R** or **U**	R
DESCLSY	DES Security Classification System. This field is out of the DIGEST scope. A valid code is expected when the value of the DCLASY Field is not **U**. In this case, the IIF default is **NS**. Else, the default value is **ECS Spaces (0x20)**.	2	ECS-A **NS** and other codes allowed by NSIF (default **is ECS Spaces (0x20)**)	<R>
DESCODE, DESCTLH, DESREL	NSIF unused Fields. These Fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces** (0x20).	33	ECS-A (Default is **ECS Spaces (0x20)**)	<R>
DESDCTP	DES Declassification Type. This field shall contain a valid indicator of the type of security Declassification or Downgrading instructions, which apply to the Segment. The value can be defaulted to the value of the Declassification Type Field of the Header (FSCLAS) or Image Subheader (ISCLAS) which overflows.	2	ECS-A **O**, **DD** and other codes allowed by NSIF (Default is **ECS Spaces (0x20)**)	<R>
DESDCDT	DES Declassification Date. This field shall indicate the date on which a Segment is to be declassified if the value of the DESDCTP field is DD. If this field is all ECS Spaces (code 0x20), it shall imply that no Segment Declassification date applies. The value can be defaulted to the value of the Declassification Date Field of the Header (FSCLAS) or Image Subheader (ISCLAS) which overflows.	8	ECS-A CCYYMMDD (Default **is ECS Spaces (0x20)**)	<R>

Table D-7 TRE_OVERFLOW DES

FIELD	NAME	SIZE	VALUE RANGE	TYPE
DESDCXM, DESDG, DESDGDT, DESCLTX, DESCATP, DESCAUT, DESCRSN, DESSRDT, DESCTLN	NSIF unused Fields. These Fields are out of the DIGEST scope. Their value can be defaulted to **ECS Spaces** (0x20).	121	ECS-A (Default is **ECS Spaces (0x20)**)	<R>
DESOFLW	Overflowed Header Type. This field indicates that the DES contains a TRE that would not fit in the NSIF File Header or Segment Subheader where it would ordinarily be located. Its value indicates the data type to which the enclosed TRE is relevant.	6	BCS-A **UDHD**, **UDID**, **XHD**, **IXSHD**, **SXSHD** or **TXSHD**	R
DESITEM	Data Item Overflowed. This field shall contain the number of the data item in the NSIF File, of the type indicated in the DESOFLW field to which the TREs in the Segment apply. If the value of the DESOFLW field is UDHD or XHD, the value of the DESITEM field shall be 000.	3	BCS-N positive integer **000** to **999**	R
DESSHL	DES User-Defined Subheader Length.	4	BCS-N positive integer **0000**	R
DESDATA	DES-Defined Data Field. This field shall contain data of either binary or character types defined by and formatted according to the user's specification. The length of this field shall not cause any other NSIF field length limits to be exceeded, but is otherwise fully user-defined.	Profile defined	User-defined TREs with no intervening octets.	R

APPENDIX D1 - NSIF STANDARD GEOSPATIAL SUPPORT DATA EXTENSIONS

This appendix specifies the format and content of a set of Tagged Record Extensions controlled by the custodian of NSIF. Detailed descriptions are provided for the overall structure, as well as specification of the valid data content and format, for all fields defined within TREs constituting the Standard Geospatial Support Data Extensions (GeoSDEs). In addition, technical information is presented to provide a general understanding of the significance of the included fields.

D1.1 NSIF General Requirements

D1.1.1 Overview of the NSIF Standard Geospatial Support Data Extensions

That set of support data needed to accomplish the mission of a system receiving an NSIF File is referred to as "appropriate" support data. The appropriate support data may vary across systems receiving NSIF Files. A system receiving an NSIF File may add or subtract support data before passing the File to another system with a different mission. This strategy implies a modular support data definition approach.

Image and raster map providers produce NSIF Files with support data from other formats that also contain support information. The extensions described herein define the format for that support information required within an NSIF File containing geo-referenced image, matrix, or raster map data such as that defined in the DIGEST standard. The information that makes up the GeoSDEs is derived from referenced standards including DIGEST. Systems using DIGEST imagery, matrix, or raster map data formatted according to NSIF should be designed to extract the needed data from the following:

a. For spatial location:

   GEOPS for geo-referencing parameters including datums, ellipsoids;

   PRJPS for complementary geo-referencing parameters defining projections;

   GRDPS for non-rectified image, raster, or matrix data that is positioned using a location grid;

   GEOLO for image, raster, or matrix data rectified consistently with geographic (lat/long) coordinate systems;

   MAPLO for image, raster, or matrix data rectified consistently with cartographic (E,N) coordinate systems;

   REGPT for registration points in either geographic or cartographic systems.

   BNDPL for an accurate geographic location of the significant part of the image.

b. For positional accuracy (positional accuracy description is required when spatial location is defined):

   ACCPO for horizontal and vertical accuracy over regions for which the definitions are constant;

   ACCHZ for horizontal accuracy when the vertical accuracy varies across the region for which horizontal accuracy is constant;

   ACCVT for vertical accuracy when the horizontal accuracy varies across the region for which vertical accuracy is constant.

c. For source description:

SNSPS for sensor parameters;

SOURC for map source information.

d. For other needs:

FACCB for Attribute FACC Code definition.

The categories of image and extensively digital geographic information, to which the standard GeoSDEs applies are shown in Table D1-1. Note that the FACCB extension is highly recommended for matrix data (ICAT containing MATR), but can be associated with any Image Segment using attribute codes from the DIGEST FACC (See DIGEST Part 4 – Annex B). Because of this specific status, the FACCB extension does not appear in Table D1-1.

A main Image Segment containing image/raster/matrix data may be associated with one or more Images Segments containing auxiliary data: the legend or the colour-patch of a map, or a location grid. An associated Image Segment contains no GeoSDE; it refers to the main Image Segment GeoSDEs (for example, the coordinates of a location grid are expressed in the absolute reference system defined by the GEOPS extension).

Table D1-1 Categories of Image/Matrix/Grid Data

<table>
<tr><th colspan="3">Categories of Image/Matrix/Grid Data</th><th colspan="3">Data extension
to be included in the image subheader</th></tr>
<tr><th>Data type</th><th>ICAT</th><th>IREP</th><th>ACCURACY</th><th>LOCATION</th><th>SOURCE</th></tr>
<tr><td>Raster Maps</td><td>MAP</td><td>MONO,
RGB,
RGB/LUT</td><td rowspan="3">ACCPO
and/or
ACCHZ &
ACCVT</td><td rowspan="3">GEOPS
+ conditionally
PRJPS
+ one of:
GEOLO
MAPLO
GRDPS
REGPT
+ optionally
BNDPL</td><td>SOURC</td></tr>
<tr><td>Matrix Data
(Digital Terrain
Elevation Models
and Others)</td><td>DTEM,
MATR</td><td>NODISPLY,
MONO,
RGB/LUT</td><td>SOURC or
SNSPS</td></tr>
<tr><td>Geo-referenced
Imagery</td><td>VIS, SL, TI,
FL, RD, EO,
OP, HR, HS,
CP, BP, SAR,
IR, MS</td><td>MONO,
RGB,
RGB/LUT,
MULTI</td><td>SNSPS</td></tr>
<tr><td rowspan="2">Auxiliary Data
(Legend,
colour-patch,
Location grid)</td><td>LEG,
PAT</td><td>MONO,
RGB,
RGB/LUT</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>LOCG</td><td>NODISPLY</td></tr>
</table>

All the GeoSDEs corresponding to a given image (DIGEST Layer) appear necessarily in an IXSHD Field of the image subheader (or in the corresponding TRE_OVERFLOW DES), except the geo-referencing parameters (GEOPS and optionally PRJPS) which shall be placed in the XHD Field of the File Header (or in the corresponding TRE_OVERFLOW DES).

D1.1.2 NSIF Tagged Record Extension Mechanism

D1.1.2.1 General Mechanism

The TREs defined in this appendix are "Controlled TREs" as defined in clause 27a of the STANAG 4545, Edition 1 - Annex C. The TRE format is summarized here for ease of reference. Table D1-2 describes the general format of a Controlled TRE.

The CETAG and CEL fields essentially form a small (11 byte) tagged record subheader. The format and meaning of the data within the CEDATA field is the subject of this appendix for all the NSIF Standard GeoSDEs. Multiple TREs can exist within the TRE area. There are several such areas, each of which can contain 99,999 bytes worth of tagged extensions.

NSIF provides an overflow mechanism when the sum of all tags in area exceeds 99,999 bytes. The overflow mechanism allows for up to one gigabyte of tags. While the extensions defined in this document will typically be found in the Image Subheader (IXSHD field) or in the File Extended Header (XHD field), it is possible that they could appear in a Data Extension Segment which is being used as an overflow of the Image Subheader or File Header.

D1.1.2.2 Tagged Record Extension Format

If the information contained within an extension is not available, the extension will not be present in the NSIF File. For example, if positional accuracy is homogeneous across the whole Image Segment, then the Horizontal and Vertical Accuracy Records will not appear since all of the accuracy will be contained in the Positional Accuracy Record. When an extension is present, all of the information listed as Required (type = R) must be filled in with valid information.

Table D1-2 Controlled Tag Record Extension Format

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Type Identifier. The identifier of a GeoSDE is composed of two parts: its name (five characters) and a unique character identifying its version. All the characters are uppercases. The versions of the GeoSDEs are numbered in alphabetic order from 'A' to 'Z'. 'B' is last version of the GeoSDEs and its use is highly recommended since there is no backward compatibility between versions A and B.	6	BCS-A	R
CEL	Length of CEDATA Field (Number of Bytes). This field shall contain the length, in bytes, of the data contained in CEDATA. The tagged record's length is 11 + the value of CEL.	5	BCS-N positive integer **00001** to **99985**	R
CEDATA	User-defined Data. This field shall contain data of either binary or character data types defined by and formatted according to user specification. The length of this field shall not cause any other NSIF field length limits to be exceeded but is otherwise fully user-defined.	Value of the CEL field	User-defined	R

D1.2 Spatial Data Extensions

This clause is intended to describe the NSIF standard Support Data Extensions (GeoSDEs) used to properly transfer geospatial information to provide accuracy and coordinate data.

The nature of raster data is inherently different than vector data because the pixel representations are rows and columns which means the surface of the earth is being mapped to some type of rectangular grid. Mapmakers have faced this challenge since the beginning of their profession and many solutions have been put forth to project the spheroidal geometry of the earth to a flat surface such as a paper map. Images of the earth's surface inherit additional complexities due to the look angle of cameras and the other imaging parameters such as focal length, atmosphere refraction, etc.

D1.2.1 Geographic Location

The IGEOLO and ICORDS Image Subheader Fields shall only be used for coarse representation of the geographic or cartographic coordinates of the image.

The specified TREs incorporate all GeoSDEs relevant to geo-referenced image, matrix, or raster map data. The information that makes up the GeoSDE is derived from referenced standards including DIGEST. Systems using DIGEST and/or NIMA's imagery, matrix or raster map data formatted according to NSIF (and IIF) should be designed to extract the needed data from the tagged records described herein.

D1.2.2 Coordinate Systems

Most people are familiar with the concept of latitude and longitude for locating places on the face of the earth. Most people have also used graph paper to lay out a garden or house plan where distances left-right and up-down are so many grids cells or simple (x-y) orthogonal measurements in inches or centimetres. These principles for coordinates apply in the geospatial sense but more detail is needed to ensure data transfer carries the meaning intended by the transmitter to the receiver.

Three types of coordinate systems are defined for geospatial information: (1) Geographic (GEO), (2) Cartographic or Grid (MAP), and (3) Relative (DIG).

