CMETA – Complex SAR Imagery Data Extension

1.0 INTRODUCTION

As Synthetic Aperture Radar (SAR) complex imagery becomes increasingly available to intelligence activities, separate organizations, each serving its own community, independently advance their ability to sense, process, disseminate, and exploit complex SAR data. Typically, complex data from one class of sources can only supply one class of users. Although sophisticated processing and exploitation algorithms exist for end-to-end transmission, these sources can not exchange information from the sensor to multiple classes of users, or from user to user, because a standard format does not exist.

An increasing number of MASINT algorithms require Complex SAR Data (Complex Image – CI) Data and SAR Video Phase History (VPH)) as input. There is a growing need for a common data file to support interoperability capabilities between users, since a variety of platforms and processors generate this data.

The Complex SAR Data Format Standard Initiative (CDFI) effort developed the CMETA Tagged Record Extension (TRE) to satisfy this interoperable need. Used in conjunction with the NSIF file format, CMETA provides the structure for complex SAR data metadata while NSIF provides the data formatting structure.

1.1 PURPOSE OF THIS SECTION

This section establishes the specification of the CMETA TRE which has been developed to provide a foundation for interoperability in the interchange of Synthetic Aperture Radar (SAR) imagery and SAR imagery related data among applications. The CMETA preamble provides a detailed description of the background and structure of the format, as well as specification of the valid data and format for all fields defined with CMETA. CMETA conforms to the architectural and data object specifications of the NATO Secondary Imagery Format Version 1.0 (NSIF 1.0). NSIF is a profile of the International Standard ISO/IEC 12087-5, the Basic Image Interchange Format (BIIF). Compliance with this specification will support consistent community implementation of CMETA.

1.2 BACKGROUND

Under the Complex SAR Data Format Standard Initiative (CDFI), established in the Fall of 1997, a team of engineers was tasked to select an existing or create a new file format appropriate for housing VPH, and pre- and post-autofocus CI data. CDFI activities began by characterizing the present sources of complex SAR data. This task was broken down into three areas: 1) determining the SAR processing chains for a variety of space/airborne commercial and government SAR platforms including: Global Hawk, ASARS 2 Legacy, AIP, RADARSAT; 2) identifying the complex data port of each processing chain; and 3) ascertaining the file format of each SAR data port. Next, CDFI examined the SAR exploitation algorithms, specifically MASINT algorithms, noting their metadata requirements and comparing them to the formats now used in SAR sources.

Once the various SAR platforms, file formats and exploitation algorithms metadata requirements had been identified, the CDFI program proceeded to identify a flexible file format that was inclusive of present formats and requirements. Nine candidate file formats were reviewed and compared against an ideal format. At the conclusion of the process, the NSIF file format was identified as being best suited for SAR complex data.

Finally, with the file format identified, CDFI developed potential migration strategies for each SAR system. This included identifying obstacles which might hinder a SAR system ability to comply with the standard, and proposing methods to overcome these obstacles.

Running concurrent to the CDFI TRE development activities was the CMPLX TRE. Designed to support the down link activities of the ASARS Improvement Program (AIP), CMPLX specifically addressed the metadata needs of the ASARS platform. As both the CMPLX and CMETA tags matured, the US NITF Technical Board (NTB) requested that the two tags merge to better support community interoperability requirements. As part of this task, the AIP contractor and CDFI personal organized joint editing sessions. One of the tools used during these sessions was a field-by-field rating system of the CMETA TRE to indicate the level of difficulty the AIP contractor expected to encounter during CMETA implementation.

2.0 CMETA STRUCTURE

The CMETA TRE data structure is divided into the following 2 sections.

Section 1 - General SAR information. (indices 100 - 700)

This section contains general descriptive information about the SAR complex data contained in the NSIF file structure: e.g. collection mode, center frequency, processor version number. It also contains two fields (RELATED_TRES and ADDITIONAL_TRES) which indicates if the NSIF file contains additional TREs related to SAR processing. The TREs listed in these fields are done so with the approval of the NSIF Custodian. For more information on these TREs see the NSIF Tag Registry.

Section 2 - Complex Image Data. (indices 800 - 19300)

This section contains the CMPLXA TRE and additional complex data metadata.

3.0 TERMS, DEFINITIONS, AND ABBREVIATIONS

3.1 DEFINITIONS

For the purposes of the CMETA TRE, the following definitions apply.

2D-FFT. Two dimensional Fast Fourier Transform. Transforms spatial domain data into the frequency domain using the discrete Fourier transform as defined below:

$$F(u,v) = \Im(f(m,n)) = \left(\frac{1}{MN}\right)\sum_{n=0}^{N-1}\sum_{m=0}^{M-1} f(m,n)e^{-j2p\left[\frac{u \bullet m \bullet \mathrm{IF\_AFFTS}}{M} + \frac{v \bullet n \bullet \mathrm{IF\_RFFTS}}{N}\right]}$$

where CMETA fields IF_AFFTS and IF_RFFTS are equal to one another and have a value of ±1.

Antenna Aim Point. The Antenna Aim point is the location on the ground of the center of the antenna beam pattern at the sensor reference point. The values are given in degrees and/or meters depending on the choice of the nominal geometry reference.

Band. One of the two-dimensional (row/column) arrays of pixel sample values that comprise an image. For the basic use of NSIF, the band values are homogeneous data types for each band. In the case of monochrome or indexed color images (single 2-dimensional array of pixel values with possible look-up-tables), the image array consists of one band. In the case of RGB images (three 2-dimensional arrays of pixel values; 8 bits each of Red, Green and Blue values for each pixel), the image consists of three bands. In the case of complex data, it is possible to specify inphase (I) and quadrature (Q) samples as separate bands, or alternatively, magnitude (M) and phase (P) as separate bands.

Basic Character Set.. This character set is selected from ISO/IEC 646. Valid BCS character codes range from 20 through 0xFF and line feed (0x0A), form feed (0X0B), and carriage return (0X0C).

Basic Character Set-Alphanumeric. A subset of the Basic Character Set. The range of allowable characters consists of space through tilde (single bytes with values ranging from 20 to 7E) from the Basic Latin Collection.

Basic Character Set-Numeric. A subset of the Basic Character Set which consists of the digits ‘0’ through ‘9’, ‘plus sign’, ‘minus sign’, ‘decimal point’, and ‘slash’.

Block. A rectangular array of pixel values within a NSIF file which is a subset of an image. An image consists of the union of non-overlapping blocks.

Channel. A channel, in this context, is mapped to the transmit and receive signal modes in the radar hardware. For example, the transmitted signal could be through a horizontally-polarized transmit antenna and the received signal through a vertically-polarized receive antenna. This specifies a specific polarimetric channel, typically written, HV. An HH channel could have the same transmitted signal, but a received signal through a horizontally-polarized receive antenna. Other channels might include VV and VH. Note that a collection of polarimetric channels might be related, but each is given its own CMETA header. The balancing of the polarimetric channels can be included in the CMETA header, however. Note that there is no balancing field for interferometric (up-and-down antenna) and bistatic (side-by-side antenna) channels, however.

Complex SAR Data. Complex SAR Data traditionally takes the form of Complex Image (CI) Data or Video Phase History (VPH) Data. While both data are represented as complex numbers, the CI data has gone through a 2D-FFT and can be viewed as an image, while VPH data has not been through a 2D-FFT and therefore is not viewable as an image.

Conditional. An adjective applied to data fields whose existence depends on the value of the designated Required field preceding the Conditional field.

Coordinated Universal Time. The time scale maintained by the Bureau International de L'Heure (International Time Bureau) that forms the basis of a coordinated dissemination of standard frequencies and time signals. UTC is equivalent to the mean solar time at the prime meridian at Greenwich, England.

Data Extension Segment. Data Extension Segment is a construct used to encapsulate different data types where each type is encapsulated in its own DES.

Displayable. Information that can be exhibited in visual form.

Field. Logically primitive item of data, sometimes referred to as an attribute.

Focus Plane. The focus plane is defined to be the XY plane in an orthogonal XYZ coordinate system with its origin at the center of the scene being imaged. The focus plane normal unit vectors describe this XY plane. The Image Formation Processor (IFP) selects parameters to optimally focus scatterers located in this plane. The focus plane is defined to be the same as the ground plane, even though the term 'ground plane' has some geographical notions associated with it. Sometimes IFPs include a 'height-of-focus' from some nominal geographical ground plane to focus scatterers at a certain height, but here the ground plane and focus plane definition includes this height-of-focus.

Frame Image. A Synthetic Aperture Radar (SAR) data collection in which the sensor steers its antenna beam to continuously illuminate the area being imaged.

Ground Plane. One of the two most common viewing perspectives for SAR imagery. The ground plane is defined to be the same as the focus plane.

Image. A representation of physical visualization, for example, a picture. An image is the computer (digital) representation of a picture. An image is comprised of discrete picture elements called pixels structured in an orderly fashion consisting of pixel value arrays formatted using bands and blocks.

Image Display Plane. The plane that the Image Formation Processor (IFP) projects or positions scatters in the three dimensional scene. One common choice for the Image Display Plane is a close fit to the nominal data collection surface, defined here to be the slant plane. Another common choice for the Image Display Plane is the focus plane or, equivalently, the ground plane.

Imaging Operation. Refers to all of the SAR coverage necessary to satisfy one tasking assignment. Note: a tasking assignment may be one frame image or one scan image. An imaging operation is composed of one or more image segments.

Image Output Reference Point. The Image Output Reference point is defined to be the same as the scene center.

Non-blank. Non-blank indicates that the field cannot be filled entirely by the BCS-A space character (0x20). It may contain space characters when included with other characters.

Patch. An image formation processing element (i.e. that portion of the SAR data segment that undergoes a 2D-FFT). In some systems the patch size and the segment size will be the same (e.g. Source 1); for other systems patches will be smaller (e.g. AIP).

Pixel. An abbreviation for the term “picture element”.

Profile. A set of one or more base standards, and where applicable, the identification of chosen classes, subsets, options, and parameters of those base standards, necessary for accomplishing a particular function.

Required. An adjective applied to data fields that must be present and filled with valid data or default data.

Scan Image. A SAR data collection in which antenna pointing is fixed relative to the flight line resulting in a moving antenna footprint that sweeps along a strip of terrain parallel to the path of motion.

SARIQ. Radio hologram (initial phase information) from a synthetic aperture radar.

Scene Center. The scene center is defined to be the center of a spotlight SAR image. It is also known as the motion compensation point and central reference point. For a strip map image, the scene center is defined to be the intersection of the motion compensation line with the line down the center of the azimuth collection aperture.

Segment. Definition 1: An instance of a data type that is contained in a NSIF file. A segment is comprised of a subheader and associated data (e.g., an image subheader together with image data comprises an image segment).
Definition 2: An instance of an imaging operation. A segment is as large a phase continuous portion of the scene as the sensor can generate. The following actions cause a segment change to occur:

1) Vehicle re-aiming
2) Segment size exceeds file constraints of the systems.

Sensor Reference Point. The Sensor Reference point is defined to be the position of the sensor at aperture center. These values can be expressed in meters or degrees and meters, depending on the nominal geometry reference that is specified.

Slant Plane. The Slant Plane is defined to be the instantaneous slant plane at aperture center. The instantaneous slant plane is the plane containing the instantaneous antenna phase center velocity vector and the instantaneous slant range vector, which is the line-of-sight vector from scene center to the antenna phase center. Since the antenna phase center velocity vector is changing over time, the reference point is just chosen to be at aperture center to give a close fit to the nominal data collection surface.

Sub-Patch. Aggregate of data that is smaller than a patch.

Swath/Swath Width. In strip map mode, the Swath Width is defined to be the width in range of the image in the slant plane. Usually, it corresponds to a range gate or time window in the sensor hardware that is centered around the nominal motion compensation line (or, equivalently, motion compensation time).

Tagged Record Extension. A means to provide additional attributes about standard data segments not contained in the standard NSIF header or sub-header fields.

Tile. A subsection of the patch containing a single NSIF file used during down link by some systems (e.g. AIP). This should not be confused with the NSIF “blocking” structure within an NSIF file.

