esa estec

Doc. No.: PO-TN-ESA-GS-0242
Issue: 5.1
Date: February 5, 1997
Sheet: 1/ 49

ENVISAT-1 Product Format Guidelines

Prepared by: **Date:**

ENVISAT-1 System Division

Checked by:

Approved by:

Distribution list:

41505
Vol 5

Envisat
Operations and Ground Segment Section

Table of contents

List of Tables

List of Figures

DOCUMENT CHANGES RECORD

Issue #	Date	Page #	Description
3.0	02/06/95	all	New revision from TN-18, with inputs from YL Desnos, O. Arino
4.0	01/07/95	all	Reformatting Inputs after ESA review
4.1	16/10/95	all	Taking account ESRIN / ESTEC review (O. Arino, M. Falcone, YL Desnos M. Paganini, C. Garrido, G.Brooker, J.Louet) - Glossary of terms - Use systematically and consistently the expression "Satellite Binary Time" - Use systematically the expression "orbit state vector" - chapter 7 "extracted product"
4.2	19/10/95	all	Taking account : - ESRIN memo ref. PO-TN-ESR-GS-0119 - J.Louet's comments
5.0	10/11/95	all	Taking account Thomson-CSF inputs from the ESA/ CSF working meeting at the Prime Contractor premises (30-31 October 1995). - New product structure
5.1	22/11/95	p. 21 & 22 p. 27	Taking account Thomson-CSF inputs from the ESA/ CSF 2nd technical meeting at ESRIN (14/15 November 1995). See minutes PO-MN-CSF-GS-0338: - spare fields added to the MPH and SPH - DSD type flag to distinguish ADS from MDS - figure updated, more details about the changes to be brought to the MPH, SPH, ... during the extraction process - removal of all the information relative to processing

1 Introduction

The purpose of this document is to define the guidelines to be followed for the formatting of the Envisat-1 Products, in order to get a consistent set of Payload Data Segment products, in terms of format, throughout the whole Envisat-1 mission.

The specified guidelines are contained within numbered brackets, such as:
[G xx: *This is a guideline*]

The PDS product list and characteristics is specified in document [R - 6].

[G 1 : These guidelines must be used as a reference by the:

- PDS implementation Prime and Sub Contractors
- Instrument Algorithm developers]

The guidelines specified in this document are fully applicable to the PDS products delivered to the PDS users through:

- the on-line communication ground links.
- the broadcasting link
- the multicasting link
- physical media (Exabyte, DAT, CD-ROM, floppy disc, NTP...)

The guidelines specified in this document are applicable to products distributed to the users including PACs.

The user of this technical note is supposed to be knowledgeable about the ENVISAT-1 mission.

2 Documentation

2.1 Applicable documents

[A - 1] "ENVISAT-1 PDS ITT Appendix 1, Annex D", ref. PO-RS.ESA.GS.0239, issue 3.0, dated 27 February 1995.

[A - 2] Envisat-1 GS Concepts ESA/PB-EO(94)24, rev. 3.

2.2 Reference documents

[R - 1] Guidelines for the specifications of the ground processing Algorithms PO-RS-ESA-GS-0252

[R - 2] "IEEE Standard for Binary Floating-Point Arithmetic, ANSI/IEEE Std 754-1985 (IEEE 754), Institute of Electrical and Electronics Engineers, 1985.

[R - 3] DMA Technical Report "Department of Defense World Geodetic System 1984. Its definition and relationships with local geodetic systems", DMA-TR-8350.2, second edition, 1 September 1991.

[R - 4] "Astronomical Almanac for the year 1996", Nautical Almanac Offices - US Naval Observatory and Royal Greenwich Observatory.

[R - 5] "ERS Ground Stations Products Specifications", ref. ER-IS-EPO-GS-0201, issue 3/1, dated 9 December 1994.

[R - 6] "ENVISAT Product Definition Guidelines", ref. PO-TN-ESA-GS-0231

3 Glossary

ADS	Annotation Data Set
AGC	Automatic Gain Control
AO	Announcement of Opportunity
AOIP	Announcement of Opportunity Instrument Provider
ARF	Archiving Facility
BER	Bit Error Rate
CFI	Customer Furnished Item
DDT	Data Dictionary Tool
DS	Data Set
DSD	Data Set Descriptor
DSR	Data Set Record
EOF	End Of File
FD	Fast Delivery
FOS	Flight Operation Segment
FR	Full Resolution
FTP	File Transfer Protocol
GS	Ground Segment
HDDR	High Density Digital Recorder
HDF	Hierarchical Data Format
HK	House Keeping
HR	High Rate
ISP	Instrument Source Packet
LBR	Low Bit Rate
LRAC	Low Rate Archiving Centre
LUT	Look Up Table
MDS	Measurement Data Set
MJD	Modified Julian Day
MPH	Main Product Header
NaN	Not a Number
NRT	Near Real Time
OCD	Product Confidence Data
OS	Operating System
PDCC	Payload Data Control Centre
PDS	Payload Data Segment
PDHS	Payload Data Handling Station
RA	Radar Altimeter
SPH	Specific Product Header
SBT	Satellite Binary Time
SW	Software
USF	User Service Facility
UT1	Universal Time

UTC Universal Time Coordinated
VCDU Virtual Channel Data Unit

4 PDS Product

An Envisat PDS PRODUCT is defined as:

- the result of processing raw data acquired by one or more instruments on board the satellite, using auxiliary data.
- House/Keeping telemetry data
- auxiliary data

Auxiliary data is defined as:

- System wide parameters used by all the PDS processors, i.e SBT to UTC conversion table and Orbit state vector
- Parameters specific to the processing algorithm(s) used. It may consist of static data, such as instrument characterization measurements or mathematical constants, and/or dynamic data, such as recent meteorological forecasts or precise orbit measurements.

PDS products are classified in a number of PRODUCT LEVELS (see document [R - 6]):

- Raw data
  - Data as transmitted by the satellite
- Level 0
  - Extracted and formatted source packets from the raw data stream
- Level 1b
  - Geolocated, engineering calibrated processed data
- Level 2
  - Geophysical, geolocated processed data

Raw data is the LOWEST level. Level 0 is HIGHER than raw data, level 1b is higher than level 0, and so forth.

[G 2 : Any product is a segment defined between a start and stop time.The maximum interval between start and stop times is one orbit. In the case of the atmospheric instruments, the product coverage could exceed slightly one orbit in order to complete a natural observation in sequence of an instrument (e.g. limb scan or star occultation).]

[G 3 : The following guidelines apply to all PDS products other than raw data]

[G 4 : The following guidelines apply to the auxiliary data, distributed to users, as PDS products]

[G 5 : for any PDS product (level 0, 1b and 2) the product format shall be independent of the generation time (unconsolidated or not, generated in Near Real Time or Off-line.]

4.1 Raw Data

This is the data as recorded from the X and Ka band demodulators output interfaces, stored on high density data media (currently D1)

The raw data media contains:

- CADUs as received from the down link
- The Ground station reference time
- The acquisition PCDs

The format of the media containing the raw data will be defined once the media has been selected by the PDS Contractor.