GEO Geographic coordinates are expressed in latitude and longitude and are based on a geodetic datum, including both the geodetic ellipsoid and zero meridian. For the purposes of this standard, the zero meridian will default to GREENWICH (zero degrees longitude). Datums and ellipsoids are carried in the GEOPS extension. DIGEST lists more than 200 different datums. There are so many datums because geodesy continues to refine the understanding of the shape and gravity of the earth. As these refinements mature, maps and other spatial data tend to reflect the best knowledge available at the time the maps and/or data were produced. To properly interpret coordinates, one must take into account the mathematics in effect at the time of production. It is often necessary to convert coordinates to a common coordinate system when using data produced in different time frames or by different organizations. Ellipsoids go along with many datums, but DIGEST lists fewer than 60 different ellipsoids. This is because many local datums exist without reference to an ellipsoid but all global coordinate systems use an ellipsoid. Modern mapping prefers the ellipsoid and datum to be consistent with the World Geodetic System 1984 (WGS84).

MAP When using a cartographic (grid) coordinate system a location is specified as being so many units North/South (Northing) and so many units East/West (Easting) from a reference point within a defined projection plane. The projection is a mathematical relationship that defines a one-to-one mapping between the geodetic ellipsoid and the projection plane. A cartographic coordinate system is based on a projection (with values for all its associated parameters) applied to a geodetic datum (see above). The projection parameters are described in the PRJPS extension. DIGEST lists approximately 30 different projections and they require from one to six parameters. Note: The complete definition of a cartographic coordinate system requires of course the definition of the projection used, and the description of the geographic coordinate system to which the defined projection applied.

DIG A relative coordinate system is the natural occurrence when using a digitizing tool, a scanner, or raw imagery. These relative coordinate systems must be registered to an absolute coordinate system in order to represent real locations. The absolute coordinate systems may be GEO or MAP as described above. The registration between the relative and absolute coordinate systems will be defined either by the description of registration points (generally three or more) or by the description of location grid(s) (at least one). Normally, the error introduced during digitizing is small compared to the error in the source graphic, but it should not be ignored.

D1.2.3 Rectified Image/Raster Local Coordinate System

Rows and columns of a rectified image/raster data form a regular grid whose axes are parallel to the axes of the absolute coordinate system as defined in the GEOPS (and possibly PRJPS) extensions. When terrain relief is included in the rectification process, the result is called «ortho-rectified». This will be more spatially correct, especially in area that have considerable elevation differences. In this local coordinate system, coordinate sets are composed of a row number and a column number (r,c). The order in which rows and columns are numbered is described in paragraph "D.1.3.4. Display of IIF Images".

Let CS be the column sequence of the image. Let RS be the row sequence of the image. CS is equal to **+1** when the first or four corner of the IGEOLO field is the westernmost (**-1** in all other cases). RS is equal to **+1** when the first or second corner of the IGEOLO field is the southernmost (**-1** in all other cases). The GEOLO and MAPLO extensions provide the appropriate parameters for computing the spatial location of each pixel from its row and column number.

a. MAPLO must be used if the absolute coordinate system is a cartographic coordinate system (E, N). It defines the Easting and Northing of the origin of the grid (LSO,PSO) and the rows and columns width (LAD,LOD) using a defined linear unit (UNILOA).

$$E = LSO + CS*c * LOD * (1_{UNI} / 1_{UNILOA})$$
$$N = PSO + RS*r * LAD * (1_{UNI} / 1_{UNILOA})$$

NOTE: $(1_{UNI} / 1_{UNILOA})$ means the conversion of the unit of LOD (LAD) given by the field UNILOA into the unit of E (N) called UNI in these formulas. If the units are the same, this ratio is equal to 1.

b. GEOLO must be used if the absolute coordinate system is a geographic coordinate system (Long, Lat). It defines the longitude and latitude of the origin of the grid (LSO,PSO), and the number of rows and columns in 360° (BRV,ARV).

$$\text{Long} = \text{LSO} + \text{CS}*c * (360°)_{UNI} / \text{ARV}$$
$$\text{Lat} = \text{PSO} + \text{RS}*r * (360°)_{UNI} / \text{BRV}$$

NOTE: $(360°)_{UNI}$ means the value of a 360° angle expressed in the unit of Lat (Long). If the units are degrees, the value is 360.

D1.2.4 GRID Reference Image

Non-rectified image or matrix data can be accurately geo-referenced with a grid reference image file. This is the GRDPS extension. Basically, this involves superimposing a grid of spatial location information on top of the image for which the spatial information applies. For example, the grid could have location information (coordinates) at every 10th image pixel (N-S) and (E-W). Then for every image pixel, one could interpolate, using surrounding grid pixels, to estimate the actual geospatial location.

This scheme eliminates the need to re-sample the base image to place it in a rectified form. This is important if the base image was a map scanned at a relatively low resolution (e.g., 100 dots per inch) and the re-sampling process would tend to make the resultant raster map too blurred to read. This process also allows a very non-linear stretch within the image space to be geo-referenced with reasonable accuracy, for example, aircraft reconnaissance using low scan angles. This results in near field pixels relatively close together and far field pixels far apart. Even with a horizon in the image, one can fill pixel spaces above this horizon with null values to signal that spatial location has no meaning in this empty part of the scene.

Another advantage of the grid reference is the simplification of the application software. By using the same grid reference scheme for various types of imagery, the application software can use the same logic and not require a library of algorithms for various projection and sensor parameter solutions.

The extension includes the NSIF File identifier of the grid (The BAD Field of the GRDPS TRE contains the value of the IID1 Subheader Field of the Image Segment corresponding to the grid) and precise coordinates of four bounding corners. It also contains the absolute elevation of the grid relative to mean sea level or other specified vertical reference system. The elevation data provides spatial data refinement in areas where terrain relief complicates the geospatial reference problem. For regions of pronounced differences in terrain elevation, it may be necessary to include several sets of grid reference images where the elevation of the grid is adjusted to best match the terrain elevation over that region.

It is important to note that while the grid reference generally gives good accuracy, the quantitative accuracy value at each pixel is difficult to describe.

The grid Image Segment contains two bands: Band X giving the longitude or easting coordinates and Band Y giving the latitude or northing coordinates for each grid element. The “ISUBCATn” Field of the Band X may be CGX or GGX and the “ISUBCATn” Field may be CGY or GGY. CGX and CGY indicate geographic coordinates (longitude & latitude) and GGX and GGY indicate grid (Easting (X) & Northing (Y)) coordinates.

The coding of band values BandX and BandY will be:

- either integer for cartographic grids, giving easting and northing (in metres); in that case, the values of the location grid Image Segment fields are:
  PVTYPE = INT,
  NBANDS = 2,
  IREPBAND1 = LX, ISUBCAT1 = CGX,
  IREPBAND2 = LY, ISUBCAT2 = CGY.

- or real (float) for geographic grids, giving longitude and latitude (in decimal seconds); in that case, the values of the location grid Image Segment fields are:
  PVTYPE = R,
  NBANDS = 2,
  IREPBAND1 = LX, ISUBCAT1 = GGX,
  IREPBAND2 = LY, ISUBCAT2 = GGY.

Let (LSO, PSO) be the origin of the location grid in columns and rows within the image, (LAD, LOD) the interval (measured in image pixels) between 2 consecutive elements of grid (in rows, columns), also being the ratio of image pixels to grid pixels, by row and column. Note that LOD and LAD don't represent necessarily an integer number of pixels.

Let (r,c) be the row and column numbers, of a pixel of interest, within the image. The location of the pixel (r,c) can be interpolated from the four grid points that surround it. Let (LGR, LGC) be the row and column number (in grid numbers) of the upper left corner of the grid square that surrounds the image pixel of interest. These values can be computed as follows:

$$LGR = [\ (r-PSO) / LAD] \qquad LGC = [\ (c-LSO) / LOD]$$

where... [x] = integer part of x

Let the four corners of the grid square be numbered 1, 2, 3, 4, as shown on Figure D1-1. The upper left corner (corner number 1) row and column indexes are $(R_1, C_1) = (LGR, LGC)$. The row and column numbers (R_i, C_i), (i = 2, 3, 4) of the other corners are:

$$(R_2, C_2) = (LGR, LGC + 1) \quad (R_3, C_3) = (LGR + 1, LGC) \quad (R_4, C_4) = (LGR + 1, LGC + 1)$$

For the example in Figure D1-1, the grid coordinates of the four corners are:

$$(R_1, C_1) = (0,1) \qquad (R_2, C_2) = (0,2) \qquad (R_3, C_3) = (1,1) \qquad (R_4, C_4) = (1,2)$$

The image pixel coordinates of the 4 grid corners (r_i, c_i), (i = 1,2,3,4) can be computed as:

$$(r_i, c_i) = (PSO + R_i * LAD, LSO + C_i * LOD).$$

Depending on the LAD and LOD values, r_i and c_i are not necessarily integer values. For the example, the pixel coordinates of the four corners are:

$$(r_1, c_1) = (3,5) \qquad (r_2, c_2) = (3,8) \qquad (r_3, c_3) = (7,5) \qquad (r_4, c_4) = (7,8)$$

In this example, the pixel of interest is (r, c) = (5, 7).

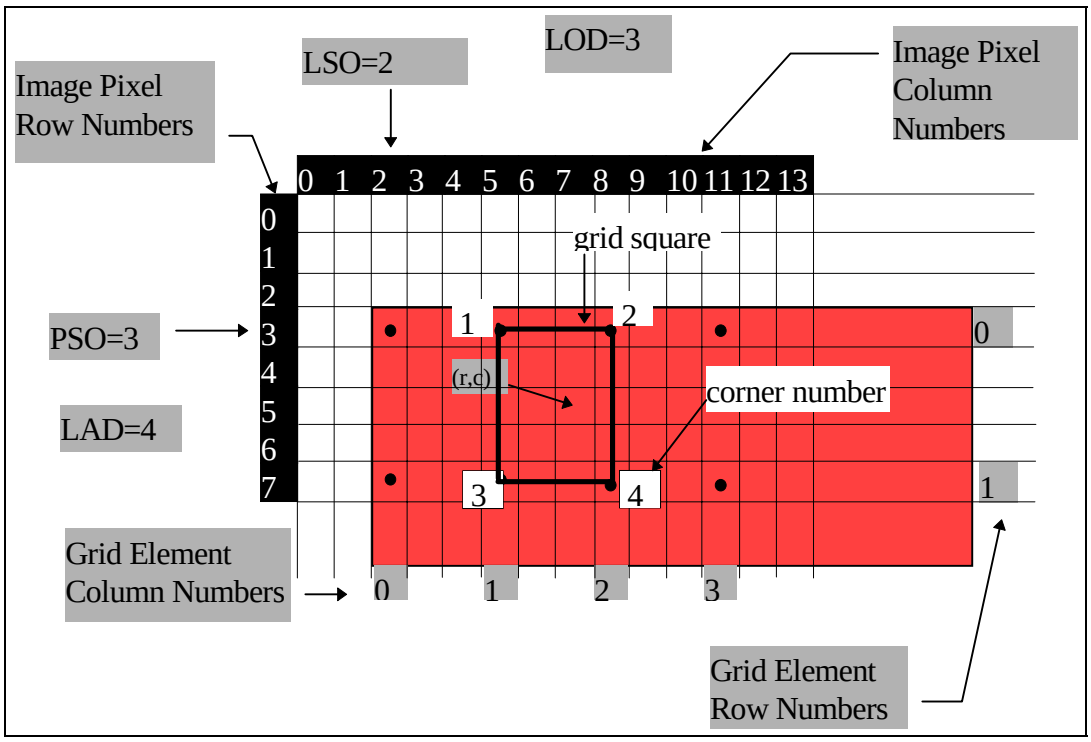

Figure D1-1 Example of a Location Grid

The location information provided by grid data at each of the four corners (X_i, Y_i), (i = 1,2,3,4) is given by:

$$(X_i, Y_i) = (\text{BandX}(R_i, C_i), \text{BandY}(R_i, C_i)).$$

The interpolation algorithm is a bilinear interpolation between the 4 corners of the grid square. The column and row deltas (a and b), for c and r, are computed as follows:

$$a = (c - c_1) / \text{LOD} = (c - (\text{LSO} + C_1 * \text{LOD})) / \text{LOD}$$
$$b = (r - r_1) / \text{LAD} = (r - (\text{PSO} + R_1 * \text{LAD})) / \text{LAD}$$

and a and b lie between 0 and 1.