3.2 ABBREVIATIONS:

a.	ASCII	American National Standard Code for Information Interchange
b.	BCS	Basic Character Set
c.	BCS-A	Basic Character Set - Alphanumeric
d.	BCS-N	Basic Character Set - Numeric
e.	C	Conditional
f.	CI	Complex Image

g.	CMETA	Complex Metadata Tagged Record Extension Version A
h.	CS	Character String
i.	DES	Data Extension Segment
j.	FFT	Fast Fourier Transform
k.	NITF	National Imagery Transmission Format
l.	NSIF	NATO Secondary Image Format
m.	R	Required field that must be filled by a value
n.	<R>	Required field that may be filled with zeros if BCS-N or spaces if BCS-A. <R> fields should be populated with non-space or non-zero values whenever possible.
o.	SAR	Synthetic Aperture Radar
p.	TRE	Tagged Record Extension
q.	UTC	Coordinated Universal Time

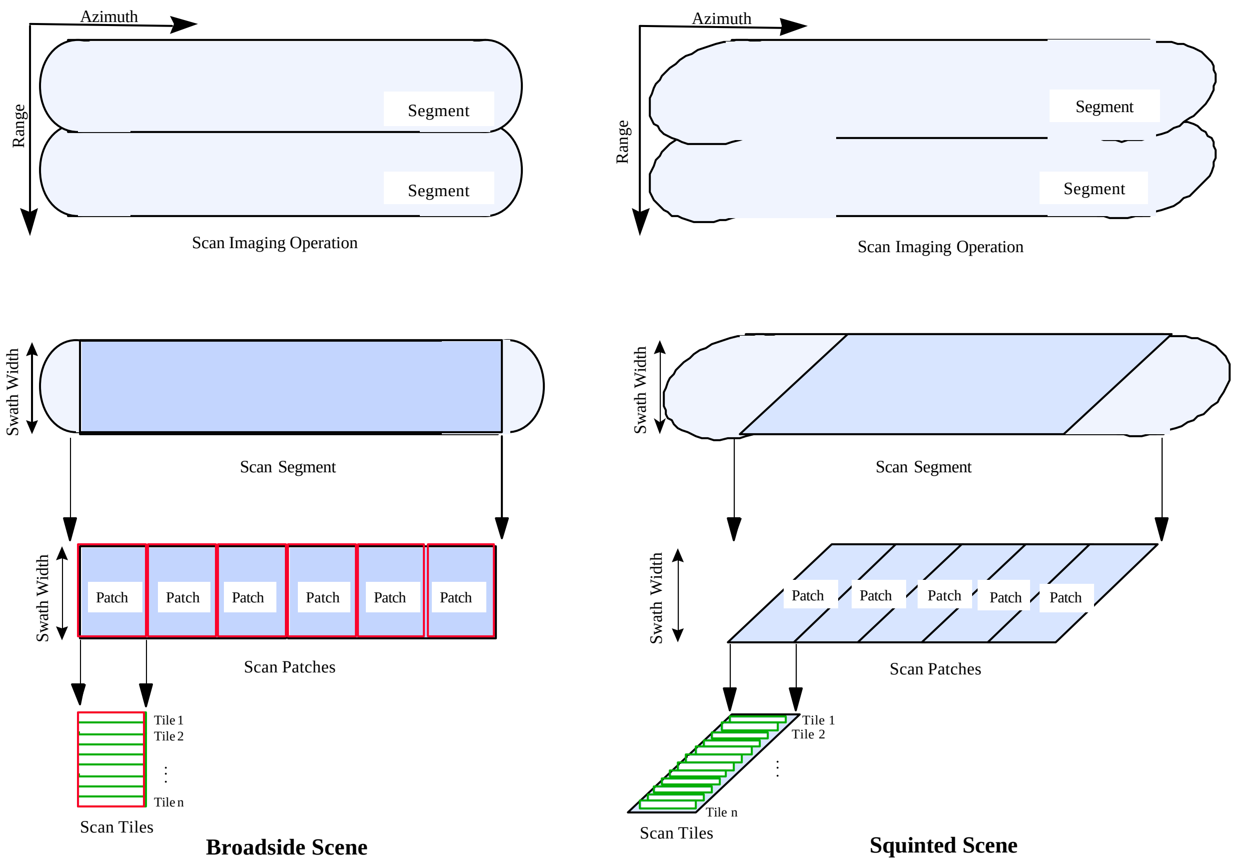

FIGURE 1. GENERIC COMPLEX DATA MODEL FOR A SCAN COLLECTION

r. UTM Universal Transverse Mercator

s. VPH Video Phase History Data

4.0 SPECIFICATION

4.1 SCOPE

The goal of the CMETA specification is to provide a common data format that increases interoperability among disparate SAR collectors and processing/exploitation systems; and to facilitate the full understanding of a complex scene (e.g., as part of a battlefield, intelligence, commercial or military situation).

Complex SAR data preserves both the phase and the magnitude information of the returned signal, as contrasted with magnitude-detected SAR data, in which an image is produced that corresponds to the point-by-point magnitude of the complex data, but from which all phase information has been removed. Thus, CMETA is applicable to <u>all</u> SAR collection systems – those that preserve phase history data and provide it to users along with imagery, as well as those that provide only magnitude-detected SAR data (i.e., imagery alone).

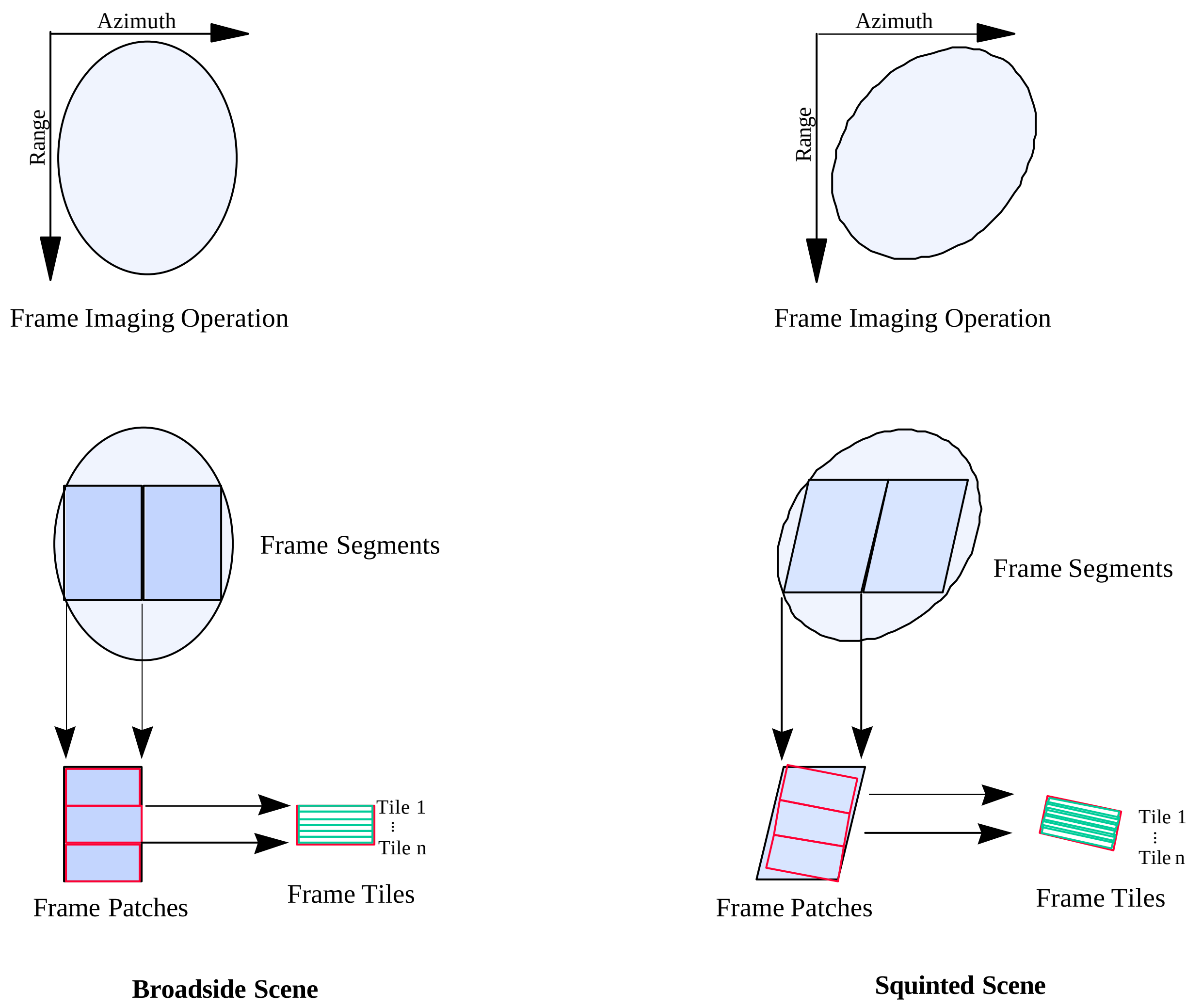

FIGURE 2. GENERIC COMPLEX DATA MODEL FOR A FRAME COLLECTION

4.2 MODEL FOR USING CMETA

Some of the terms used in CMETA refer to a generic SAR data collection model. This model was designed to aid interoperability processes between different SAR systems by providing a common frame of reference to discuss a wide range of SAR data collections. Key terms used to describe the CMETA data model are: imaging operation, segment, patch, and tile; and are defined in paragraph 3.1, above. Figures 1 and 2 illustrate CMETA data model. Since the AIP program will be the first system to use CMETA operationally, Figures 3 and 4 demonstrate how the generic model can be applied to an existing SAR system.

