SAR Data Products Format Standard

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Synthetic Aperture Radar Data Product Format Standards

(CEOS-SAR-CCT Iss/Rev: 2/0)

by

CEOS WGD on SAR Data Standards
(February 10, 1989)

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BACKGROUND OF CEOS-WGD

Remote sensing from space has greatly evolved from an initial situation of restricted applications satellite programs to a phase where the existing missions can be distinguished by the technology employed, rather than by the disciplines served in system operations. A variety of international, national, and regional space-borne earth observation systems, will, in future operate at the same time, and support both interdisciplinary and international applications.

The organisation of international co-operation in space-borne earth observations systems IS also evolving, from aspects specific to missions to interdisciplinary co-ordination of Multi-mission programs.

Discussions and co-operation between agency representatives of USA, ESA, Canada, Japan, India, France etc. have emphasised the utility of space-borne earth observation data to users world-wide, encouraged the co-ordination of program plans among space-borne earth observation system operators, and incited the international receptivity and acceptance of, space-borne earth observation system activities and applications.

Therefore the representatives of a large number of international, national, and regional space-borne earth observation systems, considering the overlap of space-borne earth observation mission objectives, the inter-disciplinary applications of remotely sensed data, the advantages of ongoing communication and co-operation among space-borne earth observation system operators, have affirmed the value of the activities described above, and have agreed to co-ordinate informally their current and planned Systems for earth observations from space, through the organisation of a Committee on Earth Observation Satellites (CEOS).

The CEOS is not meant to take the place of current or potential agreements by members, but, instead, serves to promote the international growth and potential benefits of space-borne observation of the earth.

Participation in its activities does not impose any preclusion upon space-borne earth observation system operators, leaving to these ones the right to develop and manage earth observation systems according to their needs.

CEOS tries to enhance the advantages of space-borne earth observations for its members and international user community. It serves as a forum for the exchange of information on technical subjects, and encourages complementarity and compatibility among space-borne earth observation systems that are currently in service or development.

Co-operation in the development and management of remote sensing programs, co-operation in mission planning and development of compatible data products, services and applications, can improve complementarity and compatibility and be of benefit to operators of space-borne earth observation systems and to users of earth observation data.

CEOS members exchange technical information and pursue the potential for co-ordination of space and ground segments. Such co-ordination includes discussions on current and future mission parameters, sensor capabilities, sensor intercalibration, and data, telemetry downlink characteristics.

In addition, earth observation systems co-ordination within CEOS can address issues of ground station technical compatibility for back-up satellite tracking, command and control, and sensor and telemetry data reception.

The CEOS members look into the means for increasing data utility and cost-effectiveness, for both operators and users. CEOS activity includes co-ordination of data acquisition, sampling and pre-processing methodologies, standardisation of data formats, where appropriate, increase in compatibility of data archives, enhancement of user access to CEOS member data bases, information products, application services. They also try to make sure that the user community is informed about their current and future satellite programs and encourage discussions between the users and the relevant satellite system -operators, as necessary.

CEOS convenes at least once every two years in plenary session. In its plenary session, CEOS may establish on an ad hoc basis, special temporary Working Groups.

These groups are in charge to investigate specific areas of interest, co-operation, and co-ordination and to report at subsequent plenary meetings. The existence of each ad hoc Working Group is confirmed at each plenary session.

Issues resulting from CEOS plenary sessions, or the findings and Recommendations of ad hoc CEOS Working Groups, will be considered at the discretion of each CEOS member.

At the present there are two such Working Groups specialised on:

- Data Management Aspects (chaired by NOAA
- Intercalibration and Performance (chaired by ESA)

The first Working Group, called Working Group on Data (WGD) was established by the CEOS at its first meeting held on September 24-25,1984.
The objective of such a group is to define areas where progress is feasible and to develop plans for proceeding, bearing in mind the risk of attacking too large a problem and never making any substantial, practical progress. These areas have been identified as:

- International network for data exchange for research
- Data formats
- Archival activities
- User involvement
- Mass storage technology
- Product quality
- Standard reference system
- Catalogue techniques

In order to achieve good results in data management at international level; in order to enhance the benefits of space-borne earth observations for members and international user community; system operators and data managers must ensure, as a

minimum, that all earth observation systems are well documented so that users can easily obtain information about them. In addition, users should be able to obtain and read data from these systems, which suggests format and cataloguing standardisation or compatibility. As a further step, users would like to be able to analyse and merge data from multiple sources. This requires much more extensive co-ordination; generation of common products in common formats, with common quality control, documentation, etc.

Consequently the WGD has set up specific working subgroups on each of the objectives above mentioned.

One of them, (CEOS WGD subgroup on SAR FORMAT STANDARDISATION), is concerned with the examination of SAR formats with the objective of reaching agreement on common approaches for Shuttle-borne radar, airborne radar, ERS-l, and other radar sensors to fly in the future.

This WGD subgroup has worked out a proposal on standards for SAR products on CCT and Photographic support. The case of other media, such as optical disks, will be considered as soon as a standard software interface is available.

The CEOS-WGD has encouraged consideration of compatibility with non-imaging sensors in this endeavour. A report from the SAR subgroup is expected at the time of the next CEOS plenary session (1988)

For the second Working Group the expected outcome of the tasks can be briefly summarised as:

- Optimise the use of equipments, sites, resources, and available expertise for:
  - Calibration,
  - Performance evaluation of sensors with similar characteristics.

- Confront and improve methods for calibration and performance evaluation of sensors, taking advantage, where possible, of intercalibration of similar sensors flying on different platforms.

SCOPE OF DOCUMENT

This document addresses the dissemination of Synthetic Aperture Radar (SAR) data products from the processing facilities to the user community.

Data products may be in the form of framed scenes or continuous strip data, either as unprocessed signal data, or partially processed signal data, fully processed image data, geocoded products (with or without digital elevation correction) and mosaiked geocoded products.

Media for dissemination of such products discussed in this document are, specifically, Computer Compatible Tape (CCT), photographic (film) products. The file structure outlined in this document is compatible with optical disk.

The LGSOWG (LANDSAT GROUND STATION OPERATORS WORKING GROUP) developed and maintained a standard for a "FAMILY OF FORMATS" for international exchange of remotely sensed data and processed products on computer compatible tape (CCT).

With the successful launch of LANDSAT-4 and indications of the high quality data from its sensor, the THEMATIC MAPPER (TM), the LTWG LANDSAT TECHNICAL WORKING GROUP) addressed specific format standardisation issues. Technical complexities of the TM (larger arrays in all three dimensions, forward and reverse scans, thermal calibration of IR. data, etc.) and the variations in data processing at individual stations produced a situation wherein the various formats defined for the data all met the general standard requirements, but yet were very different in terms of specific information content and data organisation.

In light of the interest in, and potential value of TM imagery, the LTWG defined certain fixed record, file and volume formats and recommended their use by all TM data processing and tape producing facilities.

The standard includes a set of records, which forms a superstructure for all data formats of the family and guidelines/directives for organising data within volumes, files, and data records. The objective is to include in each tape format sufficient information (via standard superstructure records) to identify and locate data within the tape, and sufficient common conventions to promote systematic compatibility among the various tape products. Considerable latitude is allowed to designers of individual formats as to content and format of specific data records.

The family of formats was initially maintained by the LTWG, but this function has now passed to the Committee on Earth Observation Satellites (CEOS) Working Group on Data (CEOS-WGD).

Working in parallel with the LGSOWG LTWG, and encouraged by the success of the international TM format, the CEOS-WGD has defined a format to be used internationally for the distribution and exchange of radar data in both video-signal and processed image data form.

RECOMMENDATIONS

The recommendations provided here by the CEOS_WGD for a radar CCT format were based on a review of the concepts used in the preparation of the existing international LANDSAT THEMATIC MAPPER CCT FORMAT as defined by the LGSOWG-LTWG.

An international format under the LGSOWG-LTWG umbrella for the dissemination of SAR data is already in use by Canada, Europe (DFVLR) and some processing facilities in the United States. However, it was felt that a detailed format specification, applicable to a variety of radar sensors, could be developed for implementation by a much broader base of processing facilities. These recommendations have been generalised to cover product definition, logical volume definition, file structure within a logical volume, file classes, record structure within a file, record types and data structure within a record. The major objective of the recommendations is to promote the easy interchange of data from various remote-sensing sources and in particular, the international interchange of radar image data, and raw radar video signal data.

The format relies heavily on the work of the LTWG in terms of both logical volume, file and record formats, using whenever possible identical record format definitions with blank rill for non-relevant fields. The CEOS-WGD recommends its use for all radar data processing and tape producing facilities.

This document addresses itself to the format, content, and organisation of the complete SAR data set, including all support data. It must be used in conjunction with existing standards documentation ("The standard CCT family tape formats", CCB-CCT-0002) in completely defining a given remote sensed tape product.

The formats, medium specific, namely for CCT and Photographic Support, are described in detail in appendix A and B respectively.

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APPENDIX A

Synthetic Aperture Radar Computer Compatible Tape Format Specifications

(CEOS-SAR-CCT Iss/Rev: 2/0)

by

CEOS WGD on SAR Data Standards
(March 1989)

1.0 INTRODUCTION

1.1 FOREWORD

There are three major considerations to be accommodated in the specification of a generalised SAR CCT format. Firstly, the standard CCT format should be defined down to the byte/bit level. Secondly, there should be adequate space for facility-specific information. Thirdly, data not strictly synchronised with the SAR data set (such as platform position information) need to be provided. In addition, it should be possible to readily select parameters relating to the applicability and quality of the data set.

In order to achieve these objectives, the format is defined in terms of one logical volume, called the "SAR Logical Volume". The format definition incorporates two basic superstructure components, namely, the volume directory file and the file descriptor records. These describe in detail the configuration of the logical volume structure and the files contained within it. The data record definitions include specifications for SAR data records along with auxiliary data records such as the data set summary and ancillary information.

This CCT format specification follows the format coding conventions defined for the family of tape formats (LGSOWG CCT Format CCB Document. CCB-CCT-0002E The Standard CCT Family of Tape Formats (Ref.#1)).

1.2 DOCUMENTATION CONVENTIONS

To improve compatibility between different installations, certain conventions have been used for the specification of the data formats on the CCT. The conventions apply to the definitions of the field formats and are described below.

The basic unit of storage on a CCT is defined as an 8-bit byte. All other fields are built up using this basic unit. The order of each byte on the CCT conforms to the LGSOWG family of Standard CCT Formats.

Alphanumeric fields are defined as textual strings containing either textual or alphanumeric information to be interpreted as textual information. The fields are defined as multiples of 8-bit byte fields which contain either the ASCII or EBCDIC binary value of the alphanumeric character. The 8-bit byte fields are stored sequentially on the CCT in that the first byte contains the first character, the second the second character, and so on. In this document, these fields are identified with the "Aw" character similar to the Fortran format statement convention, where the "A" indicates textual data and the "w" specifies the field width in bytes. For example the definition "A32" is used to specify a text string of 32 characters.

Numeric fields are used to define numerical data in textual form. They are defined to be multiples of 8-bit bytes and are stored on the CCT in a fashion that is

similar to the textual data above. The fields are denoted by "Iw" for Integer, "Fw.d" for Floating point decimal and "Ew.dEe" for Exponential representations. Where "w" specifies the field width, "d" specifies the digits after the decimal point and "e" specifies the exponent. Specifically, "F16.7" specifies a 16-byte field with the sign in the first byte, the non-fractional component in the next 7 byte and the fractional component in the 7 bytes following the decimal point (e.g. +1234567.1234567). Similarly, "E20.l0" is a 20-byte field with a sign in the first byte, a decimal value in bytes 2-5, a decimal point in the 6-th byte, fractional part in bytes 7-16 and the last 4 bytes used for the exponent (e.g. -1234.1234567890E+04).

Binary fields are used to define binary data values. The basic element of storage for binary values are also defined in multiples of 8-bit bytes. For binary data, the order of each byte on the CCT conforms to the LGSOWG family of Standard CCT Formats, i.e. the most significant bytes appearing before the least significant bytes. Unlike for the alphanumeric definitions above, binary data need not be encoded as integral multiples of 8-bits. In this type of usage encoding may be used and generally the encoding will be data dependent. The field definitions cannot be generalised and are addressed at the data file specification level. Nevertheless, the basic element of storage on the CCT is the 8-bit byte and binary fields are designated in this document as "Bw", where the "B" specifies binary data and the "w" the field width in bytes. For the cases where the unit of binary data width is not an integral multiple of 8-bits, the field size may be specified as an acceptable common multiple of 8-bit bytes.

For example, in one configuration of SEASAT, the signal data is quantized to 5-bit unsigned integer valued pixels. One method of storing this data is to use the low order 5-bits of a byte for data and zero fill the high order bits of the byte. Another more efficient method is to define a field as 2 bytes wide in which the high order bits are used to store 3 pixels of data and the remaining bit is zero filled.

In addition to the above format specification conventions, additional notation conventions have been adopted to further assist with the clarity in this document. These notation conventions are:

$ - the use of the "$" (dollar sign) in the documentation denotes a requirement for the blank character (i.e. the ASCII or EBCDIC space character).

(TBC) - "TO BE CONFIRMED", a value has been supplied by the format definition document pending approval by the committee on CCT standard formats.

(TBD) - "TO BE DEFINED", a value for this field has not been assigned by the CEOS-WGD subgroup on SAR data and is still to be defined by the group.

<tbd> - "to be determined", this expression is used to flag a field or its contents which will vary depending on the product type or data origin and will have to be defined and/or supplied on the, CCT by the facility generating the CCT.

(n) - this expression is used to denote the contents of an integer binary field which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

<xxxx> - this expression is used to denote the contents of an alphanumeric text field, in this case 4-bytes wide, which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

<nnnn> - this expression is used to denote the contents of an integer numeric field, in this case 4-bytes wide, which will vary depending on the product type or data origin and will have to be supplied on the CCT by the facility generating the CCT.

1.3 FILE TYPE CONVENTIONS

Special mention should be made of the "referenced file data type" field of the file pointer records. The standard format family definitions for types of file data has limitations. On the CCT these are expressed as a description field, A28 (field 13) and as an abbreviation field, A4 (field 14) in the file pointer record. The data types currently defined are.

"8BITASCII$ONLY$$$$$$$$$$$"	"ASCO"	-ASCII only data
"EBCDIC$0NLY$$$$$$$$$$$$$$$$"	"EBCO"	-EBCDIC only
"BCD$0NLY$$$$$$$$$$$$$$$$$$"	"BCDO"	-BCD only
"BINARY$0NLY$$$$$$$$$$$$$$$$"	"BINO"	-binary only data
"MIXED$BINARY$AND$ASCII$$$$$$"	"MBAA"	-binary & ASCII
"MIXED$BINARY$AND$EBCDIC$$$$$$"	"MBAE"	-binary &EBCDIC
"MIXED$BINARY$AND$BCD$$$$$$$$"	"MBAB"	-binary & BCD
"UNDEFINED,$ETC.$$$$$$$$$$$$$"	"UNDF"	-undefined
"COMPLEX$$$$$$$$$$$$$$$$$$$$"	"COMP"	-complex
"REAL$$$$$$$$$$$$$$$$$$$$$$$"	"REAL"	-floating point

Problems arise because there are two main types of binary representations (i.e. signed binary and two’s complement) and two main types of floating point representations (binary exponent and hexadecimal exponent). These definitions above are not explicit enough to uniquely specify the representation used interpret the data. Furthermore, historically the data format was tied to the sensor and product type. For SAR data the format in most cases is not dependent on either the sensor or the product type. For example, SAR image data type can be detected or undetected (complex) and may be expressed as either REAL numbers or INTEGER numbers independently from the data obtained from the sensor.

For consistency with past standard format family usage, in this document the term "BINARY" is all inclusive and will be interpreted to mean any binary bit pattern which may follow any interpretation convention (i.e. two’s complement variable width integer, combined pixels, status bits, etc.).

Historically the use of this term was closely tied to data source and usage of the description field. In one such implementation, the term "COMPLEX" was used to denote a complex 4 byte pair with each real and imaginary components stored as a pair of 2 byte two’s complement signed integer values (i.e.: 16-bits real and 16-bits imaginary).

In this document the file data type is not used to specify the data format. For the SAR data, the actual format of the SAR specified in the tile descriptor record.

1.4 SAR DATA TYPE SPECIFICATION CONVENTIONS

For this format specification, the "referenced file data type" field definition is "MIXED BINARY AND ASCII" and abbreviated to "MBAA" in the file pointer record. However to adequately distinguish between the different formats of SAR data, two fields have been added to the variable segment of the SAR data file descriptor record, these are the "data format type indicator" (field 61) and the "data format type code" (field 62). These fields are used to specify the format used to store the SAR data. To allow for a more unique specification of the data formats, again Fortran like conventions have been adopted. The conventions used are illustrated by the following examples.

"INTEGER*1$$$$$$$$$$$$$$$$$$$" "I*1$" (1 byte wide)
"INTEGER*2$$$$$$$$$$$$$$$$$$$" "I*2$" (2 byte wide)
"INTEGER*4$$$$$$$$$$$$$$$$$$$" "I*4$" (4 byte wide)
- one, two and four byte two's complement integer representation

"SIGNED$INTEGER*1$$$$$$$$$$$" "1S1$" (1 byte wide)
"SIGNED$INTEGER*2$$$$$$$$$$$" "1S2$" (2 byte wide)
"SIGNED$INTEGER*4$$$$$$$$$$$" "1S4$" (4 byte wide)
- one, two and tour byte signed integer with the most significant bit used to denote sign

"UNSIGNED$INTEGER*1$$$$$$$$$" "IU1$" (1 byte wide)
"UNSIGNED$INTEGER*2$$$$$$$$$" "IU2$" (2 byte wide)
"UNSIGNED$INTEGER*4$$$$$$$$$" "IU4$" (4 byte wide)
- one, two and four byte unsigned integer with the most significant bit used as part of the pixel value, the pixel is always positive.

"REAL*2$$$$$$$$$$$$$$$$$$$$" "R*2$" (2 byte wide)
"REAL*4$$$$$$$$$$$$$$$$$$$$" "R*4$" (4 byte wide)
"REAL*8$$$$$$$$$$$$$$$$$$$$" "R*8$" (8 byte wide)
- two, four and eight byte two's complement floating point representation with the exponent denoted in two's complement binary. (note that the REAL*8 representation is the same as double precision.)

"REAL*2$HEXADECIMAL$$$$$$$$$" "R*2H" (2 byte wide)
"REAL*4$HEXADECIMAL$$$$$$$$$" "R*4H" (4 byte wide)
"REAL*8$HEXADECIMAL$$$$$$$$$" "R*8H" (8 byte wide)
- two, four, eight byte hexadecimal floating point representation with the exponent denoted as a hexadecimal exponent. (note that the REAL*8... representation is the same as double precision.)

"COMPLEX*4$$$$$$$$$$$$$$$$$$" "C*4$" (4 byte wide)
"COMPLEX*8$$$$$$$$$$$$$$$$$$" "C*8$" (8 byte wide)

- four byte field with the first half (two bytes) containing the two's complement floating point representation value of the real component and the second half containing the imaginary component. Similarly for the eight byte type, with each half of the field containing the real and imaginary pairs.

"COMPLEX$INTEGER*2$$$$$$$$$$" "CI*2" (2 byte wide)
"COMPLEX$INTEGER*4$$$$$$$$$$" "CI*4" (4 byte wide)
"COMPLEX$INTEGER*8$$$$$$$$$$" "CI*8" (8 byte wide)

- similar to the complex floating point representation above except that each component is stored as a two's complement integer.

"COMPLEX$SIGNED$INTEGER*2$$$$" "C1S2" (2 byte wide)
"COMPLEX$SIGNED$INTEGER*4$$$$" "C1S4" (4 byte wide)
"COMPLEX$SIGNED$INTEGER*8$$$$" "C1S8" (8 byte wide)

- similar to the complex floating point representation above except that each component is stored as a signed integer.

"COMPLEX*4$HEXADECIMAL$$$$$$$" "C*4H" (4 byte wide)
"COMPLEX*8$HEXADECIMAL$$$$$$$" "C*8H" (8 byte wide)

- same as the floating point complex notation above except that the representation follow the hexadecimal conventions.

2.0 STANDARD FORMAT FAMILY CONVENTIONS

2.0 STANDARD FORMAT FAMILY CONVENTIONS

In order for a specific CCT format implementation to be considered as a member of the standard format family of tape formats, a few rules governing the logical organisation of files, and records within files, must be followed. Initially, the format designer selects the group of data files, which will embody the data set to be supplied on the CCT. The group of data files is called a logical volume. An envelope of superstructure records, defined by the standard format family with formats rigidly enforced by the controlling organisation, is then appended to this data set. This envelope, which completely defines the logical and physical organisation of the data set, can be described in the following way.

The first requirement of the superstructure is to add a file called the VOLUME DIRECTORY FILE. This is the first file in the logical volume and contains only fixed-format records and consists of a Volume Descriptor Record, a group of File Pointer Records (one for each data file contained in the logical volume), and one or more Text Records. The length of each of the records in this file is defined to be 360 bytes. Since this file describes not only the logical organisation of the data set, but also the physical organisation on one or more individual tapes, it is repeated at the start of each tape with certain fields updated to indicate the new physical volume sequence number, and, assuming that a data file spans over several physical volumes, to indicate the precise location within the data file where the split has occurred. (Figures 2.0.1)

The first record of the volume directory file, the VOLUME DESCRIPTOR RECORD, is employed to define in general terms the logical and physical construction of the data set. The record describes the volume and contains a count of the total number, of records in the volume directory file. This is followed by one or more FILE POINTER RECORDs and TEXT RECORDS. Each file pointer record contains sufficient introductory information to locate the file in the logical volume and permit the reading of the data file to which it points. The information contained in this record consists of the record count, and maximum record length and the generic class name assigned to the data file.

The text records generally contain an alphanumeric string of characters, which describe the data set in the logical volume.

After the volume directory file, the subsequent files are data files. The second requirement for the superstructure is to supply an additional record, called the FILE DESCRIPTOR RECORD, at the start of each data file. The purpose of this record is to provide details on the format used to store the data in the file. It is supplied once only, at the start of the file, and is not repeated if the file is split over one or more tapes. The file descriptor record may be considered as consisting of two portions the fixed segment and the variable segment. The format of the fixed segment is common to all file descriptor records and provides more information on how to read the referenced data file. The format of the variable segment is defined once only, when the file class is initially assigned. In general terms, it may be considered as providing much more specific information pertaining to the detailed layout of information within the data records (for example, pixel grouping information for imagery data), and hence, is described in detail at the start of subsequent chapters in this document which describe the content of individual data files.

In the standard family, all records are uniquely identified. Regardless of whether the data in the record is formatted or binary, each record has a 12 byte binary header attached to it which gives the record count in the file, the record type Identification and the record length in bytes.