The location (X,Y) of the pixel (r,c) is then given by:

$$X = (1-a)*(1-b)*X_1 + a*(1-b)*X_2 + (1-a)*b*X_3 + a*b*X_4$$
$$Y = (1-a)*(1-b)*Y_1 + a*(1-b)*Y_2 + (1-a)*b*Y_3 + a*b*Y_4$$

For the example, the values of (a and b) are:

$$a = (c - c_1) / \text{LOD} = (7 - 5) / 3 = 2/3 \quad \text{and} \quad b = (r - r_1) / \text{LAD} = (5 - 3) / 4 = 1/2$$

giving the interpolation algorithm the following weighted sum:

$$X = X_1/6 + X_2/3 + X_3/6 + X_4/3 \quad \text{and} \quad Y = Y_1/6 + Y_2/3 + Y_3/6 + Y_4/3$$

Note that the sum of the weights (1/6 + 1/3 + 1/6 + 1/3) is always equal to 1.

D1.2.4.1 Grid and Elevation

A grid is computed at a given elevation, and is valid for that elevation. In most cases, the location given by a grid varies smoothly with this elevation. If the surface covered by the image is flat, its associated grid should be computed at the average ground elevation in this area. Otherwise, in case of significant elevation variations over the spot covered by the grid, the image is associated with two grids, one at minimum elevation z_{min}, and the other at maximum elevation z_{max}. A more accurate location of the pixel of interest can be computed by a linear interpolation between the locations computed with the two grids taking account of the estimated elevation from some additional data (such as digital terrain model or maps).

The process is then the following:

- computing the location with the two grids: (X_{min} , Y_{min}) at elevation z_{min} and (X_{max} , Y_{max}) at elevation z_{max}
- from an additional data (e.g., Digital Terrain Model, map ...), estimation of elevation z of pixel (whose location can be estimated as ((X_{min} +X_{max})/2, (Y_{min} +Y_{max})/2)
- compute: $\mu = (z - z_{min}) / (z_{max} - z_{min})$ (notice that $0 <= \mu <= 1$)
- compute the final location (X, Y) by linear interpolation:

$$(X, Y) = ((1-\mu)*X_{min} + \mu*X_{max} , (1-\mu)*Y_{min} + \mu*Y_{max})$$

This solution is robust only when the elevation gradient is smooth.

D1.2.5 Registration Points

Each registration point is described by two sets of coordinates: one describes the position of the point using the absolute coordinate system (as described in the GEOPS and possibly PRJPS extensions), the other describes the row and column of the corresponding pixel in the image.

The REGPT extension is used to support relative coordinate systems. Note: The position accuracy will be affected by the mathematical function used to transform the coordinates from the relative coordinate system to the absolute one. This process is often referred to a "rubber sheeting" or "warping" an image (or scanned raster file) to best fit an absolute coordinate system. The mathematics will obviously be improved if approximate pixel spacing (in terms of the absolute coordinate system) is known.

D1.2.6 Geo-reference Values for Certain Standard Products

Several standard raster map products exist for which the geo-reference values are understood by default. These default values are summarized in this section:

- Arc Standard Raster Product (ASRP)
  Type: Geographic (GEO)
  Units: Seconds (SEC)
  Ellipsoid: WGS84
  Datum: WGS84
  Projection: *Not Applicable*

- UTM/UPS Standard Raster Product (USRP)
  Type: Cartographic (MAP)
  Units: Metres (M)
  Ellipsoid: WGS84
  Datum: WGS84

  If Zone Number is +60 to +1 (for north of Equator) or -60 to -1 (for south of Equator) the default projection will be consistent with Zone Number given in MAPLO Extension:

  Projection: Universal Transverse Mercator
  Parameter 1: Central Meridian for UTM Zone (Given in MAPLO)
  Parameter 2: 0.9996
  Parameter 3: None
  Parameter 4: None
  X (Easting) false origin: 500000
  Y (Northing) false origin: 0(N) or 10000000(S)

  If Zone Number is +61 or -61 the default projection will be:

  Projection: Universal Polar Stereographic
  Parameter 1: 0 or 648000
  Parameter 2: 0.994
  Parameter 3: None
  Parameter 4: None
  X (Easting) false origin: 2000000
  Y (Northing) false origin: 2000000

Note : The Arc system is described in the "DIGEST Support Document - Part 3 : The Arc System".

D1.2.7 Detailed Requirements of the Spatial Data Extensions

The minimum set of spatial data extensions required for spatial location is composed as follows. The GEOPS extension is required and shall be associated with one of the GEOLO, MAPLO, GRDPS or REGPT extensions. The PRJPS extension is required when the absolute coordinate system is a cartographic coordinate system. This minimum set of extensions is required for compliance with DIGEST.

The BNDPL extension is optional and is not required for compliance with DIGEST.

D1.2.7.1 GEOPS - Geo positioning Information

GEOPS defines (possibly associated with the PRJPS extension) the absolute coordinate system to which the data is geo-referenced. This absolute coordinate system may be a geographic system or a cartographic (grid) coordinate system. The user-defined fields of the GEOPS extension are detailed in Table D1-3. A single GEOPS shall be placed in the XHD Field (or corresponding TRE_OVERFLOW DES) of a NSIF/NITF File.

Table D1-3 GEOPS - Geo Positioning Information Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier The last character identifies the version of the TRE.	6	BCS-A **GEOPSB**	R
CEL	Length of Data to Follow The CEL Field value shall be equal to **00443**	5	BCS-N positive integer **00443**	R
The following fields define GEOPS...				
TYP	Coordinate System Type This field shall contain the type of coordinate system to which the Image Segment refers. Valid values are **GEO** for a geographic coordinate system (longitude & latitude), **MAP** for a cartographic (grid) coordinate system (easting & northing) and **DIG** for a geographic or cartographic coordinate system registered through location grids or registration points. See clause D1.2.2 for details. The default value is **MAP**.	3	BCS-A **MAP**, **GEO** or **DIG**	R
UNI	Coordinate Units This field shall contain the units of measure to which the Image Segment refers. Valid values are **SEC** (Decimal seconds of arc), **DEG** (Decimal degrees) and **M** (Metres). The value must be consistent with the coordinate system type. **SEC** and **DEG** are not allowed when the coordinate system type is MAP. **M** is not allowed when the coordinate system type is GEO. The PRJPS extension is expected when the value is **M**. The default value is **M**.	3	BCS-A **SEC**, **DEG** or **M**	R
DAG	Geodetic Datum Name This field shall contain the name of the geodetic datum to which the Image Segment refers. The default value is **World Geodetic System 1984**.	80	BCS-A See Part 3-6	R
DCD	Geodetic Datum Code This field shall contain the code of the geodetic datum to which the Image Segment refers. The default value is **WGE**.	4	BCS-A See Part 3-6	R
ELL	Ellipsoid Name This field shall contain the name of the ellipsoid to which the Image Segment refers. The default value is **World Geodetic System 1984**.	80	BCS-A See Part 3-6	R
ELC	Ellipsoid Code This field shall contain the code of the ellipsoid to which the Image Segment refers. The default value is **WE**.	3	BCS-A See Part 3-6	R
DVR	Vertical Datum Reference This field shall contain the name of the vertical datum reference to which the Image Segment refers, or **BCS Spaces** if no elevation value appears in the Image Segment. The default name is **Geodetic**.	80	BCS-A See Part 3-6	<R>

Table D1-3 GEOPS - Geo Positioning Information Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
VDCDVR	Code (Category) of Vertical Reference This field shall contain the code (or category) of the vertical reference to which the Image Segment refers, or **BCS Spaces** if no elevation value appears in the Image Segment. The default code is **GEOD**.	4	BCS-A See Part 3-6	<R>
SDA	Sounding Datum Name This field shall contain the name of the sounding datum to which the Image Segment refers, or **BCS Spaces** if no sounding appears in the Image Segment. The default value is **Mean Sea**.	80	BCS-A See Part 3-6	<R>
VDCSDA	Code for Sounding Datum This field shall contain the code of the sounding datum to which the Image Segment refers, or **BCS Spaces** if no sounding appears in the Image Segment. The default valid code is **MSL**.	4	BCS-A See Part 3-6	<R>
ZOR	Z values False Origin This field shall contain the elevation and depth false origin for Z values to which the Image Segment refers. The default value is **000000000000000**, which implies that there is no projection false Z origin.	15	BCS-N positive integer	R
GRD	Grid Code This field shall contain the identification code of the grid system to which the Image Segment refers, or **BCS Spaces**. The default value is **BCS Spaces**.	3	BCS-A See Part 3-6	<R>
GRN	Grid Description If the GRD Field value is not BCS Spaces, this field can contain a text description of the grid system. The default value is **BCS Spaces**.	80	BCS-A	<R>
ZNA	Grid Zone number This field shall contain the zone number when the GRD Field contains a significant grid code and the corresponding grid system comprises more than one zone. Defaulted to **0000** otherwise.	4	BCS-N integer See Part 3-6	R

D1.2.7.2 PRJPS - Projection Parameters

The PRJPS extension contains the projection parameters of the absolute coordinate system when it's a cartographic (grid) coordinate system. This extension shall be present when the coordinate units (GEOPS.UNI Field) are Metres (M). The fields of the PRJPS extension are detailed in Table D1-4. PRJPS is necessarily associated with a single GEOPS extension and shall be placed in the same Field or TRE_OVERFLOW DES.

Table D1-4 PRJPS - Projection Parameters Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier The last character identifies the version of the TRE.	6	BCS-A **PRJPSB**	R
CEL	Length of Data to Follow The CEL Field value shall be equal to: 113 + NUM_PRJ ∗15	5	BCS-N positive integer **00113** to **00248**	R
The following fields define PRJPS...				
PRN	Projection Name This field shall contain the name of the projection to which the Image Segment refers. The default value is **Transverse Mercator**.	80	BCS-A See Part 3-6	R
PCO	Projection Code This field shall contain the code of the projection to which the Image Segment refers. The default value is **TC**.	2	BCS-A See Part 3-6	R
NUM_PRJ	Number of Projection Parameters This field shall contain the number of projection parameters. The PRJ Field should be repeated as necessary depending on the projection code (see Part 3-6). If the number of projection parameters provided is lower than specified in Part 3-6, the missing parameters value is **0**.	1	BCS-N positive integer **0** to **9**	R
. . . . Start for each projection parameter				
PRJn	Projection Parameter Each occurrence of this field provides an appropriate parameter to accurately describe the projection. See Part 3-6 to know the kind of parameters needed for each projection code.	15	BCS-N	C
. . . . End for each projection parameter				
XOR	Projection False X (Easting) Origin This field shall contain the projection false X (easting) origin. The default value is **000000000000000**, which implies that there is no projection false X origin.	15	BCS-N positive integer	R
YOR	Projection False Y (Northing) Origin This field shall contain the projection false Y (northing) origin. The default value is **000000000000000**, which implies that there is no projection false Y origin.	15	BCS-N positive integer	R

D1.2.7.3 GRDPS - Grid Reference Data

When the image, matrix, or raster data is not rectified, the geographic location of each pixel may be derived from a given set of location grids computed for a given elevation. The user-defined fields of the GRDPS extension are detailed in Table D1-5. A single GRDPS is placed in the Image Subheader. The coordinates expressed in the location grids refer to the absolute coordinate system defined in GEOPS (and possibly PRJPS).