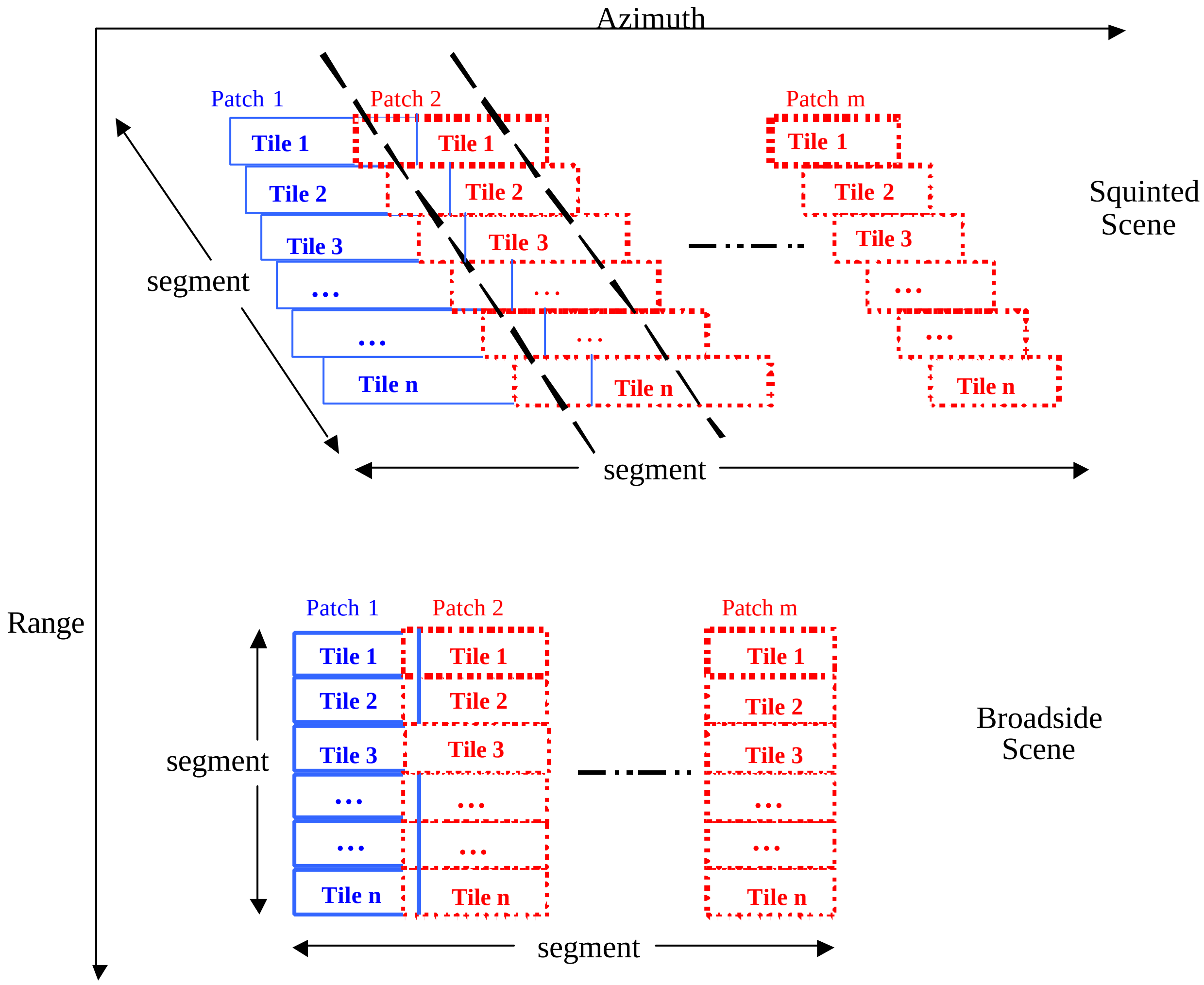

FIGURE 3.
AIP REPRESENTATION OF A SCAN IMAGE, BROADSIDE AND SQUINTED

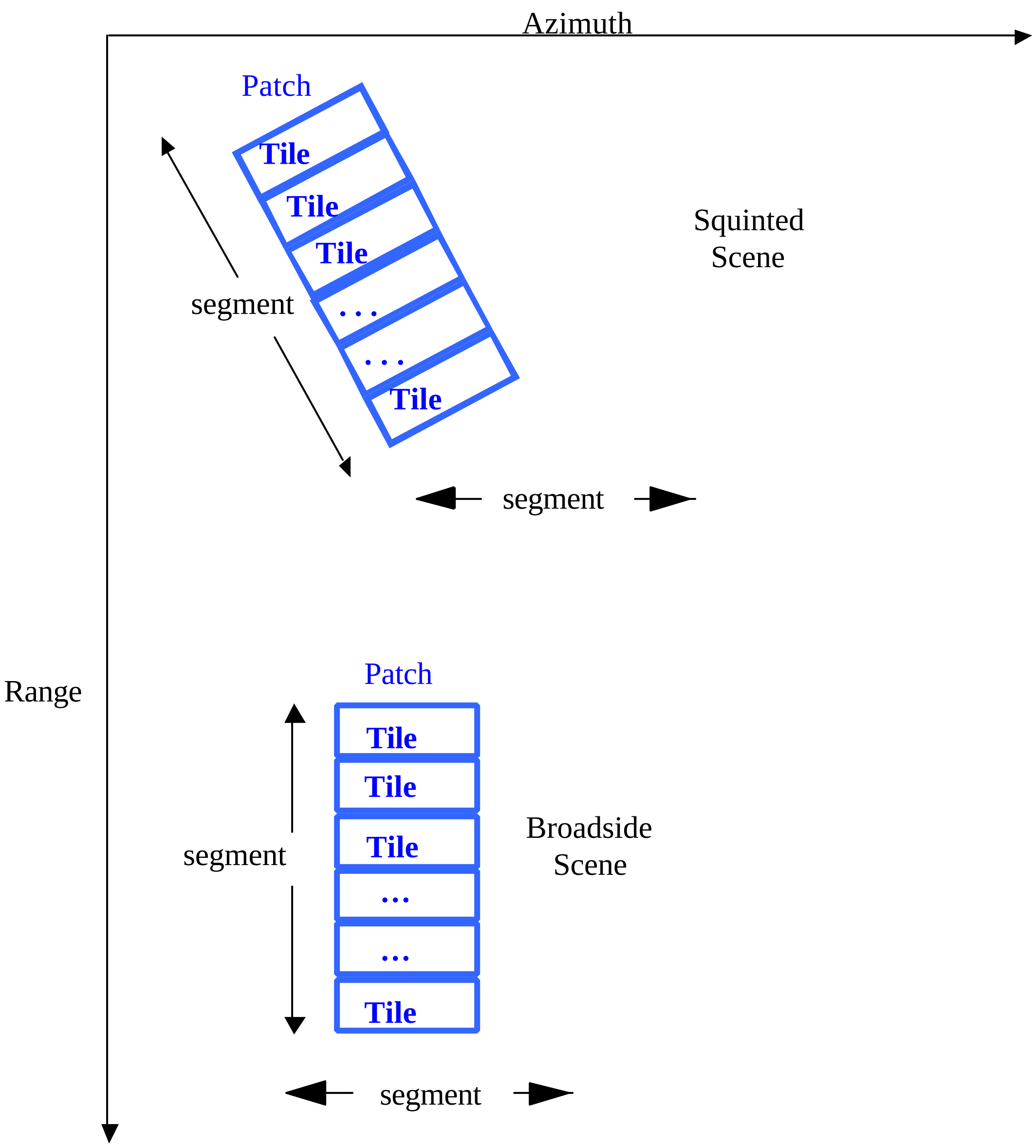

FIGURE 4.
AIP REPRESENTATION OF A FRAME IMAGE, BROADSIDE AND SQUINTED

4.4 FUNCTIONALITY PROVIDED BY CMETA

In the past, complex SAR information was transformed to magnitude-detected data at the source with the resulting real imagery from a single source being transmitted directly to only one user. Currently, if complex data (i.e., complex imagery data or complex phase history data) from a single source is desired, then its sensor-specific format must be understood and handled by the end-user.

CMETA's vision for the future is the total interoperability of complex SAR data, where data can be exchanged among sources and users, and where all users can receive complex data in a standard format from all sources and platforms, whether airborne or spaceborne, commercial- or government-operated.

CMETA will support the transition from point-to-point dissemination (where less metadata is needed, since both sides know about the system) to broadcast (where recipients need more metadata across diverse communities). The standard consists of product data (VPH, Complex Image, detected in various forms) and product support data (metadata or auxiliary data).

The standard will accommodate data collected to optimize response to a particular exploitation algorithm. For example, since different exploitation algorithms excel under different collection parameters, CMETA can provide the information that allows a user to know which exploitation algorithm governed the collection of a particular data set. It will also simplify data representation from current and future sources, since CMETA can reduce the large amount of AUX information and system-specific knowledge needed to be transmitted to a user.

Also, in keeping with evolving security considerations, CMETA will make it easier to generate exploitation products using published algorithms on unprotected data. This is because classification is moving toward restrictions based on content (e.g., target) rather than type of data (e.g., VPH). Finally, CMETA will ultimately lead to a complex SAR data dissemination environment dominated by “user pull of data”, incremental transmission, and automated target/data identification and extraction, all crucial to handling the growing volume of data that will test the resources of government and commercial users.

4.5 FORMAT

The format of the NSIF file consists of a header, followed by data type segments with their associated subheaders. The header specifies profile and structural information that allows proper interpretation of the rest of the header and subheaders.

A TRE that pertains to the entire file is typically part of the User Defined Header Data field (UDHD) or the Extended Header Data field (XHD) in the file header. If the TRE pertains to individual images, the TRE can be found in the User Defined Image Data field (UDID) or the Image Extended Subheader Data field (IXSHD) of each image subheader. If the TRE does not fit in these fields it will overflow into a TRE_Overflow Data Extension Segment (DES). Complex Image Data will be placed in the image segment data field with the CMETA TRE in the image segment subheader while Video Phase History Data and its auxiliary metadata will be placed in a DES that is defined in a separate document. The CMETA TRE will be placed in the IXSHD field of each appropriate image subheader.

All headers and subheaders have their character data specified in the lexical constraints of BCS-A or BCS-N.

4.5.1 ENCODING

This section describes the six columns comprising the CMETA TRE which is in paragraph xxx of this document.

Column I Index: A numbered index used to locate fields.

Column II Field name: A short name used for references in the text descriptions. For most field names, the first part of the field name gives the classification of the field:

- RD_ - Radar Parameters
- CMPLX _ - Complex Image
- IF_ - Image Format
- POL_ - Polarimetrics
- T_ - Time Parameters
- CG_ - Collection Geometry
- MC_ - MOCOMP, Motion Compensation
- CA_ - Calibration
- WF_ - Waveform Parameters
- VPH_ - Video Phase History
- RF_ - Interference
- PP_ - Per Pulse Descriptors

Column III Description: A short descriptive name, followed by a more detailed definition.

Column IV CE/Size: Character Encoding: A = BCS-A; N =BCS-N. Size: Equals the number of bytes that are reserved for the field. Size is fixed and must be filled with valid data or the specified default. For those “Required” fields BCS-A “trailing spaces” will be applied to fill the field, for fields labeled BCS-N “leading zeros (0)” will be applied to fill the field.

Column V Value Range: Valid information must fall within the ranges identified and may be a range, an enumerated set, or a single value.

Column VI Type: A selection from the following codes:

R: Required element It must be present.

<R> Required element that has a default value of zero if BCS-N, or spaces if BCS-A. The intent of these optional fields is to fill them with appropriate values whenever possible.

C: Conditional element; this element is omitted based on the value of its “dependent element”. For example, if IF_MAP_TYPE is not MGRS than no MGRS Coordinates (IF_MGRSZONE, etc.) are present in the file. A conditional field may or may not be present depending on the value of one or more preceding required fields.

The data that appears in all fields specified in the tables, including numbers, shall be represented using the basic character set with eight bits (one byte) per character. All field size specifications given specify a number of bytes.

4.5.2 HEADER/SUBHEADER

Each NSIF file begins with a header whose fields contain identification, origination information, security information, and the number and size of data items contained in file structure. Figure 5 provides an overview of a NSIF file as well as the organization of the Image Segment component. As Figure 5 shows, the CMETA TRE will be housed in the IXSHD field of the image subheader. A more complete discussion of a NSIF header can be found in STANAG 4545. Note: Some controlled extensions may appear in the UDID field of the image subheader. VPH metadata will be housed in a different portion of the NSIF file structure, the Data Extension Segment (DES), which will be described under a separate text.

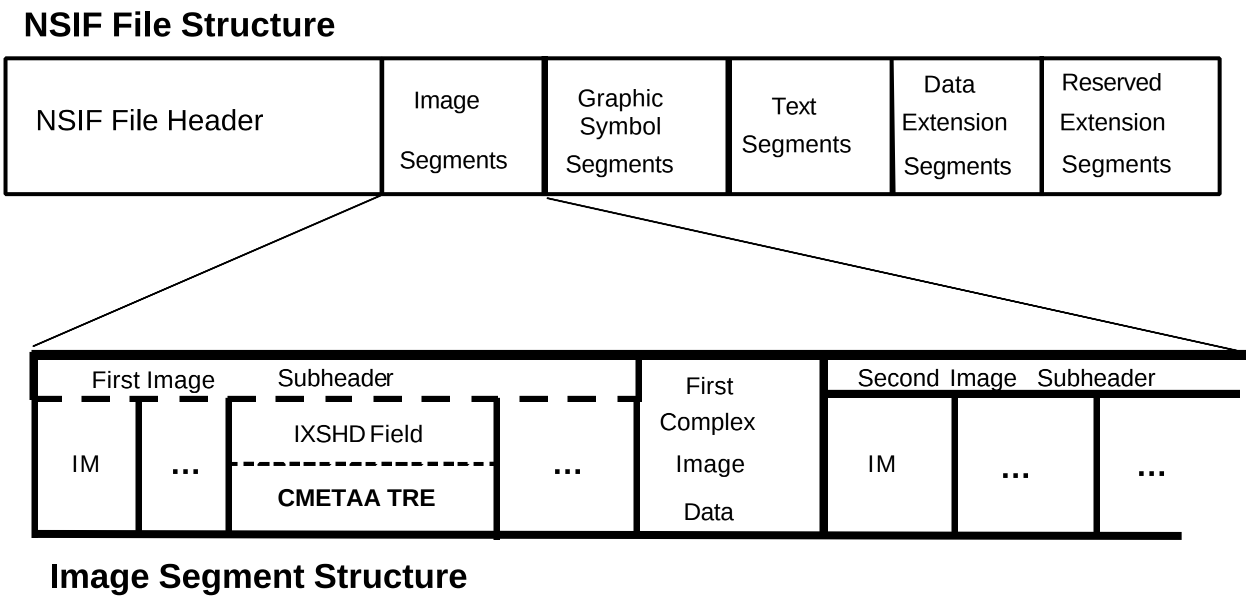

FIGURE 5. HEADER/SUBHEADER STRUCTURE

4.5.3 IMAGE DATA FIELD

The complex image data is found in the image data section following the appropriate image subheader.

4.5.4 COMPLEX SAR DATA

Complex SAR data is generally found in one of two data formats, In-phase and Quadrature phase (IQ) or Magnitude and Phase (MP) data, where IQ and MP are related as follows:

$$M = \sqrt{I^2 + Q^2} \qquad\qquad P = tan^{-1}(Q/I)$$

In CMETA, the format type is indicated in the CMPLX_DOMAIN field. This field not only informs the user whether the data is in IQ or MP format but also describes the data ordering. Choices for CMPLX_DOMAIN are as follows:

- IQ – I and Q interleaved data, I values are the first pixel component

- QI – Q and I interleaved data, Q values are the first pixel component

- MP – Magnitude and Phase interleaved data, Magnitude values are the first pixel component

- M – Magnitude only

- P – Phase Only

- I1Q2 – I and Q data in the 1^{st} and 2^{nd} bands, respectively.

- Q1I2 – Q and I data in the 1^{st} and 2^{nd} bands, respectively.

- M1P2 – M and P data in the 1^{st} and 2^{nd} bands, respectively.

- P1M2 – P and M data in the 1^{st} and 2^{nd} bands, respectively

As shown in Figure 5, complex data is located within the NSIF file after the image subheader. Possible formats for complex data storage include the following:

- IQ interleaved – I and Q data values are interleaved and stored sequentially in one image data file.

- QI interleaved – Q and I data values are interleaved and stored sequentially in one image data file.

- IQ banded - I and Q data values are stored separately i.e. all of the I data is stored sequentially in the first band followed by all of the Q data is stored sequentially in the second band. This format is similar to NITF multispectral imagery.

- QI banded - Q and I data values are stored separately i.e. all of the Q data is stored sequentially in the first band followed by all of the I data is stored sequentially in the second band. This format is similar to NITF multispectral imagery.

- MP interleaved– M and P data values are interleaved and stored sequentially in one image data file.

- MP banded - M and P data values are stored separately i.e. all of the M data is stored sequentially in the first band followed by all of the P data is stored sequentially in the second band. This format is similar to NITF multispectral imagery and is the format selected by the AIP platform.

- M, Magnitude only - Only M values stored sequentially in one image data file.

- P Phase Only - Only P values stored sequentially in one image data file.

Sizes of each I,Q,M,P components range from 04 to 64 bits with 8, 16, 32 bits per complex data component being the most common.