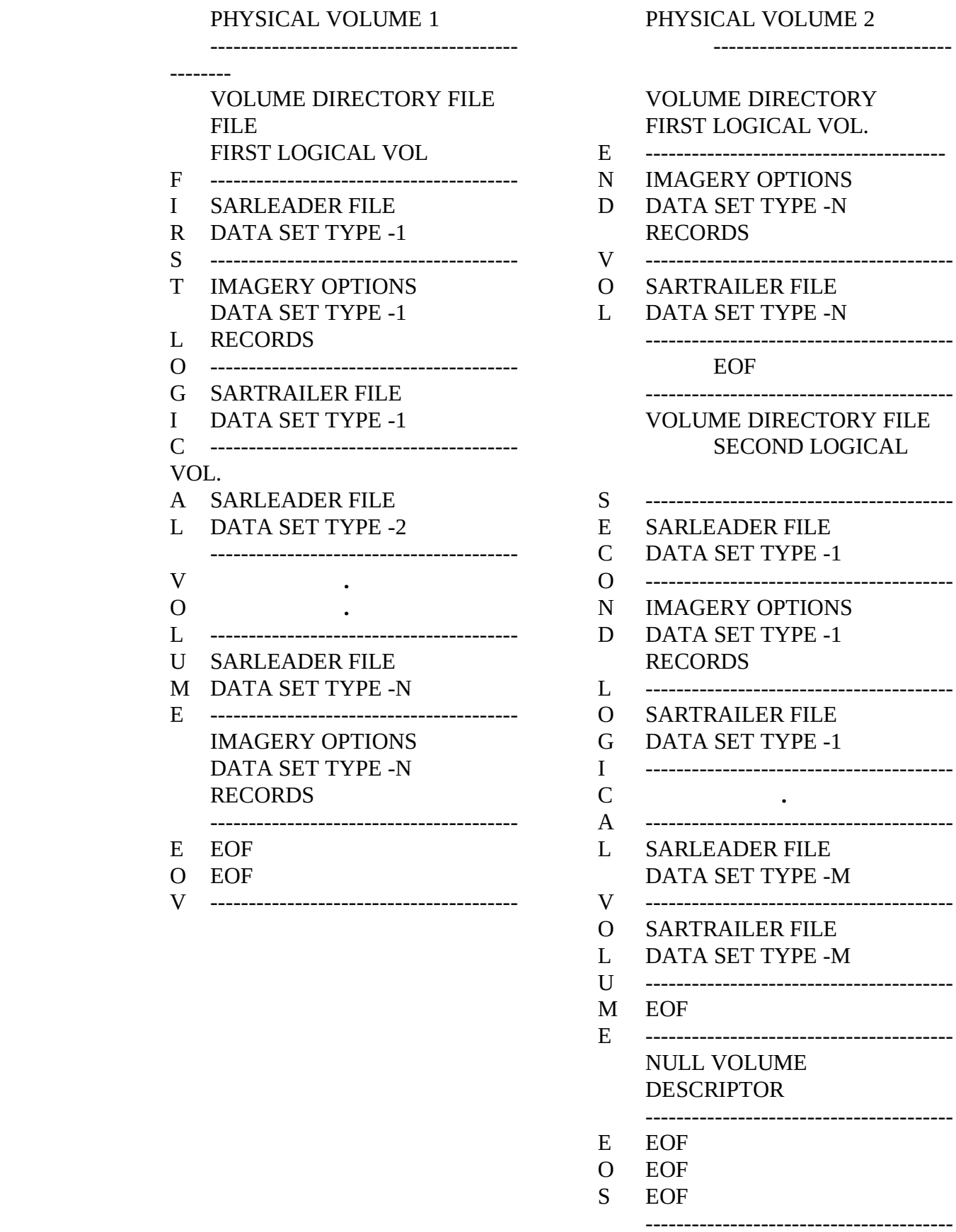


Figure 2.0.1 CCT Family Layout Example:

Two Logical Volume Data Sets on Two Physical Volume Sets

3.0 SAR CCT PHYSICAL VOLUME ORGANISATION

3.0 SAR CCT PHYSICAL VOLUME ORGANISATION

SAR CCT data products are organised into logical volumes, which can span one or more physical volumes, Computer Compatible Tapes (CCTs). The simplest products will be those that occupy only one physical volume. The superstructure concepts used in the standard format family and are adhered to by this format, conveniently handle multiple physical volumes, permit the SAR logical volume data to be split across physical volumes between data files or even between data records within the files. (Figures 2.0.1)

4.0 THE SAR LOGICAL VOLUME

The "SAR Logical Volume" as defined in this document, encompasses all modes of SAR data. This includes signal data obtained directly from the sensor (RAW), image data (processed into imagery), enhanced SAR data (i.e. higher level products derived from SAR image data), synchronised information from the sensor platform downstream telemetry with associated georeferencing data and facility related parameters, such as correction tables or matrices.

This logical volume is structured using the following classes of Files:

- VOLUME DIRECTORY FILE (superstructure)
- SARLEADER FILE
- IMAGERY OPTIONS FILE
- SARTRAILER FILE
- NULL VOLUME DIRECTORY FILE

Both the SARLEADER FILE and SARTRAILER FILE contain auxiliary information pertaining to the data, such as platform geometry, data

THE IMAGERY OPTIONS FILE contains the SAR data. This format specification supports all of the SAR data product types:

- SAR Signal Data (unprocessed or partially processed)
- SAR Image Data (fully processed)
- SAR Corrected Image data
- SAR Enhanced Image Data
- etc.

Figures 4.0.1 and 4.0.2 show the organisation of the files in the logical volume for Band Sequential (BSO) and Band Interleaved by Line (BIL) or by Pixel data respectively (BIP).

VOLUME DIRECTORY FILE

SARLEADER FILE
DATA SET TYPE -l

IMAGERY OPTIONS
DATA SET TYPE -l

SARTRAILER FILE
DATA SET TYPE-l

SARLEADER FILE
DATA SET TYPE-2

.
.
.

SARLEADER FILE
DATA SET TYPE-N

IMAGERY OPTIONS
DATA SET TYPE-N

SARTRAILER FILE
DATA SET TYPE-N

FIGURE 4.0.1 BAND SEQUENTIAL ORGANIZATION

VOLUME DIRECTORY FILE

SARLEADER FILE

IMAGERY OPTIONS FILE
DATA SET TYPES 1 TO N

SARTRAILER FILE

FIGURE 4.0.2 BAND-INTERLEAVED BY LINE OR BY PIXEL ORGANIZATION

5.0 SAR CCT STRUCTURE OVERVIEW

5.0 SAR CCT STRUCTURE OVERVIEW

5.1 VOLUME DIRECTORY FILE

The volume directory file is the first file of the SAR logical volume and consists of a volume descriptor record, file pointer records (one for each of the files that follow) and text records. The purpose of this file is to identify the logical volume and to specify its structure as it relates to the physical volume. Although the standard definitions allow for EBCDIC text, in this definition, these records are written in ASCII except for the first 12 bytes which are in binary. The length of each of the records in the file is 360 bytes.

5.1.1 VOLUME DESCRIPTOR RECORD

The volume descriptor record is the first record in the volume directory file. Its purpose is to identify the logical volume and indicate its size by specifying the number of data files contained within it. It also contains the relationship of this particular physical volume to the logical volume.

5.1.2 FILE POINTER RECORD(S)

The tile pointer records are the second record types in the, volume directory file. They are the pointers to the files and contain information required to access the data files in the logical volume. There are three pointer records, one for each file in the SAR logical volume. Each pointer record indicates the file type, file size and position in the SAR logical volume.

5.1.3 TEXT RECORD(S)

The text records contain information identifying the CCT product and a brief textual summary of its contents. The information contained is constructed in plain English so that it can be readily displayed at a terminal upon reading the CCT. There is only one text record in the SAR logical volume.

5.2 SARLEADER FILE

The SARLEADER file contains auxiliary information corresponding to the SAR data contained in the data file. The SAR leader file contained a file descriptor record followed by one or more auxiliary information packet. Each packet is organised into one or more records. The SAR leader file supports the following record types:

1. One file descriptor record
2. Any or all of the following record types; (record-type)

- DATA SET SUMMARY RECORD	(18, 10,18,20)
- MAP PROJECTION DATA RECORD	(18, 20,18,20)
- PLATFORM POSITION DATA RECORD	(18, 30,18,20)
- ATTITUDE DATA RECORD	(18, 40,18,20)
- RADIOMETRIC DATA RECORD	(18, 50,18,20)
- RADIOMETRIC COMPENSATION RECORD	(18, 51,18,20)
- DATA QUALITY SUMMARY RECORD	(18, 60,18,20)
- DATA HISTOGRAMS RECORD	(18, 70,18,20)
- RANGE SPECTRA RECORD	(18, 80,18,20)
- DIGITAL ELEVATION MODEL DESCRIPTOR REC.	(18, 90,18,20)
- RADAR PARAMETER DATA UPDATE REC.	(18,100,18,20)
- ANNOTATION DATA RECORD	(18,110,18,20)
- DETAILED PROCESSING PARAMETERS RECORD	(18,120,18,20)
- CALIBRATION DATA RECORD	(18,130,18,20)
- GROUND CONTROL POINTS RECORD	(18,140,18,20)
- FACILITY RELATED DATA RECORDS	(18,200,18,20)

Although all of the possible auxiliary record types are defined, not all of these records may appear on a particular COT. Since the data may be both sensor and product related, all of the records may not be appropriate for some CCT products. The exact contents of the SAR leader file are determined by the product type and sensor type combination. For example, the map projection data is not relevant to unprocessed SAR signal data and therefore will not appear on the signal CCT products. In the cases where the auxiliary data is inappropriate or the data is not available, the corresponding field of the descriptor record has a zero record count and the records are not written to the SAR leader file.

In the instances where the auxiliary data to complete the record is not available until the end of the CCT generation process, the format allows the inclusion of these records into the SAR trailer file instead of the SAR leader file (refer to SARTRAILER file format description). The format definition of the auxiliary information packet records are identical in both files.

The SAR auxiliary data records are recorded as numeric or alphanumeric text strings. The length of the records varies depending on the type of ancillary data contained in it. For the facility defined records, the record length is defined by the CCT generating facility. In instances where the information is less than the defined record length, the remaining part of the record is filled with blanks.

5.2.1 SARLEADER FILE DESCRIPTOR RECORD

The SAR leader file descriptor record is subdivided into two major segments, namely, the descriptor record fixed segment and the Descriptor record variable segment.

The SAR leader file descriptor record fixed segment, as the name implies, is fixed in length and its definition is common to all file descriptor records. It contains information on how to read the file.

The SAR leader file descriptor-record variable segment is SAR leader file data specific and provides information on the presence or absence of the SAR auxiliary data records, the length of each of the different types of records and the number of each type of record in the SAR leader file.

5.2.2 DATA SET SUMMARY RECORD

The data set summary record contains information about the mission, data acquisition, the sensor parameters and the processing parameters used to generate the SAR data on this logical volume.

5.2.3 MAP PROJECTION DATA RECORD

The map projection data record provides information about the geometric characteristics of the input (raw) and processed imagery data.

5.2.4 PLATFORM POSITION DATA RECORD

The platform position data record provides position/orbit information for the aircraft/spacecraft. Although the format is not dependent on the platform type, the content of the record differs for airborne and spaceborne sensors.

5.2.5 ATTITUDE DATA RECORD

The attitude data record contains attitude information of the sensor platform over the time spanning the SAR data.

5.2.6 RADIOMETRIC DATA RECORD

The radiometric data record contains the look up tables that relate data numbers in the image to a geophysical parameter of the target area (e.g. backscatter coefficient, soil moisture, surface roughness, etc.).

5.2.7 RADIOMETRIC COMPENSATION RECORD

The radiometric compensation record contains information about the range and azimuth radiometric correction applied to the data including compensation for the antenna illumination pattern in the range direction and/or illumination variations in azimuth due to aircraft roll.

5.2.8 DATA QUALITY SUMMARY RECORD

The data quality summary record contains information about the data set quality.

5.2.9 DATA HISTOGRAMS RECORD

The data histograms records contain sampled histograms and histogram derived statistics of the data set.

5.2.10 RANGE SPECTRA RECORD

The range spectra record contains the spectra of the unprocessed raw signal data.

5.2.11 DIGITAL ELEVATION MODEL DESCRIPTOR RECORD

The digital elevation model descriptor record contains the description of the characteristics of the Digital Elevation Model (DEM) used in the generation of the geocoded SAR image data.

5.2.12 RADAR PARAMETER DATA UPDATE RECORD

The Radar parameter data update record contains the radar parameters as they are updated.

5.2.13 ANNOTATION DATA RECORD

The annotation data record contains edge and intra-image annotation information used to annotate image data.

5.2.14 DETAILED PROCESSING PARAMETERS RECORD

The detailed processing parameter record contains all processing parameters necessary to characterise the processor performance and operation. This record may be both sensor and processing facility dependent and its format may differ from one facility to another. It is anticipated that each facility will use the record type codes to specify their own unique processing parameters record format for this data.

5.2.15 CALIBRATION DATA RECORD

The calibration data record contains information used to calibrate the SAR instrument such as may be from pre-flight sensor measurements and on ground calibration.

GROUND CONTROL POINTS RECORD

The ground control points record contains the description of the Ground Control Points (GCPs) used to adjust the initial system geometry and to asses the geometric quality of geocoded SAR image data.

FACILITY RELATED DATA RECORD

This record contains in a free format all information which is strictly facility related. The record type codes are used to indicate the type and source of this data. It is anticipated that each facility will use the record type codes to specify their own unique processing parameters record format for this data.

5.3 SAR DATA FILE

The SAR data is classed as a class "IMAGERY OPTIONS" file, or "IMOP", under the LGSOWG file type descriptions. The IMOP class was adopted because it offered the most flexibility for storing the large variety of data types and formats available from current and anticipated SAR sensors. In addition, this class also provides the capability for storing SAR data as either unprocessed. (Raw) signal data processed image data or enhanced SAR data. In all of the cases the "product type" fields (field 9 of the text record and field 83 of the data summary record) are used to indicate the type of SAR data and the "data type" fields (fields 61 & 62 of file descriptor record) are used to indicate the data format. The file contents are basically.

1. One file descriptor record
2. SAR data records

All imagery options file records are fixed length in the logical volume for a given sensor, and product combination. The record sizes may vary from one logical volume to another. Each record contains the standard twelve bytes of record introductory data (namely, record number, record type and sub-types, and record length). The remainder of the file descriptor record contains the file structure information. The remainder of the SAR data records contain the SAR data related information. The SAR data records contain not only the SAR data, but also support data, i.e. ancillary data, such as line count, sensor time, geographic location and data quality codes. This support data is physically separated in the record into the prefix data which precede the SAR data and suffix data which follows it.

The organisation of the imagery file may be "Band Sequential" (BSQ), where the file contains image data for one SAR sensor channel only, "Band Interleaved by Line" (BIL) or band interleaved by pixel (BIP), where the file contains data for one or more channels. The contents of the descriptor record are coded in ASCII where as the contents of the SAR data records are binary. Any binary fields occupying more than one byte are stored with the bytes in descending order of significance with the most significant being stored first on the tape.

5.3.1 SAR DATA FILE DESCRIPTOR RECORD

The SAR data file descriptor record is the same length as the SAR data record and is subdivided into two major segments, namely, the descriptor record fixed segment and the descriptor record variable segment. The SAR data file descriptor record definition follows the "IMOP" class definition.

As the name implies, the fixed segment is fixed in length and its definition is common to all file descriptor records of the Standard CCT Family of Tape Formats. This segment identifies the organisation of the file in the logical volume and the 12 bytes of standard record introductory data.

The SAR data file descriptor record variable segment is "IMOP" definition dependent and defines the format of the SAR data in the file. It gives the number and the length of the SAR data records contained in the file. The remainder of the variable segment contains detailed information on the method used to pack the SAR data samples in the SAR data record within the-data fields, each of which may consist of a group of bytes. In addition, the data dynamic range, the encoding of individual samples, the size (if any) of left, right, top and bottom borders, the size of the prefix and suffix data, byte pointers to key SAR parameters and finally the nature of the packing of multi-channel lines are also supplied. (Additional information on data packing appear in section 1.4)

5.3.2 SIGNAL DATA RECORD

The definition of the SAR signal data record is a record containing the following groups of data:

1. The twelve bytes of standard record introductory data (namely, record number, record type and sub-types, and record length)
2. Prefix data
3. One line of signal data
4. Suffix data

5.3.3 PROCESSED DATA RECORD

The definition of the SAR processed data record is a record containing the following groups of data:

1. The twelve bytes of standard record introductory data (namely, record number, record type and sub-types, and record length)
2. Prefix data.
3. One line of processed data, including left fillers and right fillers, where necessary.
4. Suffix data.

5.4 SARTRAILER FILE

The SAR trailer file contains additional information about the logical volume that is not present in the SAR leader file. Its contents are:

1. One file descriptor record
2. Any or all of the following record types; (record-type)
   - DATA SET SUMMARY RECORD (18, 10,18,20)
   - MAP PROJECTION DATA RECORD (18, 20,18,2U)
   - PLATFORM POSITION DATA RECORD (18, 30,18,20)
   - ATTITUDE DATA RECORD (18, 40,18,20)
   - RADIOMETRIC DATA RECORD (18, 50,18,20)
   - RADIOMETRIC COMPENSATION RECORD (18, 51,18,20)
   - DATA QUALITY SUMMARY RECORD (18, 60,18,20)
   - DATA HISTOGRAMS RECORD (18, 70,18,20)
   - RANGE SPECTRA RECORD (18, 80,18,20)
   - DIGITAL ELEVATION MODEL DESCRIPTOR RECORD (18, 80,18,20)
   - RADAR PARAMETER DATA UPDATE RECORD (18,100,18,20)
   - ANNOTATION DATA RECORD (18,110,18,20)
   - DETAILED PROCESSING PARAMETERS RECORD (18,120,18,20)
   - CALIBRATION DATA RECORD (18,130,18,20)
   - GROUND CONTROL POINTS RECORD (18,140,18,20)
   - FACILITY RELATED DATA RECORDS (18,200,18,20)

Some of this data is sensor, product and generating facility related and may not be appropriate for a specific CCT product. In the case where this data is not present in the SAR trailer file, and has been omitted due to inappropriateness or data is not available, the corresponding field of the descriptor record has a zero record count for that record and the records are not written to tape as part of this file. Note also that the auxiliary data definitions in this file are identical to the auxiliary data definitions in the SAR leader file. The reason for this is to allow the auxiliary data records to be written into either the SAR leader of the SAR trailer file. This allows the auxiliary data to be recorded at the end of the CCT when the data is not available at the start of the CCT generation process.

The SAR auxiliary data records are of' variable length and each contain the standard twelve bytes of record introductory data followed by data fields. The data fields are recorded as either alphanumeric text or binary valued data. The individual record format specifications appear in the section describing the SAR leader file auxiliary data records.

5.4.1 SARTRAILER FILE DESCRIPTOR RECORD

The SAR trailer file descriptor record is subdivided into two major segments, namely, the descriptor record fixed segment and the descriptor record variable segment.

The SAR trailer file descriptor record fixed segment, as the name implies is fixed in length and its definition is common to all file descriptor records. It contains information on how to read the file.

The SAR trailer file descriptor record variable segment is similar to the SAR leader file descriptor record variable segment. It gives the number and length of the auxiliary data records in the SAR trailer file.

5.4.2 AUXILIARY PARAMETERS RECORDS

The auxiliary parameters records in the SAR trailer file are identical to the auxiliary parameters records in the SAR leader file. A description of these records appear in section 5.2.

5.5 NULL VOLUME DIRECTORY FILE

The logical volume set is terminated with a null volume directory file. The null volume directory contains only one record, namely, the null volume descriptor record.

5.5.1 NULL VOLUME DESCRIPTOR RECORD

The null volume descriptor record indicates the end of the logical volume. Its definition is identical to the volume descriptor record (defined in Table 6.1.1.1) and the data contained indicates the end of the volume.

6.0 SAR CCT FORMAT DEFINITION

6.0 SAR CCT FORMAT DEFINITION

The following subsections define in detail the format of each of the records of the SAR logical volume: Each section is headed by an explanation of the record and possibly information on the method used to define the field contents: This is then followed by tables containing the detailed field by field definition and in some cases by tables illustrating the field contents. The table numbering convention is such that the definition table has the form 6:j:k:l and the field content tables are of the form 6.j.k.2, 6.j.k.3, etc., where "6.j.k.", is the subsection number.

6.1 VOLUME DIRECTORY FILE

6.1.1 VOLUME DESCRIPTOR RECORD

The definition of the VOLUME DESCRIPTOR RECORD is presented in Table 6.1.1.1 and its contents are shown in Table 6.1.1.2.

TABLE 6.1.1.1 VOLUME DESCRIPTOR RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number = 1
2	5	B1	-st record subtype code = 192
3	6	B1	Record type code = 192
4	7	B1	2-nd subtype code = 18
5	8	B1	3-rd subtype code = 18
6	9-12	B4	length of this record = 360
7	13-14	A2	ASCII/EBODIC flag, always ="A$" for ASCII or "E$" for EBCDIC
8	15-16	A2	blanks
9	17-28	A12	Superstructure format control document ID. (the ID of the CCB document)
10	29-30	A2	Superstructure format control document revision level = "$E"
11	31-32	A2	Superstructure record format revision level "$A" (for original)
12	33-44	A12	Logical volume generating facility software release and revision level (i.e. name and version left justified).
13	45-60	A16	ID of physical volume containing this volume descriptor (tape ID)
14	61-76	A16	Logical volume ID (scene related information uniquely identifying this logical volume)
15	77-92	A16	Volume set ID (16 character string assigned to uniquely identify a multiple physical volume data set.) (e.g.: scene centre date & time: YYYYMMDDhhmmssdd, where dd=deci-secs)
16	93-94	I2	Total number of physical volumes in the logical volume="$l, $2, "$3", etc.
17	95-96	I2	Physical volume sequence number of the first tape within the logical volume
18	97-98	I2	Physical volume sequence number of the last tape within the logical volume $1,, ,$2,, "$3", etc.
19	99-100	I2	Physical volume sequence number of the current tape within the logical volume $1,, ,$2,, "$3", etc.
20	101-101	I4	First referenced file number in this physical volume within the logical volume, i.e.: the first file which follows this volume directory (can be larger than one when a logical volume spans multiple physical volumes)

TABLE 6.1.1.1 VOLUME DESCRIPTOR RECORD DEFINITION (Cont'd.)