5 PDS Product general requirements

The Envisat PDS product design is driven by:

- the product usage
- the product generation
- the product distribution
- the product archiving

5.1 PDS Product usage

The use of PDS products may be split into four categories:

- Distribution to end users of level 1b and 2 products. Lower level products may be required to derive products using algorithms not incorporated into the PDS.
- Platform and instrument performance monitoring, by ESA or AOIPs. Level 0 and level 1b products, plus housekeeping telemetry.
- Browse products
- Processing performance monitoring, by ESA or AOIPs. Level 1b and level 2 products.

[G 6 : When designing the content and format of PDS products, these four uses must be addressed.]

[G 7 : To simplify the task of analysing and monitoring the data, the PDS products must contain sufficient annotation for the monitoring of instrument, platform and processing performance, as well as the scientific analysis of the data.]

[G 8 : To simplify the decoding and comprehension of PDS products, the PDS product content must be organised into groups of associated parameters and statistics, depending on the intended use. See MPH, SPH, DSD and DS structures in section 6]

5.2 PDS Product generation

Product generation includes near real time and off-line products.

[G 9 : Products must contain sufficient information to determine all the input data that was used during its processing. This information will include:

- the time period of the input raw data stream
- the identifiers of all auxiliary parameter tables (LUTs, Meteo,...)
- all auxiliary data not provided in LUTs (e.g Orbit state vector, SBT - UTC relationship)]

[G 10 : If a foreseeable error occurs during processing of a product, that product will be annotated with a flag or count identifying/quantifying that error.]

Errors occurring during processing are likely to have an impact on the quality of the resulting data. It must be possible to determine the errors that occurred when examining such data.

Backlog processing

backlog processing is the generation or re-generation of PDS Products off-line.

[G 11 : All PDS products can be regenerated at a later date. All the additional information which has been used to process the raw data must be traceable.]

This is important both for ensuring the product quality, and to be able to re-create the same environment should a product needs to be re-generated (e.g to trace or correct errors).

Reprocessing

During the lifetime of the mission, improvements may be made to the algorithms used to derive level 1b and 2 products. Should significant improvements be made, products may be reprocessed using the improved algorithms.

5.3 PDS Product distribution

The PDS products are distributed through the PDS and to the PDS users via several types of media depending on the size of products, the number of simultaneous destinations and the delivery time.

The types of media used for distribution are:

- Physical media:
  - D1 for raw data (backup tapes) (not distributed to users).
  - DAT, CD-ROM, Exabyte, Floppy Disc, NTP,...
  - These media are distributed by terrestrial mail (Post or courier)
- Electronic ground link (networks) between the PDS internal elements and from the PDS User Service facility (USF) and the PDS Users, for small and medium size products. This distribution uses the TCP/IP suite of protocols, initiated by the PDS User.
- 2 Mbps Multicast link for the large fast Delivery (less than 3 hours from data sensing) products.
- 64 Kbps Broadcast link for the small and medium size Fast Delivery products Transmission time]

[G 12 : PDS product format must be independent of the means of distribution.]

[G 13 : The packaging procedure must optimize the utilisation of media (i.e, Exabyte or DAT) capacity by maximising the ratio between the useful data logical record length and the physical record length.]

6 Product format

[G 14 : A PDS product must consist of 4 parts as shown in the example, figure 1, page 18:

- a **Main Product Header (MPH).**
- an optional **Specific Product Header (SPH)** containing the **Data Set Descriptors (DSD)**
- one or more **Data Set (DS)**]

These various records are described in the following sections:

- section figure 2 on page 19 for the MPH
- section 6.3 on page 21 for the SPH
- section 6.4 on page 22 for the DSD
- section 6.5 on page 23 for the DS

6.1 General usage & terminology

Main Product Header

[G 15 : the **Main Product Header (MPH)** permits to identify the product and its main characteristics. The MPH is one record. The MPH has a fixed format / fixed length for all products]

Specific Product Header

[G 16 : The **Specific Product Header (SPH)** must contain general information applicable to the whole product. References to auxiliary data files are stored in the DSD. The SPH is one record. The SPH has a fixed format / fixed length for a given product type]

Data Set Descriptors (included at the end of the SPH)

[G 17 : The **Data Set Descriptor (DSD)** must be used to describe either the Data Sets on board this product or to provide references to external products (auxiliary data, etc...). The DSD is a collection of **DSD records**. There must be one DSD record either per Data Set or per external product referenced. The format / length of each DSD record is identical for all products.]

[G 18 : in the case the volume of auxiliary data is too large (e.g. ECMWF Meteo tables) it must be referenced in one DSD record as an external product (file).]

Data Set

[G 19 : in order to store various type of information (instrument data, processed data, auxiliary data, etc....) different types of **Data Sets (DS)** must be used. Information of the same types must be gathered in a single DS. Each DS must be identified by a single DSD record.]

[G 20 : When a DS contains the instrument/processed data, it must be called **Measurement Data Set (MDS)** by opposition to the **Annotation Data Set (ADS)** which contains only auxiliary data]

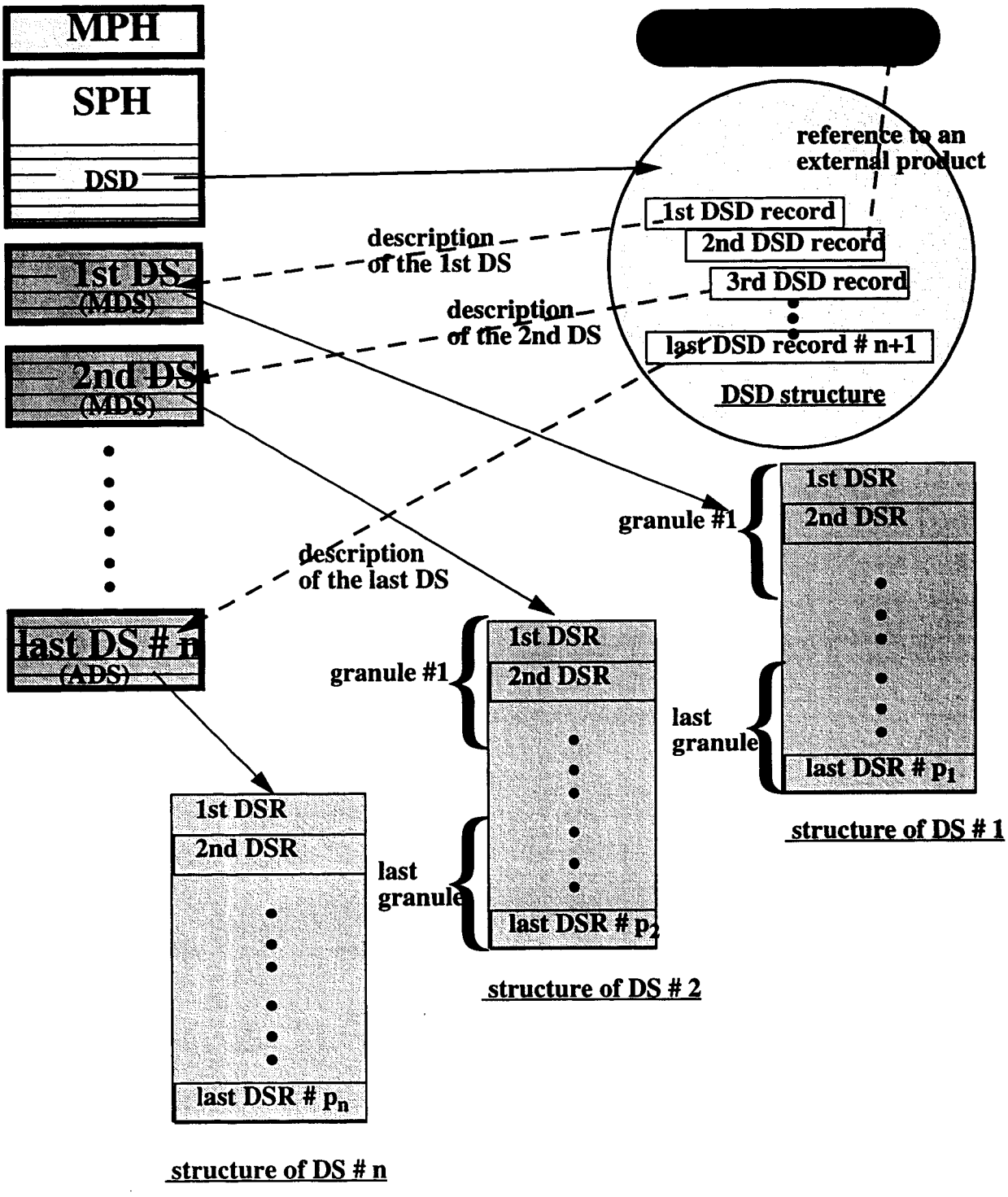
[G 21 : a product can contain several MDS]