Note that when the data is interleaved, the number of columns (NCOLS) in the NSIF image subheader refers to the number of data pairs (I, Q, or M, P). Also, the block size element (NPPBH) refers to the number of data pairs in a block. In addition, the CMETA fields include the number of bits per first component and the number of bits per second component. In the NSIF image subheader, the number of bits per pixel would be the sum of bits in these two components (e.g., 8 bits magnitude and 12 bits phase would translate to 20 bits per pixel (NBPP)). However, the two components would occupy the nearest byte boundary to store the data. In other words, in the example, the 8 bits magnitude component would occupy one byte, while the 12 bits phase component would occupy 2 bytes. Note that this overrides the definition of 'INT' in the NSIF image subheader field PVTYPE which denotes 16 bits or 2 bytes.

4.5.5 DEFINITIONS FOR FFT & ZERO PADDING

The 2D-FFT of motion-compensated (and possibly polar-formatted) phase history data produces a complex image which, after additional enhancement processing, produces an exploitable SAR image. The phase history is often "zero padded" to increase the sampling density of the complex SAR image. For many exploitation algorithms, it is important to know the exact details of the zero-padding, so that approximations do not introduce unwanted phase contributions.

Figure 6 shows an exact specification of zero padding, where the signal data is denoted as gray and the zeros as white in the diagram. The record and element (row, column) locations of the DC point (zero frequency) and the corner locations of the signal data is specified in the CMETA header. These locations are sufficient to describe the signals and zeros from any processor.

The header row and column notation apply to whatever data enters the 2D-FFT. If the input into the 2D-FFT is a subsection of a larger data array then the location of the zero pad and signal location reported in the header correspond to this subsection, not the full-sized data array. The first example depicts the DC in the data center with phase history data in the slant plane. The second example depicts the DC in the data corner with phase history in the slant plane. The third example depicts the DC in the data center with phase history data in the ground plane. The fourth example depicts the DC in the data corner with phase history data in the ground plane.

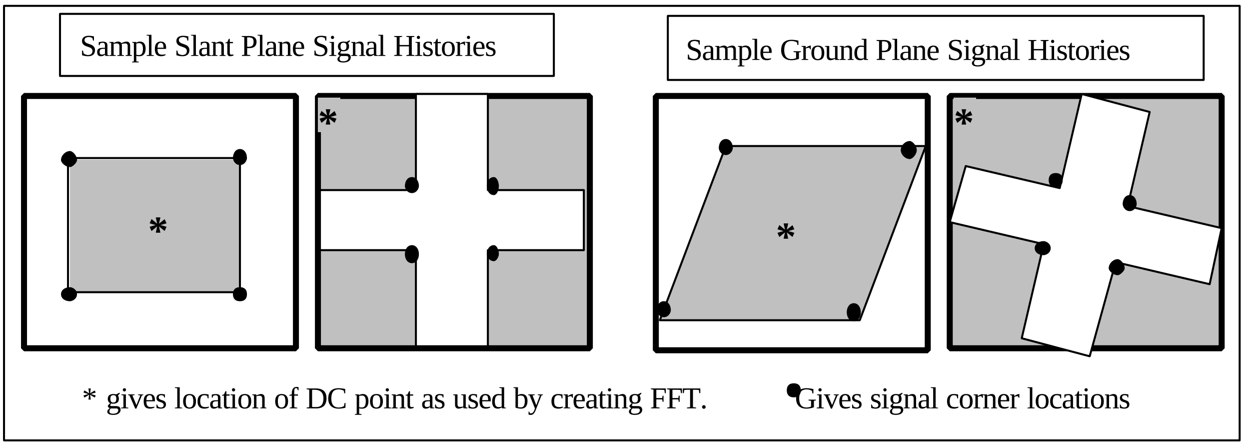

FIGURE 6. SIGNAL HISTORIES

4.6 CMETAA

The following table contains all of the fields for CMETAA. Note that <R> means that the indicated default value may occupy this field with the intent to ease early implementation of the TRE. Alphabetic fields are left justified and blank filled, numeric fields are right justified and zero filled.