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
21	105-108	I4	Logical volume within a volume set
22	109-112	I4	Logical volume number within physical volume (if a logical volume spans physical volumes, the portion of the logical volume on this tape is counted as an entire logical volume)
23	113-120	A8	Logical volume creation date (YYYYMMDD)
24	121-128	A8	Logical volume creation time (hhmmssdd, where dd=deci-seconds)
25	129-140	A12	Logical volume generation country
26	141-148	A8	Logical volume generating agency
27	149-160	A12	Logical volume generating facility
28	161-164	I4	Number of file pointer records in volume directory
29	165-168	I4	Number of records in volume directory
30	169-260	A92	Volume descriptor spare segment (always blank filled)
31	261-360	A100	Local use segment

TABLE 6.1.1.2 VOLUME DESCRIPTOR RECORD

CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
1	1-4	B4	1	- record sequence number
2	5	B1	192	- 1-st rec.subtype code
3	6	B1	192	- record type code
4	7	B1	18	- 2nd rec.subtype code
5	8	B1	18	- 3rd rec.subtype code
6	9-12	B4	360	- record length
7	13-14	A2	A$	- ASCII flag
8	15-16	A2	$$	- blanks
9	17-28	A12	CCB-CCT-0002	- format control doc
10	29-30	A2	$A	- format control doc.version
11	31-32	A2	$A	- record format rev.level
12	33-44	A12	<software.id.>	
13	45-60	A16	<physical.tape.id.>	
14	61-76	A16	<logical.set.id..>	
15	77-92	A16	<volume.set.id...>	- e.g. : <YYYYM~MDDhhmmssdd> (scene centre sensor, acquisition time, where dd=deci-seconds)
16	93-94	I2	<nfl>	- total number of physical volumes $1,$2,$3, etc.
17	95-96	I2	<fln>	-1-st physical volume seq. # $1,$2,$3, etc.
18	97-98	I2	<nfl>	-last physical volume seq. # $1,$2,$3, etc.
19	99-100	I2	<nfl>	-this physical volume seq. # $l,$2,$3, etc.
20	101-104	I4	<nnnn>	-1-st ref.file in volume $$$l,$$$2,$$$3, etc.
21	105-108	I4	<nnnn>	- logical volume in set $$$l,$$$2,$$$3, etc.
22	109-112	I4	<nnnn>	- logical volume number in physical volume $$$l, $$$2, etc.
23	113-120	A8	<YYYYMMDD>	-(cct creation date)
24	121-128	A8	<hhmmssdd>	-(cct creation time, where dd=deci-seconds)
25	129-140	A12	<country.. >	- creating country
26	141-148	A8	<agency..>	- creating agency
27	149-160	A12	<facility.>	- creating facility
28	161-164	I4	<nnnn>	- no.of pointer records
29	165-168	I4	<nnnn>	- no.of records
30	169-260	A92	(blanks)	- spare
31	261-360	Al00	(blanks)	- spare

6.1.2 FILE POINTER RECORD

6.1.2 FILE POINTER RECORD

There are three file classes in the SAR logical vo1ume and a FILE POINTER RECORD contains the name and code of each file class as follows:

CLASS NAME	CLASS CODE
SARLEADER FILE	SARL
IMAGERY OPTIONS FILE	IMOP
SARTRAILER FILE	SART

The definition of the file pointer record is presented in Table 6.1.2.1. Tables 6.1.2.2 to 6.1.2.5 show the content of the file pointer record for the SARLEADER, IMAGERY OPTIONS and SARTRAILER files respectively.

TABLE 6.1.2.1 FILEPOINTER RECORD DEFINITION

FIELD	BYTES	FRM	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record number = 2,3, etc.
2	5	B1	1-st record subtype code = 219
3	6	B1	record type code = 192
4	7	B1	2-nd subtype code = 18
5	8	B1	3-rd subtype code = l8
6	9-12	B4	Length of this record = 360
7	13-14	A2	ASCII/EBCDIC flag for referenced file, "A$" for ASCII or "E$" for EBCDIC
8	15-16	A2	blank
9	17-20	I4	Referenced file number (the position of this file in the logical volume ie:="$$$l" for first SAR leader file "$$$2" for first SAR data file, etc.)
10	21-36	A16	Referenced file name (16 characters indicating nature of the data,ie header, annotation, SAR product type, etc.)
11	37-64	A28	Referenced file class (one of "SARLEADER$FILE$$$$$$$$$$$$$" or "IMAGERY$OPTIONS$FILE$$$$$$$" or "SARTRAILER$FILE$$$$$$$$$$$$$"
12	65-68	A4	Referenced file class code (one of "SARL" -for SAR leader file, or "IMOP" -for SAR data file, or "SART" -for SAR trailer file)
13	69-96	A28	Referenced file data type (sec #1.3) (one of"MIXED$BINARY$AND$ASCII$$$$$$" or "BINARY$ONLY$$$$$$$$$$$$$$$$$$" or "COMPLEX$$$$$$$$$$$$$$$$$$$$" or "REAL$$$$$$$$$$$$$$$$$$$$$$$$"
14	97-100	A4	Referenced file data type code (sec.#l.3) (one of "MBAA", "BINO3', "COMP" or "REAL")
15	101-108	I8	Number of records in referenced file
16	109-116	I8	Referenced file 1-st record length (length of the first record in the file)
17	117-124	18	Referenced file maximum record length (length of largest record in the file)
18	125-136	A12	Referenced file record length type ("FIXED$LENGTH" -all records in the referenced file have the same length or "VARIABLE$LEN" -the records in the file are of different lengths)
19	137-140	A4	Referenced file record length type code "FIXD" or "VARE")
20	141-142	12	Referenced file physical volume start number (the number of the physical volume set containing the first record of the file)
21	143-144	12	Referenced file physical volume end number (the number of the physical volume set containing the last record of the file)

22	145-152	I8	Referenced file portion start, 1-st record number for this physical volume (record number of the first record appearing on this physical volume)
23	153-160	I8	Referenced file portion end, last record number for this physical volume (record number of the last record appearing on this physical volume)
24	161-260	A100	File pointer spare segment
25	261-360	A100	Local use segment

TABLE 6.1.2.2 "SARLEADER" FILE POINTER RECORD

CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
1	1-4	B4	(n)	-record sequence number (2 for BIL; 3Tn-l for BSQ)
2	5	B1	219	-1-st rec.subtype code
3	6	B1	192	-record type code
4	7	B1	18	-2nd rec.subtype code
5	8	B1	18	-3rd rec.subtype code
6	9-12	B4	360	-record length
7	13-14	A2	A$	-ASCII flag
8	15-16	A2	$$	-blank
9	17-20	I4	(n)	-file number (1 for BIL; 3Tn-2 for BSQ)
10	21-36	A16	cfile.name.....>	
11	37-64	A28	SARLEADER$FILE$$$$$$$$$$$$$$	-file class
12	65-68	A4	SARL	-file class code
13	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	-data type
14	97-100A4	MBAA		-data type code
15	-101-108	I8	<nnnnnnnn>	-no.of records
16	109-116	I8	<nnnnnnnn>	-1-st rec.length
17	117-124	l8	<nnnnnnnn>	-max.rec.length
18	125-136	A12	VARIABLE$LEN	-record type
19	137-140	A4	VARE	-record type code
20	141-142	I2	<nn>	-start file vol.no.
21	143-144	I2	<nn>	-end file vol.no.
22	145-152	I8	<nnnnnnnn>	-l-st rec.no. on CCT
23	153-160	I8	<nnnnnnnn>	-last rec.no. on CCT
24	161-260	Al00	(blanks)	
25	261-360	Al00	(blanks)	

TABLE 6.1.2.3 "IMAGERY OPTIONS" FILE POINTER RECORD

CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
1	1-4	B4	(n)	-record sequence number
			(3 for BIL; 3Tn for BSQ)	
2	5	B1	219	-1-st rec.subtype code
3	6	B1	192	-record type code
4	7	B1	18	-2nd rec.subtype code
5	8	B1	18	-3rd rec.subtype code
6	9-12	B4	360	-record length
7	13-14	A2	A$	-ASCII flag
8	15-16	A2	$$	-blank
9	17-20	I4	(n)	-file number
				(2 for BIL; 3-1 for BSQ)
10	21-36	A16	<filename…….>	
11	37-64	A28	IMAGERY$OPTIONS$FILE$$$$$$$$	
				-file class
12	65-68	A4	IMOP	-file class code
13	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	
				-data type
14	97-100	A4	MBAA	-data type code
15	101-108	I8	<nnnnnnnn>	-no.of records
16	109-116	I8	<nnnnnnnn>	-l-st rec.length
17	117-124	I8	<nnnnnnnn>	-max.rec.length
18	125-136	A12	FIXED$LENGTH	
				-record type
19	137-140	A4	FIXD	-record type code
2q.	141-142	I2	<nn>	-start file vol.no.
21	143-144	I2	<nn>	-end file vol.no.
22	145-152	I8	<nnnnnnnn>	-1-st rec.no. on CCT
23	153-160	I8	<nnnnnnnn>	-last rec.no. on CCT
24	161-260	A100	(blanks)	
25	261-360	A100	(blanks)	

TABLE 6.1.2.4 "SARTRAILER" FILE POINTER RECORD

CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
1	1-4	B4	(n)	-record sequence number (4 for BIL; 3Tn+1 for BSQ)
2	5	B1	219	-1-st rec.subtype code
3	6	B1	192	-record type code
4	7	B1	18	-2nd rec.subtype code
5	8	B1	18	-3rd rec.subtype code
6	9-12	B4	360	-record length
7	13-14	A2	A$	-ASCII flag
8	15-16	A2	$$	-blank
9	17-20	I4	(n)	-file number (3 for BIL; 3 for BSQ)
10	21-36	A16	<file.name.....>	
11	37-64	A28	SARTRAILER$FILE$$$$$$$$$$$$	-file class
12	65-68	A4	SART	-file class code
13	69-96	A28	MIXED$BINARY$AND$ASCII$$$$$$	-data type
14	97-100	A4	MBAA	-data type code
15	101-108	I8	<nnnnnnnn>	-no.of records
16	109-116	I8	<nnnnnnnn>	-l-st rec.length
17	117-124	I8	<nnnnnnnn>	-max.rec.length
18	125-136	A12	-VARIABLE$LEN	-record type
19	137-140	A4	VARE	-record type code
20	141-142	I2	<nn>	-start file vol.no.
21	143-144	I2	<nn>	-end file vol.no.
22	145-152	I8	<nnnnnnnn>	-l-st rec.no. on CCT
23	153-160	18	<nnnnnnnn>	-last rec.no. on CCT
24	161-260	A100	(blanks)	
25	261-360	A100	(blanks)	

6.1.3 TEXT RECORD

The VOLUME DIRECTORY FILE contains one or more TEXT RECORDS. The text records contain textual information in either fixed or free format. The information contained in this record may be redundant and the purpose of these records is to allow the reader of the CCT to simply print out a short description of the data. In this definition the format of the text information is divided into three general fields consisting of:

- record header
- product identifier
- processing facility identification
- physical tape identification
- data source identification
- framing

The actual format of the text information within these fields is up to the facility generating the CCT. The general definition of the text record is defined in Table 6.1.3.1. A formatted implementation is presented in Table 6.1.3.2.

TABLE 6.1.3.1 TEXT RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record number
2	5	B1	1-st record sub-type code = 18
3	6	B1	record type code = 192
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 18
6	9-12	B4	Length of this record = 360
7	13-14	A2	ASCII/EBCDIC flag for this record, always="A$" for ASCII or (“E$" for EBCDIC
8	15-16	A2	Continuation flag ("C$" if information is continued on the next text record, else "$$" for no continuation)
9	17-56	A40	Product type specifier
10	57-116	A60	Location and date/time of product creation
11	117-156	A40	Physical volumes identification
12	157-196	A40	Scene identification
13	197-236	A40	Scene location
14	237-256	A20	spares
15	257-360	A104	spares

TABLE 6.1.3.2 TEXT RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 192
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 18
6	9-12	B4	Length of this record = 360
7	13-14	A2	ASCII/EBCDIC flag for this record, always="A$" for ASCII or ("E$" for EBCDIC
8	15-16	A2	Continuation flag ("C$" if information is continued on the next text record, else "$$" for no continuation)
9	17-56	A40	Product type specifier of the form. "PRODUCT: xxxxxxxxxxxxxxxxxxxxx xxxxxxxxxx" (combination of field 14 of the volume descriptor record and field 82 of the data summary record)
10	57-116	A60	Location and date/time of product creation of the form: "PROCESS.country.....agency... facility..... YYYYMMDD....."
11	117-156	A40	Physical volumes identification: "TAPE$ ID: xxxxxxxxxxxxxxx, $TAPE nnOFnn" where <xx.. .x> is the physical ID)
12	157-196	A40	Scene identification of the form: "ORBIT$: nnnnnnn$DYYYYMMDD-Thhmm ssttt$$$$$" (where: nnnnnnn - orbit number and Dyy::tt - frame centre, acquisition date and time)
13	197-236	A40	Scene location of the form: "FRAME$ CENTRE: $p±nnn. nn$$q±nnn. (where: p - N or S latitude; q - E or W long: innn.nn - degrees)
14	237-256	A20	(blanks)
15	257-360	A104	(blanks)

6.2 SARLEADER FILE

6.2.1 FILE DESCRIPTOR RECORD

The FILE DESCRIPTOR Record Fixed Segment is defined in Table 6.2.1.1. Its content, for the SARLEADER FILE, is shown in Table 6.2.1.3. The FILE DESCRIPTOR RECORD VARIABLE SEGMENT of the SARLEADER FILE is defined in Table 6.2.1.2 and its content is shown in Table 6.2.1.4.

TABLE 6.2.1.1 SARLEADER FILE - FILE DESCRIPTC'R RECORD (FIXED SEGMENT) DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number = 1
2	5	B1	1-st record sub-type code = 11
3	6	B1	Record type code = 192
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 18
6	9-12	B4	Length of this record = 720
7	13-14	A2	ASCII/EBCDIC flag, always ="A$" for ASCII or "E$" for EBCDIC
8	15-16	A2	blanks
9	17-28	A12	Format control document ID for this data file format (the ID of this document)
10	29-30	A2	Format control document revision level = "$A" (for original)
11	31-32	A2	File design descriptor revision letter= "$A" (for original)
12	33-44	A12	Generating software release and revision level (i.e.: name & version; same as field 12 of the volume descriptor record)
13	45-48	I4	File number
14	49-64	A16	File name (same as field 10 in file pointer record in volume directory file)
15	65-68	A4	Record sequence and location type flag
16	69-76	I8	Sequence number location
17	77-80	I4	Sequence number field length
18	81-84	A4	Record code and location type flag
19	85-92	I8	Record code location
20	93-96	I4	Record code field length
21	97-100	A4	Record length and location type flag
22	101-108	I8	Record length location
23	109-112	I4	Record length field length
24	113	A1	Reserved
25	114	A1	Reserved
26	115	A1	Reserved
27	116	A1	Reserved
28	117-180	A64	Reserved segment
29	181-186	I6	Number of data set summary records

TABLE 6.2.1.2 SARLEADER FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT) DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
30	187-192	I6	Data set summary record length
31	193-198	I6	Number of map projection data records
32	199-204	I6	Map projection record length
33	205-210	I6	Number of platform pos. data records
34	211-216	I6	Platform position record length
35	217-222	I6	Number of attitude data records
36	223-228	I6	Attitude data record length
37	229-234	I6	Number of radiometric data records
38	235-240	I6	Radiometric record length
39	241-246	I6	Number of rad. compensation records
40	247-252	I6	Radiometric compensation rec. length
41	253-258	I6	Number of data quality summary records
42	259-264	I6	Data quality summary record length
43	265-270	I6	Number of data histograms records
44	271-276	I6	Data histogram record length
45	277-282	I6	Number of range spectra records
46	283-288	I6	Range spectra record length
47	289-294	I6	Number of DEM descriptor records
48	295-300	I6	DEM descriptor record length
49	301-306	I6	Number of Radar par. update records
50	307-312	I6	Radar par. update record length
51	313-318	I6	Number of Annotation data records
52	319-324	I6	Annotation data record length
53	325-330	I6	Number of Det.processing records
54	331-336	I6	Det.processing record length
55	337-342	I6	Number of Calibration records
56	343-348	I6	Calibration record length
57	349-354	I6	Number of GCP records
58	355-360	I6	GCP record length
59	3C1-366	I6	spare
60	367-372	I6	spare
61	373-378	I6	spare
62	379-384	I6	spare
63	385-390	I6	spare
64	391-396	I6	spare
65	397-402	I6	spare
66	403-408	I6	spare
67	409-414	I6	spare
68	415-420	I6	spare
69	421-426	I6	Number of Facility data records
70	427-432	I6	Facility data record length
71	433-720	A288	blanks

TABLE 6.2.1.3 SARLEADER FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT)

CONTENTS

FIELD	BYTES		FORMAT	CONTENT
1	1-4	B4	1	-record sequence number
2	5	Bl	11	-1-st rec.subtype. code
3	6	Bl	192	-record type code
4	7	Bl	18	-2nd rec.subtype code
5	8	Bl	18	-3rd rec.subtype code
6	9-12	B4	720	-record length
7	13-14	A2	$A	-ASCII flag
8	l5-16	A2	$$	-blank
9	17-28	A12	CEOS-SAR-CCT	-format control doc.
10	29-30	A2	$A	-format control doc.version
11	31-32	A2	$A	-record format rev.level
12	33-44	A12	<software.id.>	(same code as field 12 of volume descriptor record)
13	45-48	I4	<nnnn> -file number	(1 for BIL; 3*n-2 for BSQ)
14	49-64	A16	<file.name.....>	(same code as field 10 of file pointer record)
15	65-68	A4	FSEQ	
16	69-76	I8	$$$$$$$1	
17	77-80	I4	$$$4	
18	81-84	A4	FTYP	
19	85-92	I8	$$$$$$$5	
20	93-96	I4	$$$4	
21	97-100	A4	FLGT	
22	101-108	I8	$$$$$$$9	
23	109-112	I4	$$$4	
24	113	A1	blank	
25	114	A1	blank	
26	115	A1	blank	
27	116	A1	blank	
28	117-180	A64	(blanks)	
29	181-186	I6	<nnnnnn>	-no.of data set summary
30	187-192	I6	$$4096	records & record length
31	193-198	I6	<nnnnnn>	-no.of map projection data
32	199-204	I6	$$1620	records & record length
33	205-210	I6	<nnnnnn>	-no.of platform position data
34	211-216	I6	$$8960	records & record length
35	217-222	I6	<nnnnnn>	-no.of attitude data records

TABLE 6.2.1.4 SARLEADER FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT)

CONTENTS

FIELD	BYTES		FORMAT	CONTENT
36	223-228	I6	$$9860	& record length <tbd>
37	229-234	I6	<nnnnnn>	-no.of radiometric data
38	235-240	I6	$$9860	records & record length <tbd>
39	241-246	I6	<nnnnnn>	-no.of radiometric compen
40	247-252	I6	$$8600	sation records & record length <tbd>
41	253-258	I6	<nnnnnn>	-no.of data quality summary
42	259-264	I6	$$1620	records & record length <tbd>
43	265-270	I6	<nnnnnn>	-no.of data histograms
44	271-276	I6	$16920	records & record length
45	277-282	I6	<nnrinnn>	-no.of range spectra records
46	283-288	I6	<nnnnnn>	& record length <tbd>
47	289-294	I6	<nnnnnn>	-no.ot DEM descriptor records
48	295-300	I6	<nnnnnn>	& record length <tbd>
49	301-306	I6	<flflnnnfl>	-no.of Radar par.update rec.s
50	307-312	I6	<nnnnnn>	& record length <tbd>
51	313-318	I6	<nnnnnn>	-no.of annotation data records
52	319-324	I6	<nnnnnn>	& record length <tbd>
53	324-330	I6	<nnnnnn>	-no.of Detailed proces. rec.s
54	331-336	I6	<nnnnnn>	& record length <tbd)
55	337-342	I6	<nnnnnn>	-no.of calibration data
56	343-348	I6	<nnnnnn>	records & record length <tbd>
57	349-354	I6	<nnnnnn>	-no.of GCP records
58	355-360	I6	<nnnnnn>	& record length <tbd>
59	361-366	I6	$$$$$$	-blanks
60	367-372	I6	$$$$$$	& blanks
61	373-378	I6	$$$$$$	-blanks
62	379-384	I6	$$$$$$	& blanks
63	385-390	I6	$$$$$$	-blanks
64	391-396	I6	$$$$$$	& blanks
65	397-402	I6	$$$$$$	-blanks
66	403-408	I6	$$$$$$	& blanks
67	409-414	I6	$$$$$$	-blanks
68	415-420	I6	$$$$$$	& blanks
69	421-426	I6	<nnnnnn>	-no.of facility data records
70	427-432	I6	<nnnnnn>	& record length <tbd>
71	433-720	A288	(blanks)	

TABLE 6.2.2 DATA SET SUMMARY RECORD

6.2.2 DATA SET SUMMARY RECORD

The purpose of the SAR data set summary record is to provide a summary of the parameters relevant to the SAR data. The record is organised along a set of segments with each segment containing information pertaining to a major step in the data path. The segments are.

- Record Specific information
  (i.e.: 12 byte header, size and channel indicator)

- Scene Specific parameters
  (i.e.: ID, date & time, location, ...)

- General Mission/Sensor parameters
  (i.e.: sensor ID, mode of operation, operational parameters)

- General Processing parameters
  (i.e.: processing facility, processing parameters, ...)

- Sensor Specific Local use segment (Local use segment for sensor specific parameters)

- Processor Specific Local use segment (Local use segment for processing facility parameters)

- Limited Annotation segment (i.e.: edge annotation latitudes and longitudes)

The complete format of DATA SET SUMMARY RECORD is defined in Table 6.2.2.1.