Table D1-5 GRDPS - Grid Reference Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier The last character identifies the version of the TRE.	6	BCS-A **GRDPSB**	R
CEL	Length of Data to Follow The CEL Field value shall be equal to: 2 + NUM_GRDS * 66	5	BCS-N positive integer **00068** to **06536**	R
The following fields define GRDPS...				
NUM_GRDS	Number of Location Grids This field defines the number of location grids described in the GRDPS extension. Usually, only one or two grids are needed.	2	BCS-N positive integer **01** to **99**	R
. . . . Start for each location grid				
ZVLn	Location Grid Elevation This field shall contain the elevation (Meters) to which the n^{th} location grid has been computed, or **BCS Spaces** if this elevation is not useful (a single grid is provided, for example). The default value is **BCS Spaces**.	10	BCS-N ±zzzzzz.zz or **BCS Spaces**	<R>
BADn	Location Grid ID This field shall contain the identification of the Image Segment (IID1 Field) which contains the n^{th} location grid data.	10	BCS-A	R
LODn	Data density in columns This field shall contain the interval (measured in image pixels) between two consecutive elements of the n^{th} location grid (in columns). Positive (decimal or integer) values are required.	12	BCS-N	R
LADn	Data density in rows This field shall contain the interval (measured in image pixels) between two consecutive elements of the n^{th} location grid (in rows). Positive (decimal or integer) values are required.	12	BCS-N	R
LSOn	Origin in columns This field shall contain the column number of the origin of the n^{th} location grid.	11	BCS-N positive integer	R
PSOn	Origin in rows This field shall contain the row number of the origin of the n^{th} location grid.	11	BCS-N positive integer	R
. . . . End for each location grid				

D1.2.7.4 GEOLO - Local Geographic (lat/long) Coordinate System

For rectified data (rows and columns are aligned with the coordinate system axis) GEOLO provides the description of the link between the local coordinate system (rows and columns) and the absolute geographic coordinate system (longitude and latitude) defined by GEOPS. The user-defined fields of the GEOLO extension are detailed in Table D1-6. A single GEOLO is placed in the Image Subheader.

Table D1-6 GEOLO - Local Geographic (lat/long) Coordinate System Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier The last character identifies the version of the TRE.	6	BCS-A **GEOLOB**	R
CEL	Length of Data to Follow The CEL Field value shall be equal to **00048**	5	BCS-N positive integer **00048**	R
The following fields define GEOLO...				
ARV	Longitude density This field shall contain the pixel ground spacing in E/W direction that is the number of pixels or elements intervals in 360°.	9	BCS-N positive integer **000000002** to **999999999**	R
BRV	Latitude density This field shall contain the pixel ground spacing in N/S direction that is the number of pixels or elements intervals in 360°.	9	BCS-N positive integer **000000002** to **999999999**	R
LSO	Longitude of Reference Origin This field shall contain the longitude of the origin pixel (row number 0, column number 0) in the absolute coordinate system.	15	BCS-N	R
PSO	Latitude of Reference Origin This field shall contain the latitude of the origin pixel (row number 0, column number 0) in the absolute coordinate system.	15	BCS-N	R

D1.2.7.5 MAPLO - Local Cartographic (x/y) Coordinate System

For rectified data (rows and columns are aligned with the coordinate system axis) MAPLO provides the description of the link between the local coordinate system (rows and columns) and the absolute cartographic coordinate system (Easting and Northing) defined by GEOPS and PRJPS. The user-defined fields of the MAPLO extension are detailed in Table D1-7. A single MAPLO is placed in the Image Subheader.

Table D1-7 MAPLO - Local Cartographic (x/y) Coordinate System Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **MAPLOB**	R
CEL	Length of Data to Follow The CEL Field value shall be equal to **00043**.	5	BCS-N positive integer **00043**	R
The following fields define MAPLO ...				
UNILOA	Length units This field shall contain the unit of measure used for easting (LOD) and northing (LAD) intervals. The default value is **M**.	3	BCS-A See Part 3- 7	R
LOD	Easting interval This field shall contain the data density in E-W direction that is the column width of an image pixel.	5	BCS-N positive integer **00001** to **99999**	R

Table D1-7 MAPLO - Local Cartographic (x/y) Coordinate System Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
LAD	Northing interval This field shall contain data interval in N-S direction that is the line width of an image pixel.	5	BCS-N positive integer **00001** to **99999**	R
LSO	Easting of Reference Origin This field shall contain the easting of the origin pixel (row number 0, column number 0) in the absolute coordinate system.	15	BCS-N ±mmmmmmmmmmmm.m	R
PSO	Northing of Reference Origin This field shall contain the northing of the origin pixel (row number 0, column number 0) in the absolute coordinate system.	15	BCS-N ±mmmmmmmmmmmm.m	R

D1.2.7.6 REGPT - Registration Points

Registration points may be provided for image or map data to identify specific pixels in this data and provide spatial locations (geographic or cartographic) for these pixels. With this information, the entire image or map pixel set can be adjusted to improve overall accuracy. The extension is called REGPT and Table D1-8 details the user-defined fields. The coordinates of the registration points refer to the absolute coordinate system defined in GEOPS (and possibly PRJPS).

Table D1-8 REGPT - Registration Points Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **REGPTB**	R
CEL	Length of Data to follow The CEL Field value shall be equal to: 4 + NUM_PTS*77	5	BCS-N positive integer **00081** to **99950**	R
The following fields define REGPT...				
NUM_PTS	Number of Registration Points to Follow.	4	BCS-N positive integer **0001** to **1298**	R
. . . . Start for each registration point				
PIDn	Registration Point ID This field shall contain a unique identifier of the registration point.	10	BCS-A	R
LONn	Longitude/Easting This field shall contain the easting (when the value of GEOPS.UNI is M) or longitude (otherwise) of the registration point in the absolute coordinate system.	15	BCS-N	R
LATn	Latitude/Northing This field shall contain the northing (when the value of GEOPS.UNI is M) or latitude (otherwise) of the registration point in the absolute coordinate system.	15	BCS-N	R

Table D1-8 REGPT - Registration Points Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
ZVLn	Elevation This field can contain the elevation of the registration point in the absolute coordinate system if a vertical reference is defined (see GEOPS.VDCDVR). The default value is **BCS Spaces**.	15	BCS-N	<R>
DIXn	Column Number of Registration Point This field shall contain the column number of the corresponding pixel.	11	BCS-N positive integer **00000000001** to **99999999999**	R
DIYn	Row Number of Registration Point This field shall contain the row number of the corresponding pixel.	11	BCS-N positive integer **00000000001** to **99999999999**	R
. . . .	End for each registration point			

D1.2.7.7 BNDPL - Bounding Polygon

This optional extension is dedicated to provide an accurate location of the significant data contained in the Image Segment. The coordinates of this bounding polygon refer to the absolute coordinate system defined in the GEOPS (and possibly in the PRJPS) extension. The extension is called BNDPL and Table D1-9 details the user-defined fields.

Table D1-9 BNDPL - Bounding Polygon Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **BNDPLB**	R
CEL	Length of Data to follow The CEL Field value shall be equal to: 4 + NUM_PTS ∗ 30	5	BCS-N positive integer **00124** to **99964**	R
The following fields define BNDPL...				
NUM_PTS	Number of points in bounding polygon This field shall contain the number of points (coordinate pairs) constituting the bounding polygon. The first and last points shall be the same. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS).	4	BCS-N positive integer **0004** to **3332**	R
. . . .	Start for each bounding polygon point			
LONn	Longitude/Easting This field shall contain the easting (when the value of GEOPS.UNI is M) or longitude (otherwise) of the n^{th} bounding polygon point.	15	BCS-N	R
LATn	Latitude/Northing This field shall contain the northing (when the value of GEOPS.UNI is M) or latitude (otherwise) of the n^{th} bounding polygon point.	15	BCS-N	R
. . . .	End for each bounding polygon point			

D1.3 Positional Accuracy Extensions

D1.3.1 Positional Accuracy

Positional accuracy is expressed as a circular error for X,Y-value and as linear error for Z-value according to STANAG 2215. Accuracy values are computed as 90% probability (see STANAG 2215 - Edition 4).

There must be 100% areal coverage of the geo-referenced image extent for the total area of the horizontal accuracy regions and 100% areal coverage of the geo-referenced image extent for the sum of the vertical accuracy regions. A specific mechanism is used within the positional accuracy extensions in order to identify where the information is unknown or not applicable.

Where the region or sub-region boundaries are coincident with both horizontal and vertical accuracy regions, then the accuracy regions may be combined in the same accuracy Support Data Extension ACCPO. Where the horizontal and vertical boundaries differ in whole or in part, then either totally distinct horizontal and vertical sub-regions may be defined (ACCHZ, ACCVT), or the two approaches may be mixed (e.g., Figure D1-2).

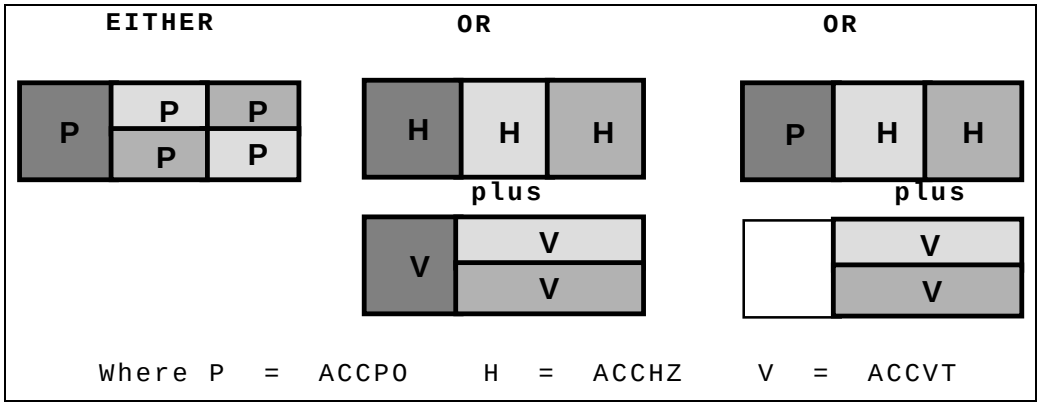

Figure D1-2 Alternatives for Defining Mixed Positional Accuracy Areas

D1.3.2 Detailed Requirements of the Positional Accuracy Extensions

The positional accuracy extensions require the presence of the spatial data extensions because they concern geospatial information. Although positional accuracy is very important for geospatial information, it is admitted that the presence of these extensions is not required. Yet, the presence of the positional accuracy extensions is necessary for compliance with DIGEST.

D1.3.2.1 ACCPO - Positional Accuracy

This extension is dedicated to convey accuracy information where the boundaries of the horizontal and vertical regions are coincident. There may be many positional accuracy regions, possibly associated with vertical and horizontal accuracy regions conveyed respectively by the ACCVT and ACCHZ extensions. When vertical and horizontal accuracies are homogeneous over the whole extent of the Image Segment, the ACCPO extension contains a single positional accuracy region and the ACCVT and ACCHZ are not present. The user-defined fields of the ACCPO extension are detailed in Table D1-10.