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
	TRETAG	TRE Name. This field shall contain the unique extension name or ID for the TRE.	A/6	CMETAA	R
	TREL	TRE Data Length. This field shall contain the total length of the TRE.	N/5	01582	R
100	RELATED_TRES	Related TREs. Subtag mechanism. Indicates the number of additional TREs contained in this NSIF file which pertain to SAR processing. Default = 00 For more information on the approved TREs see the NSIF Tag Registry.	N/2	01 to 20 or 00	R
200	RELATED_TRES	Name of Additional TRE. States the name of the TRE referenced by RELATED_TRES. Each TRE name is 6 bytes in length. Note: CMETAA's listing of additional TREs is done so with the approval of the STANAG 4545 Custodian.	A/120	Alphanumeric AIMIDA AIMIDB AIPBCA	R
300	RD_PRC_NO	Processor Version Number. Describes the software/hardware configuration used to generate the data.	A/12	Alphanumeric	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
400	IF_PROCESS	VPH Processing Method. Method of image formation (i.e. VPH processing alg.). This list is extensible through the STANAG 4545 Custodian. RM = Range migration PF = Polar Format CD = Chirp Descaling (alphabetic fields are left justified and blank filled)	A/4	RM PF CD	R
500	RD_CEN_FREQ	Nominal Center Frequency Band. Describes the nominal center frequency band. This list is extensible through the STANAG 4545 Custodian. L C P S SC X KA KU	A/4	L C P S SC X KA KU	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
600	RD_MODE	Collection Mode. Describes the collection mode. This list is extensible through the STANAG 4545 Custodian. 0FR - Mode 0, slant plane 0FG - Mode 0, ground plane 1FR - Mode 1, slant plane 1FG - Mode 1, ground plane 2FR - Mode 2, slant plane 2FG - Mode 2, ground plane 22FR - Mode 5, slant plane 22FG - Mode 5, ground plane 07A - Mode 3 area, slant plan 07L - Mode 3 LOC, slant plan 14A - Mode 4 area, slant plane 14L - Mode 4 LOC, slant plane 1SP - ETP, spotlight 1, slant 3SP - ETP, spotlight 3, slant 10S - ETP, scan, slant GSP - Tier 2+ spot mode GSH - Tier 2+ search mode AIP13 - Monopulse Calibration AIP14 - Wide Area MTI (WAMTI) AIP15 - Coarse Resolution Search AIP16 -Medium Resolution Search AIP17 - High Resolution Search AIP18 - Point Imaging AIP19 - Swath MTI (SMTI) AIP20 - Repetitive Point Imaging AS201 - Search AS202 - Spot 3 AS204 - Spot 1 AS207 - Continuous Spot 3 AS208 - Continuous Spot 1 AS209 - EMTI Wide Frame Search AS210 - EMTI Narrow Frame Search AS211 - EMTI Augmented Spot AS212 - EMTI Wide Area MTI (WAMTI) AS213 – Monopulse Calibration	A/5	0FR 0FG 1FR 1FG 2FR 2FG 22FR 22FG 07A 07L 14A 14L 1SP 3SP 10S GSP GSH AIP13 AIP14 AIP15 AIP16 AIP17 AIP18 AIP19 AIP20 AS201 AS202 AS204 AS207 AS208 AS209 AS210 AS211 AS212 AS213	R
700	RD_PATCH_NO	Data Patch Number Field. Patch instance for an imagery operation. <R> = 0000 = Not Applicable	N/4	0001-9999 or 0000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
800	CMPLX_DOMAIN	Complex Domain. Defines whether the two components form a rectangular (IQ) or a polar (MP) coordinate system and which component are present in this image. Operational and efficiency considerations may dictate that the magnitude and phase components be contained in a separate files with the M or P defining the content of this image type of image samples. This list is extensible through the STANAG 4545 Custodian. IQ = I and Q interleaved data, note I values = first pixel component QI = Q and I interleaved data, note Q values = first pixel component MP = Magnitude and Phase interleaved data, note Magnitude values = first pixel component I1Q2 – I and Q data stored in the 1st and 2nd bands, respectively Q1I2 – Q and I data stored in the 1st and 2nd bands, respectively M1P2 – M and P data stored in the 1st and 2nd bands, respectively P1M2 – P and M data stored in the 1st and 2nd bands, respectively M = Magnitude P = Phase	A/5	IQ QI MP I1Q2 Q1I2 M1P2 P1M2 M P	R
900	CMPLX_MAG_ REMAP_TYPE	Type of Magnitude Mapping applied to M pixel component values. This list is extensible through the STANAG 4545 Custodian. NS = No Scaling LINM = Linear Magnitude LINP = Linear Power LOGM = Log Magnitude LOGP = Log Power LLM = Lin-Log Magnitude Default = NA = Not Applicable	A/4	NS LINM LINP LOGM LOGP LLM or NA	<R>
1000	CMPLX_LIN_ SCALE	Complex Linear Scale Factor. Complex Linear Scale Factor applied to each pixel in the image or image block. Used for LINM, LINP and LLM mapping in index 900. Default = 1.00000	N/7	.000001 to 99999.9 or 1.00000	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
1100	CMPLX_AVG_ POWER	Average Power of the image data associated with the NSIF IM sub-header containing CMETAA. Avg. Power = $S(I^2 + Q^2)/n$ Default = 0000000, unknown Avg. Power	N/7	.000001 to 99999.9	<R>
1200	CMPLX_LINLOG_ TP	Complex LinLog Transition Point. Refers to the pixel value where linear scaling is applied to pixels less than the Transition Point (TP) value. Log scaling is applied to pixel values larger than the TP. Applied to LLM data denoted in field CMPLX_MAG_SCALE_TYPE (Index 900). Default = 00000 = Not Applicable	N/5	00000 to 65535	<R>
1300	CMPLX _PHASE _QUANT_FLAG	Phase Quantization Flag. Quantization Flag Indicates whether the phase data has been quantized. This list is extensible through the STANAG 4545 Custodian. NS = No Scaling UQ1 = Uniformly Sampled (low) Quantizer UQ2 = Uniformly Sampled (center) Quantizer	A/3	NS UQ1 UQ2	R
1400	CMPLX_PHASE_ QUANT_BIT_ DEPTH	Phase Quantization Bit Depth. The number quantizer bits used in UQ1 or UQ2 in index 1300. If "CMPLX _PHASE _QUANT_FLAG" = NS than field contains 00.	N/2	01 to 32, or 00 if field 1300 is NS	R
1500	CMPLX _SIZE_1	Size of First Pixel Component in Bits The Inphase component when CMPLX_DOMAIN is IQ; The Quadrature component when CMPLX_DOMAIN is QI; The magnitude component when CMPLX_DOMAIN is MP. Note: component sizes will be identical for I and Q	N/2	04 to 64 Commonly 8,16,32	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
1600	CMPLX _IC_1	Data Compression of First Pixel Component. Magnitude only (M) or the magnitude portion of the Magnitude/Phase (MP). No Compression (NC) for IQ or Phase (P) until standard compression available. This list is extensible through the STANAG 4545 Custodian. NC = No compression C3 = JPEG Lossy C5 = JPEG Lossless I1 = Downsampled JPEG Data Compression Information C4 = Vector Quantizer C6 = JPEG 2000 C7 = Complex Data Compression (designator reserved for future complex data compression) TC = Trellis Coded Quantizer NS = Nonlinear Scalar Quantized US = Uniform Scalar Quantized Default = NC	A/2	NC C3 C5 C6 I1 C4 C7 TC NS US	R
1700	CMPLX _SIZE_2	Size of Second Pixel Component in Bits. The Quadrature component when CMPLX_DOMAIN is IQ; The Inphase component when CMPLX_DOMAIN is QI; The phase component when CMPLX_DOMAIN is MP Use blanks for either mag or phase alone (as the only component) Default = 00 Note: component sizes will be identical for I and Q.	N/2	04 to 64 Commonly 8,16,32 or 00 indicating no second component	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
1800	CMPLX _IC_2	Data Compression, second pixel component. Phase compression. No Compression (NC) for IQ until standard compression available. Spaces indicate that field is not applicable. This list is extensible through the STANAG 4545 Custodian. NC = No compression C3 = JPEG Lossy C5 = JPEG Lossless I1 = Downsampled JPEG Data Compression Information C4 = Vector Quantizer C6 = JPEG 2000 C7 = Complex Data Compression (designator reserved for future complex data compression) TC = Trellis Coded Quantizer NS = Nonlinear Scalar Quantized US = Uniform Scalar Quantized Default = NC	A/2	NC C3 C5 C6 I1 C4 C7 TC NS US	R
1900	CMPLX _IC_BPP	Complex Imagery Compressed Bits per Pixel. The average bits per pixel for the complex pixels after compression. Default = 00000, implies no compression	N/5	0.001 to 64.00 or 00000	<R>
2000	CMPLX_WEIGHT	Type of Weighting applied to data. Weighting is applied to I,Q data prior to conversion to MP data. This list is extensible through the STANAG 4545 Custodian. UWT = Unweighted, uniform (default) SVA = Spatially Variant Apodization TAY = Taylor Weighting HNW = Hanning Window HMW = Hamming Window	A/3	UWT SVA TAY HNW HMW	R
2100	CMPLX_AZ_SLL	Azimuth (AZ) Sidelobe Level. Absolute value of the level that the azimuth (AZ) sidelobe response is below that of the main return. Applies only to Taylor weighted data. Default = 00 = Unweighted or other	N/2	00 to 99 (decibels)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
2200	CMPLX_RNG_SLL	Range (RNG) Sidelobe Level. Absolute value of the level that the range (RNG) sidelobe response is below that of the main return. Applies only to Taylor weighted data. Default = 00	N/2	00 to 99 (decibels)	R
2300	CMPLX_AZ_TAY_NBAR	Azimuth Taylor nbar. Number of sidelobes affected by weighting. Applies only to Taylor weighted data. Default = 00 = Unweighted or other	N/2	00 to 99	R
2400	CMPLX_RNG_TAY_NBAR	Range Taylor nbar. Number of sidelobes affected by weighting. Applies only to Taylor weighted data. Default = 00 = Unweighted	N/2	00 to 99	R
2500	CMPLX_WEIGHT_NORM	Complex Weight Normalization function for Taylor weighting. This list is extensible through the STANAG 4545 Custodian. AVG: Average normalization RMS: Root Mean Square normalization Default = Three spaces if not applied	A/3	AVG RMS or 3 spaces	<R>
2600	CMPLX_SIGNAL_PLANE	Plane of the complex image. S = Slant plane G = Ground Plane	A/1	S/G	R
2700	IF_DC_SF_ROW	Sample Location of DC (zero frequency) in row dimension in the spatial frequency domain for the 2-D FFT of the patch.	N/6	000000 to 999999	R
2800	IF_DC_SF_COL	Sample Location of DC (zero frequency) in column dimension in the spatial frequency domain for the 2-D FFT of the patch.	N/6	000000 to 999999	R
2900	IF_PATCH_1_ ROW	Sample Location of the signal corner in the row dimension, upper left in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The row coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system. Default = -99999 = NA = Not Applicable	N/6	000000 to 9999999 or -99999	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
3000	IF_PATCH_1_COL	Sample Location of the signal corner in the column dimension, upper left in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The column coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system. Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
3100	IF_PATCH_2_ ROW	Sample Location of the signal corner in the row dimension, upper right in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The row coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system. Default = -99999 = NA = Not Applicable	N/6	000000 to 9999999 or -99999	<R>
3200	IF_PATCH_2_COL	Sample Location of the signal corner in the column dimension, upper right in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The column coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
3300	IF_PATCH_3_ ROW	Sample Location of the signal corner in the row dimension, bottom right in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The row coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system. Default = -99999 = NA = Not Applicable	N/6	000000 to 9999999 or -99999	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
3400	IF_PATCH_3_COL	Sample Location of the signal corner in the column dimension, bottom right in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corne of the patch. Note: The column coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
3500	IF_PATCH_4_ ROW	Sample Location of the signal corner in the row dimension, bottom left in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corner of the patch. Note: The row coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system. Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
3600	IF_PATCH_4_COL	Sample Location of the signal corner in the column dimension, bottom left in the spatial frequency domain for the 2-D FFT of the patch. Origin (0,0) is located at the upper left corne of the patch. Note: The column coordinate shown in this field is a localized value specific to one patch. It does not correspond to a multiple patches row/col coordinate system Default = -99999 = NA = Not Applicable	N/6	000000 to 9999999 or -99999	<R>
3700	IF_DC_IS_ROW	Sample Location of DC (zero frequency) in row dimension in the image space relevant to the origin of the full image (i.e. image segment). Origin (0,0) is located at the upper left corner of the image segment	N/8	00000000 to 99999999	R
3800	IF_DC_IS_COL	Sample Location of DC (zero frequency) in column dimension in the image space relevant to the origin of the full image (i.e. image segment). Origin (0,0) is located at the upper left corner of the image segment	N/8	00000000 to 99999999	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
3900	IF_IMG_ROW_DC	Row Location of Patch (IM) relative to the full image (image segment). If this image is the entire image segmen use 00000000. Origin (0,0) is located at the upper left corner of the image segment Default = 00000000	N/8	00000001 to 99999999 or 00000000	<R>
4000	IF_IMG_COL_DC	Column Location of Patch (IM) relative to the full image (image segment). If this image is the entire image segment use 00000000. Origin (0,0) is located at the upper left corne of the image segment Default = 00000000	N/8	00000001 to 999999999 or 00000000	<R>
4100	IF_TILE_1_ROW	Sample Location of valid tile data in the row direction, upper left. Origin (0,0) is located at the upper left corne of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4200	IF_TILE_1_COL	Sample Location of valid tile data in the column direction, upper left. Origin (0,0) is located at the upper left corner of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4300	IF_TILE_2_ROW	Sample Location of valid tile data in the row direction, upper right. Origin (0,0) is located at the upper left corne of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4400	IF_TILE_2_COL	Sample Location of valid tile data in the column direction, upper right. Origin (0,0) is located at the upper left corner of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4500	IF_TILE_3_ROW	Sample Location of valid tile data in the row direction, lower right. Origin (0,0) is located at the upper left corne of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4600	IF_TILE_3_COL	Sample Location of valid tile data in the column direction, lower right. Origin (0,0) is located at the upper left corner of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
4700	IF_TILE_4_ROW	Sample Location of valid tile data in the row direction, lower left. Origin (0,0) is located at the upper left corne of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4800	IF_ TILE_4_COL	Sample Location of valid tile data in the column direction, lower left. Origin (0,0) is located at the upper left corner of the tile Default = -99999 = NA = Not Applicable	N/6	000000 to 999999 or -99999	<R>
4900	IF_RD	Range Deskew. Indicates whether range deskew has been applied to the VPH data. Y = Yes, range deskewed applied N = No, range deskewed still exists O = Obviated (range deskew not necessary/not applicable)	A/1	Y/N/O	R
5000	IF_RGWLK	Range Walk Correction. Y = yes, range walk applied N = no, range walk exists in image O = Obviated (not necessary/not applicable)	A/1	Y/N/O	R
5100	IF_KEYSTN	Range Curvature and Keystone Distortion Correction. Y = yes, range curvature and keyston distortion correction applied N = no, range curvature and keystone distortion exists in image O = Obviated (not necessary/not applicable) Default = One space	A/1	Y/N/O or 1 space	<R>
5200	IF_LINSFT	Residual Linear Shift Correction. Y = Yes, correction applied N = No, correction not applied O = Obviated (not necessary/not applicable) Default = One space	A/1	Y/N/O or 1 space	<R>
5300	IF_SUBPATCH	Sub-patch Phase Correction. Y = Yes, sub-patch phase correction applied N = No, correction not applied O = Obviated (not necessary/not applicable) Default = One space	A/1	Y/N/O or 1 space	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
5400	IF_GEODIST	Other Deterministic Geometric Distortion Corrections. Y = Yes, correction applied N = No, correction not applied O = Obviated (not necessary/not applicable) Default = One space	A/1	Y/N/O or 1 space	<R>
5500	IF_RGFO	Range Fall-off Correction (Sensitivity Time Control). Y = Yes, correction applied N = No, correction not applied O = Obviated (not necessary/not applicable)	A/1	Y/N/O	R
5600	IF_BEAM_COMP	Antenna Beam Pattern Compensation Applied Image amplitude deshading applied to compensate for antenna pattern falloff. Y = Yes, correction applied N = No, correction not applied O = Obviated (not necessary/not applicable)	A/1	Y/N/O	R
5700	IF_RGRES	Range Direction Resolution. (cross track, cross scan) Resolution of the main lobe of the SAR IPR at the -3db, range direction. Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	0000.000 to 9999.999 (meters)	R
5800	IF_AZRES	Azimuth Resolution. (along track) Resolution of the main lobe of the SAR IPR at the -3db, azimuth direction. Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	0000.000 to 9999.999 (meters)	R
5900	IF_RSS	Range Sample Spacing. (cross track, cross scan) Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	00.00000 to 99.99999 (m/pix)	R
6000	IF_AZSS	Azimuth Sample Spacing. (along track) Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	00.00000 to 99.99999 (m/pix)	R
6100	IF_RSR	Range Sample Rate. (samples/ commanded IPR) Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	00.00000 to 99.99999 (samples/IPR)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
6200	IF_AZSR	Azimuth Sample Rate (samples/ Commanded IPR) Note: This definition pertains to the image plane of the image. mmmm.mmm	N/8	00.00000 to 99.99999 (samples/IPR)	R
6300	IF_RFFT_SAMP	Original Range. (cross scan, cross-track) FFT Non-zero Input Samples. The original number of input FFT range samples prior to zero padding (e.g. at polar format).	N/7	0000001 to 9999999	R
6400	IF_AZFFT_SAMP	Original Azimuth. (along track) FFT Non-zero Input Samples. The original number of input FFT azimuth samples prior to zero padding (e.g. at polar format).	N/7	0000001 to 9999999	R
6500	IF_RFFT_TOT	Total Range. (cross scan, cross-track) FFT Length. The total number of input FFT range samples (e.g. at polar format).	N/7	0000001 to 9999999	R
6600	IF_AZFFT_TOT	Total Azimuth. (along track) FFT Length. The total number of input FFT azimuth samples (e.g. at polar format).	N/7	0000001 to 9999999	R
6700	IF_SUBP_ROW	Sub-patch Size, Row (Range Direction). Number of row pixels (i.e. pixels per row) in one processing sub-patch (size and locations of phase discontinuities) Default = 000000, no sub-patch	N/6	000001 to 999999 (pixels) or 000000	<R>
6800	IF_SUBP_COL	Sub-patch Size, Column (Azimuth Direction). Number of column pixels (i.e. pixels per column) in one processing sub patch (size and locations of phase discontinuities) Default = 000000, no sub-patch	N/6	000001 to 999999 (pixels) or 000000	<R>
6900	IF_SUB_RG	Subpatch Counts, Range, (e.g. cross scan, cross-track). Number of processing sub patches in the range direction (size and locations of phase discontinuities) Default = 0000, no sub-patch	N/4	0001 to 1000 or 0000	<R>
7000	IF_SUB_AZ	Subpatch Counts, Azimuth, (e.g. along track). Number of processing sub patches in the azimuth direction (size and locations of phase discontinuities) Default = 0000, no sub-patch	N/4	0001 to 1000 or 0000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
7100	IF_RFFTS	FFT Sign Convention in Range. (cross scan, cross-track). Defines sign of exponent in kernel for range FFT. exp ±j2p… + = positive - = negative	A/1	+, -	R
7200	IF_AFFTS	FFT Sign Convention in Azimuth. (along track). Defines sign of exponent in kernel for azimuth FFT. exp ±j2p… + = positive - = negative	A/1	+, -	R
7300	IF_RANGE_DATA	Range Data Range. (cross-scan, cross-track) Indicates range orientation of the data ROW_INC = range increases as row index increases ROW_DEC = range decreases as row index increases COL_INC = range increases as column index increases COL_DEC = range decreases as column index increases	A/7	ROW_INC ROW_DEC COL_INC COL_DEC	R
7400	IF_INCPH	Increasing phase. Flag to indicate whether phase increases or decreases with increasing range (e.g. cross-scan, cross-track). + = Increases with distance - = Increases with distance Default = Space = unknown	A/1	+,- or 1 space	<R>
7500	IF_SR_NAME1	Super Resolution Algorithm Name, First Iteration. This list is extensible through the STANAG 4545 Custodian. S-SVA = Super SVA NLS = Non Linear Least Squares HDI = High Definition Imaging HDSAR = High Definition SAR CLEAN = Point Return Cleaning SPECEST= General Spectrum Estimation Default = Eight spaces = Not applied	A/8	S-SVA NLS HDI HDSAR CLEAN SPECEST or 8 spaces	<R>
7600	IF_SR_AMOUNT1	Amount or Factor of Super Resolution Applied to the Image, First Iteration. Amount or Factor of Super Resolution Applied to image. ss.sssss Default = 01.00000	N/8	01.00000 to 99.99999	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
7700	IF_SR_NAME2	Super Resolution Algorithm Name, Second Iteration. This list is extensible through the STANAG 4545 Custodian. S-SVA = Super SVA NLS = Non Linear Least Squares HDI = High Definition Imaging HDSAR = High Definition SAR CLEAN = Point Return Cleaning SPECEST= General Spectrum Estimation Default = Eight spaces = Not applied	A/8	S-SVA NLS HDI HDSAR CLEAN SPECEST or 8 spaces	<R>
7800	IF_SR_AMOUNT2	Amount or Factor of Super Resolution Applied to the Image, Second Iteration. Amount or Factor of Super Resolution Applied to image. ss.sssss Default = 01.00000	N/8	01.00000 to 99.99999	R
7900	IF_SR_NAME3	Super Resolution Algorithm Name, Third Iteration. This list is extensible through the STANAG 4545 Custodian. S-SVA = Super SVA NLS = Non Linear Least Squares HDI = High Definition Imaging HDSAR = High Definition SAR CLEAN = Point Return Cleaning SPECEST= General Spectrum Estimation Default = Eight spaces = Not applied	A/8	S-SVA NLS HDI HDSAR CLEAN SPECEST or 8 spaces	<R>
8000	IF_SR_AMOUNT	Amount or Factor of Super Resolution Applied to the Image, Third Iteration. Amount or Factor of Super Resolution Applied to image. ss.sssss Default = 01.00000	N/8	01.00000 to 99.99999	R
8100	AF_TYPE1	First Autofocus Iteration. This list is extensible through the STANAG 4545 Custodian. N = None MD = Mapdrift PGA = Phase Gradient Autofocus PHDIF = Phase Difference Autofocus HOAF = High Order Auto Focus	A/5	N MD PGA PHDIF HOAF	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
8200	AF_TYPE2	Second Autofocus Iteration. This list is extensible through the STANAG 4545 Custodian. N = None MD = Mapdrift PGA = Phase Gradient Autofocus PHDIF = Phase Difference Autofocus HOAF = High Order Auto Focus	A/5	N MD PGA PHDIF HOAF	R
8300	AF_TYPE3	Third Autofocus Iteration. This list is extensible through the STANAG 4545 Custodian. N = None MD = Mapdrift PGA = Phase Gradient Autofocus PHDIF = Phase Difference Autofocus HOAF = High Order Auto Focus	A/5	N MD PGA PHDIF HOAF	R
8400	POL_TR	Transmit Polarization. Describes polarization of the electromagnetic plane wave transmitted from the antenna. This list is extensible through the STANAG 4545 Custodian. V = Vertical polarization H = Horizontal polarization L = Left Circular R = Right Circular T = Theta (described in reference to an X-Z coordinate system plane) P = Phi (described in reference to an X-Y coordinate system plane)	A/1	H, V, L, R, T, P	R
8500	POL_RE	Receive Polarization. Describes the sensitivity of the receive antenna to the polarized plane wave. This list is extensible through the STANAG 4545 Custodian. V = Vertical polarization H = Horizontal polarization L = Left Circular R = Right Circular T = Theta (described in reference to an X-Z coordinate system plane) P = Phi (described in reference to an X-Y coordinate system plane)	A/1	H, V, L, R, T, P	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
8600	POL_REFERENCE	Polarization Frame of Reference. Describes the polarization frame of reference Examples: ANT = Antenna pointing coordinates (e.g. H and V referenced to the face of a phased array antenna). SCN = Scene or Target centered coordinates (e.g. H and V referenced to local gravity and ground plane). User may blank fill or add additional data. XYZ = General reference frame describing Theta Phi coordinate frames (XYZ directions specified in the user defined data of this field). Entries left justified, blank filled to the right. Default = 40 spaces	A/40	ANT (plus user defined data) SCN (plus user defined data) XYZ (plus user defined data) or 40 spaces	<R>
8700	POL	Polarimetric Data Set. Is this image part of a polarimetric data set? P = Yes, a fully polarimetric data set. Like and cross poles simultaneously transmitted and received. D = Yes, a polarimetrically diverse data set. Like and cross poles alternately transmitted; simultaneously received. N = No polarimetric	A/1	P, D, N	R
8800	POL_REG	Pixel Registered. Are the images in the polarimetric data set pixel to pixel registered and overlapping? Y = Yes N = No Default = Space. Space is required when POL (index 8700) = N	A/1	Y/N/space	<R>
8900	POL_ISO_1	Minimum Polarization Isolation. between this image / signal channel and the other channels. dd.dd Default = 00000. 00000 required when POL (index 8700) = N	N/5	00.00 to 99.99 (decibels) or 00000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
9000	POL_BAL	RCS Gray Level Balancing. Indicated if the pixel radar cross section (gray level) has been balanced against other channels, requires balancing and if the balancing coefficients are present in this file. A = Balancing coefficients have not been applied and are provide in fields 9100-9200. B = Data has balanced channels, coefficients not provided in fields 9100-9200. C = Balancing coefficients have been applied and are provide in fields 9100-9200. U = Unbalanced channels, no coefficients given; no balancing applied. Default = Space. Space is required when POL (index 8700) = N	A/1	A B C U or space	<R>
9100	POL_BAL_MAG	Pixel Amplitude Balance Coefficient. Coefficient to be applied for pixel RCS amplitude balance of this channel against the others (at least 1 polar channel has mag = 1) where a channel is a collection specified by polarization of the antenna on transmit and receive. Default = 00000000 when POL (index 8700) = N or POL_BAL (index 9000) is U. c.cccccc Default = 00000000. 00000000 is required when POL (index 8700) = N or POL_BAL (index 9000) is U.	N/8	0.000000 to 0.999999 or 00000000	<R>
9200	POL_BAL_PHS	Pixel Phase Balance Coefficient. Coefficient to be applied for pixel phase balance of this channel against the others (at least 1 polar channel has phase = 0). Default = 00000000. 00000000 is required when POL (index 8700) = N or POL_BAL (index 9000) is U.	N/8	±n.nnnnn 0.000000 to 9.999999 (radians) or 00000000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
9300	POL_HCOMP	Radar Hardware Phase Balancing. Radar hardware phase balancing required to give a flat response in fast time to a sphere return. A = Balancing coefficients have not been applied and are provided in fields 9400-9500. B = Data has balanced channels, coefficients not provided in fields 9100-9200. C = Balancing coefficients have been applied and are provide in fields 9100-9200 U = Unbalanced channels, no coefficients given; no balancing applied Default = Space. Space is required when POL (index 8700) = N	A/1	A B C U space	<R>
9400	POL_HCOMP_ BASIS	Basis Set. Name of the basis set for phase balancing coefficients. This list is extensible through the STANAG 4545 Custodian. LEGENDRE POLYNOMIAL Default = 10 spaces. 10 spaces are required when POL (index 8700) = N or POL_BAL (index 9000) is U.	A/10	LEGENDRE POLYNOMIAL or 10 spaces	<R>
9500	POL_HCOMP_ COEF_1	First Radar Hardware Phase Balancing. Radar hardware phase balancing first coefficient needed to give a flat response in fast time to a sphere return Default = 00000000. 00000000 is required when POL (index 8700) = N or POL_BAL (index 9000) is U.	N/9	-99999999 to 999999999 (may include explicit decimal point) or 000000000	<R>
9600	POL_HCOMP_ COEF_2	Second Radar Hardware Phase Balancing. Radar hardware phase balancing second coefficient needed to give a flat response in fast time to a sphere return Default = 000000000. 000000000 is required when POL (index 8700) = N	N/9	-99999999 to 999999999 (may include explicit decimal point) or 000000000	<R>
9700	POL_HCOMP_ COEF_3	Third Radar Hardware Phase Balancing. Radar hardware phase balancing third coefficient needed to give a flat response in fast time to a sphere return Default = 000000000. 000000000 is required when POL (index 8700) = N	N/9	-99999999 to 999999999 (may include explicit decimal point) or 000000000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
9800	POL_AFCOMP	Radar Autofocus Phase Balancing. Autofocus has been done the same or differently for each channel, where a channel is a collection specified by polarization of the antenna on transmit and receive. This list is extensible through the STANAG 4545 Custodian. A = Autofocus applied to this channe using the same methods and coefficients as for the other channels. D = Different autofocus applied to this channel than to the other channels. M= Master autofocus channel. Autofocus derived from this channel is used on the other channels. N = No autofocus applied to this channel Default = Space. Space is required when POL (index 8700) = N	A/1	A D M N space	<R>
9900	POL_SPARE_A	Spare alpha field. Default = 15 spaces	A/15	15 spaces	<R>
10000	POL_SPARE_N	Spare numeric field. Default = 000000000	N/9	000000000	<R>
10100	T_UTC_ YYYYMMMDD	Collection Date. The 4 digit year, letter month and Universal Time Coordinated (UTC) date. This field and the next time field establishes the date/ time of collection (e.g. at center of aperture reference point) for complex-image data contained in this file. Note: The date found in this field may or may not match the IDATIM field found in the image subheader.	A/9	YYYYMMMDD	R
10200	T_HHMMSSUTC	Collection Time. The UTC hours, minutes and seconds, 24 hour clock, associated with the data set. This field and the previous date field establishes the date/ time of collectior (e.g. at center of aperture) for complex-image data contained in this file. Note: The time found in this field may or may not match the IDATIM field found in the image subheader.	N/6	HHMMSS	R
10300	T_HHMMSSLOCAL	Civil Time of Collection. Local civil time of collection, 24 hour clock. Default = six spaces	A/6	HHMMSS or 6 spaces	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
10400	CG_SRAC	Slant Range at Sensor Reference Center. Distance from the sensor reference point (e.g. aperture reference point) to the ground reference point. mmmmmmmm.mm	N/11	00000000.00 to 99999999.99 (m)	R
10500	CG_SLANT_ CONFIDENCE	Slant Range 95% Confidence Interval. The accuracy at the 95% confidence interval of the slant range measurement. This is the magnitude of the confidence interval. mmmm.mm Default = 0000000	N/7	0000.00 to 9999.99 (m) or 0000000	<R>
10600	CG_CROSS	Cross Track Range at Sensor Reference Center. (Aperture Center) Distance from the sensor reference point center to the broadside point on the scene center line. mmmmmmmm.mm Default = 00000000000	N/11	00000000.00 to 99999999.99 (m) or 00000000000	<R>
10700	CG_CROSS_ CONFIDENCE	Cross Track Range at Sensor Reference Center 95% Confidence Interval. (aperture reference point) The accuracy at the 95% confidence interval of the cross track range measurement. This is the magnitude of the confidence interval. Default = 0000000	N/7	0000.00 to 9999.99 (m) or 0000000	<R>
10800	CG_CAAC	Cone Angle at Sensor Reference Point. (aperture reference point) The angle, measured at the radar, between the reference velocity vector and the reference range vector. ±ddd.dddd	N/9	±ddd.dddd (deg) ±179.000 deg	R
10900	CG_CONE_ CONFIDENCE	Cone Angle 95% Confidence. The accuracy at the 95% confidence interval of the Cone Angle measurement. This is the magnitude of the confidence interval. d.dddd Default = 000000	N/6	0.0000 to 0.9999 (deg) or 000000	<R>
11000	CG_GPSAC	Ground Plane Squint Angle. The Ground Plane Squint Angle is the angle measured from cross track (broadside) to the great circle joining the ground point directly below the Sensor Reference Point (SRP) to the Output Reference Point (ORP). Forward looking Squint Angles range from 0 (broadside) to +89 degrees and aft looking Squint Angles range from broadside to -89 degrees. ±dd.dddd	N/8	±dd.dddd (deg)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
11100	CG_ GPSAC_CONFIDENCE	Squint Angle 95% Confidence. The accuracy at the 95% confidence interval of the Squint Angle measurement. This is the magnitude of the confidence interval. d.dddd Default = 000000	N/6	0.0000 to 0.9999 (deg) or 000000	<R>
11200	CG_SQUINT	Slant Plane Squint Angle. The Squint Angle is the angle measured from cross track (broadside) in the slant plane to the vector joining the Aperture Reference Point (ARP) to the Output Reference Point (ORP). Forward looking Squint Angles range from 0 (broadside) to +89 degrees and aft looking Squint Angles range from broadside to -89 degrees. ±dd.dddd	N/8	±dd.dddd (deg)	R
11300	CG_GAAC	Grazing Angle at Sensor Reference Point Center. (aperture center) The angle, measured at the Output Reference Point, between the ground plane and the Reference Position Vector. dd.dddd	N/7	00.0000 to 89.9999(deg)	R
11400	CG_GAAC_ CONFIDENCE	Grazing Angle at Sensor Reference Point Center 95% Confidence. The accuracy at the 95% confidence interval of the Grazing Angle at Aperture Center measurement d.dddd Default = 000000	N/6	0.0000 to 0.9999 (deg) or 000000	<R>
11500	CG_INCIDENT	Incidence angle. The angle between an incoming beam and the perpendicular to the object surface at the point of incidence. This value is the compliment of the grazing angle (index 11300). dd.dddd Default = 0000000	N/7	00.0000 to 89.9999 (deg) or 0000000	<R>
11600	CG_SLOPE	Slope angle. The angle between the slant plane and the focus plane of the image i.e. cross track grazing angle. ±dd.ddd Default = 0000000	N/7	±dd.ddd (deg) 00.0000 to 89.9999 or 0000000	<R>
11700	CG_TILT	Tilt angle. The angle between the respective Y axes of the slant plane and the focus plane coordinate systems. ±dd.dddd Default = 00000000	N/8	±dd.dddd (deg) ±44.9999 or 00000000	<R>
11800	CG_LD	Look Direction. Indicates which side of the imaging platform the image was taken, left or right of the velocity vector.	A/1	L, R	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
11900	CG_NORTH	North Relative to the Top Image Edge. Angle from right (defined at the top edge of the image i.e. first row of the image data when the origin (0,0) is located at the upper left corne of the patch) counter-clockwise to north. e.g. On an image viewed north up, this angle is 90 deg. ddd.dddd	N/8	ddd.dddd (deg) 000.0000 to 359.9999	R
12000	CG_NORTH_ CONFIDENCE	North Angle 95% Confidence. The accuracy at the 95% confidence interval of the North Angle measurement. d.dddd Default = 000000	N/6	0.0000 to 9.9999 (deg) or 000000	<R>
12100	CG_EAST	East Relative to the Top Image Edge. Angle from right (defined at the top edge of the image) counter-clockwise to east. e.g. On an image viewed north up, this angle is 0 deg. ddd.dddd	N/8	ddd.dddd (deg) 000.0000 to 359.9999	R
12200	CG_RLOS	Range LOS Relative the Top Image Edge. Angle from right (defined at the top edge of the image) counter-clockwise to the LOS from near range to far range. Note: This points in the general direction away from the SAR. ddd.dddd	N/8	ddd.dddd (deg) 000.0000 to 359.9999	R
12300	CG_LOS_ CONFIDENCE	Range LOS 95% Confidence. The accuracy at the 95% confidence interval of the range LOS angle measurement. This is the magnitude of the confidence interval. d.dddd Default = 000000	N/6	0.0000 to 9.9999 (deg) or 000000	<R>
12400	CG_LAYOVER	Layover Angle. Angle from right (defined at the top edge of the image) counter-clockwise to the layover direction. Note: This points in the general direction of the SAR. ddd.dddd Default = 00000000	N/8	ddd.dddd (deg) 000.0000 to 359.9999 or 00000000	<R>
12500	CG_SHADOW	Shadow Angle. Angle from right (defined at the top edge of the image) counter-clockwise to the angle at which shadows fall behind illuminated targets. Note: This points in the general direction away from the SAR. ddd.dddd Default = 00000000	N/8	000.0000 to 359.9999 (deg) or 00000000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
12600	CG_OPM	Out of Plane Motion. Maximum angle between the slant plane and imaging platform flight path with respect to the ground reference point. nnn.nnn Default = 0000000	N/7	nnn.nnn (miliarcsec) 000.000 to 999.999 or 0000000	<R>
12700	CG_MODEL	Nominal Geometry Reference. Geometry Coordinate System used for the Collection Geometry Data Items. This geometry applies to fields 12800 - 137000 and 14400 - 14800 and 15900 – 16100. These fields come in triples *_X, *_Y, *_Z.. The X field is used for the first coordinate (WGS latitude; ECEF distance from the center of the earth to an earth surface point), The _Y field is used for the second (WGS longitude; ECEF distance from the center of the earth through the equator 90 deg. east) and _Z the third (WGS altitude; ECEF from the center of the earth through the north pole 90 deg. east). This list is extensible through the STANAG 4545 Custodian. ECEF = Earth Centered Earth Fixed (meters from geocenter) WGS84 = Latitude (deg) Longitude (deg) Alt (m) XYZSC = local flat earth coords; scene center as origin	A/5	XYZSC ECEF WGS84	R
12800	CG_AMPT_X	Aimpoint of Antenna, x. (Illum. Ref Pt.). x coordinate of the center of the antenna beam pattern aimpoint at the sensor reference point. If index 12700 has ECEF or XYZSC use meters. If WGS84 use degrees. ±dddddddd.ddd or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0089.9999999 (deg)	R
12900	CG_AMPT_Y	Aimpoint of Antenna, y. (Illum. Ref Pt.) y coordinate of the center of the antenna beam pattern aimpoint at the sensor reference point. If index 12700 has ECEF or XYZSC use meters. If WGS84 use degrees. ±mmmmmmmm.mmm or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0179.9999999 (deg)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
13000	CG_AMPT_Z	Aimpoint of Antenna, z. (Illum. Ref Pt.). z coordinate of the center of the antenna beam pattern aimpoint at the sensor reference point. ±mmmmmmmm.mmm	N/13	±99999999.999 (meters)	R
13100	CG_AP_CONF_XY	Aimpoint X,Y 95% Confidence. States the 95% confidence at the horizontal aimpoint measurement Circular Error distance. Default = 000000	N/6	000000 to 999.99 (meters) or 000000	<R>
13200	CG_AP_CONF_Z	Aimpoint Z 95% Confidence. States the confidence at the vertical aimpoint measurement as a Linear Error Percent Distance. Default = 000000	N/6	000000 to 999.99 (meters) or 000000	<R>
13300	CG_APCEN_X	Sensor Reference Point, x. x component of the sensor position at the sensor reference point (e.g. aperture center). If index 12700 has ECEF or XYZSC use meters. If WGS84 use degrees. ±mmmmmmmm.mmm or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0089.9999999 (deg)	R
13400	CG_APCEN_Y	Sensor Reference Point, y. y component of the sensor position at the sensor reference point (e.g. aperture center). If index 12700 has ECEF or XYZSC use meters. If WGS84 use degrees. ±mmmmmmmm.mmm or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0179.9999999 (deg)	R
13500	CG_APCEN_Z	Sensor Reference Point, z. z component of the sensor position at the sensor reference point (e.g. aperture center). ±mmmmmmmm.mmm	N/13	±99999999.999 (meters)	R
13600	CG_APER_CONF_XY	Sensor Reference Point X,Y 95% Confidence. States the 95% confidence at the horizontal sensor reference point (e.g. aperture center) measurement Circular Error distance. mmm.mm Default = 000000	N/6	000.00 to 999.99 (meters) or 000000	<R>
13700	CG_APER_CONF_Z	Sensor Reference Point Z 95% Confidence. States the 95% confidence at the vertical sensor reference point (e.g. aperture center) measurement Linear Error distance. mmm.mm Default = 000000	N/6	000.00 to 999.99 (meters) or 000000	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
13800	CG_FPNUV_X	Focus Plane Normal Unit Vector, x. x component of the unit vector perpendicular to the focus plane.	N/9	-1.000000 to +1.000000 (unitless)	R
13900	CG_FPNUV_Y	Focus Plane Normal Unit Vector, y. y component of the unit vector perpendicular to the focus plane.	N/9	-1.000000 to +1.000000 (unitless)	R
14000	CG_FPNUV_Z	Focus Plane Normal Unit Vector, z. z component of the unit vector perpendicular to the focus plane.	N/9	-1.000000 to +1.000000 (unitless)	R
14100	CG_IDPNUVX	Image Display Plane Normal Unit Vector, x. x component of the unit vector perpendicular to the plane of the formed image	N/9	-1.000000 to +1.000000 (unitless)	R
14200	CG_IDPNUVY	Image Display Plane Normal Unit Vector, y. y component of the unit vector perpendicular to the plane of the formed image.	N/9	-1.000000 to +1.000000 (unitless)	R
14300	CG_IDPNUVZ	Image Display Plane Normal Unit Vector, z. z component of the unit vector perpendicular to the plane of the formed image.	N/9	-1.000000 to +1.000000 (unitless)	R
14400	CG_SCECN_X	Scene Center, x. Image Output Reference Point, x coordinate in the ground plane. If index 12700 has ECEF or XYZSC use meters, if WGS84 use degrees. ±mmmmmmmm.mmm or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0089.9999999 (deg)	R
14500	CG_SCECN_Y	Scene Center, y. Image Output Reference Point, y coordinate in the ground plane. If index 12700 has ECEF or XYZSC use meters, if WGS84 use degrees. ±mmmmmmmm.mmm or ±dddd.ddddddd	N/13	±99999999.999 (meters) or ±0179.9999999 (deg)	R
14600	CG_SCECN_Z	Scene Center, z. Image Output Reference Point, z coordinate. ±mmmmmmmm.mmm	N/13	±99999999.999 (meters)	R
14700	CG_SC_CONF_XY	Scene Center X,Y 95% Confidence. States the 95% confidence at the scene center horizontal measurement (ground plane) as a circular error distance. mmm.mm	N/6	000.00 to 999.99 (meters)	R
14800	CG_SC_CONF_Z	Scene Center Z 95% Confidence. States the 95% confidence at the scene center vertical measurement as a Linear error distance. mmm.mm	N/6	000.00 to 999.99 (meters)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
14900	CG_SWWD	Swath Width. Range width for a SAR strip map or scan mode. The refers to the slant plane image segment and patch width in the range direction. If frame image, value equals range width. mmmmm.mm	N/8	00000.00 to 99999.99 (meters)	R
15000	CG_SNVEL_X	Sensor Nominal Velocity, x'. x component of the sensor velocity at the sensor reference point. ±mmmmm.mmm	N/10	±99999.999 (m/sec)	R
15100	CG_SNVEL_Y	Sensor Nominal Velocity, y'. y component of the sensor velocity at the sensor reference point. ±mmmmm.mmm	N/10	±99999.999 (m/sec)	R
15200	CG_SNVEL_Z	Sensor Nominal Velocity, z'. z component of the sensor velocity at the sensor reference point. ±mmmmm.mmm	N/10	±99999.999 (m/sec)	R
15300	CG_SNACC_X	Sensor Nominal Acceleration x". x component of the sensor acceleration at the sensor reference point. ±mmmmm.mmm	N/10	±99.999999 (m/sec^2)	R
15400	CG_SNACC_Y	Sensor Nominal Acceleration y". y component of the sensor acceleration at the sensor reference point. ±mmmmm.mmm	N/10	±99.999999 (m/sec^2)	R
15500	CG_SNACC_Z	Sensor Nominal Acceleration z". z component of the sensor acceleration at the sensor reference point. ±mmmmm.mmm	N/10	±99.999999 (m/sec^2)	R
15600	CG_SNATT_ROLL	Sensor Nominal Attitude Roll. Sensor angular attitude around the nominal velocity vector at the sensor reference point (e.g. aperture center). ±ddd.ddd Default = -9999999 = NA = Not Applicable	N/8	±179.999 (deg) or -9999999	<R>
15700	CG_SNATT_PITCH	Sensor Nominal Attitude Pitch. Sensor angular attitude around the pitch axis at the sensor reference point. ±ddd.ddd Default = -9999999 = NA = Not Applicable	N/8	±179.999 (deg) or -9999999	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
15800	CG_SNATT_YAW	Sensor Nominal Attitude Yaw. Sensor angular attitude around the yaw axis at the sensor reference point (e.g. aperture center). ±ddd.ddd Default = -9999999 = NA = Not Applicable	N/8	±359.999 (deg) or -9999999	<R>
15900	CG_GTP_X	Geoid Tangent Plane Normal, x. x component of the unit vector perpendicular to the reference geoid (reference geoid WGS84) at the output reference point. Default = 000000000	N/9	-1.000000 to +1.000000 (unitless) or 000000000	<R>
16000	CG_GTP_Y	Geoid Tangent Plane Normal, y. y component of the unit vector perpendicular to the reference geoid (reference geoid WGS84) at the output reference point. Default = 000000000	N/9	-1.000000 to +1.000000 (unitless) or 000000000	<R>
16100	CG_GTP_Z	Geoid Tangent Plane Normal, z. z component of the unit vector perpendicular to the reference geoid (reference geoid WGS84) at the output reference point. Default = 000000000	N/9	-1.000000 to +1.000000 (unitless)	<R>