TABLE 6.2.2.1 DATA SET SUMMARY RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record Sequence Number	= 2
2	5	B1	1-st record sub-type code	= 18

3	6	B1	Record type code	= 10
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= 4096
7	13-16	I4	Data set Summary Record sequence number (starts at 1)	
8	17-20	I4	SAR channel indicator	

SCENE PARAMETERS

9	21-36	A16	Scene identifier
10	37-68	A32	Scene designator (such as framing reference number if one exits, e.g.: WRS-path#,row#)
11	69-100	A32	Input scene centre time <YYYYM~DDhhmmssttt$$$$$$$$$$$$>1 where: YYYY = year MM = month OD = day hh = hours (00 to 23) mm = minutes (00 to 59) ss = seconds (CO to 59) ttt = milliseconds (000 to 999)
12	101-116	A16	spare
13	117-132	F16.7	Processed scene centre geodetic latitude defined as positive to the north of the equator and negative to the south (deg.)
14	133-148	F16.7	Processed scene centre geodetic longitude defined as positive to the east of the prime meridian and negative to the west. (deg.)
15	149-164	F16.7	Processed Scene Centre true heading as calculated relative to true North (deg.)
16	165-180	A16	Ellipsoid designator
17	181-196	F16.7	Ellipsoid semi-major axis (km) -(R)
18	197-212	F16.7	Ellipsoid semi-minor axis (km)
19	213-228	F16.7	Earth’s mass - (M)
20	229-244	F16.7	Gravitational constant - (G)
21	245-260	F16.7	Ellipsoid J2 parameter
22	261-276	F16.7	Ellipsoid J3 parameter
23	277-292	F16.7	Ellipsoid J4 parameter
24	293-308	A16	spare
25	309-324	F16.7	Average terrain height above Ellipsoid at scene centre (km)
26	325-332	I8	Scene centre line number (the line no. at the scene centre including zero fill)
27	333-340	I8	Scene centre pixel number (the pixel number at the scene centre including zero

			fill)
28	341-356	F16.7	Processed scene length (km) including zero fill
29	357-372	F16.7	Processed scene width (km) including zero fill
30	373-388	A16	spare

NOTE:

The J2, J3, and J4 parameters are the first terms which appear in the expression of the gravitational potential at a point P, due to earth oblateness:

$$V = (G M e / R p) (1 - \sum_{n=2}^{\infty} J n (R e / R p) ^{n} P n (C O S (\theta p)) \}$$

where: Σ = sum performed for n=2 to infinity (~)
G = gravitational constant
Me = Earth's mass
Rp = distance of point P from earth's centre of mass
Re = ellipsoid semi-major axis
θp = latitude of point P
Pn(x) = Legendre polynomial of order "n"

GENERAL MISSION/SENSOR PARAMETERS

31	389-392	I4	Number of SAR channels
32	393-396	A4	spare
33	397-412	A16	Sensor platform mission identifier (this field identifies the platform for the sensor that transmitted the SAR data,

			e.g.: "STS-41G$$$$$$$$$" for SIR-B)
34	413-444	A32	Sensor ID: and mode of operation for this channel: (this field specifies the sensor and its mode of operation in the form of: <AAAAAA-BB-CCDD-EF$$$$$$$$$$$$$$> where: AAAAAA = six characters sensor ID (e.g.: SEASAT, SIR-B, ERS-l, etc.:) BB = SAR band (e.g.: X$, L$, C$, KU, KA, etc.:) CC = code for resolution mode (e.g.: high, low, survey, etc.:) DD = code for imaging mode (e.g.: near, far, browse, scan, etc.:) E = transmit polarisation (H or V) F = receiver polarisation (H or V)
35	445-452	A8	Orbit number or flight line indicator (e.g.: "00001239" for SEASAT)
36	453-460	F8:3	Sensor Platform geodedic Latitude; at nadir corresponding to Scene Centre (degrees)
37	461-468	F8:3	Sensor Platform geodedic Longitude at nadir corresponding to Scene Centre (degrees)
38	469-476	F8:3	Sensor Platform Heading at nadir corresponding to Scene Centre (degrees)
39	477-484	8:3	Sensor clock angle as measured relative to sensor platform flight direction (degrees) (i.e.: -90:0 = left pointing, and +90:0 = right pointing)
40	485-492	F8:3	Incidence angle at scene centre as derived from sensor platform orientation, electronic boresight and Earth's geometry
41	493-500	A8	spare
42	501-516	F16.7	Radar wavelength (meters)
43	517-518	A2	Motion compensation indicator "00" = no compensation "01" = on board compensation "10" = in processor compensation "11" = both on board and in processor
44	519-534	A16	Range pulse code specifier (e.g.: "LINEARFMCHIRP$", "PHASE$MODULATOR$", etc.)

45	535-550	E16.7	Range pulse amplitude coefficient #1 (Chirp range chirp constant term (offset from DC) (Hz))
46	551-566	E16.7	Range pulse amplitude coefficient #2 (Chirp= range chirp linear term (Hz/sec))
47	567-582	E1E.7	Range pulse amplitude coefficient #3 (quadratic. term)
48	583-598-	E16.7	Range pulse amplitude coefficient #4 (cubic term)
49	599-614	E16.7	Range pulse amplitude coefficient #5 (quartic term)
50	615-630	E16.7	Range pulse phase coefficient #1 (offset in radians)
51	631-646	E16.7	Range pulse phase coefficient #2 (linear term in rads./sec)
52	647-662	E16.T	Range pulse phase coefficient #3 (quadratic term in rads./sec')
53	663-678	E16.7	Range pulse phase coefficient #4 (cubic term)
54	679-694	E16.7	Range pulse phase coefficient #5 (quartic term)
55	695-702	18	Down linked data chirp extraction index (in samples)
56	703-710	A8	spare
57	711-726	F16.7	Sampling rate (MHz)
58	727-742	F16.7	Range gate at early edge (in time) at the start of the image (Vsec)
59	743-758	F16.7	Range pulse length (Vsec)
60	759-762	A4	Base band conversion flag (YES$/NOT$) (YES = base band converted
61	763-766	A4	Range compressed flag (YES$/NOT$) (YES = range compressed)
62	767-782	F16.7	Receiver gain for like polarised at early edge at the start of the image (dB)
63	782-798	F16.7	Receiver gain for cross polarised at early edge at the start of the image(dB)
64	799-806	I8	Quantization in bits per channel
65	807-818	A12	Quantizer descriptor (eg:"UNIFORM$11Q$")
66	819-834	F16.7	DC Bias for I-component
67	835-850	F16.7	DC Bias for Q-component
68	851-866	F16.7	Gain imbalance for I & Q
69	867-882	F16.7	spare
70	883-898	F16.7	spare
71	899-914	F16.7	Antenna electronic boresight relative to platform vertical axis at the start of the image (degrees)

72	915-930	F16.7	Antenna mechanical boresight relative to platform vertical axis at the start of the image, positive to the right, negative to the left (degrees)
73	931-934	A4	Echo tracker-on/off designator ("ON$$", or "OFF$")
74	935-950	F16.7	Nominal PRF (Hz)
75	951-966	F16.7	Effective two-way antenna elevation 3dB beam width at boresight (degrees)
76	967-982	F16.7	Effective two-way antenna azimuth 3dB beam width at electronic boresight (degrees)

SENSOR SPECIFIC PARAMETERS

77	983-998	I16	(ERS-l=Satellite encoded binary time code)
78	999-1030	A32	(ERS-l=Satellite clock time, <YYYYMMDDhhmmssttt$$...$>
79	1031-1038	I8	ERS-l=Satellite clock increment (nano-secs))
80	1039-1046	A8	spare
81	1047-1062	A16	Processing facility identifier
82	1063-1070	A8	Processing system identifier
83	1071-1078	A8	Processing version identifier
84	1079-1094	A16	Processing facility process code
85	1095-1110	A16	Product level code (Ref.#2)
86	1111-1142	A32	Product type specifier (Ref.#2)
87	1143-1174	A32	Processing algorithm identifier (e.g.: "SPECTRAL$ANALYSIS$CORRELATION$$$" "TIME$D0MAIN$C0NV0LUTI0N$$$$~$$$$"
88	1175-1190	F16.7	Nominal effective number of looks processed in Azimuth
89	1191-1206	F16.7	Nominal effective number of looks processed in Range
90	1207-1222	F16.7	Bandwidth per look in Azimuth Hz
91	1223-1238	F16.7	Bandwidth per look in Range Hz
92	1239-1254	F16.7	Total processor bandwidth in Azimuth
93	1255-1270	F16.7	Total processor bandwidth in Range
94	1271-1302	A32	Weighing function designator in Azimuth
95	1303-1334	A32	Weighting function designator in Range
96	1335-1350	A16	Data input source (e.g.: HDDT identifier)

97	1351-1366	F16.7	Nominal resolution equal to 3dB points in ground range (meter)
98	1367-1382	F16.7	Nominal resolution in Azimuth (meter)
99	1383-1398	F16.7	Constant radiometric parameter (Bias)
100	1399-1414	F16.7	Linear radiometric parameter (Gain)
101	1415-1430	F16.7	Along track Doppler frequency constant term at early edge of image (Hz)
102	1431-1446	F16.7	Along track Doppler frequency linear term at early edge of the image (Hz/pixel)
103	1447-1462	F16.7	Along track Doppler frequency quadratic term at early edge of the image (Hz/pixel/pixel)
104	1463-1478	A16	spare
105	1479-1494	F16.?	Cross track Doppler frequency constant term at early edge of the image (Hz)
106	1495-1510	F16.7	Cross track Doppler frequency linear term at early edge of the image (Hz/pixel)
107	1511-1526	F16.7	Cross track Doppler frequency quadratic term at early edge of the image (Hz/pixel/pixel)
108	1527-1534	A8	Time direction indicator along pixel direction (ie:”INCREASE”-ing or "DECREASE"-ing")
109	1535-1542	A8	Time direction indicator along line direction (ie:"INCREASE"-ing or "DECREASE"-ing")
110	1543-1558	F16.7	Along track Doppler frequency rate constant term at early edge of the image (Hz/sec)
111	1559-1574	F16.7	Along track Doppler frequency rate l linear term at early edge of the image (Hz/sec/pixel)
112	1575-1590	F16.7	Along track Doppler frequency rate quadratic term at early edge of the image (Hz/sec/pixel/pixel)
113	1591-1606	A16	spare
114	1607-1622	F16.7	Cross track Doppler frequency rate constant term at near edge of the image (Hz/sec)
115	1623-1638	F16.7	Cross track Doppler frequency rate linear term relative to near edge of the image (Hz/sec/pixel)
116	1639-1654	F16.7	Cross track Doppler frequency rate quadratic term relative to near edge of the image (Hz/sec/pixel/pixel)
117	1655-1670	A16	spare
118	1671-1678	A8	Line content indicator

			(e.g.: "RANGE$$$", "AZIMUTH$" or "OTHER$$$")
119	1679-1682	A4	Clutter lock applied flag ("YES$'1/'1NOT$")
120	1683-1686	A4	Auto-focusing applied flag ("YES$"/"N0T$")
121	1687-1702	F16.7	Line spacing (meters)
122	1703-1718	F16.7	Pixel spacing (meters)
123	1719-1734	A16	Processor range compression designator ("SYNTHETIC$CHIRP$" or ('EXTRACTED$CHIRP$")
124	1735-1750	A16	spare
125	1751-1766	A16	spare

SENSOR SPECIFIC LOCAL USE SEGMENT

126	1767-1886	A120	spares

PROCESSOR SPECIFIC LOCAL USE SEGMENT

127	1887-2006	A120	spares

IMAGE ANNOTATION FIELDS

128	2007-2014	I8	Number of Annotation Points (up to 64)
129	2015-2022	A8	spare
130	2023-2030	I8	Line Number of 1st Annotation start
131	2031-2038	I8	Pixel Number of 1st Annotation start
132	2039-2054	A16	1st Annotation Text (eg: lat, long as "Nnn.nn,W-nnn.nn$"
133	2055-2062	I8	Line Number of 2nd Annotation start
134	2063-2070	I8	Pixel Number of 2nd Annotation start
135	2071-2036	A16	2nd Annotation Text
.	.	.	.
.	.	.	.
319	4039-4046	I8	Line Number of 64th Annotation Point
320	4047-4054	I8	Pixel Number of 64th Annotation Point
321	4055-4070	A16	64th Annotation Text
322	4071-4096	A26	spares

6.2.3 MAP PROJECTION DATA RECORD

6.2.3 MAP PROJECTION DATA RECORD

The map projection record is defined in Table 6.2.3 1.

TABLE 6.2.3.1 MAP PROJECTION DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	
2	5	B1	1-st record sub-type code	= 18
3	6	B1	Record type code	= 20
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= 1620
7	13-28	A16	spare	

MAP PROJECTION GENERAL INFORMATION

8	29-60	A32	Map projection descriptor (e.g.: slant range, ground range, geocoded)
9	61-76	I16	Number of pixels per line of image
10	77-92	I16	Number of lines
11	93-108	F16.7	Nominal inter-pixel distance in output scene (meters)
12	109-124	F16.7	Nominal inter-line distance in output scene (meters)
13	125-140	F16.7	Orientation at output scene centre, for geocoded products this is simply the convergence of the meridians, i.e.: the angle between geographic north and map grid north (degrees) (Angle of projection axis from true North)
14	141-156	F16.7	Actual platform orbital inclination (deg)
15	157-172	F16.7	Actual ascending node (longitude at equator) (degrees)
16	173-188	F16.7	Distance of platform at input scene centre from the geocentre (meters)
17	189-204	F16.7	Geodedic altitude of the platform relative to the ellipsoid (meters)
18	205-220	F16.7	Actual ground speed at nadir at input scene centre time (meters/sec)
19	221-236	F16.7	Platform heading (degrees): effective subplatform track direction angle relative to true north, including the effects of orbital inclination and skew due to earth rotation.
20	237-268	A32	Name of reference ellipsoid
21	269-284	F16.7	Semi major axis of ref.ellipsoid (meters)
22	285-300	F16.7	Semi minor axis of ref. ellipsoid (meters)
23	301-316	F16.	Datum shift parameter referenced to Greenwich. dx (meters)
24	317-332	F16.7	Datum shift parameter perpendicular to Greenwich. dy (meters)
25	333-348	F16.7	Datum shift parameter direction of the rotation axis. dz (meters)
26	349-364	F16.7	Additional datum shift parameter 1st rotation angle (if not used default value:-9999.99)
27	365-380	F16.7	Additional datum shift parameter 2nd rotation angle (if not used default value:-9999.99)
28	381-395	F16.7	Additional datum shift parameter 3rd rotation angle (if not used default value:-9999.99)
29	397-42	F16.7	Scale factor of reference ellipsoid

MAP PROJECTION DESIGNATOR

30	413-444	A32	Alphanumeric description of Map projection.

UTM-PROJECTION (1st default)

31	445-476	A32	UTM descriptor
32	477-480	A4	Signature of the UTM zone
33	481-496	F16.7	Map origin (false easting)
34	497-512	F16.7	Map origin (false northing)
35	513-528	F16.7	Centre of projection longitude (deg)
36	529-544	F16.7	Centre of projection latitude (deg)
37	545-560	F16.7	1st standard parallel (deg)
38	561-576	F16.7	2nd standard parallel (deg)
39	577-592	F16.7	Scale factor

UPS-PROJECTION (2nd default)

40	593-624	A32	UPS descriptor
41	625-640	F16.7	Centre of projection longitude (deg)
42	641-656	F16.7	Centre of projection latitude (deg)
43	657-672	F16.7	Scale factor

TABLE 6.2.3.1 MAP PROJECTION DATA RECORD

NATIONAL SYSTEMS PROJECTION (any others)

44	673-704	A32	Projection descriptor
45	705-720	F16.7	Map origin (false easting)
46	721-736	F16.7	Map origin (false northing)
47	737-752	F16.7	Centre of projection longitude (deg)
48	753-768	F16.7	Centre of projection latitude (deg)
49	769-784	F16.7	Standard parallels (eg,default:-9999.99)
50	785-800	F16.7	Standard parallels (deg,default:-9999.99)
51	801-816	F16.7	Standard parallels (deg,default:-9999.99)
52	817-832	F16.7	Standard parallels (deg,default:-9999.99)
53	833-848	F16.7	Central meridian (deg,default:-9999.99)
54	849-864	F16.7	Central meridian (deg,default:-9999.99)
55	865-880	F16.7	Central meridian (deg,default:-9999.99)
56	881-896	A16	spares

57	97-912	A16	spares
58	13-928	A16	spares
59	29-944	A16	spares

COORDINATES OF FOUR CORNER POINTS

60	945-960	F16.7	Top left corner northing (meters)
61	961-976	F16.7	Top left corner easting (meters)
62	977-992	F16.7	Top right corner northing (meters)
63	993-1008	F16.7	Top right corner easting (meters)
64	1009-1024	F16.7	Bottom right corner northing (meters)
65	1025-1040	F16.7	Bottom right corner easting (meters)
66	1041-1056	F16.7	Bottom left corner northing (meters)
67	1057-1072	F16.7	Bottom left corner easting (meters)
68	1073-1088	F16.7	Top left corner latitude (deg)
69	1089-1104	F16.7	Top left corner longitude (deg)
70	1105-1120	F16.7	Top right corner latitude (deg)
71	1121-1136	F16.7	Top right corner longitude (deg)
72	1137-1152	F16.7	Bottom right corner latitude (deg)
73	1153-1168	F16.7	Bottom right corner longitude (deg)
74	1169-1184	F16.7	Bottom left corner latitude (deg)
75	1185-1200	F16.7	Bottom left corner longitude (deg)
76	1201-1216	F16.7	Top left corner terrain height relative to ellipsoid (meters)
77	1217-1232	F16.7	Top right corner terrain height (meters)
78	1233-1248	F16.7	Bottom right corner height (meters)
79	1249-1264	F16.7	Bottom left corner height (meters)

COEFFS. FOR IMAGE TO MAP TO IMAGE CONVERSION

80-87	1265-1424	8E20.l0	Eight coefficients (All,A12,...,A24) to convert a line (L) and pixel (P) position to the map projection frame of reference, say (E,N) where: E = A11 +A12 +A13 +Al4TL N = A21 +A22 +A23 +A24nP
88-95	1425-1584	8E20.10	Eight coefficients (Bll,B12,.. .,B24) to convert from the map projection (E,N) to line (L) and pixel (P) position in the image, say (L,P) where: L = Bll +B12 +B13 +Bl4TETN P = B21 +B22TE +B23 +B24TN
96	1585-1620	A36	spares

6.2.4 PLATFORM POSITION DATA RECORD

6.2.4 PLATFORM POSITION DATA RECORD

The record is variable <tbd> bytes long, consisting of 12 bytes of record introductory data, followed by 64 bytes of general ancillary data, followed by up to 64 position and velocity or “vector pairs" data sets of length 132 bytes. Any unused position and velocity vector fields are filled with zeros in the following FORTRAN compatible format. 6D22.15. The format of the record is defined in Table 6.2.4.1, all numeric fields are right justified.

TABLE 6.2.4.1 PLATFORM POSITION DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT

1	1-4	B4	Sequence number	
2	5	B1	1-st record sub-type code	= 18
3	6	Bl	Record type code	= 30
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= <tbd>
7	13-44	A32	Orbital elements designator (e.g.: "ORBITAL$XEPLERIAN$ELEMENTS$$$$$$")	
8	45-60	F16	1-st orbital element	
9	61-76	F16	2nd orbital element	
10	77-92	16	3rd orbital element	
11	93-108	16	4th orbital element	
12	109-124	F16	5th orbital element	
13	125-140	F16	6th orbital element	
14	141-144	I4	Number of data points (up to 64)	
15	145-148	I4	Year of data point. (YY)	
16	149-152	I4	Month of data point. (MM)	
17	153-156	I4	Day of data point. (DD)	
18	157-160	I4	Day in the year (GMT)	
19	161-182	D22.l5	Seconds of day (GMT) of data	
20	183-204	D22.l5	Time interval between DATA points (sec)	
21	205-268	A64	Reference co-ordinate system (e.g.: "GEOCENTRIC$EQUATORIAL$INERTIAL$$$. . $"')	
22	269-290	D22.15	Greenwich mean hour angle (degrees)	
23	291-306	F16.7	Along track position error (meters)	
24	307-322	F16.7	Across track position error (meters)	
25	323-338	F16.7	Radial position error (meters/sec)	
26	339-354	F16.7	Along track velocity error (meters/sec)	
27	355-370	F16.7	Across track velocity error (meters/sec)	
28	371-386	F16.7	Radial velocity error (degrees/sec)	
FIRST POSITIONAL DATA POINT				
29	387-452	3D22.15	1st data point position vector as latitude, longitude and altitude for airborne sensor platform, and as (X,Y,Z) co-ordinates for spaceborne sensor platform in a reference system such as GSFC (meters)	
30	453-518	3D22.l5	1st data point velocity vector in airborne co-ordinates (meters/second and degrees /second) for airborne sensor platform or (X',Y',Z') in a reference system such as GSFC for spaceborne sensor platforms	
31-...	...519-...	n(6D22.15	2nd, 3rd, .. . data point position & velocity vectors (repetition of fields 29-	

		30 as specified by the number of points in field #14)
<tbd>	<tbd>-EOR A <tbd>	blanks

6.2.5 ATTITUDE DATA RECORD

6.2.5 ATTITUDE DATA RECORD

The record variable <tbd> bytes in length, consisting of 16 bytes of record introductory data followed by nominally up to 64 data sets of 120 bytes each, followed by blank fill. If the number of data sets are greater than 64, then the record size is expanded as required. Any trailing unused data sets are filled with zeros in the appropriate FORTRAN compatible ASCII format. The record is defined in Table 6.2.5.1

TABLE 6.2.5.1 ATTITUDE DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT

1	1-4	B4	Sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 40
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 20
6	9-12	B1	Length of this record = 9860 <tbd>
7	13-16	I4	Number of attitude data points (up to 64)

FIRST ATTITUDE DATA SET

8	17-20	I4	Day of the year (GMT)
9	21-28	I8	Millisecond of day (GMT)
10	29-32	I4	Pitch data quality flag
11	33-36	I4	Roll data quality flag
12	37-40	I4	Yaw data quality flag
13	41-54	E14.6	Pitch (degrees)
14	55-68	E14.6	Roll (degrees)
15	69-82	E14.6	Yaw (degrees)
16	83-86	I4	Pitch rate data quality flag
17	87-90	I4	Roll rate data quality flag
18	91-94	I4	Yaw rate data quality flag
19	95-108	E14.6	Pitch rate (degrees/sec)
20	109-122	E14.6	Roll rate (degrees/sec)
21	123-136	E14.6	Yaw rate (degrees/sec)
22-...	137-...	...	... 2nd, 3rd, ... attitude data points (repetition of fields 8-21 as specified in field #7)
<tbd>	<tbd>-EOR	A<tbd>	blanks (as required)

6.2.6 RADIOMETRIC DATA RECORD

6.2.6 RADIOMETRIC DATA RECORD

The radiometric data record is variable <tbd> bytes in length and is expanded as required. The record consists of 20 bytes of record header and one or more radiometric data sets. Each data set refers to one channel and one physical parameter. Each data set contains general information and a look-up table. The table entries are radiometric adjustment values as a function or pixel value. Each entry in the table is stored as an F16.7 numeric string. The record, with nominal 512 table entries, is defined in Table 6.2.6.1.

TABLE 6.2.6.1 RADIOMETRIC DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Sequence number
2	5	B1	Record sub-type code = 18
3	6	B1	Record type code = 50
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 20
6	9-12	B1	Length of this record = 9860 <tbd)
7	13-16	I4	Radiometric data record sequence number
8	17-20	I4	Number of radiometric data fields in the record
RADIOMETRIC DATA SET			
9	21-28	I8	Radiometric data set size in bytes.