Table D1-10 ACCPO - Positional Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **ACCPOB**	R
CEL	Length of Data to Follow (e.g., length of data in tag data field). Note that the value range for NUM_ACPO and NUM_PTSn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00017** to **99985**	R
The following fields define ACCPO...				
NUM_ACPO	Number of positional accuracy regions This field shall contain the number of positional accuracy regions to follow. The maximum number of positional accuracy regions is limited to **99**.	2	BCS-N positive integer **01** to **99**	R
. . . . Start for each region of positional accuracy				
UNIAAHn	Unit of Measure for AAHn. This field shall contain the units for AAHn or **BCS Spaces** if the absolute horizontal accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
AAHn	Absolute Horizontal Accuracy This field is omitted when UNIAAHn contains BCS Spaces. Otherwise, this field shall contain the absolute horizontal accuracy for the n^{th} region of positional accuracy.	5	BCS-N positive integer **00000** to **99999**	C
UNIAAVn	Unit of Measure for AAVn This field shall contain the units for AAVn or **BCS Spaces** if the absolute vertical accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>

Table D1-10 ACCPO - Positional Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
AAVn	Absolute Vertical Accuracy This field is omitted when UNIAAVn contains BCS Spaces. Otherwise, this field shall contain the absolute vertical accuracy for the n^{th} region of positional accuracy.	5	BCS-N **00000** to **99999**	C
UNIAPHn	Unit of Measure for APHn This field shall contain the units for APHn or **BCS Spaces** if the point-to-point horizontal accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
APHn	Point-to-Point Horizontal Accuracy This field is omitted when UNIAPHn contains BCS Spaces. Otherwise, this field shall contain the point-to-point (relative) horizontal accuracy for the n^{th} region of positional accuracy.	5	BCS-N **00000** to **99999**	C
UNIAPVn	Unit of Measure for APVn This field shall contain the units for APVn or **BCS Spaces** if the point-to-point vertical accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
APVn	Point-to-Point Vertical Accuracy This field is omitted when UNIAPVn contains BCS Spaces. Otherwise, this field shall contain the point-to-point (relative) vertical accuracy for the n^{th} region of positional accuracy.	5	BCS-N **00000** to **99999**	C
NUM_PTSn	Number of Points in Bounding Polygon This field defines the number of points (coordinate pairs) that are used to define the bounding polygon of the n^{th} region of positional accuracy. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS). First and last points shall be the same. If the accuracy information applies to the entire Image Segment (the value of NUM_ACPO is 1 and the ACCVT and ACCHZ extensions are not present), then this field does not apply and will contain **000**.	3	BCS-N positive integer **004** to **999** or **000**	R
. . . . Start for each bounding polygon point (coordinate pair)				
LONnm	Longitude/Easting This field shall be omitted when the value of NUM_PTSn is 00. Otherwise, this field shall contain the easting (when the value of GEOPS.UNI is M) or longitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
LATnm	Latitude/Northing This field shall be omitted when the value of NUM_PTSn is 00. Otherwise, this field shall contain the northing (when the value of GEOPS.UNI is M) or latitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
. . . . End for each bounding polygon point (coordinate pair)				

Table D1-10 ACCPO - Positional Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
. . . .	End for each region of positional accuracy			

D1.3.2.2 ACCHZ - Horizontal Accuracy

The user-defined fields of the ACCHZ extension are detailed in Table D1-11.

Table D1-11 ACCHZ - Horizontal Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier The last character identifies the version of the TRE	6	BCS-A **ACCHZB**	R
CEL	Length of Data to Follow Note that the value range for NUM_ACHZ and NUM_PTSn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00011** to **99985**	R
The following fields define ACCHZ...				
NUM_ACHZ	Number of horizontal accuracy regions This field shall contain the number of horizontal accuracy regions to follow. The maximum number of horizontal accuracy regions is limited to **99**.	2	BCS-N positive integer **01** to **99**	R
. . . .	Start for each region of horizontal accuracy			
UNIAAHn	Unit of Measure for AAHn This field shall contain the units for AAHn or **BCS Spaces** if the absolute horizontal accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
AAHn	Absolute Horizontal Accuracy This field is omitted when UNIAAHn contains BCS Spaces. Otherwise, this field shall contain the absolute horizontal accuracy for the n^{th} region of horizontal accuracy.	5	BCS-N positive integer **00000** to **99999**	C
UNIAPHn	Unit of Measure for APHn This field shall contain the units for APHn or **BCS Spaces** if the point-to-point (relative) horizontal accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
APHn	Point-to-Point Horizontal Accuracy This field is omitted when UNIAPHn contains BCS Spaces. Otherwise, this field shall contain the point-to-point (relative) horizontal accuracy for the n^{th} region of horizontal accuracy.	5	BCS-N **00000** to **99999**	C

Table D1-11 ACCHZ - Horizontal Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
NUM_PTSn	Number of Points in Bounding Polygon This field defines the number of points (coordinate pairs) that are used to define the bounding polygon of the n^{th} region of horizontal accuracy. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS). First and last points shall be the same. If the accuracy information applies to the entire Image Segment (the value of NUM_ACHZ is 1 and the ACCPO extension is not present), then this field does not apply and will contain **000**.	3	BCS-N positive integer **004** to **999** or **000**	R
. . . . Start for each bounding polygon point (coordinate pair)				
LONnm	Longitude/Easting This field shall contain the easting (when the value of GEOPS.UNI is M) or longitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
LATnm	Latitude/Northing This field shall contain the northing (when the value of GEOPS.UNI is M) or latitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
. . . . End for each bounding polygon point (coordinate pair)				
. . . . End for each region of horizontal accuracy				

D1.3.2.3 ACCVT - Vertical Accuracy

The user-defined fields of the ACCVT extension are detailed in Table D1-12.

Table D1-12 ACCVT – Vertical Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **ACCVTB**	R
CEL	Length of Data to Follow Note that the value range for NUM_ACVT and NUM_PTSn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00011** to **99985**	R
The following fields define ACCVT...				
NUM_ACVT	Number of vertical accuracy regions This field shall contain the number of vertical accuracy regions to follow. The maximum number of vertical accuracy regions is limited to **99**.	2	BCS-N positive integer **01** to **99**	R
. . . . Start for each region of vertical accuracy				

Table D1-12 ACCVT – Vertical Accuracy Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
UNIAAVn	Unit of Measure for AAVn This field shall contain the units for AAVn or **BCS Spaces** if the absolute vertical accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
AAVn	Absolute Vertical Accuracy This field is omitted when UNIAAVn contains BCS Spaces. Otherwise, this field shall contain the absolute vertical accuracy for the n^{th} region of vertical accuracy.	5	BCS-N **00000** to **99999**	C
UNIAPVn	Unit of Measure for APVn This field shall contain the units for APVn or **BCS Spaces** if the point-to-point (relative) vertical accuracy is unknown or not applicable.	3	BCS-A See Part 3-7	<R>
APVn	Point-to-Point Vertical Accuracy This field is omitted when UNIAPVn contains BCS Spaces. Otherwise, this field shall contain the point-to-point (relative) vertical accuracy for the n^{th} region of vertical accuracy.	5	BCS-N **00000** to **99999**	C
NUM_PTSn	Number of Points in Bounding Polygon This field defines the number of points (coordinate pairs) that are used to define the bounding polygon of the n^{th} region of vertical accuracy. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS). First and last points shall be the same. If the accuracy information applies to the entire Image Segment (the value of NUM_ACVT is 1 and the ACCPO extension is not present), then this field does not apply and will contain **000**.	3	BCS-N positive integer **004** to **999** or **000**	R
. . . .	Start for each bounding polygon point (coordinate pair)			
LONnm	Longitude/Easting This field shall contain the easting (when the value of GEOPS.UNI is M) or longitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
LATnm	Latitude/Northing This field shall contain the northing (when the value of GEOPS.UNI is M) or latitude (otherwise) of the m^{th} point.	15	BCS-N	C (R)
. . . .	End for each bounding polygon point (coordinate pair)			
. . . .	End for each region of vertical accuracy			

D1.4 Source Description Extensions

D1.4.1 Sensor Parameters Data Extension

This clause is intended to describe the sensor parameters data extension (SNSPS), containing the image auxiliary data (relevant to the capture of images by a sensor and its associated platform (aircraft, satellite...). These parameters allow a location model of the sensor(s) to accurately compute the location of any pixel of the image. An image may be composed of many parts, each of them defined by a set of sensor parameters.

The sensor parameters data extension can be used with or without (in this case some information of the extension are not applicable) the spatial data extensions. The presence of the SNSPS extension is necessary for compliance with DIGEST when the Image Segment contains data from a sensor.

D1.4.1.1 Sensor Parameters Data

When sensor parameters do not apply to the whole image, a set of bounding polygons defines the corresponding parts of the image.

The following specifies the parameters defining the attributes of the image, sensor and platform, which are most currently used. These parameters are:

- identification of bands of image at capture stage;
- resolution and pixel spacing (space sampling) at capture stage;
- basic parameters such as identification of sensor and platform, date and time of capture, processing level of image (if any), attitude of sensor.

In addition, a way to include specific parameters for a specific sensor/platform (called additional auxiliary information) is proposed by giving the related information, for each specific parameter: identification, format, unit and value. For some sensors, there may be a large number of specific parameters; in that case, a better solution may be a dedicated sensor data extension.

D1.4.1.2 SNSPS - Sensor Parameters Data Extension

The user-defined fields of the SNSPS data extension are detailed in Table D1-13, together with their descriptions. The attitude data are given relative to the orbital reference of the sensor. The additional auxiliary parameters can be either character strings, integer, or floating point numeric values. The auxiliary parameter value format discriminates between the 3 possible cases. The precision (and units) of the numeric values defines the accuracy required by the location model.

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **SNSPSB**	R
CEL	Length of Data to Follow Note that the value range for NUM_SNS, NUMBPn, NUM_PTSnp, NUM_BNDn and NUM_AUXn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00161** to **99985**	R
The following fields define SNSPS				
NUM_SNS	Number of sets of sensor parameters The image contained in the current Image Segment may be derived from one or many original scenes (source images) from different sensors. Each original scene is described using a set of sensor parameters. This field shall contain the number of sensor parameter sets to follow, that is, the number of original scenes used to produce the image.	2	BCS-N positive integer **01** to **99**	R
. . . . Start for each set of sensor parameters				
1. Bounding Polygons				
NUM_BPn	Number of Bounding Polygons This field shall contain the number of bounding polygons defining the part of the image concerned by the n^{th} original scene. If the set of sensor parameters applies to the entire Image Segment (necessary when the GEOPS extension is not present), then this field contains **00**.	2	BCS-N positive integer **01** to **99** or **00**	R
. . . . Start for each bounding polygon of the n^{th} original scene				
NUM_PTSnp	Number of Points in the p^{th} Bounding Polygon This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the number of points (coordinate pairs) that are used to define the p^{th} bounding polygon of the n^{th} original scene. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS). First and last points shall be the same.	3	BCS-N positive integer **004** to **999**	C (R)

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
. . . .	Start for each point (coordinate pair) of the p^{th} bounding polygon			
LONnpm	Longitude/Easting This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the easting (when the value of GEOPS.UNI is M) or the longitude (otherwise) of the m^{th} point of the p^{th} bounding polygon.	15	BCS-N	C (R)
LATnpm	Latitude/Northing This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the northing (when the value of GEOPS.UNI is M) or the latitude (otherwise) of the m^{th} point of the p^{th} bounding polygon.	15	BCS-N	C (R)
. . . .	End for each point (coordinate pair) of the p^{th} bounding polygon			
. . . .	End for each bounding polygon of the n^{th} original scene			
2. Identification of the bands of the n^{th} original scene at capture stage				
NUM_BNDn	Number of Bands This field shall contain the number of bands of the n^{th} original scene. NOTE: The band description of the original scene may differ from the band description of the transmitted image especially in case of radiometric treatment (e.g., infra-red band changed into red band, RGB image changed into color-coded image, ...). When there is a one-to-one correspondence between the original scene and the image, the band description order in the SNSPS extension shall be consistent with the band description order in the Image Subheader.	2	BCS-N positive integer **01** to **99**	R
. . . .	Start for each band of the n^{th} original scene			
BIDnp	Original Scene Band Identification This field shall contain an identification of the p^{th} band of the n^{th} original scene.	5	BCS-A	R
WS1np	Signal Lower Limit This field shall contain the lower limit (wavelength, amplitude or phase) of the signal for the p^{th} band of the n^{th} original scene. This value can be determined by half maximum value. The unit of measure is nanometres for wavelength.	5	BCS-N positive integer	R
WS2np	Signal Upper Limit This field shall contain the upper limit (wavelength, amplitude or phase) of the signal for the p^{th} band of the n^{th} original scene. This value can be determined by half maximum value. The unit of measure is nanometers for wavelength.	5	BCS-N positive integer	R