[G 22 : each DS includes **Data Set Records (DSR)**]

[G 23 : within a MDS, DSRs are grouped into **granules**. See chapter 7 relative to extraction]

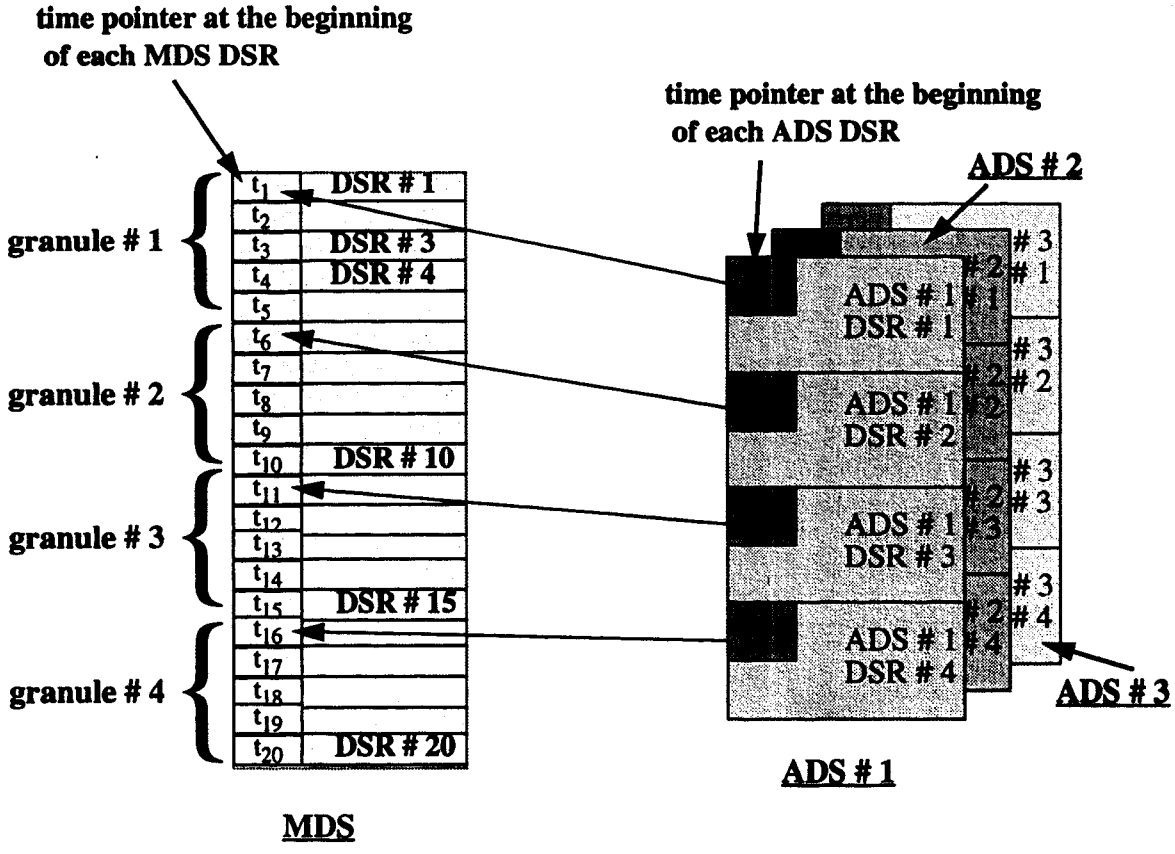
[G 24 : each ADS DSR contains auxiliary data applicable to a subset of MDS DSRs. It is valid for the time period starting at its own time pointer (time included) and ending at the next ADS DSR time pointer (time excluded)]

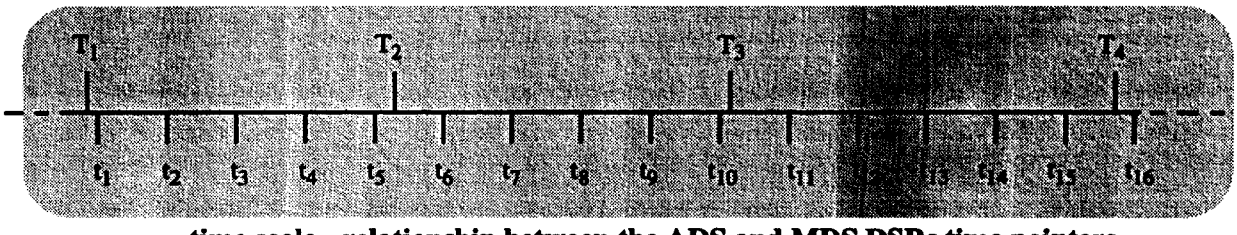
figure 1 Example of Product file structure[1]



1. the example (figure 1) shows a product structure where within the SPH, each DSD record describes a DS except the second DSD record which is used only to reference an external product. It contains 2 MDS, all other DSs being ADSs.

figure 2 Correspondence between ADS and MDS[1]





time scale - relationship between the ADS and MDS DSRs time pointers

1. figure 2 shows the correspondence between ADS and MDS DSRs. The relationship between the various DSRs is insured by the usage of time pointers. In this particular example, one single ADS DSR is valid for a time period covering 5 MDS DSRs. The mechanism is similar for the 2 other ADSs.
2. Validity of each ADS DSR: as an example, ADS # 1 DSR # 1 is valid for the time period $[T_1, T_2[$.

6.2 Main product header (MPH)

[G 25 : The MPH (Main Product Header) must contain at least (list non exhaustive):

- Product identification (filename without extension. See section 8.2)
- consolidated or unconsolidated flag. It is set respectively to "C" or "U".
- version of the document describing the product
- product source (e.g. direct downlink, level 0 from ARF, HDDR,...)
- information relative to acquisition/processing:
  - *ID of the acquisition station(s). The center ID is provided in table 2, page 30. This field must be sized to accommodate 3 acquisition centers ID when, in the worst case, the product has been generated from data acquired in PDHS-K, PDHS-E and PDAS. Therefore, it must be a 6-byte character string. Non used characters are blanked. Examples of values:*

    "HK " means that the satellite data have been acquired at PDHS-K only

    "HKHE " means that the satellite data have been acquired at both PDHS-K and PDHS-E.