10	29-32	A4	SAR channel indicator
11	33-36	A4	spare
12	37-60	A24	Look up table designator (e.g.: "BACXSCATTER$COEFFICIENT$", "IMAGE$AMPLITUDE$$$$$$$$")
13	61-68	I8	Number of samples in the look up table (up to 512 in this example)
14	69-8	A16	Sample type designator (e.g.: “V0LTAGE$$$$$$$$$”)
15	5-88	A4	spare

LOOK UP TABLE VALUES

16	89-104	F16.7	1-st sample
17	105-120	F16.7	2nd sample
.	.	.	.
.	.	.	.
527	8264-8280	F16.7	512th sample
528	8280-9860	A1580	blanks

6.2.7 RADIOMETRIC COMPENSATION DATA RECORD

6.2.7 RADIOMETRIC OMPENSATION RECORD

The radiometric compensation record is the table of Offsets and Gains used to compensate for radiometric variation as a function of geometry. One application is to correct for intensity variation resulting from the antenna illumination pattern as a function of range. Another is to compensate for intensity variations resulting from aircraft roll.

In a typical application a single correction value (Offset and Gain) is applicable to a "group" of data pixels thus the compensation table may be smaller than the actual number of pixels being corrected. For data where each compensation pair applies to more than one pixel, the "compensation pixel group size" (field 18) is used to specify the number of pixels corresponding to each table value.

The radiometric compensation record is variable <tbd> bytes in length. (The definition here is specified to accommodate a single compensation table consisting of up to 256 "Offset and Gain" pairs. For tables greater than 256, the record may be either increased or multiple records can be used.) For tables greater than that accommodated by the record, the table is divided into multiple records with each record containing part of the table. In this case fie1ds 13 and 14 are used to indicate the sequence number of the table contained in this record in the whole compensation table and fields 16 and 17 indicate the applicable pixel position. Field 15 specifies the total number of compensation pairs and field 24 specifies the number of pairs in this record.

The compensation record (for 256 samples with record length of 8600) is defined in Table 6.2.7.1.

TABLE 6.2.7.1 RADIOMETRIC COMPENSATION DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 51
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 20
6	9-12	B4	Length of this record = 8600 <tbd>
7	13-16	I4	Radiometric compensation record Sequence number
8	17-20	I4	SAR channel indicator
9	21-28	I8	Number of radiometric compensation data sets in the record
10	29-36	I8	Compensation data set size (bytes)
			COMPENSATION DATA SET

11	37-44	A8	Compensation data type designator (e.g.: "RANGE" "AZIMUTH' "PIXEL","LINE"
12	45-76	A32	Compensation data descriptor (e.g.: elevation antenna pattern", "range attenuation", "resolution cell size", "azimuth attenuation", etc.)
13	77-80	I4	Number of compensation records required to reconstitute the full compensation table
14	81-84	I4	Sequence number in the full compensation table of the table contained in this record
15	85-92	I8	Total number of compensation pairs in the full compensation table
16	93-100	I8	Data pixel number corresponding to first correction value in compensation table
17	101-108	I8	Data pixel number corresponding to last correction value in compensation table
18	109-116	I8	Compensation pixel group size (pixels) This is the number of pixels for which each of the compensation samples is applicable.
19	117-132	F16.7	Mm. table Offset value (dB)
20	133-148	F16.7	Mm. table Gain value (dB)
21	149-164	F16.7	Max. table Offset value (dB)
22	165-180	F16.7	Max. table Gain value (dB)
23	181-196	A16	spare

RADIOMETRIC COMPENSATION TABLE VALUES

24	197-204	I8	Number of compensation table entries (up to 256 samples/record in example)
25	205-220	F16.7	1-st compensation sample Offset (dB)
26	221-236	F16.7	1-st compensation sample Gain (dB)
27	237-252	F16.7	2-nd compensation sample Offset (dB)
28	253-268	F16.7	2-nd compensation sample Gain (dB)
.	.	.	.
535	8365-8380	F16.7	256-th compensation sample Offset (dB)
536	8381-8396	F16.7	256-th compensation sample Gain (dB)
537	8397-8600	A204	blanks

Note:

For multiple radiometric compensation data sets per record and assuming that the compensation table size is small enough such that each record can accommodate more than one full compensation table, the fields 11 through (24+2Tn) are repeated for each compensation table, where "n" is the number of table "Offset and Gain" pairs. The fields 9 and 10 are used to indicate the number of tables and the size of the radiometric compensation data set.

6.2.8 DATA QUALITY SUMMARY RECORD

6.2.8 DATA QUALITY SUMMARY RECORD

The data quality summary record is defined in Table 6.2.8.1.

TABLE 6.2.8.1 DATA QUALITY SUMMARY RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 60
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 20
6	9-12	Bl	Length of this record = 16 <tbd>
7	13-16	I4	Data summary quality record sequence number
8	17-20	A4	SAR channel indicator

9	21-26	A6	Date of the last calibration update as YYMY.DD, where: YY = last two digits of year MY = month of the year DD = day of the month
10	27-30	I4	Number of channels (up to 16)

ABSOLUTE RADIOMETRIC DATA QUALITY

11	31-46	F16.7	Nominal Integrated Side Lobe Ratio (ISLR) (dB)
12	47-62	F16.7	Nominal Peak Side Lobe to main lobe Ratio (PSLR) (dB)
13	63-78	F16.7	Nominal azimuth ambiguity
14	79-94	F16.7	Nominal range ambiguity
15	95-110	F16.7	Estimate of SNR (from range spectra)
16	111-126	F16.7	Actual Bit Error Rate (BER)
17	127-142	F16.7	Nominal slant range resolution (meters)
18	143-158	F16.7	Nominal azimuth resolution (meters)
19	159-174	F16.7	Nominal radiometric resolution (dB)
20	175-190	F16.7	Instantaneous dynamic range (dB)
21	191-206	F16.7	Nominal absolute radiometric calibration magnitude of uncertainty of SAR channel indicated in field 8 (dB)
22	207-222	F16.7	Nominal absolute radiometric calibration magnitude uncertainty of SAR channel indicated in field 8 (deg)

RELATIVE RADIOMETRIC DATA QUALITY

23	223-238	F16.7	Nominal relative radiometric calibration magnitude uncertainty of SAR channel (field 8) versus first of the other channels on a multi-channel volume (dB)
24	239-254	F16.7	Nominal relative radiometric calibration phase uncertainty of SAR channel (field 8) versus first of the other channels on a multi-channel volume (deg)
25-52	255-734	16F16.7	Repetition .of fields 23-24 for the remaining channels (up to 16 channels)

ABSOLUTE GEOMETRIC DATA QUALITY

53	735-750	F16.7	Nominal absolute location error along track (meters)

54	751-766	F16.7	Absolute location error cross track (meters)
55	767-782	F16.7	Nominal geometric distortion scale in line direction
56 scale	783-798	F16.7	Nominal geometric distortion in pixel direction
57	799-814	F16.7	Nominal geometric distortion skew
58	815-830	F16.7	Scene orientation error

RELATIVE GEOMETRIC DATA QUALITY

59	831-846	F16.7	Along track relative misregistration error of SAR channel (field 8) versus first of the other channels (meters)
60	847-862	F16.7	Cross track relative misregistration error of channel (field 8) versus first of the other channels (meters)
61-75	863-1342	16F16.7	Repetition of fields 59-60 for the other channels (up to 16 channels)
76	1343-1620	A278	spares

6.2.9 DATA HISTOGRAM RECORD

6.2.9 DATA HISTOGRAMS RECORD

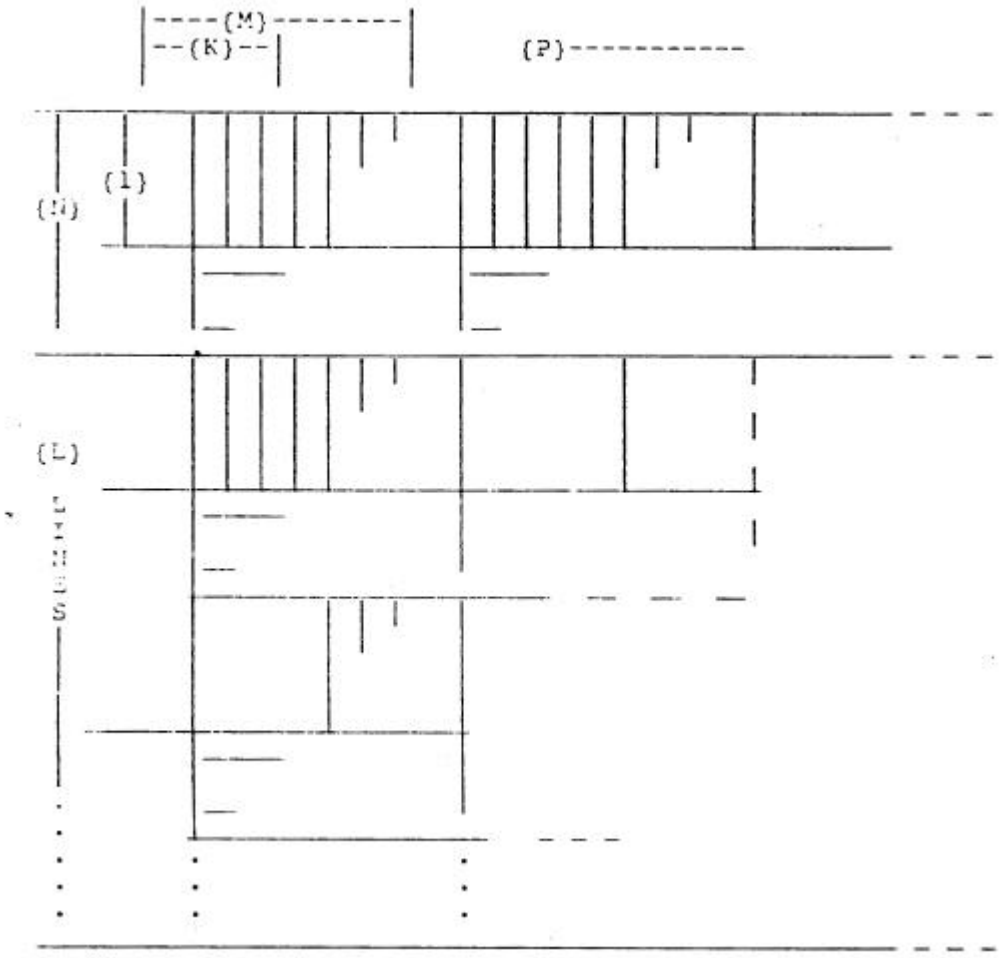
The data histograms record conveys the distribution of the data on the CCT and key statistics about the data and the histogram table. In real time operations, it is not always possible to sample all of the data on the CCT and a representative histogram 03fl be generated by sampling the scene along both pixel and line directions. The illustration below shows how a scene can be segmented and sampled to generate the representative histogram. In Figure 6.2.9.1, a (P) by (L) scene is divided into groups of (M) by (M) pixels from which (k) by (1) pixels are used to compute the representative histogram table.

The example histogram record shown, can accommodate a single histogram table data set of 2048 bin samples or two histogram table data sets with each consisting of up to 1024 bin samples. For data magnitude ranges greater than this, the magnitude of the pixels can be windowed such that each histogram table bin represents a range of pixel magnitudes. For this case, the "sample value increment" (field 2) is used to specify the bin size in pixel magnitude.

For histogram tables greater than that accommodated by the record, the histogram table can be divided into multiple records with each record containing 2048 bin samples. In this case fields 12 and 13 are used to indicate the sequence number of the table contained in this record in the whole histogram table and fields 21 and 22 indicate the valid range. Field 14 specifies the total number of histogram bins and field 30 specifies the number of bins in this record.

The histogram record is defined and explained in Table 6.2.9.1. The algorithms used to derive the histogram statistics are discussed in Ref.#4.

6.2.9 DATA HISTOGRAM RECORD



Where:

	P	=	Total number of pixels in line direction
	L	=	Total number of lines
	M	=	Group size along pixel axis
	N	=	Group size along line axis
	K	=	Number of samples used along pixel axis
	L	=	Number of samples used along line axis

FIGURE 6.2.9.1 HISTOGRAM GENERATION DATA SAMPLING

TABLE 6.2.9.1 DATA HISTOGRAM RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTFNT
1	1-4	B4	Sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 70
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = 20
6	9-12	El	Length of this record = 16920 <tbd>
7	13-16	I4	Data histograms record sequence number
8	17-20	I4	SAR channel indicator
9	21-28	I8	Number of histogram table data sets in this record
10	29-36	I8	Histogram table data set size (bytes)
HISTOGRAM TABLE DATA SET DESCRIPTION			
11	37-68	A32 (e.g.: "DETECTED$DATA$$$$$$$$$$$$$$$$$$")	Histogram descriptor
12	69-72	I4	Number of histogram records needed to reconstitute the full histogram table
13	73-76	I4	Sequence number in the full histogram table of the table contained in this record
14	77-84	I8	Total number of table bins in the full histogram table
15	85-92	I8	Total number of data samples in line direction (P)
16	93-100	I8	Total number of data samples across lines (L)
17	101-108	I8	Data samples group size in line direction (M)
18	109-116	I8	Data samples group size across lines (N)
19	117-124	I8	Number of samples used er rou in line direction (k)
20	125-132	I8	Number of samples used per group across lines (1)
DATA STATISTICS			
21	132-148	F16.7	Minimum sample value corresponding to first histogram table bin
22	149-164	F16.7	Maximum sample value corresponding to last histogram table bin
23	165-180	F16.7	Mean sample value
24	181-196	F16.7	Standard deviation of sample value
25	197-212	F16.7	Sample value increment

DATA HISTOGRAM STATISTICS

26	213-228	F16.7	Minimum histogram table value (in samples)
27	229-244	F16.7	Maximum histogram table value
28	245-260	F16.7	Mean histogram table value
29	261-276	F16.7	Standard deviation of histogram table
30	277-284	I8	Histogram table size (maximum of 1024)
31	285-292	I8	1-st histogram table value
32	293-300	I8	2nd histogram table value
.	.	.	.
.	.	.	.
1054	8468-8476	I8	1024th histogram table value
1055	8477-16920	A8444	spares

Note:
For multiple histograms per record and assuming that the histogram table size is small enough such that each record can accommodate more than one full histogram table, the fields 11 through (30+n) are repeated for each histogram table, where "n" is he number of table b-ins. The fields 9 and 10 are used to indicate the number of tables and the 5IZC of the histogram data field. The record definition accommodates two 1024 histogram tables.

6:2.10 RANGE SPECTRA RECORD

6.2.10 RANGE SPECTRA RECORD

The range spectra record contains the averaged spectra of a selected number of range returns, ie. unprocessed SAR data. The range spectra record can accommodate a single spectra table consisting of up to <tbd> frequency samples. For tables greater than that accommodated by the record, the full spectra table can be divided into several manageable records with each record containing <tbd> samples. In this case fields 11 and 12 are used to indicate the sequence number of the table contained in this record in the whole spectral table and fields 16 and 17 indicate the valid range. Field 13 specifies the total number of samples and field 22 specifies the number of samples in this record.

The range spectra record is defined in Table 6.2.10.1.

TABLE 6.2.10.1 RANGE SPECTRA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 80
4	7	E1	2-nd record sub-type code = 18
5	8	E1	3-rd record sub-type code = 20
6	9-12	E1	Length of this record = <tbd>
7	13-16	I8	Range spectra record sequence number
8	17-20	I4	SAR channel indicator
9	21-28	I8	Number of spectra table data sets in this record
10	29-36	I8	Spectra table data set size (bytes)
RANGE SPECTRA DATA			
11	37-40	I4	Number of range spectra data records required to reconstitute the full spectra table
12	41-44	I4	Sequence number in the full spectra table of the table contained in this record
13	45-52	I8	Total number of samples in range direction
14	53-60	I8	Number of samples offset from first sample in range line
15	61-68	I8	Number of range lines integrated for spectra
16	69-84	F16.7	Centre frequency of first spectra bin (Hz)
17	85-100	F16.7	Centre frequency of last spectra bin (Hz)
18	101-116	F16.7	inimum spectral power (dB)
19	7-132	F6.7	MaxImum spectral power (dE)

20	133-148	A16	spare
21	149-164	A16	spare

SPECTRAL DATA TABLE VALUES

22	165-172	I8	Number of frequency bins in table
23	173-188	F16.7	1-st spectral data value (dB)
24	189-204	F16.7	2nd spectral data value (dE)
.	.	.	.
.	.	.	.
<tbd>	<tbd>-...	F16.7	<tbd>-th spectral data value (dB)
<tbd>	<tbd>-...	A<tbd>	spare

6.2.11 DIGITAL ELEVATION MODEL DESCRIPTOR RECORD

6.2.11 DIGITAL ELEVATION MODEL DESCRIPTOR RECORD

The Digital Elevation Model (DEM) descriptor record is variable length since the number of DEM descriptor data sets and the size of the data sets are product and facility related. Each~record consists of 12 bytes of record identifier, DEM general information and a number of D~M descriptor data sets.

The record format is defined in Table 6.2.11.1.

TABLE 6.2.11.1 DIGITAL ELEVATION MODEL DESCRIPTOR RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number
2	5	E1	1-st record sub-type code = 18
3	6	E1	Record type code = 90
4	7	E1	2-nd record sub-type code = 18
5	8	E1	3-rd record Sub-type code = 20
6	9-12	I4	Length of this record = <tbd>
7	13-16	I4	Digital elevationmodeldescriptorrecord sequence number
8	17-20	I4	spare
9	21-28	I8	Number of DEM data descriptor data sets in this record. (DEM coverage must be described by the corner points of a set of polygons.)
10	29-60	A32	Original source of DEM (Copyright info)
11	61-92	A32	Height datum reference name
12	93-124	A32	DEM generation method (map, satellite stereo,..etc.)
13	125-136	A12	Original raster spacing unit (meters,degrees,arcsec, etc.)
14	137-168	A32	Original DEM presentation projection
15	169-184	F16.7	Original DEM raster spacing north-south in unit as per field 13.
16	185-200	F16.7	Original DEM raster spacing east-west in unit as per field 13.
17	201-232	A32	Applied resampling method (bilinear, spline, etc.)
18	233-248	F16.7	RMS height error (meters)
19	249-264	F16.7	RMS location error north-south in unit as per field 13.
20	265-280	F16.7	RMS location error east-west in unit as per field 13.
21	281-296	F16.7	Maximum height in DEM (meters)
22	297-312	F16.7	Minimum height in DEM (meters)

23	313-328	F16.7	Mean height value in DEM (meters). (Value computed by using the number of DEM points in original presentation)
24	329-344	F16.7	Standard deviation of heights in DEM (meters). (value computed by using the number of DEM points in original presentation)
25	345-348	I4	Number of polygons described in this record

1-ST DEM DATA DESCRIPTOR DATA SET

26	349-352	I4	Polygon sequence number
27	353-356	I4	Number of corner-points for current polygon
28	357-364	I8	spare
29	365-380	F16.7	1st corner point Latitude
30	381-396	F16.7	1st corner point Longitude
31	397-412	FXG.7	2nd corner point Latitude
32	413-428	F16.7	2nd corner point Longitude
33	429-444	F16.7	3rd corner point Latitude
34	445-460	F16 7	3rd corner point Longitude
.	.	.	.
.	.	.	.
<tbd>	<tbd>-<tbd>	F16.7	Last corner point Latitude
<tbd>	<tbd>-<tbd>	F16.7	Last corner point Longitude

2-ND,... DEM DATA DESCRIPTOR DATA SETS

<tbd>	<tbd>-<tbd> ...	Repetition of the DEM descriptor data sets (from field 26 onwards) as indicated by number of polygons (in field 25).
<tbd>	<tbd>-EOR A<tbd>	spares

6.2.12 RADAR PARAMETER DATA UPDATE RECORD

6.2.12 RADAR PARAMETER UPDATE DATA RECORDS

The Radar parameter update data record is variable length as is required. The record contains the first 12 bytes of record identifier general information and the parameter updates. The remainder of the record is blank filled as required. Each of the parameter updates is an alphanumeric text field consisting of the date and time coordinate for the update, sample address for the update, the textual description of the parameter and the parameter update (new) value. The record is defined in Table 6.2.12.1.

TABLE 6.2.12.1 RADAR PARAMETER UPDATE DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number
2	5	E1	1-st record sub-type code = 18
3	6	E1	Record type code = 100
4	7	E1	2-nd record sub-type code = 18
5	8	E1	3-rd record sub-type code = 20
6	9-12	E4	Length of this record = <tbd>
7	13-16	I4	Radar Darameter record sequence number
8	17-20	A4	spare
9	21-28	I8	Number of radar parameter update data sets in the record
10	29-36	I8	Radar parameter update data set size (bytes)
1-ST RADAR PARAMETER UPDATE DATA SET			
11	37-56	A20	GMT of Change (YYYY~MDD-hhriunssttt$$)

12	57-60	A4	SAR channel indicator
13	61-68	I8	Radar data line number where this update takes effect
14	69-76	I8	Radar data sample number where this update takes effect
15	77-108	A32	Parameter descriptor field, one of: "RECEIVER GAIN (dB) =" "RECORD WINDOW POSITION (Vsec) =" "ELECTRONIC BORESIGHT (degrees) "PRF (Hz) =" "PULSE BANDWIDTH (Hz) =" "PULSE DURATION (Vsec) =" "QUANTIZATION (bits) =" etc.
16	109-124	E16.7	Parameter value
2-ND,... PARAMETER UPDATES			
20	125-...	...	The radar parameter update data set (fields 11-16) are repeated as many times as indicated by the data set counter (field# 9)
<tbd>	<tbd>-EOR	A<tbd>	spares

6.2.13 ANNOTATION DATA RECORD

6.2.13 ANNOTATION DATA RECORD

The ANNOTATION data record is variable length <tbd> and its contents consist of the first 12 bytes containing the record identifier which is followed by the edge or intra-image annotation data sets. The actual annotation text may be of any 1ength. The remainder of the record is blank filled. The record is defined in Table 6.2.13.1.

TABLE 6.2.13.1 ANNOTATION DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	
2	5	B1	1-st record sub-type code	= 18
3	6	B1	Record type code	= 110
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= <tbd>
7	13-16	I4	Annotation data record sequence number	
8	17-20	A4	spare	
9	21-28	I8	Number of annotation data sets in the record (up to <tbd> per record)	
10	29-36	I8	Maximum annotation data set size (bytes)	
ANNOTATION DATA SET				
11	37-44	I8	Annotation data set length in bytes	
12	45-52	A8	Annotation type (ie."TOP$$$$$", "BOTTOM$$", ,LEFT$$$$", "RIGHT$$$", "OVERLAY$", etc.)	
13	53-60	I8	Image data line coordinate for annotation start	
14	61-68	I8	Image data pixel coordinate for annotation start	
15	68-76	I8	Annotation text length in bytes	
16	77-<tbd>	A<tbd>	Annotation text	
17	<tbd>-EOR	A<tbd>	spares	

6.2.14 DETAILED PROCESSING PARAMETERS DATA RECORD

6.2.14 DETAILED PROCESSING PARAMETERS RECORD

The detailed processing parameters record length, format and data content are completely facility defined <tbd> with the exception of the first 12 bytes of record identifier. The general format of the record is defined in Table 6.2.14.1.