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
. . . .	End for each band of the n^{th} original scene			
3. Image resolution at capture stage of the n^{th} original scene				
UNIRESn	Resolutions and ground sample distances units This field shall contain the unit of measure of the REXn, REYn, GSXn and GSYn Fields.	3	BCS-A See Part 3-7	R
REXn	Resolution in columns This field shall contain the resolution in columns of the n^{th} original scene at capture stage.	6	BCS-N	R
REYn	Resolution in rows This field shall contain the resolution in rows of the n^{th} original scene at capture stage.	6	BCS-N	R
GSXn	Ground Sample Distance in columns This field shall contain the ground pixel spacing in columns of the n^{th} original scene at capture stage measured at pixel GSL. The REX and GSX Fields may have different values (e.g., for ERS1 SAR PRI images, REX = 27 m, GSX = 12.5 m), but the default value of the GSX Field is the value of the REX Field (e.g., for SPOT images in PAN mode, REX = GSX = 10 m).	6	BCS-N	R
GSYn	Ground Sample Distance in rows This field shall contain the ground pixel spacing in rows of the n^{th} original scene at capture stage measured at pixel GSL. The REY and GSY Fields may have different values, but the default value of the GSY Field is the value of the REY Field.	6	BCS-N	R
GSLn	Location of pixel for GSXn and GSYn This field can contain an approximate location (e.g., UPPER LEFT, LOWER RIGHT, CENTER, ...) of the n^{th} original scene pixel where the ground sample distances and resolutions have been measured. The default value is **BCS Spaces**.	12	BCS-A	<R>
4. Basic parameters				
PLTFMn	Vector or Mission Name This field shall contain the name of the vector or mission used to produce the n^{th} original scene (e.g., **SPOT3**).	8	BCS-A	R
INSn	Sensor or Instrument Name This field shall contain the name of the sensor or instrument used to produce the n^{th} original scene (e.g., **HRV1**).	8	BCS-A	R
MODn	Spectral Mode This field shall contain the identification of the sensor processing mode used to capture the n^{th} original scene (e.g., **PAN**).	4	BCS-A	R

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
PRLn	Processing Level This field shall contain the identification of the processing level applied to the n^{th} original scene in order to produce the transmitted image (e.g., **1A**).	5	BCS-A	R
SIDn	Source Image ID This field can contain an identification of the n^{th} original scene. The default value is **BCS Spaces**.	10	BCS-A	<R>
ACTn	Acquisition Date & Time This field shall contain the acquisition date and time of the n^{th} original scene. This information is generally computed at scene centre.	18	BCS-A YYYYMMDDhhmmss.fff	R
UNINOAn	Unit of the Scene Orientation Angle This field shall contain the unit of measure of the NOAn Field, or **BCS Spaces** if this information is unknown or not applicable. The default units are decimal degrees (**DEC**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
NOAn	Scene Orientation Angle This field is omitted when UNINOAn contains **BCS Spaces**. Otherwise, this field shall contain the complement of the angle between the lines of the n^{th} original scene and the meridian of the absolute coordinate system. This angle is usually measured at scene centre.	7	BCS-N	C
UNIANGn	Unit of Incidence Angle This field shall contain the unit of measure of the incidence angle of the n^{th} original scene, or **BCS Spaces** if this angle is unknown or not applicable. The default units are decimal degrees (**DEC**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
ANGn	Incidence Angle at Original Scene Centre This field is omitted when UNIANGn contains **BCS Spaces**. Otherwise, this field shall contain the incidence angle of the n^{th} original scene. This information is generally computed at scene centre.	7	BCS-N	C
UNIALTn	Unit of Altitude This field shall contain the unit of altitude of sensor when capturing the n^{th} original scene, or **BCS Spaces** if this altitude is unknown or not applicable. The default units are metres (**M**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
ALTn	Altitude of Sensor This field is omitted when UNIALTn contains **BCS Spaces**. Otherwise, this field shall contain the altitude of sensor when capturing the n^{th} original scene.	9	BCS-N	C

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
LONSCCn	WGS84 Longitude of Original Scene Centre This field shall contain the longitude of the n^{th} original scene centre. The coordinate system is geographic and refers to the WGS84 datum. The units for longitude are seconds of arc (**SEC**).	10	BCS-N ±SSSSSS.SS	R
LATSCCn	WGS84 Latitude of Original Scene Centre This field shall contain the latitude of the n^{th} original scene centre. The coordinate system is geographic and refers to the WGS84 datum. The units for latitude are seconds of arc (**SEC**).	10	BCS-N ±SSSSSS.SS	R
UNISAEn	Unit of Solar Angles This field shall contain the unit of solar angles of the n^{th} original scene, or **BCS Spaces** if these angles are unknown or not applicable. The default units are decimal degrees (**DEC**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
SAZn	Solar Azimuth This field is omitted when UNISAEn contains **BCS Spaces**. Otherwise, this field shall contain the solar azimuth of the n^{th} original scene. This information is generally computed at scene centre.	7	BCS-N	C
SELn	Solar Elevation This field is omitted when UNISAEn contains **BCS Spaces**. Otherwise, this field shall contain the solar elevation of the n^{th} original scene. This information is generally computed at scene centre.	7	BCS-N	C
UNIRPYn	Unit of Attitude Angles This field shall contain the unit of attitude angles of the n^{th} original scene, or **BCS Spaces** if these angles are unknown or not applicable. The default units are decimal degrees (**DEC**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
ROLn	Roll of the Sensor This field is omitted when UNIRPYn contains **BCS Spaces**. Otherwise, this field shall contain the roll of the sensor while capturing the n^{th} original scene. This information is generally computed at scene centre.	7	BCS-N	C
PITn	Pitch of the Sensor This field is omitted when UNIRPYn contains **BCS Spaces**. Otherwise, this field shall contain the pitch of the sensor while capturing the n^{th} original scene. This information is generally computed at scene centre.	7	BCS-N	C

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
YAWn	Yaw of the Sensor This field is omitted when UNIRPYn contains **BCS Spaces**. Otherwise, this field shall contain the yaw of the sensor while capturing the nth original scene. This information is generally computed at scene centre.	7	BCS-N	C
UNIPXTn	Unit of Pixel Time This field shall contain the unit of the PXTn Field, or **BCS Spaces** if the pixel time is unknown or not applicable. The default units are seconds (**S**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
PXTn	Pixel Time This field is omitted when UNIPXTn contains **BCS Spaces**. Otherwise, this field shall contain the start time of acquisition of the nth original scene.	14	BCS-N	C
UNISPEn	Unit of Attitude Speed This field shall contain the unit of attitude speeds of the nth original scene, or **BCS Spaces** if these speeds are unknown or not applicable. The default units are seconds of arc per second (**SEC/S**). Angle units and time units are separated by a BCS Solidus (0x2F). The default value is **BCS Spaces**.	7	BCS-A See Part 3-7	<R>
ROSn	Roll Speed This field is omitted when UNISPEn contains **BCS Spaces**. Otherwise, this field shall contain the rotation speed around the roll axis of the sensor while capturing the nth original scene. This information is generally computed at scene centre.	22	BCS-N	C
PISn	Pitch Speed This field is omitted when UNISPEn contains **BCS Spaces**. Otherwise, this field shall contain the rotation speed around the pitch axis of the sensor while capturing the nth original scene. This information is generally computed at scene centre.	22	BCS-N	C
YASn	Yaw Speed This field is omitted when UNISPEn contains **BCS Spaces**. Otherwise, this field shall contain the rotation speed around the yaw axis of the sensor while capturing the nth original scene. This information is generally computed at scene centre.	22	BCS-N	C

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
5. Auxiliary parameters				
NUM_AUXn	Number of Auxiliary Parameters This field shall contain the number of auxiliary (additional) parameters of the n^{th} original scene. The definition of an additional parameter is necessarily given by the APIn, APFn, UNIAPXn Fields and by one of the APNn, APRn and APAn Fields, depending of the format specified by the parameter value of the APFn Field. The default value is **000**.	3	BCS-N positive integer **000** to **999**	R
. . . .	Start for each additional auxiliary parameter of the n^{th} original scene			
APInp	Auxiliary Parameter ID This field is required when the value of NUM_AUXn is greater than 00, and shall be omitted otherwise. This field shall contain an identification of the p^{th} auxiliary parameter of the n^{th} original scene. The first character of this field can't be a BCS Space as a significant ID is expected.	20	BCS-A	C (R)
APFnp	Auxiliary Parameter Value Format This field is required when the value of NUM_AUXn is greater than 00, and shall be omitted otherwise. This field shall specify the format of the auxiliary parameter value. The APNnp, APRnp and APAnp Fields are required when the APFnp value is respectively **I**, **R** and **A**.	1	BCS-A **I**, **R** or **A**	C (R)
UNIAPXnp	Unit of Auxiliary Parameter This field is required when the value of NUM_AUXn is greater than 00, and shall be omitted otherwise. This field shall specify the unit of the p^{th} auxiliary parameter, or **BCS Spaces** if not applicable (e.g., the auxiliary parameter is not numerical). When a compound unit is formed by multiplication or division of two units, they are separated by a full stop (0x2E) or respectively a solidus (0x2F). The default value is **BCS Spaces**.	7	BCS-A See Part 3-7	C (<R>)
APNnp	Auxiliary Parameter Integer Value This field appears if and only if NUM_AUXn value is greater than 00 and the APF value is I. In this case, this field contains an integer value corresponding to the p^{th} auxiliary parameter.	10	BCS-N	C
APRnp	Auxiliary Parameter Real Value This field appears if and only if NUM_AUXn value is greater than 00 and the APF value is R. In this case, this field contains a real value corresponding to the p^{th} auxiliary parameter.	20	BCS-N	C

Table D1-13 SNSPS - Sensor Parameters Data Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
APAnp	Auxiliary Parameter Characters String Value This field appears if and only if NUM_AUXn value is greater than 00 and the APF value is A. In this case, this field contains a string value corresponding to the p^{th} auxiliary parameter.	20	ECS-A	C
. . . . End for each additional auxiliary parameter of the n^{th} original scene				
. . . . End for each set of sensor parameters				

D1.4.2 Map Source Data Extension

The map source data extension (SOURC) provides extensive information about the source graphics (one or more). Since these sources are maps or charts, a cartographic (MAP) coordinate system applies and must include ellipsoid, datum, and projection data. In addition, if elevation or depth information is present on the source map, the vertical or sounding datum must be supplied.

The map source data extension can be used with or without (in this case some information of the extension are not applicable) the spatial data extensions. The presence of the SOURC extensions is necessary for compliance with DIGEST when the Image Segment contains data from a paper map.

D1.4.2.1 Map Source Data

The source graphic may include several map insets and usually includes legend data that is important to capture as raster files. Insets have a specific coordinate system defined, which may be different for each one and different to the one used for the main source graphic. The mechanism is the same as for relative coordinate systems with the four corners of the inset interpreted as registration points. Relative coordinates give the location of the outside of the corners (as computed from the row and column number of each corner). Absolute coordinates will give the location of the inside of the corners. Both locations will be described in the same coordinate system as defined in the GEOPS (and possibly PRJPS) extension(s). The only coordinate conversion allowed is change of scale and offset.