  - *ID of the processing center which has generated the current product. The center ID is provided in table 2, page 30.*
  - *UTC time of processing or product generation (e.g. reformatting of auxiliary data)*
  - *version number of the processing software*
- information relative to the product (sensing time, geographical position):
  - *UTC start time of the data sensing*
  - *UTC stop time of the data sensing*
  - *Geographical location of the product scene (start and stop)*
  - *phase*
  - *cycle*
  - *start relative orbit number*
  - *start absolute orbit number*
- auxiliary orbit information:
  - *ascending node orbit state vector used to generate the product*
  - *orbit state vector origin reference (5 possible origins)*
- auxiliary time information:
  - *SBT to UTC conversion table (includes SBT, UTC and the clock step)*
  - *leap second indicator*

- *leap second error (raised if the product contains biased UTC information due to the occurrence of the leap second within the processing segment)*

- product quality information:
  - *PCD summary byte containing:*
    - summary flag of the quality of the product (1: error, 0:no error)
    - acquisition flag
    - demultiplexing flag
    - processing flag
    - auxiliary data flag
  - *followed by PCD structures, each one associated to a flag in the PCD summary byte, to provide detailed information:*
    - error code, error parameter specifying the nature of the error.
- product size/structure information:
  - *total size of the product*
  - *number of SPH (0 or 1)*
  - *length of the SPH*
  - *number of DSD records*
  - *length of each DSD record*
  - *number of DS*
- checksum (TBD) of the product
- spare fields
- others]

[G 26 : Anomaly during product generation with the handling and availability of internal or external calibration data must be reported on PCD contained on either or both the MPH, the SPH and DSs, depending on the product type and the instrument operation.]

6.3 Specific product header (SPH)

[G 27 : the SPH is optional depending on the product type.]

[G 28 : for a given product type the length of the SPH is constant]

[G 29 : A SPH must contain at least (list no exhaustive):

- information specific to the instrument/mode at the time of data sensing

- values of some key parameters (e.g value of the Doppler Centroid for ASAR) valid for the whole product used for product monitoring

- information about the overall quality of the product by considering:

  - *the instrument status at the time of product sensing*
  - *the data link and reception equipment status (integrity of the raw data)*
  - *the quality of the data processing both on-board (when relevant) and on-ground*

- Data Set Descriptors (see section 6.4)

- spare fields

- Others]

6.4 Data set descriptor (DSD)

[G 30 : Each DSD must contain:

- a DSD type flag:

  set to "A" for an ADS. Set to "M" for a MDS.

- the Data Set type descriptor

  e.g. "STATIC_RA-2_LUT", "GOMOS_SOURCE_PACKET"..., using for instance the DDT database structure names.

- DS attachment flag:

  It must indicate whether or not there is a DS attached to the current DSD. Set to "C" (copy) when there is a corresponding DS on board this product. Set to "R" (reference) if there no corresponding DS on board this product but only a reference to external product (auxiliary data, etc...) (see next field)

- the Reference to an external product:

  When the DS attachment flag is set to "R" it contains the product file name (as it appears in the inventory). In the case the DS attachment flag is set to "C", it might be used to indicate the source file from which data have been extracted to create the DS. Otherwise, this field is blanked.

- DS offset:

  position of the first byte of the corresponding DS wrt to the whole product. Set to 0 if no DS is attached.

- number of DS records (DSR) within the DS (TBC)

- DS length:

  length in byte of the corresponding DS. Set to 0 if no DS is attached.

6.5 Data set (DS)

Refer to section 6.1 on page 16, for the definitions/terminology relative to the Data Set.

[G 31 : the number of DSs depends on the product type]

For imaging products, the number of DSRs within the DSs (MDS and ADS) is, in general, directly proportional to the length of the processing segment. For other product types, the number of DSRs is variable (i.e. level 0 products might contain instrument data covering any period of time within an orbit. In that case, the number of DSRs is proportional to the number of source packets received on-ground).

[G 32 : for level 0 products, there must be one DSR for each source packet, within a MDS.]

[G 33 : for a given DS, the DSRs must have the same length to the maximum feasible extent.]

[G 34 : In the case of level 0 products, within a MDS, the DSRs might vary in length and therefore each DSR must contain a "record length" information]

[G 35 : the ADS DSR could be used to identify long sequences of missing data within the ADS, without having to generate the corresponding blank DSRs]

[G 36 : Any DSR, within both a MDS and ADS, must include, at least (list no exhaustive):

- start time of the DSR. It is implemented for the extraction process (see section 7). The time is expressed in MJD to be used during the extraction process.
- MDS specific:
  - the DSR length (in the case of the level 0 product MDS to cover the case when source packet have variable length).
  - an indicator of the quality of the data within the data set record (PCD) if applicable. It is set to **-1** (TBC) in the case of a **blank DSR**
  - the Instrument/Processed data themselves
- ADS specific:
  - a flag indicating if DSRs are attached to the current ADS DSR (1: error, no corresponding DSRs, 0: no error, there are corresponding DSRs). It is used to identify large gaps in the sequence of MDS DSRs
  - the auxiliary data specific to a subset of DSRs (e.g. geolocation, PCDs and auxiliary data corresponding to a range/subset of all the DSRs contained in this product]

[G 37 : There is not necessarily a fixed number of DSRs associated to an ADS record:

- for imaging instruments, this relation is likely to be fixed.

- for limb instruments, where natural duration of the observation is variable (e.g. GOMOS), it could vary from observation to observation]

7 Level 0, 1b and 2 extracted product

[G 38 : the PDS user must have access to a subset of larger PDS product through an extraction process]

[G 39 : Products might be extracted from the level 0, 1b and 2 products]

[G 40 : the result of this extraction is called the **child product** wrt the source product also called the **parent product**. The **child product** is also a PDS product and follows the same format and filename principles]

[G 41 : the user may formulate his extraction request in terms of:

- time,
- location,
- star observation,
- bands,
- others

In most of the cases, this extraction request must be converted into a start/stop time window to be used by the extraction process. For that purpose, all DSRs (MDS and ADS) must include start time information. Furthermore, in the case of an optical instrument, the user must be able to specify also an extraction based on band]

[G 42 : each DS contained in the child product must be a subset of the parent product DS, extracted according to the user requested start/stop time window. The start time of each child product DSR must be within the user requested start/stop time window]