TABLE 6.2.14.1 DETAILED PROCESSING PARAMETERS RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number
2	5	B1	1-st record sub-type code = 8
3	6	B1	Record type code = 120
4	7	B1	2-nd record sub-type code = 18
5	8	B1	-rd record sub-type code = <tbd> (eg. CEOS=20, CCRS=36, ESA=50, NASA=60, NASA-JPL==61, NASDA=70, DFVLR=80, RAE=9O, TELESPAZIO=lOO, UNSPECIFIED=18, etc.)
6	9-2	B4	Length of this record = <tbd>
7	13-16	I4	Detailed processing parameters record sequence number
8	17-20	A4	blanks
9	<tbd>-...	A<tbd)	<tbd>

6.2.15 CALIBRATION DATA RECORD

6.2.15 CALIBRATION DATA RECORD

The calibration data record is (TBD) its general format is defined in Table 6.2.15.1.

TABLE 6.2.15.1 CALIBRATION DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	
2	5	B1	1-st record sub-type code	= 18
3	6	B1	Record type code	= 120
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= <tbd>
7	13-16	I4	Calibration data record sequence number	
8	17-20	A4	blanks	
9	(TBD)-...	A(TBD)	(TBD)	

6.2.16 GROUND CONTROL POINTS RECORD

6.2.16 GROUND CONTROL POINTS DESCRIPTOR RECORD

The Ground Control Points (GCP) descriptor record is variable length since the number of GOP descriptor data sets and the size of the data sets are product and facility related.

Each record consists of 12 bytes of record identifier, GCP general information and a number of GOP descriptor data sets. The record rormat is defined in Table 6.2.16.1.

TABLE 6.2.16.1 GROUND CONTROL POINTS DESCRIPTOR RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	
2	5	B1	1-st record sub-type code	= 18
3	6	B1	Record type code	= 140
4	7	R1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= <tbd>
7	13-16	I4	Ground control points descriptor record sequence number	
8	17-20	I4	spare	
9	21-24	I4	Number of GCPs in this record	
10	25-28	I4	Number of GCPs for geometric adjustment	
11	29-32	I4	Number of GCPs for quality test	
12	33-96	A64	spare (for comments)	
1-ST GCP DESCRIPTOR				
13	97-100	I4	GCP sequence number	
14	101-106	A6	Adjustment or test ("ADJUST"~/"TEST$$")	
15	107-138	A32	GOP generation method (map, DEM simulated SAR, geocoded THEMATIC MAPPER,..etc.)	
16	139-154	A16	Matching method (automatic correlation, visual match, etc.)	
17	155-170	A16	Method applied to (Slant/Ground range or Geocoded Image)	
18	171-186	F16.7	Geographic latitude of GCP	
19	187-202	F16.7	Geographic longitude of GCP	
20	203-218	F16.7	GCP height above the reference ellipsoid	
21	219-234	F16.7	Pixel first coordinate in image which matches GCP. (Pixel range line, pixel northing)	
22	235-250	F16.7	Pixel second coordinate in image which matches GCP. (Pixel azimuth line, pixel easting)	

23	251-266	F16.7	Pixel first coordinate in image which corresponds to transformed GCP coordinate/algorithmic geolocation. (Pixel range line, pixel northing)
24	267-282	F16.7	Pixel second coordinate in image which corresponds to transformed GCP coordinate/algorithmic geolocation. (Pixel azimuth line, pixel easting)
25	283-298	F16.7	Difference of (pixel) first coordinates on around (meters)
26	299-314	F16.7	Difference of (pixel) second coordinates on ground (meters)
27	315-330	F16.7	Correlation coefficient for automatic matching
28	331-346	F16.7	Reliability measure or second correlation coefficient (site and software specific)
29	347-360	A14	spare
2-ND, 3-RD, ... GOP DESCRIPTORS			
30	361-<tbd>	...	Repetition of the GCP descriptor fields (from field 13 through 29) as indicated by the number of GCPs (in field #9).
<tbd>	<tbd>-EOR	A<tbd>	spares

6.2.17 FACILITY RELATED DATA RECORD

6.2.17 FACILITY RELATED DATA RECORDS

The facility related data records format and data content are completely facility defined <tbd> with the exception of the first 12 bytes of record identifier. The general format of~the record is defined in Table 6.2.17.1.

TABLE 6.2.17.1 FACILITY RELATED DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
1	1-4	B4	Record sequence number
2	5	B1	1-st record sub-type code = 18
3	6	B1	Record type code = 200
4	7	B1	2-nd record sub-type code = 18
5	8	B1	3-rd record sub-type code = <tbd> (eg: CEOS=20, CCRS=36, ESA=50, NASA=60, NASA-JPL=61, NASDA=70, DFVLR=80, RAE=90, TELESPAZIO=l00, UNSPECIFIED=18, etc.)
6	9-12	B4	Length of this record = <tbd>
7	13-16	I4	Detailed processing parameters record sequence number
8	17-20	A4	blanks
9	<tbd>-...	A<tbd>	<tbd>

TABLE 6.3 SAR DATA IMAGERY OPTIONS FILE

6.3 SAR DATA IMAGERY OPTIONS FILE

The SAR data imagery options file contains the SAR data. The data may be unprocessed raw, partially compressed, processed into SAR image data or fully processed into application data. The data itself may be any of the types outlined in section 1.4. The data type format is specified in the file descriptor record. This CCT format definition does not allow data type format variations within a single SAR data file. For example, if the application requires that one SAR channel is complex and another is detected, then these must be stored as separate SAR data files.

Although the format permits the storage of the SAR data in a variety of formats, the format specification example (Table 6.3.1.3 and 6.3.1.4) has been constructed for the most common data format type. The example was intended for the specification of detected 16-bit unsigned integer data.

6.3.1 FILE DESCRIPTOR RECORD

The FILE DESCRIPTOR Record Fixed Segment is defined in Table 6.3.1.1. Its content for detected 16-bit unsigned ~nteger valued SAR data is shown in Table 6.3.1.3. The FILE DESCRIPTOR RECORD VARIABLE SEGMENT of the IMAGERY OPTIONS FILE is defined in Table 6.3.1.2 and its contents for 16-bit unsigned single channel SAR image data appears in Table 6.3.1.4.

TABLE 6.3.1.1 IMAGERY OPTIONS FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT) DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	= 1

2	5	B1	i-St record sub-type code	= 50
3	6	B1	Record type code	= 192
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 18
6	9-12	B4	Length of this record	= (n>
7	13-14	A2	ASOII/EBODIC flag, always ="A$" for ASCII or "E$" for EBCDIC	
8	15-16	A2	blanks	
9	17-28	A12	Format control document ID for this data file format (the ID of this document)	
10	29-30	A2	Format control document revision level= A" (for original)	
11	31-32	A2	File design descriptor revision letter= 11$A11 (for original)	
12	33-44	A12	Generating release revision level (ie. name & version; same as field 12 of the volume descriptor record)	
13	45-48	I4	File number	
14	49-64	A16	File name (same as field 10 in file pointer record in volume directory file)	
15	65-68	A4	Record sequence and location type flag	
16	69-76	I8	Sequence number location	
17	77-80	I4	Sequence number field length	
18	81-84	A4	Record code and 1ocation type flag	
19	85-92	I8	Record code location	
20	93-96	I4	Record code field length	
21	97-100	A4	Record length and location type flag	
22	101-108	I8	Record length location	
23	109-112	I4	Record length field length	
24	113	A1	Reserved	
25	114	A1	Reserved	
26	115	A1	Reserved	
27	116	A1	Reserved	
28	117-180	A64	Reserved segment	
29	181-186	I6	Number of SAR DATA records	
30	187-192	I6	SAR DATA record length (bytes)	
31	193-216	A24	Reserved (blanks)	

SAMPLE GROUP DATA

32	217-220	I4	Number of bits per sample
33	221-224	I4	Number of samples per data group (or pixel)
34	225-228	I4	Number of bytes per data group (or pixel)

35	229-232	A4	Justification and order of samples within data group (or pixel)

SAR RELATED DATA IN THE RECORD

36	233-236	I4	Number of SAR channels in this tile
37	237-244	I8	Number of lines per data set (one channel) in this file (excluding border lines)
38	245-248	I4	Number or left border pixels per line
39	249-256	I8	Total nurber of data groups (or pixels) per line per SAR channel
40	257-260	I4	Number of right border pixels per line
41	261-264	I4	Number of top border lines
42	265-268	I4	Number of bottom border lines
43	269-272	A4	Interleaving indicator "BIL$", "BSQ$", "BIP$"

RECORD DATA IN THE FILE

44	273-274	I2	Number of physical records per line
45	275-276	I2	Number of physical records per multi-channel line in this file
46	277-280	I4	Number of bytes of prefix data per record
47	281-288	I8	Number of bytes of SAR data (or pixel data) data per record
48	289-292	I4	Number of bytes of suffix data per record
49	293-296	A4	Prefix/suffix repeat flag "$$$$"

PREIX/SUFFIX DATA LOCATORS (*)

50	297-304	A8	Sample data line number locat~r
51	305-312	A8	SAR channel number locator
52	313-320	A8	Time of SAR data line locator
53	321-328	A8	Left-fill count locator
54	329-336	A8	Right-fill count locator
55	337-340	A4	Pad pixels present indicator "YES$" or "N0$$" (for SAR data, always "$$$$")
56	341-368	A28	blanks
57	369-376	A8	SAR data line quality code locator
58	377-384	A8	Calibration information field locator
59	385-392	A8	Gain values field locator
60	393-400	A8	Bias values field locator

SAR DATA PIXEL DESCRIPTION

61	401-428	A28	SAR Data format type identifier (eg. "BINARY$$$$$$$$$$$$$$$$$$$$$$", NSIGNED$INTEGER*2$$$$$$$$$$",

			IGNED$INTEGER*4$$$$$$$$$$$", c. (see section 1.4))
62	429-432	A4	SAR Data format type code (eg. "BIN$", "IU2$""I*4$", etc.)
63	33-436	I4	Number of left fill bits within pixel
64	437-440	I4	Number of right 2111 bits within pixel
65	441-448	I8	Maximum data range of pixel (starting from 0)
66	449-(n)	A(n-448)	blanks

Note. (*) The format for an 8-byte ASCII locator is as follows.
Bytes 1-4 = start byte number of the field within prefix/suffix.
Bytes 5-6 = length in bytes of the field to be located.
Byte 7 = letter "P" or "S" indicating the location of the field is in prefix or suffix.
Byte 8 = type of data format.
A = ASCII
B = Binary
N = Numeric ASCII

TABLE 6.3.1.3 IMAGERY OPTIONS FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT) CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
1	1-4	B4	1	-record sequence number
2	5	B1	50	-1-st rec.subtype code
3	6	B1	192	-record type code
4	7	B1	18	-2nd rec.subtype code

5	8	R1	18 -3rd rec.subtype code
6	9-12	B4	(n) -record length
7	13-14	A2	$A -ASCII flag
8	15-16	A2	$$ -blank
9	17-28	A12	CEOS-SAR-COT -format control doc.
10	29-30	A2	$A -format control doc.version
11	31-32	A2	$A -record format rev.level
12	33-44	A12	<software.id.> (same code as field 12 of volume descriptor record and is assigned by producing facility)
13	45-48	i4	<nnnn> -l for BIL; 3-2 for BSQ
14	49-64	A16	cfile.name.....> (same code-assigned by producing facility as field 10 of file pointer record)
15	65-68	A4	FSEQ
16	69-76	I8	$$$$$$$1
17	77-80	I4	$$$4
18	81-84	A4	FTYP
19	85-92	I8	$$$$$$$9
20	93-96	I4	$$$4
21	97-100	A4	FLGT
22	101-108	I8	$$$$$$$9
23	l09-112	I4	$$$4
24	113	A1	(blank)
25	114	A1	(blank)
26	115	A1	(blank)
27	116	A1	(blank)
28	117-180	A64	(blanks)

8.0 LIST OF TECHNICAL TERM DEFINITIONS

Absolute radiometric calibration magnitude uncertainty	The uncertainty (one sigma) is the estimate of the normalised radar cross-section (σ° -18 dB) from an image pixel value.
Absolute radiometric calibration phase	The uncertainty (one sigma) in the estimate of the phase from a complex image pixel value.

uncertainty

Ambiguity ratio

The (distributed target) ambiguity ratio is defined as the ratio Su/Sa, where:

Su is the mean image intensity corresponding to a distributed target resolution cell at a specific position in the swath (desired zone).

Sa is the sum of the mean image intensities observed in the same distributed target resolution cell in the image but originating from distributed targets located within the azimuth or range ambiguous zones.

The azimuth ambiguous zones are zoxies whose slant ranges and side are the same as the desired zone, but whose Doppler frequencies differ by multiples of the Pulse Repetition Frequency (PRF). The azimuth desired and ambiguous energies are calculated by integrating over the processed Doppler bandwidth with weighting as applicable.

The range ambiguous zones are zones whose slant ranges differ from that of the desired zone by non-zero multiples of the pulse repetition distance. (c/2.PRF), and whose doppler frequencies differ by multiples of the PRF. A composite radar reflectivity curve which defines relative signal levels is used to model the variation of radar backscattering coefficient with incidence angle. For the purpose of this calculation (range ambiguity) only, the effect of earth rotation is neglected (worse case).

TABLE 6.3.1.4 IMAGE OPTIONS FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT) CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
29	181-186	I6	<nnnnnn>	- SAR DATA recs.count
30	187-192	I6	<nnnnnn>	- SAR DATA recs.length
31	193-216	A24	(blanks)	

SAMPLE GROUP DATA

32	217-220	I4	$$16	- no.of bits/sample
33	221-224	I4	$$$1	- no.of samples per data group (or pixel)
34	225-228	14	$$$2	- no.of bytes/data group (or pixel)
35	229-232	A4	(blank)	- justification and order of samples within data group (or pixel)

SAR DATA in file

36	233-236	I4	$$$1	- no.of SAR channels
37	237-244	I8	<nnnnnnnn>	- no.of lines per SAR channel (excluding border lines)
38	245-248	I4	<nnnn>	- no.of left border pixel per line
39	249-256	I8	<nnnnnnnn>	- total no. of pixels allocated per line per SAR channel
40	257-260	I8	<nnnnnnnn>	- no.of right border pixels per line
41	261-264	I4	<nnnn>	- no.of top border lines
42	265-268	I4	<nnnn>	- no.of bottom border lines
43	269-272	A4	BSQ$	- interleaving indicator "BIL$", "BSQ$", "BIP$"

RECORD DATA IN THE FILE

44	273-274	I2	<nn>	- no.of physical records per line
45	275-276	I2	<nn>	- no.of physical records per multi SAR channel line
46	277-280	I4	<nnnn>	- length of prefix data per line (bytes)
47	281-288	I8	<nnnnnnnn>	- length of SAR data per line (bytes)
48	289-292	I4	<nnnn>	- length of suffix data per line (bytes)
49	293-296	A4	$$$$	- prefix/suffix repeat flag

PREFIX/SUFFIX DATA LOCATORS (*)

50	297-304	AS	$$l3$4PB	- line number locator
51	305-312	AS	$$49$2PB	- SAR channel number locator

52	313-320	AS	$$45$4PB	- time of line locator
53	321-328	AS	$$21$4PB	- left-fill count locator
54	329-336	AS	$$29$4PB	- right-fill count locator
55	337-340	A4	$$$$	- pad pixels present indicator
56	341-368	A28	(blanks)	
57	369-376	A8	$$$$$$$$	- line quality code locator
58	377-384	A8	$$$$$$$$	- cal.info. field locator
59	385-392	A8	$$$$$$$$	- gain values field locator
60	393-400	A8	$$$$$$$$	- bias values field locator

PIXEL DATA DESCRIPTION

61	401-428	A28	UNSIGNED$INTEGER$$$$$$$$ -SAR data Indicator	format type (section 1.4)
62	429-432	A4	1U2$	- SAR data format type code
63	433-436	I4	$$$0	- no.of left fill bits within pixel
64	437-440	I4	$$$0	- number of right fill bits within pixel
65	441-448	I8	$$$65535	- maximum data range
66	449-(n)	A(n-448)	(blanks)	- reserved for pad pixel and LINN description

Note. (*) The format for an 8-byte ASCII locator is as follows..
Bytes 1-4 = start byte number of the field within prefix/suffix.
Bytes 5-6 = length in bytes of the field to be located.
Byte 7 = letter "P" or "S" indicating the location of the field is in prefix or suffix.
Byte 8 = type of data format.
A = ASCII
B = Binary
N = Numeric ASCII

6.3.2 SIGNAL DATA RECORD

6.3.2 SIGNAL DATA RECORD

The definition of the signal data record is given in Table 6.3.2.1.

TABLE 6.3.2.1 IMAGERY OPTIONS FILE - SIGNAL DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	= 2, 3,
2	5	B1	1-st record sub-type code	= 50
3	6	B1	Record type code	= 10
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 20
6	9-12	B4	Length of this record	= (n>

PREFIX DATA - GENERAL INFORMATION

7	13-16	B4	SAR image data line number
8	17-20	B4	SAR image data record index (indicates the record sequence number in the image line)
9	21-24	B4	Actual count of left-fill pixels
10	25-28	B4	Actual count of data pixels
11	29-32	B4	Actual count of right-fill pixels

PREFIX DATA - SENSOR PARAMETERS

12	33-36	B4	Sensor parameters uodate flag (l=data in this section is an update O=data is a repeat)
13	37-40	B4	Sensor acquisition year
14	41-44	B4	Sensor acquisition day of year
15	45-48	B4	Sensor acquisition msecs of day
16	49-50	B2	SAR channel indicator (sequence number in multi-channel SAR data)
17	51-52	B2	SAR channel code (O=L, 1=5, 2=0, 3=X, 4=KU and 5=KA channel)
18	53-54	B2	Transmitted polarization (O=H, l=V)
19	55-56	B2	Received polarization (O=H, l=V)
20	57-60	B4	PRF (Hz)
21	61-64	B4	spare
22	65-66	B2	Onboard Range compressed flag (O=no/l=yes)
23	67-68	B2	Pulse (chirp) type designator (0="LINEARFMCHIRP$", 1 = "PHASE$ MODULATORS")
24	69-72	B4	Chirp length (nano-secs)
25	73-76	B4	Chirp constant coefficient (Hz)
26	77-80	B4	Chirp linear coefficient (Hz/Vsec)
27	81-84	B4	Chirp quadratic coefficient (Hz/Wsec,)
28	85-88	B4	spare
29	89-92	B4	spare
30	93-96	B4	Receiver gain (dB)
31	97-100	B4	Nought line flag (O=no/l=yes)
32	101-104	B4	Antenna electronic elevation angle from nadir (millionths of degrees)
33	105-108	B4	Antenna mechanical elevation angle from nadir (millionths of degrees)
34	109-112	B4	Electronic antenna squint angle (millionths of degrees)
35	113-116	B4	Mechanical antenna squint angle (millionths of degrees)
36	117-120	B4	Slant range to 1-st data sample (m)
37	121-124	B4	Data record window position (ie. sample delay) (nano-secs)

38	125-128	B4	spare

PREFIX DATA - PLATFORM REFERENCE INFORMATION

39	129-132	B4	Platform pos. parameters update flag (1=data in this section is an update O=data is a repeat)
40	133-136	B4	Platform latitude (millionths deg.)
41	137-140	B4	Platform longitude (millionths deg.)
42	141-144	B4	Platform altitude (meters)
43	145-148	B4	Platform ground speed (cms/sec)
44	149-160	3B4	Platform velocity X',Y',Z'(cm/sec)
45	161-172	3B4	Platform acceleration X",Y",Z",(cm/sec,)
46	173-176	B4	Platform track angle (millionths deg.)
47	177-180	B4	Platform true heading (millionths deg.)
48	181-184	B4	Platform Pitch angle (millionths deg.)
49	185-188	B4	Platform Roll angle (millionths deg.)
50	189-192	B4	Platform Yaw angle (millionths deg.)

PREFIX DATA - SENSOR/FACILITY SPECIFIC AUXILIARY DATA

51	193-412	B220	Sensor/Facility specific auxiliary information such as down linked auxiliary data (ie. pulse replicas, etc.) and data quality information (ie. frame errors, sync.loss, parity, etc.)

TABLE 6.3.2.1 IMAGERY OPTIONS FILE - SIGNAL DATA RECORD DEFINITION (Cont'd.)

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
SAR RAW SIGNAL DATA			
52	413-(I)	(j)B(k)	SAR Signal data consisting of Noise and Echo data. Where: (i)-number of bytes of data +412 (j)-number of pixels on this record (k)-size of pixel in bytes
SUFFIX DATA			

53	<tbd>-...	<tbd> B4	Processing Facility specific details (quality information such as frame errors, sync.loss, parity, etc.)
54	<tbd>-EOR	<tbd>B4	spares

6.3.3 PROCESSED DATA RECORD

6.3.3 PROCESSED DATA RECORD

The definition of the SAR processed data record is given in Table 6.3.3.1.

TABLE 6.3.3.1 IMAGERY OPTIONS FILE - PROCESSED DATA RECORD DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	= 2, 3,
2	5	B1	1-st record sub-type code	= 50
3	6	B1	Record type code	= 11
4	7	B1	2-nd record sub-type code	= 18

5	8	B1	3-rd record sub-type code = 20
6	9-12	B4	Length of this record = (n)

PREFIX DATA - GENERAL INFORMATION

7	13-16	B4	SAR image data line number
8	17-20	B4	SAR image data record index (indicates the record sequence number in the image line)
9	21-24	B4	Actual count of left-fill pixels
10	25-28	B4	Actual count of data pixels
11	29-32	B4	Actual count of right-fill pixels

PREFIX DATA - SENSOR/PROCESSING PARAMETERS

12	33-36	B4	Sensor parameters update flag (l=data in this section is an update O=data is a repeat)
13	7-40	B4	Sensor acquisition year
14	1-44	B4	Sensor acquisition day of year
15	5-48	B4	Sensor acquisition msecs of day
16	49-50	B2	SAR channel indicator (sequence number in multi-channel SAR data)
17	51-52	B2	SAR channel code (O=L, I=S, 2=0, 3=X, 4=KU and 5=KA channel)
18	53-54	B2	Transmitted polarization (O=H, l=V)
19	55-56	B2	Received polarization (O=H, l=V)
20	57-60	B4	PRF (Hz)
21	61-64	B4	spare
22	65-68	B4	Slant Range to 1-st pixel(m)
23	69-72	B4	Slant Range to mid-pixel(m)
24	73-76	B4	Slant Range to last pixel(m)
25	77-80	B4	Doppler centroid value at 1st px. (Hz)
26	81-84	B4	Doppler centroid value at mid-pixel
27	85-88	B4	Doppler centroid value at last pixel
28	89-92	B4	Azimuth FM rate of 1st px.(Hz)
29	93-96	B4	Azimuth FM rate of mid-pixel
30	97-100	B4	Azimuth FM rate of last pixel
31	101-104	B4	Look angle of nadir (millionths of deg)
32	105-108	B4	Azimuth squint angle (millionths of degrees)
33	109-112	B4	spare
34	113-116	B4	spare
35	117-120	B4	spare
36	121-124	B4	spare
37	125-128	B4	spare

PREFIX DATA - GEOGRAPHIC REFERENCE INFO.