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
16200	CG_MAP_TYPE	Mapping Coordinate. Type of mapping coordinate used. This list is extensible through the STANAG 4545 Custodian. GEOD = GEOgraphic Decimal degrees Latitude/Longitude (deg) Note: Field indexes 16300 through 17400 only appear when CG_MAP_TYPE (Index 16200) has value GEOD (133 bytes). MGRS = Military Grid Reference System UTM (Universal Transverse Mercator) expressed in MGRS uses the format: zzBJKeeeeeeennnnnnn where " zzBJK" represents the zone band and 100 km square with in the zone, and "eeeeeee' and "nnnnnnn" represent residuals of easting and northing. NA = Not Applicable Note: Field indexes 17500 – 18100 only appear when CG_MAP_TYPE (Index 16200) has value MGRS (133 bytes). NOTE: 133 space characters if fields can not be populated.	A/4	GEOD MGRS NA	R
NOTE: Field indexes 16300 through 17400 only appear when CG_MAP_TYPE (Index 16200) has value GEOD.					
16300	CG_PATCH_ LATCEN	Latitude of the Patch Center. Latitude of the patch image center ±dd.ddddddd	N/11	±89.9999999 (deg)	C
16400	CG_PATCH_ LNGCEN	Longitude of the Patch Center. Longitude of the patch image center ±ddd.ddddddd	N/12	±179.9999999 (deg)	C
16500	CG_PATCH_ LTCORUL	Latitude of the Patch Corner, upper left. ±dd.ddddddd	N/11	±89.9999999 (deg)	C
16600	CG_PATCH_ LGCORUL	Longitude of the Patch Corner, upper left. ±ddd.ddddddd	N/12	±179.9999999 (deg)	C
16700	CG_PATCH_ LTCORUR	Latitude of the Patch Corner, upper right. ±dd.ddddddd	N/11	±89.9999999 (deg)	C
16800	CG_PATCH_ LGCORUR	Longitude of the Patch Corner, upper right. ±ddd.ddddddd	N/12	±179.9999999 (deg)	C

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYPE
16900	CG_PATCH_ LTCORLR	Latitude of the Patch Corner, lower right. ±dd.ddddddd	N/11	±89.9999999 (deg)	C
17000	CG_PATCH_ LGCORLR	Longitude of the Patch Corner, lower right. ±ddd.ddddddd	N/12	±179.9999999 (deg)	C
17100	CG_PATCH_ LTCORLL	Latitude of the Patch Corner, lower left. ±dd.ddddddd	N/11	±89.9999999 (deg)	C
17200	CG_PATCH_ LNGCOLL	Longitude of the Patch Corner, lower left. ±ddd.ddddddd	N/12	±179.9999999 (deg)	C
17300	CG_PATCH_LAT_ CONFIDENCE	Latitude 95% Confidence. The accuracy at the 95% confidence interval of the patch latitude measurement.	N/9	0000000000 to 9.9999999 (deg)	C
17400	CG_PATCH_LONG_ CONFIDENCE	Longitude 95% Confidence. The accuracy at the 95% confidence interval of the patch longitude measurement.	N/9	0.0000000 to 9.9999999 (deg)	C
NOTE: Field indexes 17500 through 18100 only appear when CG_MAP_TYPE (Index 16200) has value MGRS.					
17500	CG_MGRS_CENT	MGRS Image Center.	A/23	zzBJKeeeeeeeeennnnnnnnn	C
17600	CG_MGRSCORUL	MGRS Image Upper Left Corner.	A/23	zzBJKeeeeeeeeennnnnnnnn	C
17700	CG_MGRSCORUR	MGRS Image Upper Right Corner.	A/23	zzBJKeeeeeeeeennnnnnnnn	C
17800	CG_MGRSCORLR	MGRS Image Lower Right Corner.	A/23	zzBJKeeeeeeeeennnnnnnnn	C
17900	CG_MGRCORLL	MGRS Image Lower Left Corner.	A/23	zzBJKeeeeeeeeennnnnnnnn	C
18000	CG_MGRS_ CONFIDENCE	MGRS 95% Confidence. The accuracy at the 95% confidence interval of the MGRS measurement. mmmm.mm	N/7	0000.00 to 9999.99 (meters)	C
18100	CG_MGRS_PAD	MGRS Blank Padding. Fills MGRS conditional portion to same length as the Lat/Long conditional.	A/11	ASCII spaces	C
NOTE: Field index 18150 only appears when CG_MAP_TYPE (Index 16200) has value NA.					
18150	CG_MAP_TYPE_ BLANK	Blank Fill. Fill with blanks if GEOD or MGRS are Not Applicable.	A/133	133 spaces	C
18200	CG_SPARE_A	Spare alpha field. Blank fill.	A/144	Space	<R>
18300	CA_CALPA	Radiometeric Calibration Parameter. System specific radiometric calibration parameter. Default = 0000000	N/7	nnnnnnn 0.00000 to 999.999 or 0000000	<R>
18400	WF_SRTFR	Chirp Start Frequency. Beginning frequency of transmitted linear chirp signal. HHHHHHHHHHHH.H	N/14	000000000000.0 to 999999999999.9 (Hz)	R

INDEX	FIELD	FIELD NAME AND DESCRIPTION	SIZE BYTES	VALUE RANGE	TYP E
18500	WF_ENDFR	Chirp End Frequency. Ending frequency of transmitted linear chirp signal. HHHHHHHHHHHH.H	N/14	000000000000.0 to 999999999999.9 (Hz)	R
18600	WF_CHRPRT	Chirp Rate. The ramp frequency of the linear FM chirp signal. ±MM.MMMMMM 000000000 = nonchirp signal	N/10	±99.999999 (MHz/msec) or 0000000000	R
18700	WF_WIDTH	Pulsewidth. Length of out going linear chirp pulses. s.sssssss	N/9	0.0000000 to 0.9999999 (sec)	R
18800	WF_CENFRQ	Center frequency. Center frequency of the transmitted linear chirp signal. HHHHHHHHHHH.H	N/13	00000000000.0 to 99999999999.9 (Hz)	R
18900	WF_BW	Chirp Bandwidth. Bandwidth of the transmitted linear chirp signal. HHHHHHHHHHH.H	N/13	00000000000.0 to 99999999999 .9 (Hz)	R
19000	WF_PRF	Pulse Repetition Frequency (PRF). Frequency of pulse in the pulse train, in Hz. HHHHH.H	N/7	00000.0 to 99999.9 Hz	R
19100	WF_PRI	Pulse Repetition Interval. Interpulse periods = 1/PRF s.sssssss	N/9	0.0000000 to 0.9999999 sec	R
19200	WF_CDP	Coherent Data Period. Indicates the duration of the SAR imaging operation (i.e. how long the radar beam painted the target). sss.sss	N/7	000.000 to 100.000 sec	R
19300	WF_NUMBER_OF_PULSES	Number of Pulse. The maximum number of pulses used to form this image.	N/9	2 to 999999999	R
19400	VPH_COND	VPH Data. The field is used to determine whether VPH is included in this support data tag. Y = Yes, VPH conditional fields will be present N = N, if VPH conditional fields will be not present	A/1	N	R

APPENDIX A
DEFINITIONS FOR MAGNITUDE IMAGERY PIXEL VALUE REPRESENTATION BASED ON COMPLEX I AND Q VALUES.

This Appendix describes the definitions for the magnitude representations of the pixel values used in SAR data. These representations are based on the use of complex data samples using in-phase (I) and quadrature-phase (Q) values, although the magnitude value (M) of magnitude-phase samples can also be represented in this fashion. The magnitude of the samples can be described in either power or voltage, which have a squared relationship.

Power = **Intensity** = $I^2 + Q^2$ can be 32-bit Integer or Floating Point

Voltage = **Amplitude** = $\sqrt{I^2 + Q^2}$ can be 16-bit integer or 32-bit Floating Point

A pixel **Magnitude** is either an amplitude or an intensity scaled to minimize pixel oversaturation (pixels at highest display level) and pixel under saturation (pixels at the lowest display level) when mapped into an unsigned (normally 8-bit) integer for display. **Scaling** applies a multiplication factor to the image or image block by a value chosen to maximize best use of the pixel value type's dynamic range while minimizing pixel over- and under- saturation. Scaling may be linear, logarithmic, or a combination (lin-log). For lin-log, a transition point (pixel value) from linear to logarithmic representation is chosen to optimize the qualities (e.g., display) while maximizing pixels in the linear region and minimizing pixel over- and under-saturation.

The following are descriptive examples for calculating the magnitude imagery pixel values for Linear Magnitude, Linear Power, Log Magnitude, Log Power, and Lin-Log Magnitude. Actual implementations may vary.

Linear Magnitude (LINM)

$$LINM = Amplitude = \sqrt{I^2 + Q^2}$$

If LINM is outputted in N-bit unsigned integer notation and the computations were performed in IEEE 32-bit floating point notation, then:

$$LINM = INT(Lin\_Scale\_Factor \sqrt{I^2 + Q^2})$$

where Lin_Scale_Factor for linear magnitude is the normalization factor for the conversion and is provided in IEEE 32-bit floating point. A typical scale factor is:

$$Lin\_Scale\_Factor = \frac{2^N - 1}{M_{pk}}$$

where M_{pk} is the peak magnitude of the image block.

Linear Power (LINP)

$$LINP = \text{Intensity} = I^2 + Q^2$$

If LINP is outputted in N-bit unsigned integer notation and the computations were performed in IEEE 32-bit floating point notation, then:

$$LINP = INT[Lin\_Scale\_Factor(I^2 + Q^2)]$$

where Scale_Factor for linear power is the normalization factor for the conversion and is provided in IEEE 32-bit floating point. A typical scale factor is:

$$Lin\_Scale\_Factor = \frac{2^N - 1}{P_{pk}}$$

where P_{pk} is the peak power of the image block.

Log Magnitude (LOGM)

There are various methods to computing the log magnitude so that its output is in N-bit unsigned integer notation. In general, the log magnitude can be computed by:

$$LOGM = INT\left[\frac{20\log_{10}(LINM)}{DBperSTEP}\right]$$

limit: $0 = LOGM = 2^N\text{-}1$

where LINM is the linear magnitude, and DBperSTEP is the number of decibels per output step. The ASARS-2 system uses the above form of the LOGM algorithm to remap LINM 32768 levels into 255 gray levels. Gray level “bins” are determined as follows:

dB/bin = DBperSTEP = 20*log10(32768)/255 = 0.376288
(or approximately 3/8 dB per step).

Log Power (LOGP)

Similar to LOGM, if power is available, the log power in N-bit unsigned integer notation can be computed by:

$$LOGP = INT\left[\frac{10\log_{10}(LINP)}{DBperSTEP}\right]$$

limit: $0 = LOGP = 2^N\text{-}1$

where LINP is the linear power, and DBperSTEP is the number of decibels per output step.

Lin-Log Magnitude (LLM)

There are various algorithms to calculate lin-log magnitude. The form of the lin-log magnitude equation in general use is:

For pixel value < Transition Point,

$$\textit{Lin-Log Magnitude} = \; LINM = INT\,(Lin\_Scale\_Factor\sqrt{I^2 + Q^2}\,);$$

For pixel value $\geq$ Transition Point,

$$\textit{Lin-Log Magnitude} = \; LOGM = INT\left[\frac{20\log_{10}(LINM)}{DBperSTEP}\right]$$

Where the Transition Point is 117, the lin-log magnitude equation is:

Lin-Log Magnitude = 17 $\log_2$ (*LINM*) = 56.4728 $\log_{10}$ (*LINM*).

For this form, the Lin_Scale_Factor used to calculate *LINM* is picked to drive the average image power to the range 300 < Avg_Power < 4000, where 2000 is currently specified for lin-log magnitude imagery.

Phase

Phase is the four quadrant arctan(Q/I) over the range of 0 to 2π radians. Phase may be represented by a real (32-bit floating-point) value type, or by an n-bit unsigned integer. If the data type is integer, we restrict phase to unsigned because there is only one pixel value type (PVTYPE) field in the NSIF image subheader. Hence, in the magnitude/phase mode, the PVTYPE must be set to 'INT' versus 'SI' since magnitude is always unsigned. For floating point ('R'), phase can be signed. Note that when the 'C' mode is specified, the complex data type is I, Q interleaved with a 32-bit floating point value per component. Otherwise, PVTYPE will be set to 'INT' or 'R', and the complex format is specified by CMETAA fields. Note that CMETAA overrides the size of the 'INT' field from a fixed 16 bits. In the integer mode, one way phase may be scaled is by using an n-bit uniform scalar quantizer which divides the 2π radians of phase into 2^n quanta, each $\frac{2p}{2^n}$ radians. This quantizer is denoted 'UQ1' in the CMPLX_PHASE_QUANT_FLAG in CMETAA. For example, an 8-bit USQ represents phase by 256 quanta, each $\frac{p}{128}$ radians. Another way (UQ2) phase may be scaled is centering the steps $\frac{2p}{2^n}$ over the 2^n quanta. Thus, for the 8-bit example, in UQ1, a step value of 0 corresponds to phase in the range from 0 to $\frac{p}{128}$ radians, while in UQ2, a step value of 0 corresponds to phase in the range from –0.5* $\frac{p}{128}$ radians to 0.5* $\frac{p}{128}$ radians.

DeciBels

The decibel relationship between amplitude and intensity is:

20 $\log_{10}$ (Amplitude) = 10 $\log_{10}$ (Intensity).

Definitions for Complex Imagery Weighting

Spatially Variant Apodization (SVA)

SVA is a sidelobe reduction technique that applies a windowed (e.g., 3 x 3 or 5 x 5) convolution test to the complex image. Sidelobe reduction techniques based on the convolution test results are applied to each region tested and vary spatially.

Taylor Weights

Taylor Weights are applied to I, Q data. Data and are later converted to M, P in some systems. The discrete Taylor window is specified by three parameters N, $\bar{n}$, and SLL where:

- N is the number of coefficients in the Taylor window;
- $\bar{n}$ is the number of nearly constant-level sidelobes adjacent to the mainlobe;
- SLL is the peak sidelobe level (in dB) relative to the mainlobe peak.

Typical choices for values are SLL=-30 dB with $\bar{n}$=4 and SLL = -35 dB with $\bar{n}$=5, with N dictated by the number of range or azimuth signal history samples being processed. The weights are computed as follows:

$$W(n) = 1 + 2\sum_{m=1}^{\bar{n}-1} F_m \cos\left[\frac{2\pi m(n - N/2 + 0.5)}{N}\right] \qquad \text{for } n = 0, 1, ..., N\text{-}1.$$

F_m are cosine weights determined by:

$$F_m = \frac{(-1)^{(m+1)} \prod_{i=1}^{\bar{n}-1}\left[1 - \frac{m^2/\sigma^2}{A^2 + (i-0.5)^2}\right]}{2\prod_{\substack{j=1 \\ j\neq m}}^{\bar{n}-1}\left(1 - m^2/j^2\right)}$$

where:

$$A = \frac{\ln\left(B + \sqrt{(B^2 - 1)}\right)}{\pi}, \quad B = 10^{-\frac{SLL}{20}}, \ \text{ and } \ \sigma^2 = \frac{\bar{n}^2}{A^2 + (\bar{n} - 0.5)^2}$$

The computational procedure requires $\bar{n} \geq 2A^2 + 0.5$

Hanning, Hamming, Unweighted Weights

$$W(n) = 1 - 2w\cos\left(\frac{2\pi n}{N}\right) \qquad \text{for } n = 0, 1, ..., N\text{-}1.$$

where: Unweighted: w = 0
Hanning: w = 0.5
Hamming: w = 0.42

Note: The terms “Range and Azimuth” refer to the two dimensions of the image or image block and may be interchanged with “Range and Doppler”, “Range and Cross-Range”, “Track and Cross-Track” and “Scan and Cross-Scan” as appropriate.