In northern latitudes, certain maps may include a grid overlay for convenience of navigation where longitude arcs are rapidly converging. The overlays normally include Grid North-Magnetic North Angle (GMA) and a Grid Convergence Angle (GCA). Note: When the primary grid displayed on the map is not strictly registered to the map projection, it is best to use the projection to which the primary grid is registered to the map projection. This allows the application to use the parameters of the source file for transforming the coordinates from the coordinate system of the Image Segment to the coordinate system displayed on the grid.

D1.4.2.2 SOURC - Map Source Description

The user-defined fields of the SOURC extension are detailed in Table D1-14.

Table D1-14 SOURC - Map Source Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **SOURCB**	R
CEL	Length of Data to Follow Note that the value range for NUM_SOUR, NUMBPn, NUM_PTSnp, NMIn, NLIn, NUM_PRJn and NINn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00906** to **99985**	R

The following fields define SOURC...

IS_SCA	Image Segment Reciprocal Scale This field shall contain the reciprocal scale of the Image Segment (e.g., 50000 for 1:50000). This is usually the scale of the source material.	9	BCS-N positive integer	R
CPATCH	Colour Patch Id This field shall contain the identification of the Image Segment (IID1 Field), which contains the colour patch, or **BCS Spaces** if the current Image Segment is not associated with any colour patch. The default value is **BCS Spaces**.	10	BCS-A	<R>
NUM_SOUR	Number of Source Descriptions The image contained in the current Image Segment may be derived from one or many original sources (i.e. paper maps). This field shall contain the number of source descriptions to follow, that is the number of original sources used to produce the image.	2	BCS-N positive integer **01** to **99**	R
. . . .	Start for each source description			
	1. Bounding Polygons			
NUM_BPn	Number of Bounding Polygons This field shall contain the number of bounding polygons defining the part of the image concerned by the n^{th} source description. If the source description applies to the entire Image Segment (necessary when the GEOPS extension is not present), then this field contains **00**.	2	BCS-N positive integer **01** to **99** or **00**	R

. . . .	Start for each bounding polygon of the n^{th} original scene			
NUM_PTSnp	Number of Points in the p^{th} Bounding Polygon This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the number of points (coordinate pairs) that are used to define the p^{th} bounding polygon of the n^{th} source description. Coordinate values shall refer to the coordinate system and units defined in GEOPS (and possibly in PRJPS). First and last points shall be the same.	3	BCS-N positive integer **004** to **999**	C (R)
. . . .	Start for each point (coordinate pair) of the p^{th} bounding polygon			
LONnpm	Longitude/Easting This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the easting (when the value of GEOPS.UNI is M) or the longitude (otherwise) of the m^{th} point of the p^{th} bounding polygon.	15	BCS-N	C (R)
LATnpm	Latitude/Northing This field is required when the value of NUM_BPn is greater than 00, and shall be omitted otherwise. When present, this field shall contain the northing (when the value of GEOPS.UNI is M) or the latitude (otherwise) of the m^{th} point of the p^{th} bounding polygon.	15	BCS-N	C (R)
. . . .	End for each point (coordinate pair) of the p^{th} bounding polygon			
. . . .	End for each bounding polygon of the n^{th} source description			

2. General description				
PRTn	Series This field shall contain the series designator (e.g., 1501G) of the n^{th} original source. The default value is **BCS Spaces**, but a significant value is highly recommended.	10	BCS-A	<R>
URFn	Source Identification This field shall contain a source identification, that is a number or name which, when used with series and edition, will uniquely identify the n^{th} original source.	20	BCS-A	R
EDNn	Edition This field shall contain the edition number of the n^{th} original source.	7	BCS-A	R
NAMn	Name This field shall contain the full name of the n^{th} original source document. The default value is **BCS Spaces**, but a significant value is highly recommended.	20	BCS-A	<R>

CDPn	Type of Significant Date A significant date is a designated date that most accurately describes basic date of the product for computation of the probable obsolescence date. It can be compilation date, revision date, or other depending on the product and circumstances. This field shall contain the type of the n^{th} original source significant date. The default value is **029**, which means "significant date".	3	BCS-N positive integer See Part 4 - Annex B	R
CDVn	Significant Date This field shall contain a significant date of the n^{th} original source. The type of the date is specified by the CDPn Field.	8	BCS-A YYYYMMDD	R
CDV27n	Perishable Date This field shall contain the perishable information date code of the n^{th} original source. The default value is **BCS Spaces**, but a significant value is highly recommended.	8	BCS-A YYYYMMDD	<R>
SRNn	Source Reference Number This field can contain a reference number of the n^{th} original source. The default value is **BCS Spaces**.	80	BCS-A	<R>
SCAn	Reciprocal Scale This field shall contain the reciprocal of cartographic scale (e.g., 50000 for 1/50000 scale). The default value is **BCS Spaces**, but a significant value is expected when defined on the source material.	9	BCS-N positive integer	<R>
UNISQUn	Unit of Measure for Coverage This field shall contain the unit of measure of the n^{th} original source coverage, or **BCS Spaces** when this information is unknown or not applicable. The default units are square kilometres (**KM2**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
SQUn	Coverage This field is omitted when UNISQUn contains BCS Spaces. Otherwise, this field shall contain the coverage of the n^{th} original source, that is a number, with unit above, specifying how many square units of area coverage (e.g., 43000 in the case of 43,000 km^2).	10	BCS-N positive integer	C
UNIPCIn	Unit of Measure for Contour Interval This field shall contain the unit of measure of the n^{th} original source contour interval, or **BCS Spaces** when this information is unknown or not applicable. The default units are metres (**M**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>

PCIn	Contour Interval This field is omitted when UNIPCIn contains BCS Spaces. Otherwise, this field shall contain the predominant contour interval of the nth original source.	4	BCS-N positive integer	C
WPCn	Water Coverage This field shall contain the percentage of the nth original source covered by water, or **999** if this information is unknown. The default value is **999**.	3	BCS-N positive integer **0** to **100** or 999	R
NSTn	Navigation System Type This field shall contain the navigation system type (e.g., the value 007 corresponds to LORAN, that is Long Range Air Navigation System) concerning the nth original source, or **000** if this information is unknown. The default value is **000**.	3	BCS-N positive integer See Part 4 - Annex B	R
UNIHKEn	Units of HKE This field shall contain the unit of measure of the highest known elevation on the nth original source, or **BCS Spaces** when this information is unknown or not applicable. The default units are metres (**M**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	<R>
HKEn	Highest Elevation This field is omitted when UNIHKEn contains BCS Spaces. Otherwise, this field shall contain the highest known elevation on the nth original source.	6	BCS-N	C
LONHKEn	Longitude/Easting of HKE This field is omitted when UNIHKEn contains BCS Spaces. Otherwise, this field shall contain the easting (when the value of GEOPS.UNI is M) or the longitude (otherwise) of the highest known elevation on the nth original source. This value shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C
LATHKEn	Latitude/Northing of HKE This field is omitted when UNIHKEn contains BCS Spaces. Otherwise, this field shall contain the northing (when the value of GEOS.UNI is M) or the latitude (otherwise) of the highest known elevation on the nth original source. This value shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C

QSSn	Security Classification of Source This field shall contain the security classification of the nth original source. Valid values are **T** (TOP SECRET), **S** (SECRET), **C** (CONFIDENTIAL), **R** (RESTRICTED or alternatively FOR OFFICIAL USE ONLY), and **U** (UNCLASSIFIED). The default value is **U**.	1	BCS-A **T**, **S**, **C**, **R** or **U**	R
QODn	Downgrading This field shall specify if the nth original source originator's permission is required for Downgrading. Valid values are Y (required) or N (not required). The default value is **N**.	1	BCS-A **Y** or **N**	R
CDV10n	Downgrading Date This field is omitted when the value of QSSn is **U** or when the value of QODn is **Y**. When present, this field shall contain the date of downgrading of the nth original source.	8	BCS-A YYYYMMDD	C
QLEn	Releasibility This field shall contain the releasibility restrictions for the nth original source. The default value is **UNRESTRICTED** and indicates that no release restriction exists.	80	BCS-A	R
CPYn	Copyright Statement This field shall contain the copyright statement for the nth original source. The default value is **UNCOPYRIGHTED**.	80	BCS-A	R

3. Magnetic information				
NMIn	Number of Magnetic Information This field shall contain the number of sets of magnetic information derived from the nth original source.	2	BCS-N **00** to **99**	R
. . . .	Start for each set of magnetic information			
CDV30np	Date of Magnetic Information This field is required when the value of NMIn is greater than 00. When present, this field shall contain the date of the pth set of magnetic information derived from the nth original source.	8	BCS-A YYYYMMDD	C (R)
UNIRATnp	Units for Annual Rate of Change This field is required when the value of NMIn is greater than 00. When present, this field shall contain the unit of measure of the annual angular magnetic rate of change related to the pth set of magnetic information. The default value is **DEG** (Decimal Degrees).	3	BCS-A See Part 3-7	C (R)

RATnp	Annual Rate of Change This field is required when the value of NMIn is greater than 00. When present, this field shall contain the annual angular magnetic rate of change related to the p^{th} set of magnetic information.	8	BCS-N	C (R)
UNIGMAnp	Units of GMAnp This field is required when the value of NMIn is greater than 00. When present, this field shall contain the unit of the GMAnp Field. The default value is **DEG** (Decimal Degrees).	3	BCS-A See Part 3-7	C (R)
GMAnp	G-M Angle This field is required when the value of NMIn is greater than 00. When present, this field shall contain the grid magnetic angle (GMA): grid north to magnetic north (clockwise regarded as positive).	8	BCS-N	C (R)
LONGMAnp	Longitude/Easting of GMAnp Reference Point This field is required when the value of NMIn is greater than 00. When present, this field shall contain the easting (when the value of GEOPS.UNI is M) or the longitude (otherwise) of the GMAnp reference point, or BCS Spaces if this information is unknown. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS). The default value is **BCS Spaces**.	15	BCS-N	C (<R>)
LATGMAnp	Latitude/Northing of GMA Reference Point This field is required when the value of NMIn is greater than 00. When present, this field shall contain the northing (when the value of GEOPS.UNI is M) or the latitude (otherwise) of the GMAnp reference point, or BCS Spaces if this information is unknown. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS). The default value is **BCS Spaces**.	15	BCS-N	C (<R>)
UNIGCAnp	Units of GCAnp This field is required when the value of NMIn is greater than 00. When present, this field shall contain the units of the grid convergence angle (GCAnp), or BCS Spaces if this information is unknown. The default units are Decimal Degrees (**DEG**). The default value is **BCS Spaces**.	3	BCS-A See Part 3-7	C (<R>)
GCAnp	Grid Convergence Angle This field is omitted when the value of NMIn is 00 and when the value of UNIGCAnp is BCS Spaces. When present, this field shall contain the grid convergence angle related to the p^{th} set of magnetic information.	8	BCS-N	C