38	129-136	B4	Geographic ref. parameter update flag (1=data in this section is an update O=data is a repeat)
39	133-136	B4	Latitude of 1-st pixel (millionths of deg)
40	137-140	B4	Latitude of mid-pixel
41	141-144	B4	Latitude of last pixel
42	145-148	B4	Longitude of 1-st pixel (millionths of degrees)
43	149-152	B4	Longitude of mid-pixel
44	153-156	B4	Longitude of last pixel
45	157-160	B4	Northing of 1-st pixel (m)
46	161-164	B4	spare
47	165-168	B4	Northing of last pixel (m)
48	169-172	B4	Easting of 1-st pixel (m)
49	173-176	B4	spare
50	177-180	B4	Easting of last pixel (m)
51	181-184	B4	Line heading (orienitation of the perpendicular to the data line centre relative to true north) (millionths of degs.)
52	185-188	B4	spare
53	189-192	B4	spare

SAR PROCESSED DATA

54	193-(i)	(j)B(k)	SAR processed data. Where.. (i)-number of bytes of data +412 (j)-number 6f pixels on this record (k)-size of pixel in bytes

SUFFIX DATA

55	<tbd>-...	<tbd>B4	Processing Facility specific details (quality information such as frame errors, sync.loss, parity, etc.)
56	<tbd>-EOR	<tbd>B4	spares

6.4 SARTRAILER FILE

6.4 SARTRAILER FILE

6.4.1 FILE DESCRIPTOR RECORD

The SARTRAILER file DESCRIPTOR RECORD, except for the record subtype codes, is identical to the SARLEADER file descriptor record. The SARTRAILER file DESCRIPTOR RECORD FIXED SEGMENT is defined in Table 6.4.1.1. Its content, as it applies to the SARTRAILER FILE, is shown in Table 6.4.1.3. The SARTRAILER FILE DESCRIPTOR RECORD VARIABLE SEGMENT is defined in Table 6.4.1.2 and its contents as it applies to the SARTRAILER file is shown in Table 6.4.1.3.

TABLE 6.4.1.1 SARTRAILER FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT) DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT	
1	1-4	B4	Record sequence number	= 1
2	5	B1	1-st record sub-type code	= 91
3	6	B1	Record type code	= 192
4	7	B1	2-nd record sub-type code	= 18
5	8	B1	3-rd record sub-type code	= 18
6	9-12	B4	Length of this record	= 720
7	13-14	A2	ASCII/EBODIC flag, always="A$" for ASCII or "E$" for ESCDIC	
8	15-16	A2	blanks	
9	17-28	A12	Format control document ID for this data file format (the ID of this document)	
10	29-30	A2	Format control document revision level = "$A" (for original)	
11	31-32	A2	File design descriptor revision letter ="$A" (for original)	

12	33-44	A12	Generating software release and revision level (je. name & version; same as field 12 of the volume descriptor record)
13	45-48	14	File number
14	49-64	A16	File name (same as field 10 in file pointer record in volume directory file)
15	65-68	A4	Record sequence and location type flag
16	69-76	I8	Sequence number location
17	77-80	I4	Sequence number field length
18	81-84	A4	Record code and location type flag
19	85-92	I8	Record code location
20	93-96	I4	Record code field length
21	97-100	A4	Record length and location type flag
22	101-108	I8	Record length location
23	109-112	14	Record length field length
25	114	A1	Reserved
26	115	A1	Reserved
27	116	A1	Reserved
28	117-180	A64	Reserved segment

TABLE 6.4.1.2 SARTRAILER FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT) DEFINITION

FIELD	BYTES	FORMAT	DESCRIPTION AND/OR CONTENT
29	181-186	I6	Number of data set summary records
30	187-192	I6	Data set summary record length
31	193-198	I6	Number of map projection data records
32	199-204	I6	Map projection record length
33	205-210	I6	Number of platform pos. data records
34	211-216	I6	Platform position record length
35	217-222	I6	Number of attitude data records
36	223-228	I6	Attitude data record length
37	229-234	I6	Number of radiometric data records
38	235-240	I6	Radiometric record length
39	241-246	I6	Number of rad. compensation records
40	247-252	I6	Radiometric compensation rec. length
41	253-258	I6	Number of data quality summary records
42	259-264	I6	Data quality summary record length
43	265-270	I6	Number of data histograms records
44	271-276	I6	Data histogram record length

45	277-282	I6	Number of range spectra records
46	283-288	I6	Range spectra record length
47	289-294	I6	Number of DEM descriptor records
48	295-300	I6	DEM descriptor record length
49	301-306	I6	Number of Radar par. update records
50	07-312	I6	Radar par. update record length
51	13-318	I6	Number of Annotation data records
52	19-324	I6	Annotation data record length
53	25-330	I6	Number of Det.processing records
54	331-336	I6	Det.processing record length
55	337-342	I6	Number of Calibration records
56	343-348	I6	Calibration record length
57	349-354	I6	Number of GCP records
58	355-360	I6	GCP record length
59	361-366	I6	spare
60	367-372	I6	spare
61	373-378	I6	spare
62	379-384	I6	spare
63	385-390	I6	spare
64	391-396	I6	spare
65	397-402	I6	spare
66	403-408	I6	spare
67	409-414	I6	spare
68	415-420	I6	spare
69	421-426	I6	Number of Facility data records
70	427-432	I6	Facility data record length
71	433-720	A288	blanks

TABLE 6.4.1.3 SARTRAILER FILE - FILE DESCRIPTOR RECORD (FIXED SEGMENT) CONTENTS

FIELD	BYTES	FORMAT	CONTENT
1	1-4	B4	1 - record sequence number
2	5	B1	91 - lst rec.subtype code
3	6	B1	192 - record type code
4	7	B1	18 - 2nd rec.subtype code
5	8	B1	18 - 3rd rec.subtype code
6	9-12	B4	720 - record length
7	13-14	A2	$A - ASCII flag
8	15-16	A2	$$ - blank
9	17-28	A12	CEOS-SAR-OCT - format control doc.
10	29-30	A2	$A - format control doc.version
11	31-32	A2	$A - record format rev.level
12	33-44	A12	<software.id.> (same code as field 12 of volume descriptor record)
13	45-48	I4	<nnnn> -file number (3 for BIL; 3nn for BSQ)
14	49-64	A16	<file.name.....>

			(same code as field 10 of file pointer record)
15	65-68	A4	FSEQ
16	69-76	I8	$$$$$$$1
17	77-80	I4	$$$4
18	81-84	A4	FTYP
19	85-92	I8	$$$$$$$5
20	93-96	I4	$$$4
21	97-100	A4	FLGT
22	101-108	18	$$$$$$$9
23	109-112	14	$$$4
24	113	A1	blank
25	114	A1	blank
26	115	A1	blank
27	116	A1	blank
28	117-180	A64	(blanks)

TABLE 6.4.1.4 SARTRAILER FILE - FILE DESCRIPTOR RECORD (VARIABLE SEGMENT) CONTENTS

FIELD	BYTES	FORMAT	CONTENT	
29	181-186	I6	<nnnnnn>	- no.of data set summary
30	187-192	I6	$$4096	records & record length
31	193-198	I6	<nnnnnn>	- no.of map projection data
32	199-204	I6	$$1620	records & record length
33	205-210	I6	<nnnnnn>	- no.of platform position data
34	211-216	I6	$$8960	records & record length
35	217-222	I6	<nnnnnn>	- no.of attitude data records
36	223-228	I6	$$9860	& record length ctbd>
37	229-234	I6	<nnnnnn)	- no.of radiometric data
38	235-240	I6	$$9860	records & record length ctbd>
39	241-246	I6	<nnnnnn>	- no.ofradiometriccompensation
40	247-252	I6	$$8600	records & record length ctbd>
41	253-258	I6	<nnnnnn)	- no.of data quality summary
42	259-264	I6	$$1620	records & record length ctbd)
43	265-270	I6	<nnnnnn>	- no.of data histograms
44	271-276	I6	$16920	records & record length
45	277-282	I6	<nnnnnn>	- no.of range spectra records
46	283-288	I6	<nnnnnn>	& record length ctbd>

47	289-294	I6	<nnnnnn>	- no.of DEM descriptor records
48	295-300	I6	<nnnnnn>	& record length ctbd)
49	301-306	I6	<nnnnnn>	- no.of Radar par.update records
50	307-312	I6	<nnnnnn>	& record length ctbd>
51	313-318	I6	<nnnnnn>	- no.of annotation data records
52	319-324	I6	<nnnnnn>	& record leng~h ctbd>
53	324-330	I6	<nnnnnn>	- no.of Detailed proces. records
54	331-336	I6	<nnnnnn>	& record length ctbd>
55	337-342	I6	<nnnnnn>	- no.of calibration data
56	343-348	I6	<nnnnnn>	records & record length ctbd>
57	349-354	I6	<nnnnnn>	- no.of GOP records
58	355-360	I6	<nnnnnn>	& record length ctbd>
59	361-366	I6	$$$$$$	- blanks
60	367-372	I6	$$$$$$	& blanks
61	373-378	I6	$$$$$$	- blanks
62	379-384	I6	$$$$$$	& blanks
63	385-390	I6	$$$$$$	- blanks
64	391-396	I6	$$$$$$	& blanks
65	397-402	I6	$$$$$$	- blanks
66	403-408	I6	$$$$$$	& blanks
67	409-414	I6	$$$$$$	- blanks
68	415-420	I6	$$$$$$	& blanks
69	421-426	I6	<nnnnnn>	- no.of facility data records
70	427-432	I6	<nnnnnn)	& record length ctbd>
71	433-720	A288	(blanks)	

6.5 NULL VOLUME FILE

6.5 NULL VOLUME DIRECTORY FILE

The NULL VOLUME DIRECTORY FILE is the terminator. It is essentially a volume directory file that has no data except for a volume descriptor record. The volume descriptor record definition, with the exception of the 2nd record subtype code, is the same as that of the volume directory file volume descriptor record defined in Table 6.1.1.1. The NULL VOLUME DESCRIPTOR RECORD contents are defined in Table 6.5.1.1.

TABLE 6.5.1.1 NULL VOLUME DESCRIPTOR RECORD

CONTENTS

FIELD	BYTES	FORMAT	CONTENT
1	1-4	B4	1 - record sequene number
2	5	B1	192 - 1-st rec.subtype code
3	6	B1	192 - record type code
4	7	B1	63 - 2nd rec.subtype code
5	8	B1	18 - 3rd rec.subtype code
6	9-12	B4	360 - record length
7	13-14	A2	A$ - ASCII flag
8	15-16	A2	$$ - blanks
9	17-28	A12	CEOS-SAR-CCT -format control doc.
10	29-30	A2	$A - format control doc.version
11	31-32	A2	$A - record format rev.level
12	33-44	A12	<software.id.>
13	45-60	A16	<physical.tape.id>
14	61-76	A16	$$$$$$$$$$$$$$$$ - logical.set.id.
15	77-92	A16	$$$$$$$$$$$$$$$$ - volume. set. id.
16	93-94	I2	$1 - total number of physical volumes

17	95-96	I2	$1	- 1-st physical volume seq.#
18	97-98	I2	$1	- last physical volume seq.#
	99-100	I2	$1	- this physical volume seq.#
20	101-104	I4	$$$$	- 1-st ref.file in volume
21	105-108	I4	$$$2	- 1ogica1 volume in set
22	109-112	I4	$$$2	- logical volume number in physical volume
23	113-120	A8	$$$$$$$$	
24	121-128	A8	$$$$$$$$	
25	129-140	A12	$$$$$$$$$$$$	
26	141-148	A8	$$$$$$$$	
27	149-160	A12	$$$$$$$$$$$$	
28	161-164	I4	$$$$	
29	165-168	I4	$$$$	
30	169-260	A92	(blanks)	-spare
31	261-360	A100	(blanks)	-spare

ACRONYMS AND ABBREVIATIONS

CAL/VAL	Calibration/Validation
CCRS	Canada Centre for Remote Sensing
CCT	Computer Compatible Tape
CEOS	Committee on Earth Observation Satellite
CEOS WGD	CEOS Working Group on Data
CRC	Communications Research Centre
DFVLR	Deutsche Forschungs-und Versuchsanstalt fur Luft-und Raumfahrt
ERS	European Remote Sensing Satellite
ESA	European Space Agency
GMT	Greenwich Mean Time
HDDT	High Density Digital Tape
JERS	Japan Earth Resources Satellite
JPL	Jet Propulsion Laboratory
Kbps	Kilobit per second
LGSOWG	LANDSAT GROUND STATION OPERATOR WORKING GROUP
LTWG	LANDSAT TECHNICAL WORKING GROUP
LUT	Look-Up Table
Mbps	Megabit per second
MTF	Modulation Transfer Function
NOAA	National Oceanographic and Atmospheric Administration
OD	Optica1 Digital Disk:
RAE	Royal Aircraft Establishment

RT	Real-Time
SAR	Synthetic Aperture Radar
TBC	To Be Confirmed
TBD	To Be Determined
TLC	Telecommunication
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
WRS	World Reference System

Antenna elevation pointing angle	The angle in degrees between the local vertical angle (nadir) and the SAR antenna boresight in the elevation plane. Positive is looking to the right and negative to the left of the sensor velocity vector.
Antenna squint angle	The angle in degrees between the antenna plane and the plane normal to the sensor velocity vector. A positive angle indicates a forwards squint and a negative angle a backwards squint.
Bandwidth per look	The bandwidth between the 3 dB points of the power spectrum of the look reference function.
Bit Error Rate (BER)	The fraction of bits in error related to the total number of bits transmitted.
Cross-polarisation Amplitude Calibration	Uncertainty in the estimate of the amplitude calibration back-scatter coefficient ratio between two coincident pixels from two coherent data channels within one frequency.
Cross-polarisation Phase Calibration	Uncertainty in the estimate of the relative Phase between two coincident pixels from two coherent data channels within one frequency.
Doppler Frequency Centroid Terms	Terms describing the variation of Doppler frequency centroid with azimuth and pixel number. The variation is approximated by the following second order polynomial.

$$F_c(N_a, N_r) = A_c + B_c N_a + C_c N_a^2 + D_c N_r + E_c N_r^2$$

where Na is the azimuth pixel number measured from the early edge (Na = 0) of the image and Nr the range pixel number measured from the near edge (Nr = 0) of the image.

Doppler freouency rate terms

Terms describing the variation of Doppler frequency rate with azimuth and range pixel number. The variation is approximated by the following second order polynomial:

$$F_r(N_a, N_r) = A_r + B_r N_a + C_r N_a^2 + D_r N_r + E_r N_r^2$$

where Na is the azimuth pixel number measured from the early edge (Na = 0) of the image and Nr the range pixel number measured from the near edge (Nr = 0) of the image.

Dynamic Range

The (instantaneous) dynamic range is defined as the range (lower and upper limits in dB) of radar backscattering coefficients from a distributed target over which the SNR equals or exceeds 8 dB. Optimum adjustment at the mid-swath position (geometric swath centre) of the gain setting for the A/D Converters is assumed. Extra dynamic range resulting from adjustment of the receiver gain is not included in this calculation.

E~rective antenna azimuth beamwidth

The angle in degrees between the 6 dB points on the mainlobe of the combined transmit-receive SAR azimuth antenna pattern.

Effective antenna elevation bandwidth

The angle in degrees between the 6dB points on the mainlobe of the combined transmit-receive SAR elevation antenna pattern.

Effective number of

The effective number of looks, Leff , is defined by:

looks

$$Leff = \frac{\mu^2}{\sigma^2}$$

where μ is the mean and σ is the standard deviation of the final image intensities originating from a distributed target of constant σ°

Geometric distortion scale across-track

The average fractional error (SAR distance to reference distance) over the image in the range separation. This is calculated using the following formula:

$$Pr = \sum_{j} \frac{(X_j - X') - (x_j - x')}{x_j - x'}$$

where X are the SAR range coordinates, x are the reference range coordinates, and prime indicates a tie point between the SAR system and reference system.

Geometric distortion scale along track

The average fractional error (SAR distance to reference distance) over the image in the azimuth separation. This is calculated using the following formula:

$$Pa = \sum_{i} \frac{(Y_i - Y') - (y_i - y')}{y_i - y'}$$

where Y are the SAR azimuth coordinates, y are the reference azimuth coordinate, and prime indicates a tie point between the SAR system and reference system.

Geometric distortion skew across track

The average fractional error (SAR range line to vector perpendicular to sensor velocity vector) over the image in the range direction.

Geometric distortion skew along track	The average fractional error (SAR azimuth line to sensor velocity vector) over the image in the azimuth direction.
Ground speed	The speed in m/s of the nadir point over the ellipsoid neglecting rotation of the ellipsoid. This can be derived from the sensor velocity using the following formula: $$Vg = \frac{Rc}{Rc + H} Vs$$ where Rc is the ellipsoid radius of curvature at the nadir and H is the altitude of the sensor above the ellipsoid.
Impulse Response Function	The two-dimensional final image response the SAR to a strong point target fixed on the ellipsoid and located at the centre of the image. The point target is large enough so that the effects of background clutter and additive receiver noise can be neglected, but small enough that saturation noise is not a problem.
Incidence Angle	The angle in degrees between the incident radar beam and the ellipsoid normal vector at the target.
Integrated Sidelobe Ratio (I8LR)	The Integrated Sidelobe is defined as the ratio of energy in the mainlobe to that in the sidelobes of azimuth and range cuts through the IRF. For the purpose of this definition, the main-lobe is defined to be of width 2x metres in the azimuth and 2y metres in the range directions centered on the peak of the IRF. The sidelobe area is defined to extend to a total length of 20x metres in the azimuth and 20y metres in the range dimensions centered on the peak of the IRF but excluding the mainlobe area

just defined, x and y are the azimuth and slant/ground range resolutions.

Lire content indicator	Azimuth indicates that each line represents an azimuth line (range bin) of data. An azimuth line is oriented parallel to the sensor velocity vector. Range indicates that each line represents a range line (azimuth bin) of data. A range line (azimuth bin) is oriented perpendicular to the sensor velocity vector. Pixel indicates that neither of the above apply.
Nominal resolution	The spatial resolution is the width of the Impulse Response Function (IRF) where the intensity reaches 50$ of the interpolated peak value (3 dB width). Azimuth and slant/ground range resolutions refer to along track and across track cuts respectively. The spatial resolution is x metres in the along track direction and y metres in the across track direction.
Peak Sidelobe Ratio (PSLR)	The peak sidelobe ratio is defined as the ratio of the peak intensity in the mainlobe of the iRF to the peak intensity of the most intense sidelobe. The mainlobe is defined as in the definition for ISLR, the sidelobe region extends from $\pm$2x metres in the azimuth and $\pm$2y metres in the range to the bounds of the Instantaneous Field of View (IFOV) whose (centre coincides with the peak of the IRF. The IFOV is defined by the one way antenna 3 dB beamwidth in azimuth and the unprocessed pulse length in range.
Radiometric resolution	The radiometric resolution, r , is defined by $$r = 10 \log_{10} \frac{\mu + \sigma}{\quad\quad}$$

μ

where μ is the mean and σ the standard deviation of the final image intensities originating from a distributed target of constant σ°.

Range gate delay — The total delay (including hardware delay) in microseconds between the start of a pulse transmission and the first range bin of the return corresponding to that pulse.

Range pulse coefficients — For a linear FM modulated chirp of length T the frequency response in baseband is described by,

$$Fchirp = \theta 1 + \theta 2\, t \; ; \; -T/2 \leq t \leq T/2$$

where $\theta 1$ and $\theta 2$ are the first and second range pulse coefficients.

Range pulse length — The time duration (in microseconds) between the 3 dB (half power) points of the envelope of the RF pulse.

Relative Misregistration error — The average across / along track registration error in metres of the pixels from two different channels.

Relative radiometric calibration magnitude uncertainty — The uncertainty (one sigma) in the difference between two estimates of the normalised radar cross-section (σ° = -18 dB) from image pixel values from two different channels.

Signal to Noise Ratio (SNR) estimate — The ratio of the mean level within the range signal band-width to the mean level outside this bandwidth calculated from averaged range spectra over the image.

True number of looks — The number of sub-apertures over which separate azimuth or range correlations are performed.

9.0 REFERENCES

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LGSOWG COT Format COB Document.CCB-CCT-0002E.

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J. Curlander and A. Freeman, JPL., (October 1, 1987).

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(4) "Histogram Record Data Derivation",
G. J. Princz

10.0 TABLE RECORDS-PRODUCTS

The following subsection identifies in detail the records to be provided in the CCT together with the SAR product data. This information is given in the TABLE 10.1.