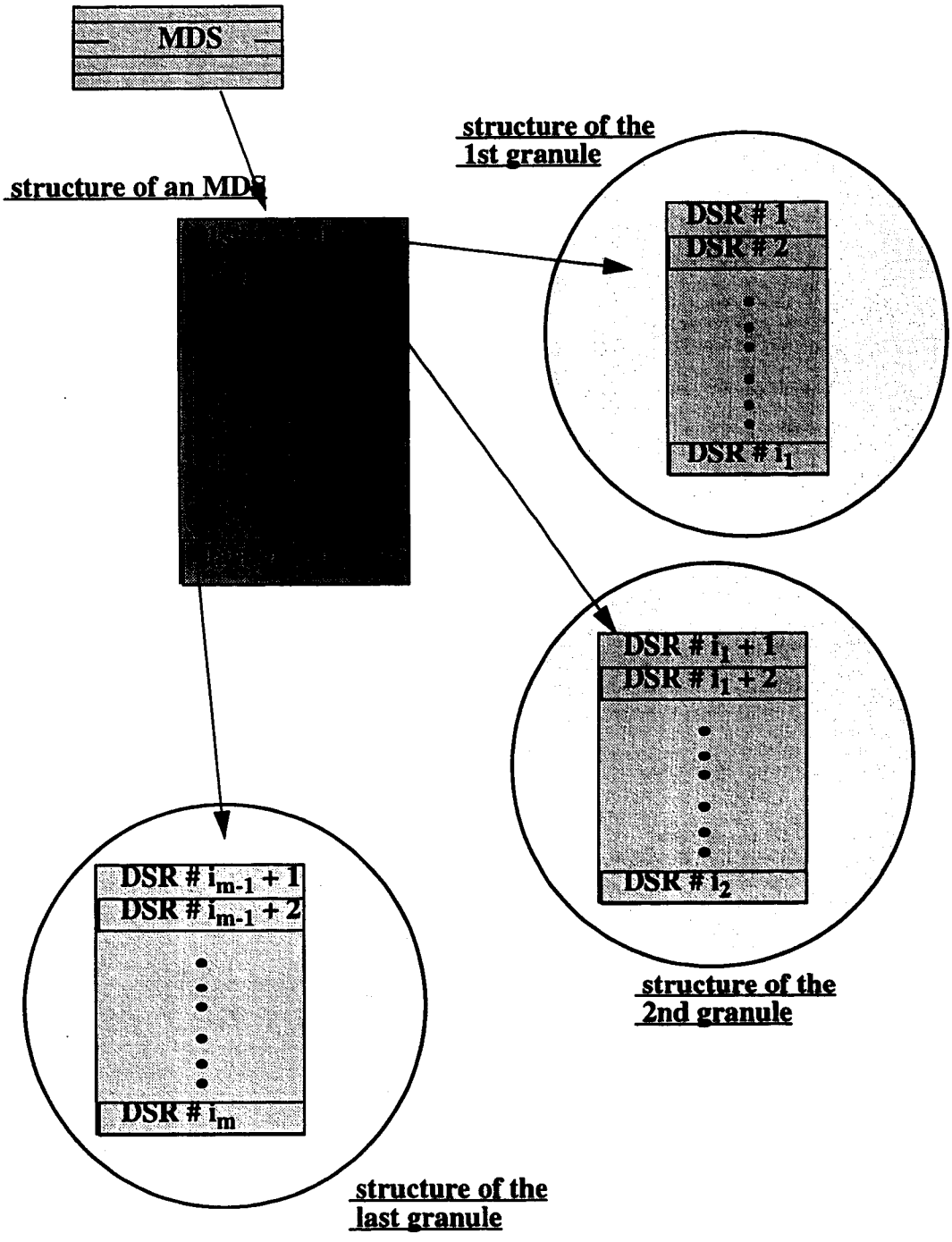
[G 43 : a granule is a set of DSR within a MDS. The size of a granule is instrument, mode and product dependant. Within an MDS, granules might not include necessarily the same number of DSR (TBC). A granule must start at specific DSR within the MDS. See figure 3, page 26]

[G 44 : within each MDS, the set of DSR contained in the child product must be an integer number of granule.]

[G 45 : in the case of imaging instruments (ASAR, MERIS and AATSR), the first child product DSR (for each DS) must correspond to the start of a granule. Therefore in order to fulfil the floating frame concept, the time interval between ADS DSRs shall not exceed one tenth of the smallest scene to be extracted (i.e. for a 100x100 km scene, no more than 10 km along track between two consecutive ADS DSRs) (TBC)]

[G 46 : for the other instruments, the first child product DSR (for each DS) must be aligned on boundaries specific to the instrument within the parent product DS (e.g. at the beginning of the star measurement for GOMOS). These boundaries must be provided by the corresponding granule for the MDS and the corresponding ADSs DSRs.]

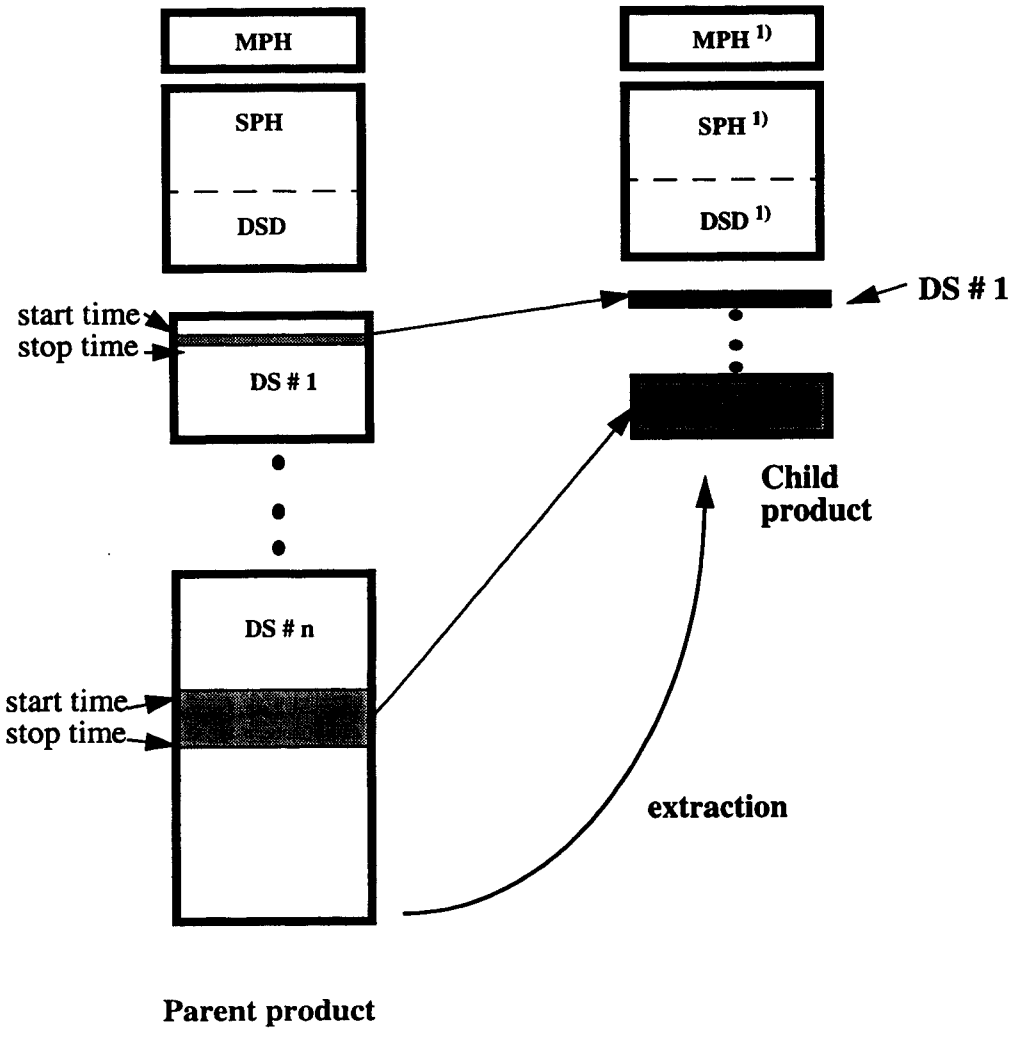
figure 3 Granule structure



[G 47 : within the child product, the DSs must contain all the parent product DSRs, extracted according to the user requested start/stop time window. The start time of each DSR is within the user requested start/stop time window]

An example of extraction is shown in figure 4.

figure 4 Product extraction



Note 1): the MPH and the DSD will be modified between the 2 products in order to reflect the new child product characteristics: time information (UTC start, UTC stop), geographical parameters (latitude, longitude, orbit number, ...), segment length and the number of records, ... As much possible, the rest of the SPH must not be changed (TBC). In general, the MPH and SPH must contain, as much as possible, information which does not need reprocessing in the case of an extraction performed within the ARF.

8 Product Files

8.1 General

As products are generated on computers, delivered via electronic links or on media, it is necessary to define a "packaging". The most natural "container" for those the products is the computer file.

[G 48 : A PDS product file contains a single product.]

[G 49 : PDS product files must have a size smaller than 2 GByte]

This constraint on the maximum file size comes from the current Unix limitation.

8.2 PDS Product file names

[G 50 : Product file names must be unique for archiving and retrieval purpose. The file name is an ASCII character string and has the following structure:

file name =
<product_type_ID><NRT_flag><start_day><"_"><start_time><"_"><duration><phase><cycle><"_"><relative_orbit><"_"><absolute_orbit><originator_ID><counter><"."><satellite_ID><.extension>
]

[G 51 : in the case of product extraction, the child product filename must be **TBD**]

The underscores ("_") and dots (".") are used to ease the decoding of the filename.

table 1 PDS Product file names

Field	Size in characters	Description
product type ID	8	product type name which might be padded with "_" (under-score) characters to make a 8 character string. The list is defined in "Product Definition Guidelines" document.
NRT_flag	1	set to "N" if the file has been generated in Near Real Time, set to "O" set to "N" if the file has been generated Off-line

table 1 PDS Product file names

Field	Size in characters	Description
start_day	8	in the case of Instrument Products, it corresponds to the start time of the product (UTC time of the first DSR). The format is: YYYYMMDD. If the start time of product is not a relevant information, it will be the generation time of the file.
start_time	6	in the case of Instrument Products, it corresponds to the start time of the product (UTC time of the first DSR). The format is: HHMMSS. If the start time of product is not a relevant information, it will be the generation time of the file.
duration	4	time coverage of the product expressed in seconds. If the duration of a product is not a relevant information, it will be set to "0000".
phase	1	phase identifier
cycle	3	cycle number within the phase
relative_orbit	3	relative orbit number within the cycle at the beginning of product
absolute_orbit	5	absolute orbit at the beginning of product
originator ID	2	Identification of the generator of the product as defined in table 2 (list non exhaustive) on page 30.
counter	4	numerical counter to identify quickly a file. For a given product type, for each new file, it is incremented by 1 from "0000" up to "9999". The counter wraps around at "9999", the next value being "0000" again.
satellite ID	2	Identification of the Satellite: • "E1" for ERS-1 • "E2" for ERS-2 • "EN" for ENVISAT

table 1 PDS Product file names

Field	Size in characters	Description
.extension (optional field)	variable	Optional field. It is not used within the PDS Inventories. Its usage is just used for distribution to users, in order to indicate if any and which compression/grouping method have been used "." followed by the file extension indicating which compression/grouping/format method has been used (i.e. ".gz", ".Z", ".tar", ".tar.Z", ".gif", ".jpeg", ".hdf", ...)

Example:

- a NRT level 1b GOMOS product which contains data starting on Feb 10, 1999 at 13:32:54 covering a complete orbit (6040 seconds), from data acquired during the "A" phase, cycle # 31, relative orbit # 67, absolute orbit # 15598, generated at PDHS-K would be named as:

  GOM1BN___19990210_133254_6040A031_067_15598HK0324.EN

- if the same file is compressed using the gzip utility, its name would become:

  GOM1BN___19990210_133254_6040A031_067_15598HK0324.EN.gz

[G 52 : the file name convention assumes that the OS can handle file names longer than at least 38 characters and less than 255 characters (Berkeley Unix limitation)]

[G 53 : Platforms and distribution media that do not support long file names must store products in a subdirectory tree, following the file name convention. The maximum length of a sub-directory name is eight characters]

[G 54 : MS-DOS file name limited to 12 characters (with a period "." on the ninth) must use a sub-directory tree structure, such as:

<product_type_ID>/<YYYYMMDD>/<time>/<duration><phase><cycle>/<relative_orbit>/<absolute_orbit><originator ID>]

table 2 List of Centers IDs[a]

Centre	ID
PDHS-K	HK
PDHS-E	HE
LRAC	LR
PDCC	CC

table 2 List of Centers IDs[a]

Centre	ID
FOS-ESOC	FO
PDAS-FUCINO	AS
UK-PAC	UP
D-PAC	DP
I-PAC	IP
F-PAC	FP
S-PAC	SP
E-PAC	EP
ECMWF	WF

a. this list is not complete today

8.3 File Compression

[G 55 : File compression software must be used to make efficient use of the physical and electronic link transport media, used to transport the PDS products.]

[G 56 : Depending on the product type, the compression algorithm must be loss-less to preserve the data integrity (scientific data), or could be lossy for redundant or non scientific data (i.e browse image which is the image corresponding to a browse product).]

[G 57 : The decompression SW must be available at the USFs, for several platforms (UNIX, MSDOS and MAC).]

As specified in document [A - 1], for the time being, the compression is to be used only on browse product.

The selection of the compression software is still TBD.

9 Physical media

[G 58 : the physical media shall be written and formatted so that it can be read on the user's platform, independently of the user's operating system]

This will be applicable to all tape media and floppy discs (if these latter are used).

[G 59 : floppy disks must be formatted using the PC DOS standards which can be read on various platforms]

[G 60 : CD-ROM must be written according to the ISO-9660 standard and the Rock Ridge extension.]

[G 61 : floppy disks and CD-ROM must contain a "product" directory at the top of the directory structure. This "product" directory contains only the product files, identified by their product filenames]

[G 62 : floppy disks and CD-ROM can contain a mixture of different product types (e.g. RA2 and MIPAS)]

Concerning tapes, they can be read on different platforms, only if they have been written independently of the operating system, using an ad hoc software.

This last method avoids the development of a transcription chain including various kinds of platforms.

There are currently 2 potential tape formats to be investigated by the PDS Contractor during the Implementation Phase. The 2 formats are described in section 9.1 and section 9.2. ESA preference is to use the second format.

[G 63 : the format of the product media sent to both users and PACs must be the same to the maximum feasible extent]

[G 64 : the chosen tape format must be compatible (readable) by any of the following platforms (Unix, Mac, PC). The user must find in the User Tool Kit and the USFs, the necessary routines to handle and read a tape]

9.1 First tape format

[G 65 : The format of the tape must be based on the ERS tape format (see document [R - 5]) as shown in figure 5 on page 35.]

[G 66 : a physical tape media might contain a mixture of different product types (e.g. RA2 and

MIPAS)]

[G 67 : a physical tape media must contain a **tape header file**, a **directory file** and a collection of **products files**]

[G 68 : the **tape header file** must contain the **tape label** and the **tape counter** to be used in the case of multi-volume set]

[G 69 : the **directory file** must contain the list of all the names of files stored in the same sequential order. In addition, the "directory file" must be to systematically E-mail to the user or must be made available on the USF with a reference to the unique tape label.]

[G 70 : multivolume media must be differentiated (e.g by the number of EOF at the end of the media. See figure 5.]

figure 5 Tape format

Start of tape
Tape Header: • Tape label • Tape counter
EOF
Directory file: • File names including extensions and sizes
EOF
First product file (might be compressed) containing: *1st product:* MPH, SPH, DSD, DSs
EOF
Second product file (might be compressed)
EOF
. . .
EOF
Last product file (might be compressed)
EOF
EOF
EOF (only if it's the last tape of a multi-volume)
End of tape

IMPORTANT NOTE: no decompress/depackaging SW have been included on the tape as it is assumed that these tools are largely available on Anonymous FTP servers and in particular on the USFs.

9.2 Second tape format

[G 71 : the tapes to be distributed to external users, must generated using Unix commands (**mt, tar**,...)]

[G 72 : each tape must contain a variable number of **tar** files (compressed or not)]

[G 73 : each tar file on the tape, must contain product files of the same type, aggregated with the Unix **tar** command]

[G 74 : each **tar** file on the tape must be named according to the filename convention (see section 8.2). The various information in the name must be based on the filename of the product which contains the earliest data. Only the duration must be changed to cover all the files included within the tar file. Of course, the file extension must be **.tar** or **.tar.Z** (compressed tar file)]

10 Product Conventions

10.1 Data representation

[G 75 : Data **must** be stored into the PDS product following the C ANSI data structure definition, with the exception of **long long** for 64 bit integers and real numbers.]

10.1.1 List of types

[G 76 : The data types listed in table 3 **must** be used to store information into the PDS products:]

table 3 Data types

variable type	C type	Abbreviation
character	**char**	**sc**: signed char **uc**: unsigned char
2-byte integer	**short**	**ss**: signed short integer **us**: unsigned short integer
4-byte integer	**long**	**sl**: signed long integer **ul**: unsigned long integer
8 -byte integer	**long long**	**sd**: signed long long integer **ud**: unsigned long long integer
4-byte single-precision floating-point	**float**	**fl**
8-byte double-precision floating-point	**double**	**do**

[G 77 : Data structure smaller than a byte **must** NOT be used to store information in the PDS product (i.e not single bit and no bit field)]

10.1.1.1 Representation of flag

[G 78 : a flag **must** be a binary information (one bit) stored within **char, short, long** or **long long** types. The convention for its value **must** be:

- FALSE = 0, if there is no error
- TRUE = 1, if there is an error]

10.1.1.2 IEEE representation for real numbers

[G 79 : The IEEE 754-1985 standard (see document [R - 2]) **must** be used to store real numbers within the PDS products]

The IEEE 754 floating-point default arithmetic is "nonstop" which means execution does not halt on occurrences like division by zero, floating point overflow, Underflows are gradual.

The IEEE 754 standard specifies two basic floating-point formats, single (equivalent to **float** in C) and double (equivalent to **double** in C).

[G 80 : The two basic floating-point formats (single and double) must be used in the product files to represent real numbers, to the maximum feasible extent.]

10.1.2 bit/byte numbering

[G 81 : The bit/byte numbering convention is: bit 0 is the least significant bit, with byte 0 being the most significant byte. During a file transfer, within any data type structure, byte 0 is transmitted before byte 1.]

10.1.3 character

- It is represented by a single byte.
- if unsigned, between **0 and 255**
- if signed between **-128 and 127** (in a two's complement machine).

10.1.4 short integer

The **short** representation is given in table 4.

- If unsigned, between **0 and 65535**
- If signed between **-32768 and 32767** (in a two's complement machine).

table 4 Short representation

Bits	Content
8-15	Byte 0
0-7	Byte 1

10.1.5 long integer

The **long** representation is given in table 5.

- if unsigned, between **0 and 4294967295**
- if signed between **-2147483648 and 2147483647** (in a two's complement machine).

table 5 Long representation

Bits	Content
24-31	Byte 0
16-23	Byte 1
8-15	Byte 2
0-7	Byte 3

10.1.6 long long integer

The **long long** representation is given in table 5.

- if unsigned, between **0 and 18446744073709551615**
- if signed between

  - 9223372036854775808 and

  +9223372036854775807 (in a two's complement machine).

table 6 Long long representation

Bits	Content
55-63	Byte 0
48-55	Byte 1
40-47	Byte 2
32-39	Byte 3
24-31	Byte 4
16-23	Byte 5
8-15	Byte 6
0-7	Byte 7

10.1.6.1 float

- The IEEE 754 Single storage format is represented in figure 6. There are 3 fields:
  - a 23-bit fraction "f", 0 being the least significant bit.
  - an 8-bit biased exponent "e"
  - a 1-bit sign "s"

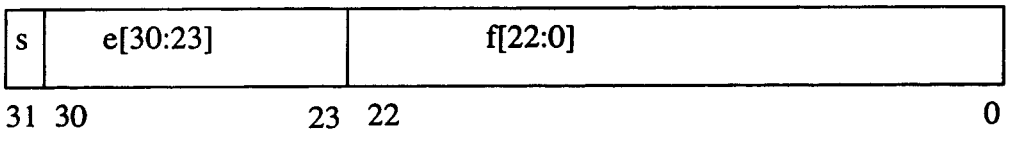
- The normal value which can be represented are:

  3.40282347e+38 for the maximum

  1.17549435e-38 for the minimum

- The number of significant decimal digits is between 6 and 9, that is, at least 6 digits, but not more than 9 digits are significative.

figure 6 Single storage format



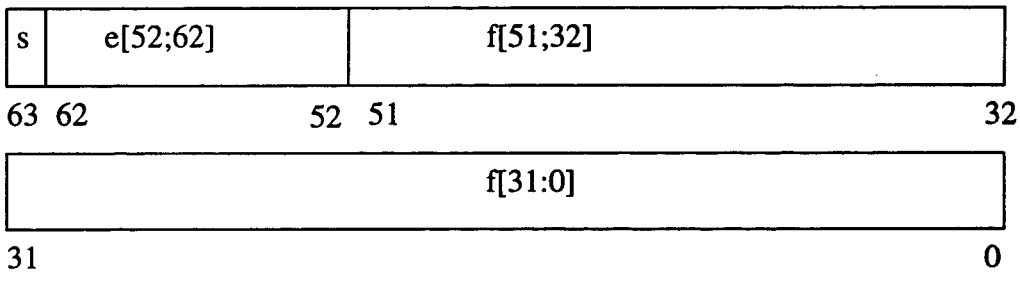
10.1.6.2 double

- The IEEE 754 Double storage format is represented in figure 7. There are 3 fields:
  - a 52-bit fraction "f", 0 being the least significant bit.
  - an 11-bit biased exponent "e"
  - a 1-bit sign "s"

- The normal value which can be represented are in the order of:
  - 1.79e+308 for the maximum
  - 2.22e-308 for the minimum

- The number of significant decimal digits is between 15 and 17, that is, at least 15 digits, but not more than 17 digits are significative.

figure 7 Double storage format



10.1.6.3 Extreme Number Representation (see document [R - 2])

[G 82 : The IEEE 754 convention for representing extreme numbers (infinity, zero, etc.) **must** be used to store such values into the PDS product]

10.2 Time

Within the PDS time is used with an accuracy of at least **0.1 msec**, expressed as:

- **UTC** (Universal Time Coordinated) almost equivalent to the GMT (Greenwich Meridian Time) presented as string of 25 significant characters with the following format:

  DD-MM-YYYY<blank>hh:mm:ss:tttt
  where:

DD	:	day	[1:31]
MM	:	month	[JAN FEB MAR... OCT NOV DEC]
YYYY	:	year	[1950: 2050]
<blank>	:	blank character	" "
hh	:	hour	[0:23]
mm	:	month	[0:59]
ss	:	second	[00:59]
tttt	:	100*microsecond	[0000:9999] (may be blanked with spaces if not relevant as well as the preceding column sign)

  Example: The 29 Dec. 1999 at 10:00 will be ASCII coded as:
  29-DEC-1999 10:00:00:0000 or
  29-DEC-1999 10:00:00

- **MJD 2000** (Modified Julian Day 2000), which is the decimal number of day since the 1 Jan. 2000 at 00:00 hours.

Note that this number may be negative at the Envisat launch (currently 30 June 1999).
This number is transported between computer platforms or software processes as two **long** integers.

Examples
The 29 Dec. 1999 at 10:00 **must** be coded as: **- 3** (first long integer) and **360 000 000** (second long integer)

10.3 Physical Units

[G 83 : All Physical Units **must** be expressed in the MKSA system, i.e meters, kilogram, second, Ampere, etc.]

[G 84 : Angular data **must** be stored in the PDS product as Degree]

[G 85 : Physical values **must** be stored into the PDS product as:

- integer value (char, short, long, long long)
- real value coded according to the IEEE 754 standard

depending on product size, and the dynamic range of the coded parameter]

10.4 Geographical location

[G 86 : Geographical Locations **must** be indicated as geographic longitude and geodetic latitude with reference to WGS84 and the following conventions on ranges based on ISO 6703:

- Latitude: -90 Degree (South Pole) to + 90 Degree (North Pole)
- Longitude: -180 Degree (Greenwich meridian) to +180Degree (increasing to East side).]

WGS84 is described in document [R - 3].

11 Product annotations

11.1 Time conversion (Satellite Binary Time to UTC)

The instrument ground processing software uses the time conversion table to convert the Satellite Binary Time (SBT) to the UTC time, for the geolocation function, using the CFI time conversion subroutines.

The SBT to UTC table is a data structure containing 4 elements:

table 7 SBT - UTC relationship

Field	Bytes	Type	Description
UTC	25	char	UTC time of ascending node state vector (see section 10.2 on page 43)
LEAP indicator	1	signed char	LEAP = +0 LEAP = +1 LEAP = -1 If the leap second correction[a] occurs on day "D" at 00:00, the LEAP indicator will be set to +1 or -1 respectively during the periods: [D - 1 day, D] and [D, D + 1 day]
SBT	4	unsigned long	Reference binary time of satellite clock (32-bit unsigned integer)
Step	4	unsigned long	SBT clock step in picoseconds

a. the leap second correction insures that after correction $|\Delta UT1| < 0.9$ second. See table 8 for a definition of $\Delta UT1$.
The correction to UTC is one second. It might occur at the end of any month. In practice, if it is applied, the leap correction occurs the 31st of December at 24:00 or the 30th of June at 24:00.

[G 87 : The MPH must contain the SBT to UTC table used for the generation of the product]

11.1.1 Orbit state vector

The instrument ground processing software uses the orbit propagator software module and an orbit state vector as input to compute all along the orbit the satellite position with other geometrical parameters (i.e range), for a given UTC time, within an earth fixed reference frame.

The Orbit state vector is a data structure containing 8 elements:

table 8 Orbit state vector

Field	Bytes	Type	Description
UTC	25	char	UTC time of ascending node state vector (see section 10.2 on page 43)
ΔUT1	6	char	ΔUT1 = UT1 - UTC. Format: ±..xxxx Example: **-.9430**
X	4	long	X position in Earth-fixed reference frame. Unit in 10^{-2} m
Y	4	long	Y position in Earth-fixed reference frame. Unit in 10^{-2} m
Z	4	long	Z position in Earth-fixed reference frame. Unit in 10^{-2} m
X velocity	4	long	X velocity in Earth-fixed reference frame. Unit in 10^{-5} m/s
Y velocity	4	long	Y velocity in Earth-fixed reference frame. Unit in 10^{-5} m/s
Z velocity	4	long	Z velocity in Earth-fixed reference frame. Unit in 10^{-5} m/s

[G 88 : The product MPH must contain the orbit state vector used for the generation of the product]

11.1.2 Geographical location

The geographic localisation (latitude/longitude) of a given piece of information within a product (i.e pixel or measurement point) depends on the product type.

[G 89 : The following alternatives must be considered to match the products requirements:

- annotate each measurement points with their geographic localization in each DSR if the product size does not become too large
- for imaging products where the pixel grid is well defined, annotate a serie of measurement points with geographic localization and auxiliary data (i.e. sun angle, etc....) within a dedicated ADS. The interpolation in between will be performed using referenced CFI software.]

[G 90 : The alternatives proposed above must be selected taking into account:

- The resulting product file size
- The repetitiveness of the geographical grid in space and in time. For instance, time repetitive geographical grid must not be copied into the product but rather referenced in the product.
- The coherence of the instrument product. It would be preferable to have the same convention for all products for a given instrument.]

11.2 Product Confidence Data

[G 91 : a PCD must be stored into one or more char, short, long or long long data types]

[G 92 : The anomaly annotations (PCDs) must be summarized at least in the MPH]

Appendix - A - Product Format Software

In order to minimize the software development and maintenance a set of standard software modules will be developed to support the relevant product developer during the following phases:

- Format Definition
- Product Generation
- Product Access

A.1 Product Format Definition

In line with the PDS Technical Specifications, the Data Definition Tool (DDT) will assist the PDS designer to specify, and keep under strict configuration control, the detailed structure of the MPH, SPH, DSD and DS of each PDS product, as specified on Table 4.2.1 of the Technical Specifications during the PDS design phase

These data structures will be stored on the DDT data base, including:

- Documentation
- Coherency check, in particular unique definition and completeness of definition
- Generation of C data structures for software development/integration/test.

A.2 Software functions

These software routines are used during the operation of the PDS in every centre/station to perform four major tasks:

- Reading products
- Writing products
- Packing products
- Unpacking products

using different media.

[G 93 : This software must be library of common subroutines (read and write) for the Product files and a set of software tool (pack/unpack) specific to the media (e.g Unix tar), to be used by all elements of the PDS and external interfaces involved on Product handing.]

The data record definition used by the READ and WRITE subroutine is directly extracted from the DDT data base.

A.3 User software

This software is used by the end-user to:

- Unpack products
- Read products
- Visualize products

on various media.

[G 94 : This software must be a suite of tools and/or software library available in the USFs and the User Tool Kit.]

Record definitions used by these tools and library are extracted from the DDT Data base.

[G 95 : The product handling user software must be delivered as an executable running on Unix, PC and Mac.]