. . . .	End for each set of magnetic information			
4. Legends				
NLIn	Number of Legend Images This field shall contain the number of legend images derived from the n^{th} original source.	2	BCS-N positive integer **00** to **99**	R
. . . .	Start for each legend image derived from the n^{th} original source			
BADnp	Legend ID This field is required when the value of NLIn is greater than 00. When present, this field shall contain the identification of the Image Segment (IID1 Field), which contains the p^{th} legend associated with the n^{th} original source.	10	BCS-A	C
. . . .	End for each legend image derived from the n^{th} original source			
5. Coordinate system				
DAGn	Geodetic Datum Name This field shall contain the name of the geodetic datum to which the n^{th} original source refers. The default value is **World Geodetic System 1984**.	80	BCS-A See Part 3-6	R
DCDn	Geodetic Datum Code This field shall contain the code of the geodetic datum to which the n^{th} original source refers. The default value is **WGE**.	4	BCS-A See Part 3-6	R
ELLn	Ellipsoid Name. This field shall contain the name of the ellipsoid to which the n^{th} original source refers. The default value is **World Geodetic System 1984**.	80	BCS-A See Part 3-6	R
ELCn	Ellipsoid Code This field shall contain the code of the ellipsoid to which the n^{th} original source refers. The default value is **WE**.	3	BCS-A See Part 3-6	R
DVRn	Vertical Datum Reference. This field shall contain the name of the vertical datum reference to which the n^{th} original source refers, or **BCS Spaces** if no elevation appears in the n^{th} original source. The default name is **Geodetic**.	80	BCS-A See Part 3-6	<R>
VDCDVRn	Code (Category) of Vertical Reference This field shall contain the code (or category) of the vertical reference to which the n^{th} original source refers, or **BCS Spaces** if no elevation value appears in the n^{th} original source. The default code is **GEOD**.	4	BCS-A See Part 3-6	<R>
SDAn	Sounding Datum Name This field shall contain the name of the sounding datum to which the n^{th} original source refers, or **BCS Spaces** if no sounding appears in the n^{th} original source. The default value is **Mean Sea**.	80	BCS-A See Part 3-6	<R>

VDCSDAn	Code for Sounding Datum This field shall contain the code of the sounding datum to which the nth original source refers, or **BCS Spaces** if no sounding appears in the nth original source. The default valid code is **MSL**.	4	BCS-A See Part 3-6	<R>
PRNn	Projection Name This field shall contain the name of the projection to which the nth original source refers. The default value is **Transverse Mercator**.	80	BCS-A See Part 3-6	R
PCOn	Projection Code This field shall contain the code of the projection to which the nth original source refers. The default value is **TC**.	2	BCS-A See Part 3-6	R
NUM_PRJn	Number of Projection Parameters This field shall contain the number of projection parameters. The PRJ Field should be repeated as necessary depending on the projection code (see Part 3-6). If the number of projection parameters provided is lower than specified in Part 3-6, the missing parameters value is **0**.	1	BCS-N positive integer **0** to **9**	R
. . . .	Start for each projection parameter			
PRJnp	Projection Parameter Each occurrence of this field provides an appropriate parameter to accurately describe the projection. See Part 3-6 to know the kind of parameters needed for each projection code.	15	BCS-N	C
. . . .	End for each projection parameter			
XORn	Projection False X (Easting) Origin This field shall contain the projection false X (easting) origin. The default value is **000000000000000**, which implies that there is no projection false X origin.	15	BCS-N positive integer	R
YORn	Projection False Y (Northing) Origin This field shall contain the projection false Y (northing) origin. The default value is **000000000000000**, which implies that there is no projection false Y origin.	15	BCS-N positive integer	R

GRDn	Grid Code This field shall contain the identification code of the grid system to which the n^{th} original source refers, or **BCS Spaces**. The default value is **BCS Spaces**.	3	BCS-A See Part 3-6	<R>
GRNn	Grid Description If the GRD Field value is not BCS Spaces, this field can contain a text description of the grid system. The default value is **BCS Spaces**.	80	BCS-A See Part 3-6	<R>
ZNAn	Grid Zone number This field shall contain the zone number when the GRD Field contains a significant grid code and the corresponding grid system comprises more than one zone. Defaulted to **0000** otherwise.	4	BCS-N integer See Part 3-6	R
6. Insets				
NINn	Number of Insets This field shall contain the number of insets derived from the n^{th} original source.	2	BCS-N positive integer **00** to **99**	R
. . . .	Start for each inset derived from the n^{th} original source			
INTnp	Inset Identification This field is required when the value of NINn is greater than 00. When present, this field shall contain the identification of the Image Segment (IID1 Field), which contains the p^{th} inset associated with the n^{th} original source.	10	BCS-A	C (R)
INS_SCAnp	Reciprocal Scale of inset This field is required when the value of NINn is greater than 00. When present, this field shall contain the reciprocal scale (e.g., 50000 for 1:50000) of the p^{th} inset associated with the n^{th} original source.	9	BCS-N positive integer	C (R)
NTLnp	Absolute longitude of lower left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute easting (when the value of GEOPS.UNI is M) or the absolute longitude (otherwise) of lower left corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TTLnp	Absolute latitude of lower left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute northing (when the value of GEOS.UNI is M) or the absolute latitude (otherwise) of lower left corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)

NVLnp	Absolute longitude of upper left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute easting (when the value of GEOPS.UNI is M) or the absolute longitude (otherwise) of upper left corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TVLnp	Absolute latitude of upper left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute northing (when the value of GEOPS.UNI is M) or the absolute latitude (otherwise) of upper left corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
NTRnp	Absolute longitude of upper right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute easting (when the value of GEOPS.UNI is M) or the absolute longitude (otherwise) of upper right corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TTRnp	Absolute latitude of upper right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute northing (when the value of GEOPS.UNI is M) or the absolute latitude (otherwise) of upper right corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
NVRnp	Absolute longitude of lower right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute easting (when the value of GEOPS.UNI is M) or the absolute longitude (otherwise) of lower right corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TVRnp	Absolute latitude of lower right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the absolute northing (when the value of GEOPS.UNI is M) or the absolute latitude (otherwise) of lower right corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)

NRLnp	Relative longitude of lower left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative easting (when the value of GEOPS.UNI is M) or the relative longitude (otherwise) of lower left corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TRLnp	Relative latitude of lower left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative northing (when the value of GEOPS.UNI is M) or the relative latitude (otherwise) of lower left corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
NSLnp	Relative longitude of upper left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative easting (when the value of GEOPS.UNI is M) or the relative longitude (otherwise) of upper left corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TSLnp	Relative latitude of upper left corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative northing (when the value of GEOPS.UNI is M) or the relative latitude (otherwise) of upper left corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
NRRnp	Relative longitude of upper right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative easting (when the value of GEOPS.UNI is M) or the relative longitude (otherwise) of upper right corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TRRnp	Relative latitude of upper right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative northing (when the value of GEOPS.UNI is M) or the relative latitude (otherwise) of upper right corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)

NSRnp	Relative longitude of lower right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative easting (when the value of GEOPS.UNI is M) or the relative longitude (otherwise) of lower right corner of inset. The longitude/easting shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
TSRnp	Relative latitude of lower right corner This field is required when the value of NINn is greater than 00. When present, this field shall contain the relative northing (when the value of GEOPS.UNI is M) or the relative latitude (otherwise) of lower right corner of inset. The latitude/northing shall refer to the coordinate system and units defined in GEOPS (and possibly PRJPS).	15	BCS-N	C (R)
. . . . End for each inset derived from the n^{th} original source				
. . . . End for each source description				

D1.5 Other Extensions

D1.5.1 Attribute FACC Code Extension

D1.5.1.1 Introduction

This clause is intended to describe the FACC attribute and value codes extension (FACCB), containing the description of the attribute and value codes from the DIGEST FACC (DIGEST Part 4 – Annex B) used in an Image Segment.

Attributes are used to describe characteristics of a feature or a matrix band. Each attribute is described within DIGEST by using attribute codes to represent the category of information. Attribute value format statements provide a computer interpretation for the attribute value data type (e.g., real, alphanumeric) and attribute values give quantitative/qualitative meaning to the attribute code.

This extension is primarily dedicated to provide the description of the FACC Attributes defining the content of a matrix. The FACCB extension can be associated with any Image Segment using attribute codes from the DIGEST FACC (See DIGEST Part 4 – Annex B), but is dedicated to convey the definition of the FACC codes appearing in the ISUBCATn Fields of an Image Segment containing a matrix (the value of the ICAT Field is equal to MATR in this case).

The FACCB provides also a mechanism allowing the use of codes that are not already in the DIGEST FACC, but which have been proposed to the DGIWG for registration. Note that the use of unregistered codes shall be assumed by the producer of the File.

D1.5.1.2 Coding of Attributes and Values

Each attribute is identified by a unique three character alphanumeric code (label). There are two types of attribute values: coded and actual. A given attribute has only one type of value, which is specified in DIGEST Part 4 - Annex B. Coded values may range from 0 to 999. Real values are typically measurements like height, width, etc. while coded values have meaning given in a look-up table. The units of measurement associated with an attribute are abbreviated according to the units of measurement codes as detailed in DIGEST Part 3 Clause 7.

For consistency and unless otherwise stated, the following coded values will be used where relevant:

0 is "Unknown"
997 is "Unpopulated"
998 is "Not Applicable"
999 is "Other"

The codes values from 989 to 996 are reserved and should not be used for future development.

Specific information for actual value attributes is contained in Annex B. Full documentation of attribute and value coding can be found in DIGEST Part 4 – 5.

D1.5.1.3 FACCB - FACC Attribute and Value Codes Extension

The fields of the FACCB extension are detailed in Table D1-15, together with their descriptions. The presence of the FACCB extension is required for compliance with DIGEST when the Image Segment contains a matrix. In this case, all the codes appearing in the ISUBCATn Field of the Image Segment shall be defined in the FACCB extension, as well as all the nominal codes appearing in the matrix when the attribute values are coded.

Table D1-15 FACCB - FACC Attribute and Value Codes Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
CETAG	Unique Extension Identifier. The last character identifies the version of the TRE	6	BCS-A **FACCBB**	R
CEL	Length of Data to Follow Note that the value range for NUM_ATT and NUM_VALn fields may be limited to less than their maximum value due to the limited length of a TRE (i.e. CEL limited to 99985).	5	BCS-N positive integer **00180 to 99985**	R
The following fields define FACCB				
NUM_ATT	Number of Attributes This field shall contain the number of FACC attributes to follow.	2	BCS-N positive integer **01** to **99**	R

Table D1-15 FACCB - FACC Attribute and Value Codes Extension

FIELD	NAME	SIZE	VALUE RANGE	TYPE
. . . . Start for each attribute				
CODEn	Code of the nth Attribute This Field shall contain an attribute code used in the Image Segment. If the value of the STATUSn Field is FACC, this attribute code is intended to come from the DIGEST FACC (See DIGEST Part 4 – Annex B). Else, this attribute code should have been proposed to the DGIWG for registration. Use of unregistered codes is under the responsibility of the file producer.	3	BCS-A See Part 4 – Annex B	R
NAMEn	Name of the nth Attribute This Field shall contain the name of the attribute code contained in the CODEn Field.	80	BCS-A See Part 4 – Annex B	R
STATUSn	Status of the nth Attribute This field shall contain a valid indicator of the status of the nth attribute. The default value is **FACC** indicating that the value of the CODEn Field is defined in the DIGEST FACC (See DIGEST Part 4 – Annex B). All other values are allowed and indicate that the value of the CODEn Field has been proposed to the DGIWG for registration.	4	BCS-A (default is **FACC**)	<R>
UNITSn	Units of the nth attribute This field defines the units of measure of the values of the nth attribute when necessary. The default value is **BCS Spaces**.	4	BCS-A See Part 3 - 7 (default is **BCS Spaces (0x20)**)	<R>
NUM_VALn	Number of values or nominal codes This field defines the number of specified values or nominal codes of the nth attribute to follow.	3	BCS-N positive integer **001** to **999**	R
. . . . Start for each attribute value or nominal code of the nth attribute				
LENnp	Length pth Value or Nominal code This Field defines the length of the VALnp Field.	3	BCS-N positive integer	R
VALnp	pth Value or Nominal code This Field shall contain the pth specific actual value or nominal code of the nth attribute.	As specified by LENnp	User-defined See Part 4 – Annex B	R
DESCnp	Description of the pth Value or Nominal Code This Field shall contain the description of the pth value or nominal code.	80	BCS-A See Part 4 – Annex B	R
. . . . End for each attribute value / nominal code of the nth attribute				
. . . . End for each attribute				

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