TABLE 10.1

CEOS FORMAT FILES/RECORDS \ DATA PRODUCT	UNPROCESSED SIGNAL DATA	PARTIALLY PROCESSED SIGNAL DATA	BASIC IMAGE	BULK IMAGE	GEOCODED DATA	SPECIAL IMAGE	DERIVED IMAGE	MULTITEMPORAL DERIVED DATA
VOLUME DIRECTORY FILE								
- VOLUME DESCRIPTOR	M	M	M	M	M	M	M	M
- FILE POINTER RECORD	M	M	M	M	M	M	M	M
- TEXT RECORD	M	M	M	M	M	M	M	M
SAR LEADER FILE								
- DESCRIPTOR RECORD	M	M	M	M	M	M	M	M
- DATA SET SUMMARY	R	R	M	M	M	M	M	R
- MAP PROJECTION DATA	N	N	O	O	R	R	R	R
- PLATFORM POSITION DATA	M	M	M	R	R	R	O	O
- ATTITUDE DATA	M	M	M	R	R	R	O	O
- RADIOMETRIC DATA	O	O	R	R	R	R	R	R
- RADIOMETRIC COMPENSATION	O	R	M	M	R	R	R	O
- DATA QUALITY SUMMARY	R	R	R	R	R	R	R	O
- DATA HISTOGRAM	R	R	R	R	O	O	O	O
- RANGE SPECTRA	R	R	R	R	O	O	O	O
SAR DATA FILE								
- DESCRIPTOR RECORD	M	M	M	M	M	M	M	M
- SIGNAL DATA	M	M	N	N	N	N	N	N
- PROCESSED DATA	N	N	M	M	M	M	M	M
SAR TRAILER FILE								
- DESCRIPTOR RECORD	M	M	M	M	M	M	M	M
- DETAILED PROCESSING PARAM.	O	O	R	R	R	R	O	O
- CALIBRATION DATA	R	R	R	R	R	R	O	O
- FACILITY RELATED DATA	O	O	O	O	O	O	O	O
NULL VOLUME DIRECTORY FILE								
- NULL VOLUME DESCRIPTOR	M	M	M	M	M	M	M	M

M = Mandatory, R = Recommended, O = Optional, N = Not Applicable

APPENDIX - B

Synthetic Aperture Radar

Photographic Image Format Specification

(CEOS-WGD on SAR Data Standards)

Contents

1. Introduction

This document address the dissemination of Synthetic Aperture Radar (SAR) photographic products from the processing centers to the uzer community. Photographic products will be delivered in different processing levels corresponding to the digital products on CCT from which they are derived.

With respect to the application and use of the sensor data, a strong international cooperation can be expected with many interfaces including exchange and comparison of data. Since all SAR data will be digitally processed, the prime data source for the data evaluation by users is the digital products to be provided on CCT or digital optical disk (see Appendix-A "Synthetic Aperture Radar Computer Compatible Tape Format Specification" (- CEOS-WGD on SAR Data Standards -)).

However, it is expected that the presentation of the data as photographic product will always play an important role. Unlike CCT-drives with their magnetic media. The image recording devices and related photographic media are not standardized at all. Therefore, it is not possible to achieve the same level of standardization as for digital products provided in the Family Format. As a result, a number of standard formats for SAR photographic presentation are specified and recommended for use.

2. General Layout of Photographic Products

Each photographic product shall have an area for the display of the image. This area shall be surrounded by enough space to allow a proper annotation of the image (black on white). As outlined in Figure 1, this information shall consist of:

- Registration Marks in the Four Image Corners
- The Standard Gray Scale and Optional Gray Scales
- An Area for Annotation Information Describing Relevant Image Parameters
- Scale Bar
- Indicators for North Direction, Flight Direction and illumination Direction
- Optional Geographic Tick Marks
- Optional Fields for a Histogram
- Optional Quality Control Information such as a Bar Pattern to Measure the MTF of the Image Recording System
- Optional Map Sheet Reference

It is expected that every product is accompanied by an information sheet which contains all necessary information reated to the image (see chapter 3.). A subset of these data are recorded as alphanumeric information on the photographic product (see chapter 5. and 6. for detailed specifications).

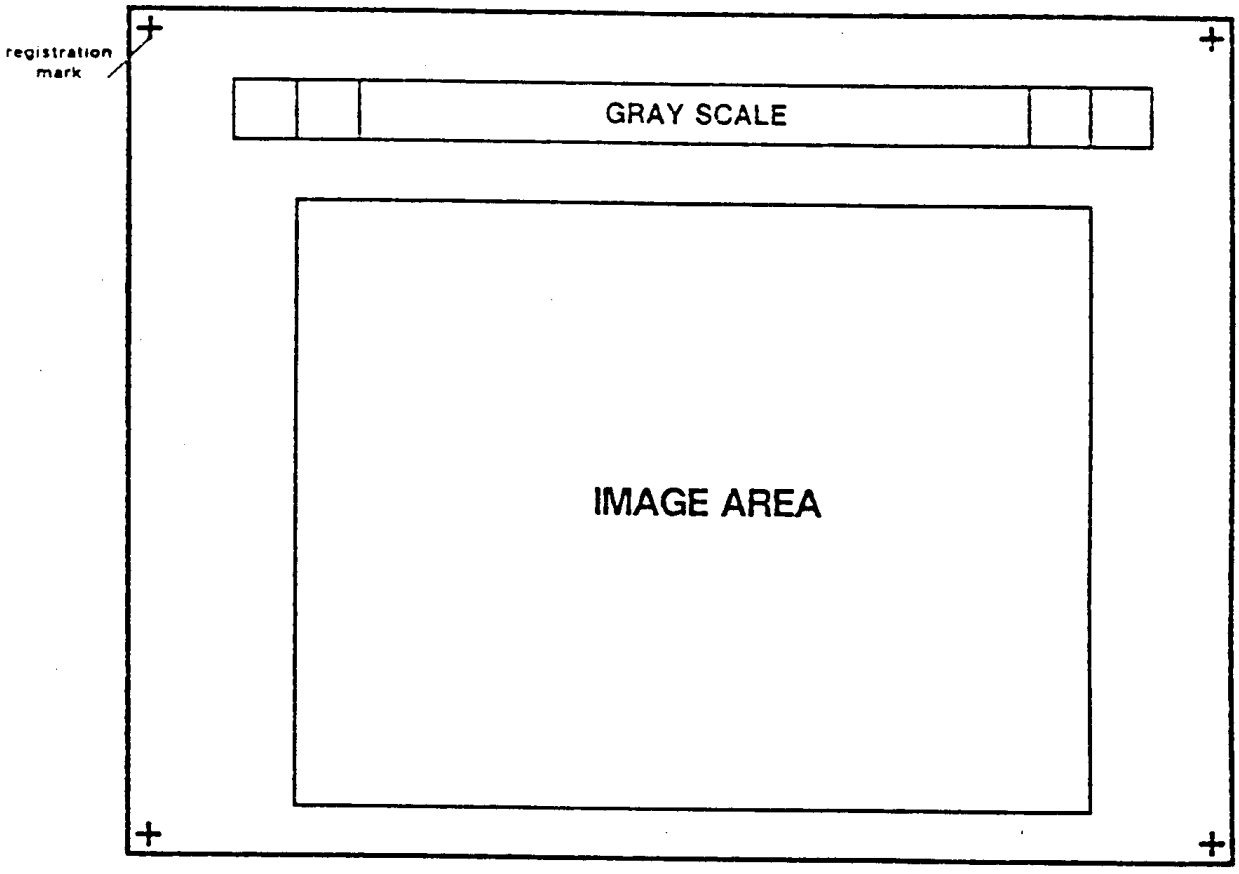


Figure 1. SAR Photographic Product Layout

3. Image Information Sheet

The Image Information Sheet which accompanies the photographic product is generated at the time the image is produced from the digital dataset. It contains the following information as available in the CCT-Format:

- General Information
  - Reference to Product Description Document (if appIicabIe)

- Mission and Sensor Parameters
  - Platform Identification
  - Orbit Number or Flight Line Indicator
  - Platform Position (x.y.z Geocentric)
  - Platform Velocity
  - Platform Heading Angle
  - Platform Attitude (Roll, Yaw, Pitch)
  - Attitude Rate
  - Altitude above Nadir Point
  - Addition Platform Parameters as Applicable
  - Sensor Identification
  - Radar Frequency
  - Chirp Identification or Characteristics
  - Polarization (Transmit, Receive)
  - Antenna Look Angle (Azimuth. Elevation)
  - Antenna Clock AngIe (- 90° , + 90°)
  - Pulse Repetition Frequency
  - Operating Mode (e.g. Quad Polarization Operation)
  - Additional Radar Parameters as Applicable (e.g. Calibration Information.
  - Receiver Gain, Data Window Position, Slant Range to 1st Pixel, Sampling Frequency. Range Bandwidth)

- Acquisition Parameters
  - Receiving Station Identification
  - Down Link Data Rate
  - Date, Time of Data Acquisition (GMT)
  - Additional Acquisition Parameters

- Processing Parameters
  - Processing Facility Information
  - Date of Processing
  - Product Type Specifier
  - Doppler Frequency (Mid Swath)
  - Total Doppler Bandwidth Used
  - Doppler Frequency Rate (Mid Swath)
  - Number of Looks Processed in Azimuth and Range
  - Bandwidth per Look in Azimuth and Range
  - Reference Function for Weighting in Range
  - Reference Function for Weighting in Azimuth

- Spatial Resolution in Range
- Spatial Resolution in Azimuth
- Number of Bits per Pixel
- Radiometric Presentation (Magnitude. Intensity)
- Additional Processing Parameters as Applicable

- Scene and lmage Presentation Parameters
  - Scene Description (Site Name)
  - Resampled Pixel Spacing on Ground
  - Image Recorder Spot Size
  - Number of Pixels per Line
  - Number of Lines
  - Coordinates of the Four Corners
  - Image Center Coordinates
  - Location Accuracy
  - GMT of Image Center
  - Ground Track Heading Relative to True North
  - Date and Time of Image Generation (Master)
  - Statistical Parameters such as
    Bit Error Rate. Signal-to-Noise Ratio. Eqivalent Number of Looks.
    Mean and Standard Deviation and Total Ambiguity Ratio
  - Map Projection
  - Reference to Map Sheet
  - Number of Ground Control Points Used and Library ID Used
  - Source. Quality and Size of Used Digital Elevation Model (if applicable)
  - Geocoding Algorithm and Related Location Accuracy
  - Resampling Algorithm Used
  - Additional Geocoding Parameters as Applicable
  - Additional Scene and Image Presentation Parameters

- Archiving Parameters
  - Image Archive Number (includes Processing Center Identification)
  - Digital Product Archive Number
  - Photograph Archive Number
  - Additional Archiving Parameters as Applicable

4. Mandatory SAR Image Annotation

A subset of the parameters provided on information sheet shall be printed on the SAR photographic products.

- Product Type
- Platform and Sensor Identification
- Sensor Operating Mode
- Product Generation Agency
- Product Identification
- Archive Number
- Date and Time of Data Acquisition (GMT for Center of Image)
- Scene Identification (Name)
- Map Projection (Name and Reference Date, if applicable)
- Radiometric Presentation (Magnitude, Intensity)
- Geographic Location of Scene Center
- Radar Frequency and Polarization
- Illumination Direction
- Incidence Angle for Scene Center
- Image Generation Date.
- Scale Bar
- Image Size
- Pixel Spacing

5. Recommended Standard Image Product for Spaceborne SAR

This chapter lists the recommended image and annotation information necessary for a standard image product for Spaceborne SAR.

A sample layout of a SAR standard image product is given on the next page. According to the characteristics of some image recorders, the annotation information may also be above or below the image information.

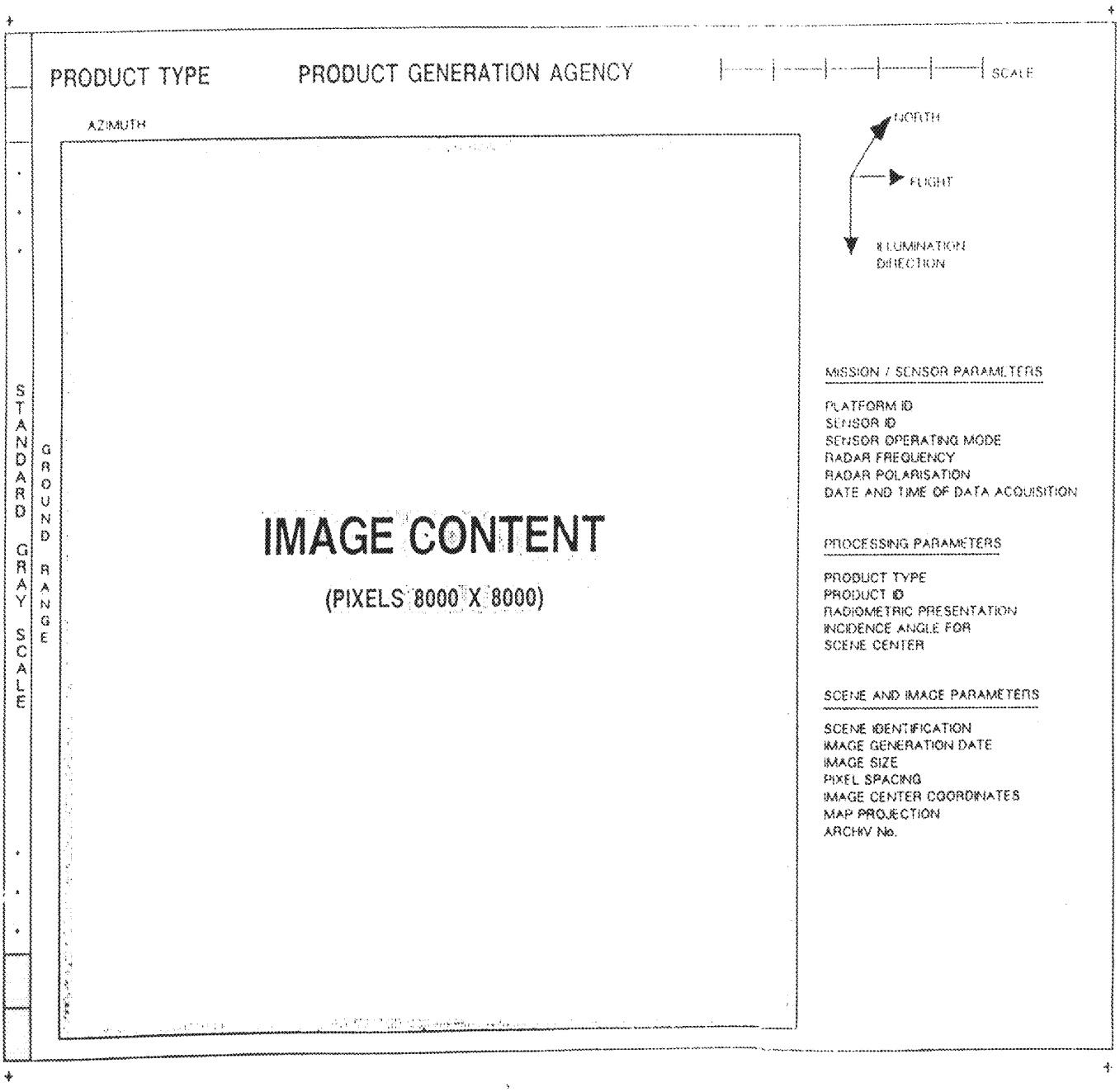
Image Information

- Full Swath Presentation (mm. 90%)
- Image Axes in Range/Azimuth Direction
- Earth Rotation Compensated
- Slant to Ground Range Converted
- Pixel Spot Size selected to generate Image on Standard Map Scale Factor (e.g. 1: 500 000)
- Pixel Representation 8 Bit Amplitude, Linearly Streched to a Mean of 100 and a Standard Deviation of 30

Annotation Data

- Mandatory SAR Image Annotation as Proposed in Chapter 4
- Registration Marks in the Four Image Corners
- Standard Gray Scale. consisting of 16 step gray scales and generated from a lookup table which takes into account the film recorder characteristics.
- Indication of Range and Azimuth Direction
- Indicators for North Direction, Flight Direction and Illumination Direction

SAMPLE LAYOUT OF A SAR STANDARD IMAGE PRODUCT



6. Recommended Standard Geocoded Image Product for Spaceborne SAR

This chapter lists the recommended image and annotation information necessary for a standard geocoded image product for spaceborne SAR. A sample layout of a SAR image geocoded product is given on the next page. According to the characteristics of some image recorders, the annotation informatidn may also be above or below the image information.

Image Information

- The image information shall consist of a geocoded SAR image, resampled in a prespecified mapping projection. In general, all mapping projections should be allowed. Besides, an international harmonized standard mapping projection for synergism of different sensor data is strongly aspired. For this projection, the Universal Transverse Mercator (UTM) and the Universal Polar Stereographic (UPS) seem to be applicable.
  The specific standards for such maps projections will be delivered by a special document (Ref. 9).

- The rows and columns of the image pixels shall be parallel to the cartographic grid (i.e. northing and easting for UTM. for the non-parallel cartographic grid of UPS worid-wide pixel reference schemes are TBD).

- To compare geocoded data of different satellites a hierarchical resampling scheme is recommended. The pixel sizes (refered to UTM coordinates (UPS TBD)) start with quadratic pixels of 6.25 m for high resolution sensors. with power of two multiples of 12.5 m. 25 m. 50 m, 100 m. Further pixel sizes may be 500 m. 1000 m, 2000 m.

- The absolute pixel location in the cartographic grid (i.e. UTM, UPS) refers to the center corner of the given pixel. (UPS TBD)

- Geocoded pixels in UTM presentation are organized in an integer kilometer structure (i.e. 1000 northing or easting meters). Therefore, an 1000 m pixel refers with its south-west corner to an northing of XXXXX000 and an easting YYYYY000. Smaller pixels are organized in the same structure. For instance, 160 pixels of 6.25 m refer to one kilometer. (UPS TBD)

- The pixel spot size on the photographic output device shall be multiples of 6.25 U. This ensures enlargement to map scale with integer factors.

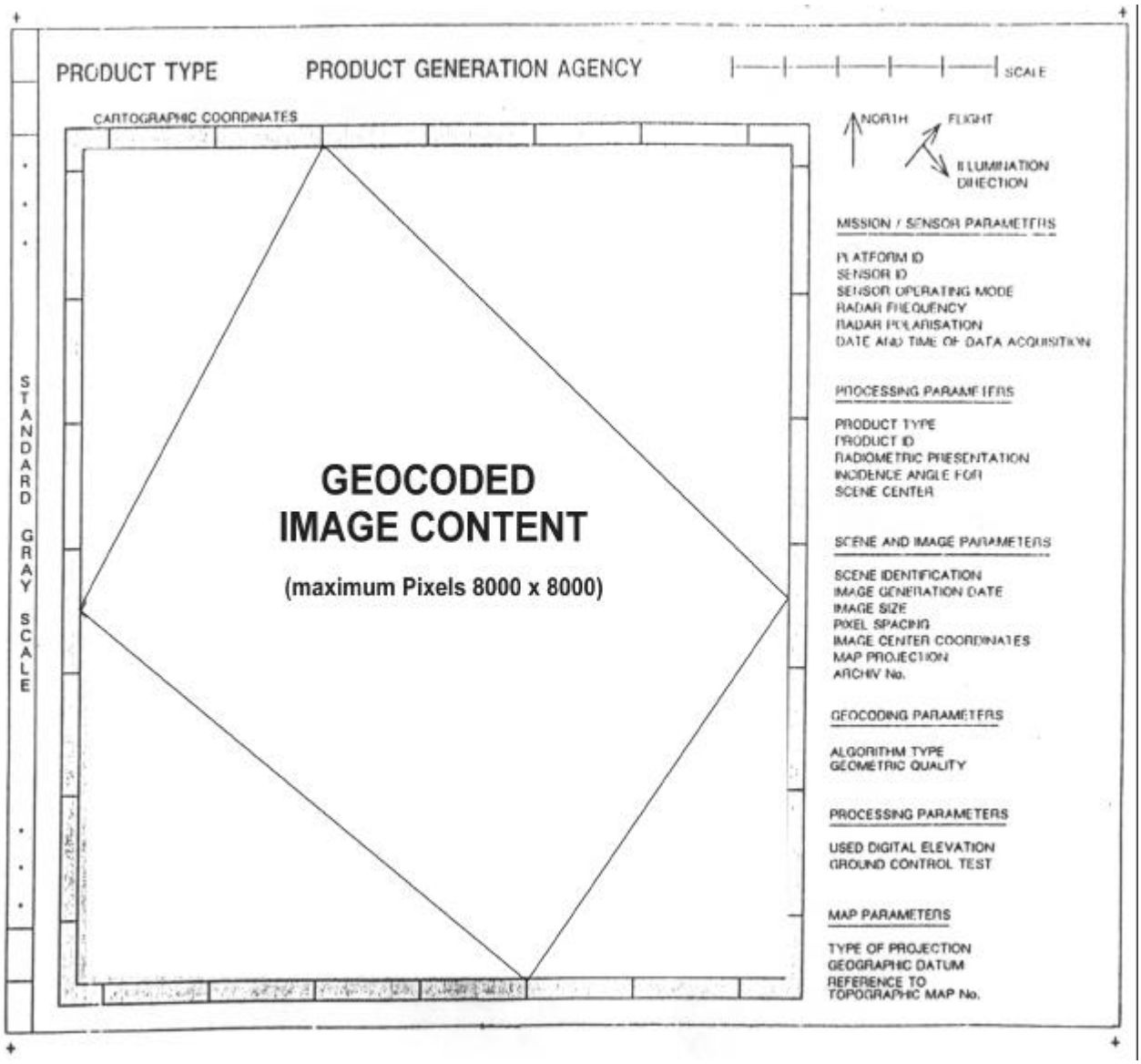
Annotation Data

- Mandatory SAR Image Annotation as Proposed in in Chapter 4. Registration Marks in the Four Image Corners

- Standard Gray Scale

- Indication of Range and Azimuth Direction
- Indicators for North Directiun, Flight Direction and Illumination Direction
- Cartographic Projection Designator/Reference Ellipsoid
- Tick Marks for Geographic Reference
- Tick Marks for Cartographic Reference
- Reference to Map Sheet Numbers
- Geocoding Algorithm and Related Location Accuracy
- Number and Location of Ground Control Points Used (if applicable)
- Source, Quality and Size of Used Digital Elevation Model (if applicable)
- Resampling Algorithm Used and information due to Affected Radiometry
- Image Supplemental Data Information
- Projected Digital Terrain Model
- Layover & Shadow Mask
- Geocoding Parameters

SAMPLE LAYOUT OF A SAR IMAGE GEOCODED PRODUCT



7. References

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2. Majumder, K.L.; Nandakumar, R., "Standardization of Photographic Products Format and Annotations". Draft Study Report prepaired for the 2nd CEOS/WGD meeting at ESRIN, Rome June 30,1986
3. CCRS, "Technical Memorandum" No. DMD-TM-85-469C, July 19, 1985 Rev(c) Dec.31, 1985. (Preliminary)
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9. Recommended Standards for Map Projections for Geocoded SAR images. In process (CEOS-WGD on SAR Data Standards)

8. Abbreviations and Acronyms

CCRS	Canada Centre for Remote Sensing. Ottawa, Canada
CCT	Computer Compatible Tape
CEOS	Commitee on Earth Observation Satellites
CRC	Communications Research Centre, Ottawa, Canada
DFVLR	Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt Oberpfaffenhofen, West Germany
GMT	Greenwich Mean Time
JPL	Jet Propulsion Laboratory, Pasadena, USA
LTWG	Landsat Technical Working Group
MTF	Modulation Transfer Function
RAE	Royal Aircraft Establishment, Famborough, Hamshire, England
SAR	Synthetic Aperture Radar
TBC	To Be Confirmed
TBD	To Be Defined
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator