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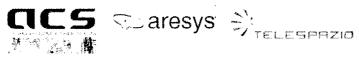
Title

[SD-60] S-1 Core PDGS

S-1 Level-0 Product Format Specifications

	Name and Function	Date	Signature
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Document type	Nb WBS	Keywords
SP	1B-1200	Sentinel-1, Core PDGS, Level 0, Product, Format, Specification







SUMMARY

This document aims to provide the format specifications for Level 0 product generated in the framework of **Sentinel-1 Payload Data Ground Segment (S1 PDGS)** project.











DOCUMENT CHANGE LOG

Issue/ Revision	Date	Modificati on Nb	Modified pages	Observations
1/0	22/10/2010		All	First Issue prepared for S1 PDGS PDR
1/1	02/02/2011		p. 17	Modified Table 4 to include updated values of GPRS Data records SIDs, extracted from latest available Issue 11 of document 'Sentinel GPSR Command and Housekeeping Data Interface Specification', as per RID [PRO-9]
			p. 17	Modified Table 4 to correct length of Product Type code for non-SAR L0 Product Types (aligned to 10 chars)
			pp. 17, 17, 17, 17	'productConsolidation' tag definition in the Manifest file modified to include new values compatible with RID [PRO- 10]
			pp. 17, 17, 17, 17	Definition of slice parameters tags in Manifest file completed as per RID [PRO-10]
			p. 17	Definition of tag 'averageBitRate' in Manifest file completed as per RID [PRO-10]
			All pages	Fixed text typos and minor rearrangements of graphical elements
1/2	21/04/2011		pp.12,14,17,23,36,38, 44,45,46,51,61,63,68, 72,74,75,79,82,83,87, 89,93,94,109,111,118, 117	Explicit list of Applicable and Reference documents replaces reference to documents identified in the CIDL of Core PDGS
			p. 22	Modified Table 4 to correct typo ("Wave Mode" instead of "Wave Wide Swath Mode"), as per comments to RID [PRO-10] by ESA
			p. 18,19,21,22,52	Modified ECC Number and Signal Type for calibration operation in Table 4,according to updated version of S1 SAR SPPDU ([CFI-06])
			pp. 45, 75, 83	Updated range of possible values for noiseCompressionType in Table 7, Table 15 and Table 16
			All pages	New SAFE version (1.2) used for product generation and for Manifest and XML Schemas examples
			pp.9,10,25,31,42, 61,86,92	In the filenames of annexed zip files the version changed from 1.0 to 1.2
			Annexed zip archive files	New XML Schemas examples, corresponding to a wider range of Sentinel-1 L0 Product types, added to the annexed zip archive files











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		pp.31,52,53,54,55,56, 57,58,64,95,96,97,98, 106,107	Updated the content of Annotated Data Component for SAR Standard L0 Product (Table 9), GPS L0 Product (Table 19) and HKTM L0 product (Table 21) according to updated ISP Annotation and Transfer Frame Annotation provided by DFEP and specified in [CFI-14]
		pp.49,71,78,85,86,91, 102	Added elements <cause> and <evidence> to elements <missingelements> and <corruptedelements> respectively in Manifest file of SAR and GPS L0 Products, in order to be consistent with SAFE core XML schemas for Manifest</corruptedelements></missingelements></evidence></cause>
		p. 117,119	Updated Sentinel-1 L0 Annotations Product size estimation in Table 28, according to updated version of S1 SAR SPPDU [CFI-06]
1/3	13/06/2011	pp. 10, 11, 25, 31, 36, 43, 62, 88, 94	In the filenames of annexed zip files the version changed from 1.2 to 1.3
		pp. 12, 14, 17, 23, 39, 46, 47, 52, 62,66, 68, 69, 73, 75,76, 80,84, 85, 89, 91, 95,96, 113, 115, 121, 122	As per RID #1 of ACQ_Review_Sheet-SD-60-RM.xls, the use of project's documents reference (eg: TDB-31) has been reintroduced
		p. 12	As per RID #2 of ACQ_Review_Sheet_SD-60-RM.xls, the issues of reference documents have been re-aligned with CIDL-2.0
		pp. 31, 53, 54, 55, 56,57,65, 97, 98, 99, 100 Annexed zip archive files	In order to be aligned to the content of ISP annotation (for SAR and GPS) as described in [CFI-14], a "spare" field (1- byte long) has been added at the end of structure of Annotation Data Component (Fig. 12, Table 9, Table 12, Fig. 16, Table 19, annexed file SD- 60_S1PD.SP.00110.ASTR_1.3_L0FICD_ANNEX3.zip)
		p.41, 105, 106, 107, 108, 109, 110, 111 Annexed zip archive files	In order to align the HKTM L0 Product format to the content of TF annotation as described in [CFI-14], description of structure and content of Annotation Data Component has been updated
		pp. 34,35, 42,52,80, 100, 114	Minor modifications of layout of figure and text
		pp.49,72, 79, 86, 87	Definition of tag <footprint> updated to include the case when the footprint is represented by more than 2 couples of coordinates</footprint>
		pp. 63, 64 (Table 11)	Minor typos and updates (on data types and size) in the description of Representation Schema for Measurement Data Component
		pp. 59, 60, 66. Annexed zip archive files	Definition of field "dateAndTime" of Index Data Component record has been aligned to the common definition of SAFE Index Components contained in [TDB-07] (see ch.6.5, Table 6.6)













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		pp. 45, 46, 17, 68, 69, 75, 76, 84	Description of "General Product Information" section of Manifests updated in order to reflect interpretation of Instrument configuration ID and Mission Data Take ID, as clarified in [CDB-03]
		p. 17	List of Record types for GPRS (Table 18) updated as per updated version of [TDB-32]
		p.113, 115	Typo in the definition of value range for Mission Data Take Identifier has been fixed (000000-FFFFFF replaced by 000001-FFFFFF)
1/4	22/08/2011	pp. 25, 26, 48, 49, 51 to 60, 71 to 97, 99 to 104, 110 to 113 Annexed zip archive files	Usage of <safe:extension> element and of namespaces specific to Sentinel-1 L0 Products have been introduced in order to add elements specific to Sentinel-1 L0, while keeping the Manifests compliant to XFDU and SAFE Core specifications, as per JIRA issue S1PDGS-1745.</safe:extension>
		pp. 29, 33 Annexed zip archive files	Hierarchical structure of Manifest and Data Component Schema modified to accommodate elements specific to Sentinel-1 L0 Products, introduced through the <safe:extension> mechanism, as per JIRA issue S1PDGS- 1745.</safe:extension>
		p. 17	Missing examples of Data Component name for GPS L0 Product added in section 3.4.3
1/5	14/11/2011	pp. 44, 46 to 54, 65 to 72, 74 to 81, 83 to 90, 92 to 97, 103 to 106 Annexed zip archive files	Completed the list of Manifest schemas for L0 format , aligned to document issue 1.4, as per Jira issue S1PDGS- 2182. Completed the set of Data Component files for all S1 L0 Product types. Schemas are provided as annexed files. Minor typos and disalignments between provided schemas and description of content of Manifests for some Product Types have been fixed. Reference to Metadata Objects
		p. 24, 44	IDS detailed (reported both Metadata Object ID and corresponding xmlDataType) Typos in definition of SAFE Manifest Schema root path and in the provided example of a specialization namespace
		Fig. 1, Fig. 2	Fixed minor disalignments of hierarchical tree of Manifest and Data Component Schemas w.r.t. provided complete set of Schemas
		pp. 10, 11, 25, 33, 37, 45, 60, 88, 95	Updated document version in annexed zip archive files name
		Fig. 3	Minor update of S1 L0 Product family tree in order to highlight RFC Products content
		pp. 59, 71, 80, 89	Definition of instrument footprint revised (area defined by 4 or more coordinates, excluding nadir points)
		pp. 49, 68, 76, 94	Definition of Packet Store ID corrected (removed incorrect sentence "equal to VC ID")
		p.iv	Date of Change Log for version 1.3 corrected









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1/6	13/12/2011	pp. 13, 25, 53	As per CDR Review RID #1 of Internal Review sheet SD- 60_ESA_CP.xls annexed to Jira issue S1PDGS-2449, the document has been aligned to the updated version od SAFE Suite "Sentinel-Safe Suite 1-0-rc-1", w.r.t. the following points: • The namespace of the Sentinel-SAFE Core has been set to " <u>http://www.esa.int/safe/sentinel-1.0</u> "; • dataObject's repID attribute is optional; • dataObject's byteStream sub-element occurrences set to 1:1; • byteStream's size attribute is required; • MIME type of Data Components referenced in the Manifest is no longer restricted to an enumeration list.
		pp. 21, 22	Typo corrected: "emisphere" replaced by "hemisphere"
		pp. 11, 12, 26, 32, 36, 44, 59, 87, 94	Updated document version (1.6) in annexed zip archive files names
1/6.1	20/11/2012	pp. 55, 75, 85, 94	As per Jira issue S1PDGS-30105, minimum footprint vertex number set to 2 for WV and RFC mode
		pp. 50, 71, 81, 90	As per Jira issues S1PDGS-29958 and S1PDGS-3163, textual description of Manifest tag <productconsolidation> detailed and clarified in terms of time-partiality of the segment.</productconsolidation>
		pp.31, 35, 36	As per Jira issue S1PDGS-3163, added a dedicated section 3.2.1.1.1 for S1 SAR RFC L0 products, containing or referencing information already provided for other SAR operating modes,
		pp. 128 to 132	As per Jira issue S1PDGS-3163, added detail to the computation method used to derive the estimated size for SAR, GPS and HKTM L0 Products
		pp. 49, 69, 79, 88	As per Jira issue S1PDGS-3005, description of Manifest tags <starttime> and <stoptime> improved, by stating that times refer to Measurement Data Components of Products</stoptime></starttime>
		pp. 54, 74, 84, 93, 101, 112	As per Jira issue S1PDGS-1664, name of Manifest tag <organization> in section "processing" corrected into <organisation>, in compliance to [TBD-07]</organisation></organization>







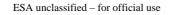




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		Table 7, Table 8, Table 14, Table 15, Table 16,Table 17, Table 20	 As per Jira issue S1PDGS-1664, in order to avoid misunderstandings concerning Xpaths, the description of the Manifests content is further detailed through the following actions: XML attributes are clearly distinguished from nodes by prefixing an "@" to their names; attribute @type of both tags <orbitnumber> and "relativeOrbitNumber> is explicitly indicated in a separate row from its corresponding tag;</orbitnumber> also in order to align description with SAFE Core [TDB-07], tag <location> (child tag of tags <missingelements> and <corruptedelements>) is exploded into its child tag <path> and its attributes "following", "after" and "before"</path></corruptedelements></missingelements></location>
		Table 7, Table 8, Table 14, Table 15, Table 16	Typo in measurementFrameSet section corrected (wrong name <footprint> corrected as <footprint>); child node <coordinates> of tag <footprint> indicated explicitly and separately from corresponding tag</footprint></coordinates></footprint></footprint>
		Table 27 on p.129	Replaced correct references to Applicable Document [TDB-31]
		Annexed zip archive files	As per Jira issue S1PDGS-30110, Manifest and Data Component Schema aligned w.r.t. S1PDGS ACQ subsystem (v.2.2.1); Data Component schemas include correction of typos detected as per S1PDGS-1664
		Fig. 2 on p.29	Typo in the description of structure of Data Component Schema folders fixed (correct name s1-level-0-index.xsd of Index File Schema replaces index.xsd and); the file is provided in the annexed SD- 60_S1PD.SP.00110.ASTR_1.6.1_L0FICD_ANNEX3.zip archive file
		Annexed zip archive files pp. 12, 13, 27, 34, 40, 48, 64, 96, 104	Updated document version (1.6.1) in annexed zip archive files names
1/7	20/12/2012	p.15	Issue of Reference Documents [CFI-06] updated to 8.0; issue of Reference Documents [CFI-14] updated to 1.2
		p.15	Typo in the name of Reference Documents [TDB-21] corrected
		p.15	Added document "GMES Sentinel-1 PDGS – Handling of Satellite Notch Modes" GMES-S1GS-EOPG-TN-12-0029 to list of Reference Documents
		pp.17, 18	Elevation and Azimuth Notch modes added to the S1 L0 Products overview (section 3.1)
		pp.20, 21, 26	Elevation and Azimuth Notch modes added to the S1 L0 Product Types description (section 3.1.1, Table 4)
		pp.22 to 26	Signal Type 15 (EPDN Cal Iso) added to list of Calibration Signal Types in the S1 L0 Product Types description (section 3.1.1, Table 4)













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pp.28, 30	Folders containing XML Schemas associated to Manifest files for Elevation and Azimuth Notch products added to the description (section 3.1.2) and the graphical view (Fig. 1) of S1 L0 XML Schema structure
pp.31, 35, 36	As per Jira issue S1PDGS-1664, added a dedicated section 3.2.1.1.2 for S1 SAR RFC L0 products, containing or referencing information already provided for other SAR operating modes,
pp.32, 33	Elevation and Azimuth Notch modes products added to the description (section 3.1.3) and the graphical view (Fig. 3) of S1 L0 Products family tree
Table 7	As per Jira issue S1PDGS-1664, added acronyms for Elevation and Azimuth Notch modes in the description of tag <instrumentmode> in the Manifests content for the SAR Standard L0 Product</instrumentmode>
Table 7, Table 8, Table 14, Table 15, Table 16,Table 17, Table 20	As per Jira issue S1PDGS-1664, added optional attribute "version" to the tag <resource> in the Processing section of the Manifest for the SAR, GPSR and HKTM L0 Products, in order to accommodate version of resources (in particular SPPDU version for the measurement data set included in the Level-0 product)</resource>
Table 11, p.70, 71	As per Jira issue S1PDGS-1664, content of Representation Schema for Measurement Data Component updated with respect to change of format of SES SSB and SAS SSB data in Secondary Header of Sentinel-1 ISP, introduced with version 6 of [CFI-06]
Table 22, p.122 Table 23, p.124	Naming convention for both S1 L0 Products and Data Component files inside the Products updated in order to include the Elevation and Azimuth Notch modes.
pp.130, 132, 133	Estimation of S1 L0 products size updated with respect to the Elevation and Azimuth Notch modes
Annexed zip archive file SD- 60_S1PD.SP.00110.A STR_1.7_L0FICD_AN NEX2.zip	As per Jira issue S1PDGS-1664, in order to include Schemas associated to Manifest for Elevation and Azimuth Notch modes, added folders ensp, endp, ansp, andp to the folder "~\sentinel-1\sar\level-0\standard" in the delivered Schemas provided with zip file SD- 60_S1PD.SP.00110.ASTR_1.7_L0FICD_ANNEX2.zip
Annexed zip archive file SD- 60_S1PD.SP.00110.A STR_1.7_L0FICD_AN NEX3.zip	As per Jira issue S1PDGS-1664, in order to include change of format of SES SSB and SAS SSB data in Secondary Header of Sentinel-1 ISP, introduced with version 6 of [CFI-06], the Data Component Schemas provided with zip file SD- 60_S1PD.SP.00110.ASTR_1.7_L0FICD_ANNEX3.zip have been modified correspondingly; some minor typos concerning namespaces have been fixed.
Annexed zip archive files pp. 13, 14, 29, 39, 45, 53, 69, 101, 109	Updated document version (1.7) in annexed zip archive files names











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1 INTRODUCTION

1.1 SCOPE OF THE DOCUMENT

This document, starting from SAFE documentation (see [TDB-07] and [TDB-08]), aims to provide the Level 0 format specifications to meet the specific needs of Sentinel-1 mission.

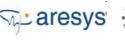
1.2 PRESENTATION OF THE DOCUMENT STRUCTURE AND CONTENTS

The document is structured as follows:

Chapter	Title	Objectives and Contents	
Number			
1	INTRODUCTION	This chapter: - Presents the scope of the document	
		- Introduces its contents, in order to provide the reader with a road map into the document	
		- Lists the Applicable and Reference Documents	
		- Provides the list of acronyms and abbreviations	
2	APPLICABLE AND REFERENCE DOCUMENTS, ACRONYMS	This chapter contains references to the project documents and used acronyms.	
3	SENTINEL-1 L0 PRODUCT FORMAT	This chapter presents an overview of the organization and content of a Sentinel-1 Level 0 product, provides a more detailed description (both in tabular and graphical form) of the contents of the product components and defines the product naming convention.	
		The following zip archive files are also separately provided, together with the present document:	
		 file SD- 60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX1.zip, 	
		containing examples of the Manifest files (described in	

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	Chapter	Title	Objectives and Contents
	Number		
			section 3.3) for some significant Sentinel-1 Level 0 products;
1			• file SD-
			60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip , containing all the XML Schemas (according to the structure described in section 3.1.2) associated to the Manifest files for all Sentinel-1 Level 0 products;
			 file SD- 60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX3.zip, containing all the XML Schemas (according to the structure described in section 3.1.2) associated to the Data Component files for Sentinel-1 L0 products.

Table 1 - Document Structure











2 APPLICABLE AND REFERENCE DOCUMENTS, ACRONYMS

2.1 APPLICABLE DOCUMENTS

ID	Document Title	Document Reference
TDB-07	SAFE (Sentinel-SAFE-CORE) Control Book – Volume 1 - Core Specifications	GAEL-P264-DOC- 0001-01-01
	Issue 1.0, 25 July 2011 SAFE Control Book – Volume 2 – Recommendation for Specialization	PGSI-GSEG-EOPG-FS-05-0002
TDB-08	Issue 1.11, 22 June 2010	

2.2 REFERENCE DOCUMENTS

ID	Document Title	Document Reference
TDB-19	Sentinel-1 Product Definition	S1-RS-MDA-52-7440
IDD-19	Issue 2.2, 17 November 2010	
TDB-31	GMES Sentinel-1 SAR Performance Analysis	S1-TN-ARE-PL-0001
100-51	Issue 1.5, 24 September 2010	
CFI-06	Sentinel-1 SAR Space Packet Protocol Data Unit	S1-IF-ASD-PL-0007
CF1-00	Issue 58, 15-23 September-August 20120	
	Sentinel GPSR – Command and Housekeeping Data Interface	S1-IF-AAE-SC-0001
TDB-33	Specification	
	Issue 12, 18 January 2011	
TDB-32	Sentinel GPSR – Measurement Data Interface Specification	S1-IF-AAE-SC-0002
100 32	Issue 8, 18 January 2011	
CFI-14	External ICD Volume 2 DFEP->PDGS ICD	DFEP-ICD-KSAC-ESA-1066
CI-1-14	Issue 1.2 1 , 29 02 March April 2011	
CDB-03	GMES Sentinel-1 PDGS Operations Concept Document	GMES-GSEG-EOPG-TN-08-0012
CDB-05	Issue 2.0, 22 April 2011	
	Sentinel GPSR Measurement Data Interface SpecificationSAR	S1-PL-ASD-PL-0001 S1-IF-AAE-SC-
TDB-21	Instrument Calibration and Characterization Plan	0002
	Issue 68, 1 18-4 January September 2010 1	
RD-01	GMES Sentinel-1 PDGS – Handling of Satellite Notch Modes	GMES-S1GS-EOPG-TN-12-0029
	Issue 1.1, 13 December 2012	

2.3 ACRONYMS

The specific terminology and acronyms in this document are defined in [SD-133], S1 Core PDGS Glossary.

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3 SENTINEL-1 L0 PRODUCT FORMAT

The purpose of this chapter is to provide a definition of the Sentinel-1 Level 0 format and a description of the structure and content of a product generated according to this format, through the following steps:

- defining the different Sentinel-1 Level 0 product types;
- providing an overview of the organization and content of a generic Sentinel-1 Level 0 product;
- providing a more detailed description of the contents of the product components;
- defining a naming convention for the Sentinel-1 Level 0 products and for the product components;
- providing an estimation of the size of the Sentinel-1 Level 0 products.

The definition of the specifications has also taken into account, to minimise as much as possible in the format content and conventions, the number of product types definition with respect to the different processing scenarii for generating L0 (i.e.: separate per data take or split in slicing segmentation).









3.1 SENTINEL-1 L0 PRODUCTS OVERVIEW

This section contains an overview of the Sentinel-1 Level 0 Products.

In particular, the following aspects are considered:

- Sentinel-1 L0 Product Types
- Sentinel-1 L0 Schemas Structure
- Sentinel-1 L0 Product Family Tree

The Sentinel-1 L0 products can be divided into the following main types:

Sentinel-1 Level 0	Short Description				
Product Types					
SAR L0 Products	 Containing the SAR Raw data, namely the downlinked and compressed ISPs stream; this group of products can be further sub-divided into the following classes: <u>SAR Standard L0 products</u>, representing the stream of ISPs containing SAR echo, calibration or noise signal; 				
	 <u>SAR L0 Cal products</u>, representing the calibration pulses as extracted from the SAR ISPs stream; <u>SAR L0 Noise products</u>, representing the noise pulses as extracted from the SAR ISPs stream; <u>SAR L0 Annotations products</u>, containing the primary and secondary headers as extracted from the SAR ISPs stream; 				
GPS L0 Products	Containing the data generated by the <u>Sentinel GPSR</u> downlinked as a stream of telemetry packets;				
HKTM L0 Products	Containing Sentinel-1 recorded housekeeping telemetry data downlinked in <u>X-Band</u> to the S1 PDGS				

Table 2 - Product Types for Sentinel-1 L0 Products

For what concerns the Sentinel-1 SAR L0 Products, considerations about instrument operating modes and available polarisation modes are provided. The Sentinel-1 SAR instrument can operate in the following modes four-(imaging and calibration, imaging modes plus one calibration mode (see also [TDB-19], section 3.2.1 for further details):

- Stripmap Mode (SM);
- Interferometric Wide Swath Mode (IW);

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- Extra Wide Swath mode (EW);
- Wave Mode (WV);
- RF Characterisation Mode (**RFC**);











- Elevation Notch Acquisition Mode (**EN**);
- Azimuth Notch Acquisition Mode (AN).-

Within each imaging mode, different polarisation capabilities are provided:

- For the **SM**, **IW**-and, -**EW**, **EN** and **AN** modes, the following polarisation modes are available (each polarisation mode is composed by one or two polarisation combinations, each coded in two letters representing respectively the polarisation of the transmitted and received signal):
 - 2 single polarisation modes (HH or VV);
 - 2 dual polarisation modes (HH/HV or VV/VH); based on the fact that the two polarisation combinations (co-polar and cross-polar, HH and HV or VV and VH respectively) are stored in two separate packet stores in the on-board memory and downlinked in two separate virtual channels.
- For **WV** mode, the acquisition is possible in single polarisation mode (HH or VV); the data take is handled as a single binary file;
- For **RFC** mode, only the dual polarisation modes (HH/HV or VV/VH) are possible.

The Sentinel-1 SAR L0 Product format includes the following two cases:

- a Product containing a single Measurement Data Component (**single-pol product**, acronym SP), representing either the only channel of a single polarisation data take or one of the two channels of a dual polarisation data take;
- a Product containing two Measurement Data Components, one per polarisation combination (dual-pol product, acronym DP).











The following table summarizes all the mentioned cases and combinations (applicable to SAR L0 Products), with the corresponding acronyms used throughout the document; in the table, the terms "channel" is used, for brevity, as a synonym of "polarisation combination" HH, VV, HV, VH, while the term "polarisation data take" is a synonim of "polarisation mode":

Name		Description	Acronym
Single-pol data takeSingle-pol product,polarisation SH			
	Single-pol product, polarisation SV	A single-pol product containing the channel VV of a single polarisation data take	SV
	Single-pol product, polarisation HH	A single-pol product containing the channel HH of a dual polarisation data take	нн
	Single-pol product,A single-pol product containing the channel VVpolarisation VVof a dual polarisation data take		VV
	Single-pol product, polarisation HV	A single-pol product containing the channel HV of a dual polarisation data take	HV
Dual-pol data take	Single-pol product, polarisation VH	A single-pol product containing the channel VH of a dual polarisation data take	VH
	Dual-pol product, polarisation HH/HV	A dual-pol product containing two Measurement Data Components corresponding to the channels HH and HV of a dual polarisation data take	DH
Dual-pol product.		A dual-pol product containing two Measurement Data Components corresponding to the channels VV and VH of a dual polarisation data take	DV

Table 3 - SAR L0 Products Polarisation Combinations











3.1.1 Sentinel-1 L0 Product Types

The Table 4 shows the Sentinel-1 L0 Product Types for SAR, GPS and HKTM L0 products; it reports, for each Product Type, the following information:

- column "Product Type" contains a brief description of the Product Type;
- column "Product Type code" contains the Product Type code (fixed length = 10 chars), that follows the convention:

BB_TTTR_LF

where:

- BB = instrument mode/type of data, possible values "SM", "EW", "IW", "WV", "RF", "EN", "AN" (for SAR instrument modes Stripmap, Extra Wide Swath, Interferometric Wide Swath, Wave, and RF Characterisation Mode, Elevation Notch and Azimuth Notch Modes respectively), "GP" (for GPSR) or "HK" (for HKTM);
- TTT = "RAW" fixed string, indicating RAW L0 Products;
- R = "_" fixed string

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- L = "0" fixed string, indicating L0 Processing Level;
- F = Product Class, possible values "S", "C", "N" or "A" (for SAR L0 Standard, SAR L0 Cal, SAR L0 Noise and SAR L0 Annotations respectively);
- column "ISP Headers information" provides, for each Product Type, the "signature" of the ISPs contained in a product of that Product Type (in terms of relevant fields of the ISP Headers; for each field, the section of [CFI-06] is indicated between parenthesis, where a detailed description of the field is provided); namely, if the values of the listed ISP Header fields correspond to those indicated for a Product Type (one row), then ISP will belong to a S1 L0 Product having that Product Type;- in particular, for what concerns SAR Azimuth Notch Mode (N1 to N6), as these modes have the same characteristics as the Stripmap Mode (S1 to S6) (see [RD-01], requirement GMES-S1-PDGS-0662), it is assumed that Signal Type information is the same as for Stripmap Mode for Standard L0 Products; for Elevation Notch mode, a similar assumption is not confirmed, and the Signal Type information is left TBD;











For example, the Product Type "IW_RAW_0C" includes ISPs corresponding to the following values:

- PID = 65 (decimal)
- PCAT = 12 (decimal)
- ECC number = 8
- SSBFlag = 1
- Signal Type = any value in the range 8 to 12

As shown by the table, for the different Sentinel-1 payload instruments:

- SAR L0 products; one Sentinel-1 L0 Product Type corresponds to each combination of the following elements:
 - o the instrument (SAR);
 - the five-seven Sentinel-1 SAR operating modes (the four-imaging modes SM, IW, EW, WV, plus the calibration RFC mode, the Elevation and Azimuth Notch modes);
 - the Product Class for SAR L0 Products (SAR Standard, SAR L0 Cal, SAR L0 Noise and SAR L0 Annotations).

On the contrary, other features of the product (in particular the concepts of data segment "slicing" and "polarisation") are not included in the Product Type code; in other terms, two SAR L0 products representing respectively a slice or a data segment can be managed with the same Product Type code and the same applies to 2 products representing a different polarisation (for example dual polarisation HH/HV or single polarisation HH).

• GPS and HKTM L0 products; one single Product Type is defined for each of these products.

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	Product Type	Product Type code	ISP Headers information				
I			APID (section 3.1)			Signal Type	
			PID (decimal)	PCAT (decimal)	ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)
	SAR Stripmap Mode L0 Standard	SM_RAW0S	65	12	 1 to 4 = Stripmap 1 to 4 5 = Stripmap 5, ground imaging on north hemisphere 10 = Stripmap 5, ground imaging on south hemisphere 6 = Stripmap 6 	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15-= Calibration
	SAR Stripmap Mode L0 Cal	SM_RAW0C	65	12	 1 to 4 = Stripmap 1 to 4 5 = Stripmap 5, ground imaging on north hemisphere 10 = Stripmap 5, ground imaging on south hemisphere 6 = Stripmap 6 	1	8 to 12, 15



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ſ	Product Type	Product Type code	ISP Headers information					
			APID	(section 3.1)		Signal Type		
			PID (decimal)	PCAT (decimal)	ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)	
	SAR Stripmap Mode L0 Noise	SM_RAW0N	65	12	 1 to 4 = Stripmap 1 to 4 5 = Stripmap 5, ground imaging on north hemisphere 10 = Stripmap 5, ground imaging on south hemisphere 6 = Stripmap 6 	0	1	
	SAR Stripmap Mode L0 Annotations	SM_RAW0A	65	12	 1 to 4 = Stripmap 1 to 4 5 = Stripmap 5, ground imaging on north hemisphere 10 = Stripmap 5, ground imaging on south hemisphere 6 = Stripmap 6 	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration	
	SAR Interferometric Wide Swath Mode L0 Standard	IW_RAW0S	65	12	8	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration	



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Product Type	Product Type code		ISP Headers information				
		APID	(section 3.1)		Signal Type		
		PID (decimal)	PCAT (decimal)	ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)	
SAR Interferometric Wide Swath Mode L0 Cal	IW_RAW0C	65	12	8	1	8 to 12, 15	
SAR Interferometric Wide Swath Mode L0 Noise	IW_RAW_0N	65	12	8	0	1	
SAR Interferometric Wide Swath Mode L0 Annotations	IW_RAW0A	65	12	8	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration	
SAR Extra Wide Swath Mode L0 Standard	EW_RAW0S	65	12	7	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration	
SAR Extra Wide Swath Mode L0 Cal	EW_RAW0C	65	12	7	1	8 to 12, 15	
SAR Extra Wide Swath Mode L0 Noise	EW_RAW0N	65	12	7	0	1	



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Product Type	Product Type code	ISP Headers information				
		APID	(section 3.1)		Signal Type	
		PID (decimal)	PCAT (decimal)	ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)
SAR Extra Wide Swath Mode L0 Annotations	EW_RAW0A	65	12	7	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration
SAR Wave Mode L0 Standard	WV_RAW0S	65	12	9	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration
SAR Wave Mode L0 Cal	WV_RAW0C	65	12	9	1	8 to 12
SAR Wave Mode L0 Noise	WV_RAW0N	65	12	9	0	1
SAR Wave Mode L0 Annotations	WV_RAW_0A	65	12	9	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration
RF Characterisation Mode	RF_RAW0S	65	12	15	1	TBD



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Product Type	Product Type code	ISP Headers information				
		APID (section 3.1)			Signal Type	
		PID (decimal) PCAT (decimal)		ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)
Elevation Notch Mode L0 Standard	EN_RAW0S	65	12	17	TBD	TBD
Azimuth Notch Mode L0 Standard	AN_RAW0S	65	12	 18 to 21 = Swaths from 1 to 4 22 = Swath 5, on north hemisphere 23 = Swath 5, on south hemisphere 24 = Swath 6 	0 = Echo or Noise 1 = Calibration	0 = Echo 1 = Noise 8 to 12, 15 = Calibration



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Product Type	Product Type code	ISP Headers information					
		APID	(section 3.1)		Signal Type		
		PID (decimal)	PCAT (decimal)	ECC Number (section 3.2.2.3)	SAS SSB Data Field SSBFLAG (section 3.2.5.13)	Signal Type (section 3.2.5.14.3)	
			4 (Data Records with SID 213,214,219)		N.A.		
	GPS L0 GP_RAW0_		6 (Records with SID 218,223,225,226,227) 11 (Records with SID	N.A.			
GPS LO		48 (GPS-A) 49 (GPS-B)	216,217) 12 (Records with SID 224,215,235)			N.A.	
			13 (Records with SID 229,230,231,232,234) (see [TDB-33])				
HKTM L0	HK_RAW_0_	N.A	N.A.	N.A.	N.A.	N.A.	

Table 4 - Product Types for Sentinel-1 L0 Products







3.1.2 Sentinel-1 L0 XML Schemas Structure

This section describes the hierarchical structure of the Manifest XML Schemas (namely the XML Schema files xfdu.xsd associated to the Product Manifest files, see Fig. 1) and of the Representation XML Schemas (namely the XML Schema files associated to the Product Data Components, see Fig. 2).

The figures show the tree structure of the file system repository where the XML Schemas for Sentinel-1 L0 Product types are located (starting from root paths $SAFE_HOME | resources | xsd | int | esa | safe | sentinel-1.x |$ and $SAFE_HOME | resources | xsd-component | int | esa | safe | sentinel-1.x |$ respectively for Manifest Schemas and Data Component Schemas, where x is the revision number of Sentinel SAFE-Core; the present document refers to Sentinel SAFE-Core version 1.0).

This structure is compatible with Sentinel-SAFE Core specifications [TDB-07] and SAFE Recommendation for specialisation [TDB-08], and it can be used as a basis for a future definition of the SAFE specialisations for Sentinel-1 L0 Products within SAFE (though this is out of the scope of the present document); in this respect, each terminal leaf (respectively file xfdu.xsd and s1-level-0.xsd of the structures shown in Fig. 1 and Fig. 2) could represent the SAFE specialisation for a distinct Sentinel-1 L0 product; the SAFE specialisations for Sentinel-1 will require the installation "sentinel-1" of of directories Fig. 1 and Fig. 2 under the SAFE root paths \$SAFE_HOME\resources\xsd\int\esa\safe\sentinel-1.x and \$SAFE_HOME\resources\xsd*component*/*int*/*esa*/*safe*/*sentinel-1.x*/ respectively.

The following conventions apply:

- 1. for what concerns Manifest XML Schemas structure, there is a different Manifest file, and therefore a different Manifest XML Schema xfdu.xsd, for each combination of the following elements:
 - o Instrument/Data type (SAR, GPS or HKTM), each corresponding to a folder in Fig. 1 (sar, gps or hktm);
 - SAR Product Class (Standard, Calibration/Noise, Annotations), each corresponding to a folder (standard, calnoise or annotations);
 - Measurement/Calibration Modes, (EW, IW, SM, WV, RF), first two letters of a terminal folder (e.g. 'ew' of folder 'ewsp' of mode EW or 'an' for folder 'ansp' of Azimuth Notch mode);
 - Polarisation (dual-pol products or single-pol products, as defined in Table 3), last two letters of a terminal folder (e.g. 'dp' of folder ewdp or 'sp' of folder iwsp);

Each of these combinations define what is called "Manifest Type" in the rest of the document.

On the other hand, since the Data Component binary structure is independent from the Polarisation (dual-pol or single-pol) and from the Measurement Mode, one Data Component XML Schema is defined for each combination of:

o Instrument/Data type (SAR, GPS or HKTM), each corresponding to a folder in Fig. 2 (sar, gps or hktm);











SAR Product Class (Standard, Calibration/Noise, Annotations), each corresponding to a folder (standard, calnoise or annotations);

Each of these combinations define what is called "Data Component Type" in the rest of the document.

- for the sake of simplicity, the terminal leafs (represented by the Manifest XML Schema "xfdu.xsd" or the Measurement Data Component Schema "s1-level-0.xsd") are shown only for some of the "Manifest Types" defined at point 1, but the same hierarchy is applicable to all "Manifest Types";
- 3. in order to help understand how the Sentinel-1 L0 Schema tree structure can be integrated in the current SAFE, in both figures an external box is drawn that separates the Schemas tree structure specific to Sentinel-1 L0 format from the current SAFE Schema structure (of which some elements, relative to other missions, are shown);
- 4. in both figures, the internal box encloses the portion of the tree structure specific to Sentinel-1 L0 format and leaves out the portion in common with Sentinel-1 L1/L2 format; in other terms, the internal box represents the part that must be physically merged into the XML Schemas folder of Sentinel-1 L1/L2 format.

Examples of the Manifest and Data Components XML Schema folders described in Fig. 1 and Fig. 2 are provided as two separate files:

- **SD-60_S1PD.SP.00110.ASTR_1.6.17_LOFICD_ANNEX2.zip**, containing all Schemas associated to the Manifest files for all Sentinel-1 Level 0 products (corresponding to the content of external box in Fig. 1)
- SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX3.zip, including all Schemas associated to the Data Component files for all Sentinel-1 Level 0 products (corresponding to the content of external box in Fig. 2).











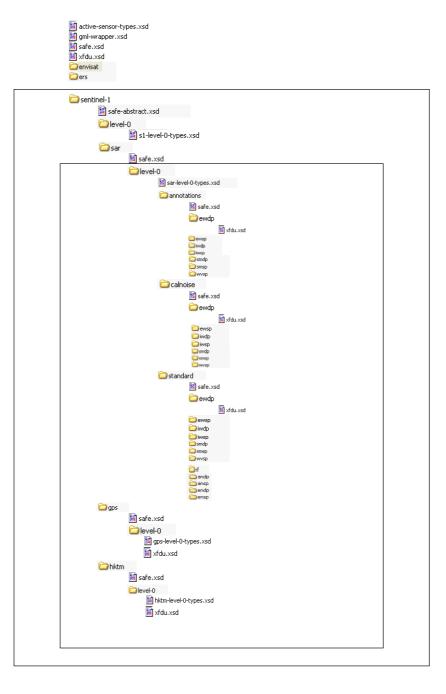










Fig. 2 - Structure of folder for Representation XML Schemas associated to Data Components

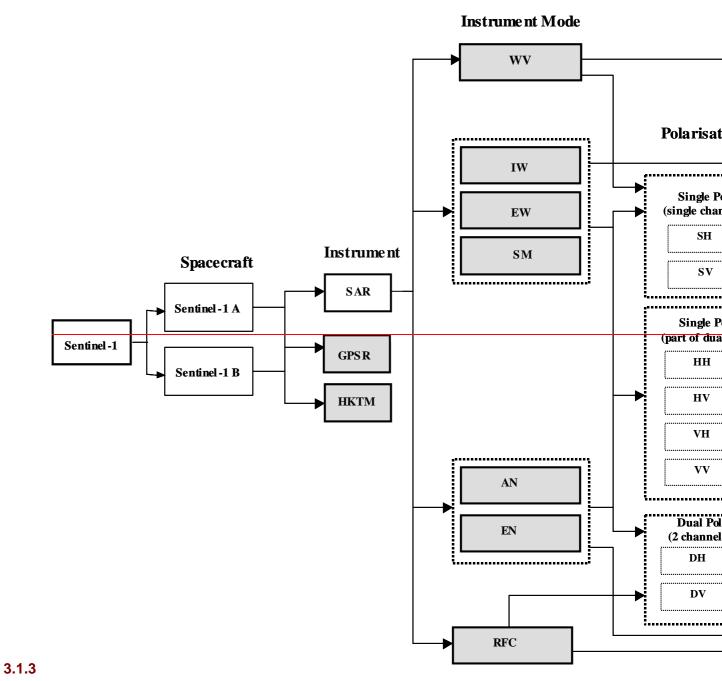
🗁 envisat 🗁 ers	
📓 s1-level-0-index.xsd	
🔁 sentinel-1 ն sar	
🗁 level-0 📓 s1-level-0-annot.xsd	
annotations 📓 s1-level-0.xsd	
S1-level-0.xsd	
Contraction and and and and and and and and and an	
🔚 s1-level-0.xsd	
🗁 gps	
Collevel-0	
📓 s1-level-0.xsd	
s1-level-0-annot.xsd	
hktm	
ievel-0 📓 s1-level-0.xsd	
si-levero.xsu	
L	







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Sentinel-1 L0 Products Family Tree

The following figure shows the family tree for the Sentinel-1 L0 Product types and XML Schemas structure described in the previous sections; the following conventions are used:







- the elements that are included in the Product Type code, namely the instrument (for GPSR and HKTM, not for SAR), the instrument mode (for SAR) and the product class have been highlighted (they are shown as light gray boxes with full line border);
- the additional elements (polarisation mode (single-pol or dual-pol) and polarisation combinations) that define a separate "Manifest Type" (namely a a separate Manifest XML Schema), but are not used to build the Product Type Code, are shown as white boxes, with broken line border;
- other elements that do not belong to the previous two categories, but are useful to understand the Products Family tree, have been shown as white boxes with full line border;
- as previously stated in section 3.1, only Single Polarisation products are possible for WV mode;
- as stated in section 3.1 and section 3.2.1.1.1, only Dual Polarisation Standard products are possible for RFC mode;
- only Standard products (no Annotations, Noise or Cal) are foreseen for Azimuth Notch, Elevation Notch and RFC modes.-





















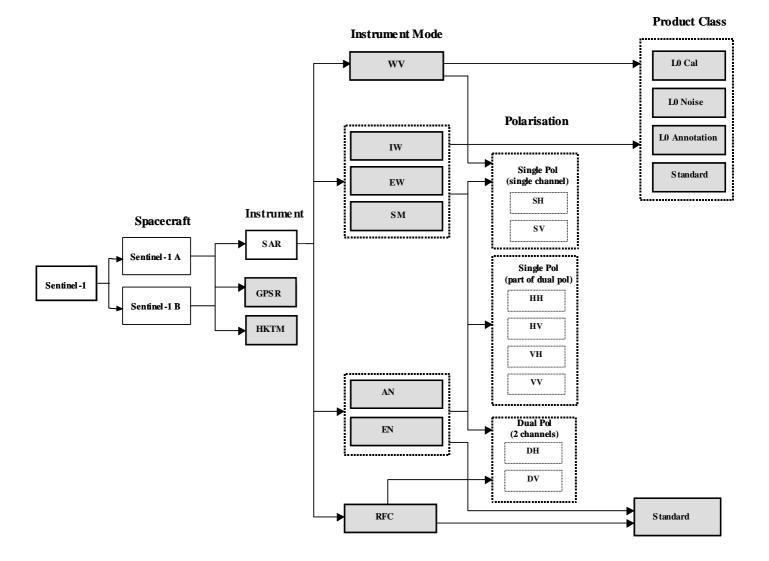


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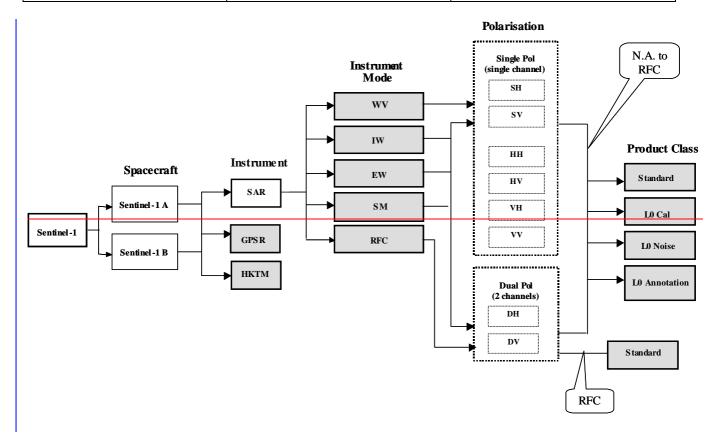
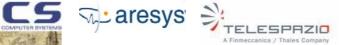


Fig. 3 - Sentinel-1 L0 Products family tree

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3.2 SENTINEL-1 L0 PRODUCTS HIGH LEVEL STRUCTURE

This section describes the high-level structure and format of the Sentinel-1 Level 0 Products.

The structure and organization of a generic Sentinel-1 Level 0 Product is specific to its Product Type; nevertheless products belonging to the same group of Product Types (as defined in Table 4, namely SAR Standard, SAR L0 Cal, SAR L0 Noise, SAR L0 Annotations, GPS, HKTM) share a common structure and content.

The section is divided into sub-sections, each devoted to one of the above-mentioned groups; for each group, a product physical overview is provided, showing the structure and content of a generic product of the group in terms of folders and folder composing physical files; the following conventions apply:

- folders (including in this definition also the L0 Product) are represented by white boxes with thick borders;
- binary files are represented by dark gray boxes;
- XML files are shown as light gray boxes;
- the occurrence of each product composing file and folder is shown;
- names of the folders and files are symbolic; the real file names are defined and related examples are provided in section 3.4.













3.2.1 SAR L0 Products structure

3.2.1.1 SAR Standard L0 Products structure

The general structure of a SAR Standard L0 Product (applicable to all SAR Measurement Modes, except for RFC, see section 3.2.1.1.1) is shown in the following figure:

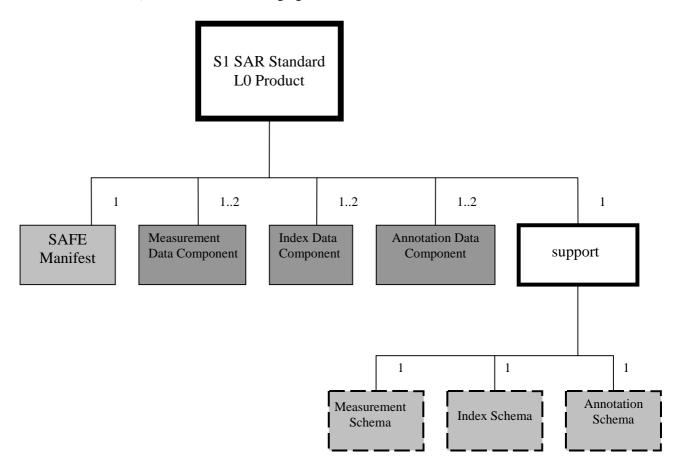


Fig. 4 – SAR Standard L0 Product structure

As described in figure, a Sentinel-1 SAR Standard L0 Product consists of the following components:

• A *Manifest* (XML File) that describes the overall context where the product was generated (platform, mission, instrumentation, product history, timing, orbit), provides some information related to the product data itself (quality and geographical information), and finally describes the content and structure of the product, through references to all the remaining components of the product; the Manifest is described in more details in section 3.3.1.1.1.

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The Manifest is validated by an xfdu.xsd XML Schema, that is not included in the product, but is part of the XML Schemas distribution; the actual Manifest XML Schemas for SAR Standard L0 Products are included in a folder provided as a zip archive **SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip**, together with the present document; the structure of the XML Schemas distribution is described in section 3.1.2;

- one or two *Measurement Data Components* (Binary Files); they contain the raw measurement data, in the form of the stream of downlinked ISPs (namely a set of ISPs, organized in the same time sequence and space alignment as the original ISPs stream). A more detailed description of these files is presented in section 3.3.1.1.2;
- one or two Annotation Data Components (Binary Files) each composed by one record for each ISP; each record contains annotations (related to ISP timing, ISP reconstruction process, Virtual Channel ID etc.), partly extracted from the ISP by the L0 Processor, partly computed (and pre-pended to the ISP) by the Demodulator and Front End Processor (DFEP). A more detailed description of these files can be found in section 3.3.1.1.3;
- one or two *Index Data Components* (Binary Files), each associated to a *Measurement Data Component* and containing the description (bytes location, time, size etc.) of the logical blocks of data in which the corresponding *Measurement Data Component* can be divided; it allows to point to each block start within the Data Component, thus enabling efficient data access and subsetting; further details on the *Index Data Component* can be found in section 3.3.1.1.4;
- Representation Data Components (Measurement Schema, Index Schema, Annotation Schema); XML Schema files, annotated with SDF mark-ups, that describe the Representation Information (format and content) of every Data Component (Measurement, Index or Annotation) of the Sentinel-1 L0 Product; they are used to access, validate and manipulate data. They are contained in a dedicated folder (named "support") within the product, as shown in Fig. 4. A detailed description of the structure and content of these Schemas can be found in section 3.3.1.1.5. The actual Schemas, included in a folder with the structure described 3.1.2, provided as zip archive SDin section are а 60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX3.zip, attached to the present document.

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3.2.1.1.1 SAR RFC Standard L0 Products structure

The RFC Characterisation mode is a dedicated calibration mode that provides the full characterisation of Transmit and Receive channels of Sentinel-1 antenna, through the individual activation of all polarisation combinations, in order to support the instrument performance monitoring and calibration activities; in this respect, an RFC mode L0 product appears as a standalone product, that can be classified as Standard, with a similar structure, but with some specificities, as shown in Fig. 3 and Fig. 5; in particular:

- RFC product size is not comparable with other SAR Measurement Modes Standard L0 products, and therefore it is not convenient to generate the Index file associated to the Measurement Data Component (Index file and corresponding Index Schema are missing in Fig. 5);
- for the same reason it is not convenient to generate the L0 Calibration, Noise and Annotations products; only the L0 Standard Product is needed (a specific link to to Standard product, marked as "RFC", is shown in in Fig. 3);
- RFC mode can be only dual-polarisation (VV/VH or HH/HV, corresponding respectively to DH or DV, see specific link "RFC" in Fig. 3).

3.2.1.1.2 SAR Elevation/Azimuth Notch Standard L0 Products structure

The Elevation and Azimuth Notch modes are dedicated acquisition modes used for calibration purposes;

The L0 products corresponding to these modes have a similar structure of the other SAR acquisition modes (see section 3.2.1), with some specificities; in particular:

- the Elevation Notch covers only one swath (center of swath 3), while Azimuth Notch can be used over 6 different swaths, as for Stripmap mode (1 to 6);
- the size of L0 Standard products acquired in Azimuth Notch Mode is comparable with L0 Standard products acquired with Stripmap Mode, for the same swath and polarisation (see details in section 3.5);
- only L0 Standard Product are generated for Notch mode (see Fig. 3, no L0 Annotation, Cal and Noise are generated);
- Notch modes products can be single or dual-polarisation (see Fig. 3).











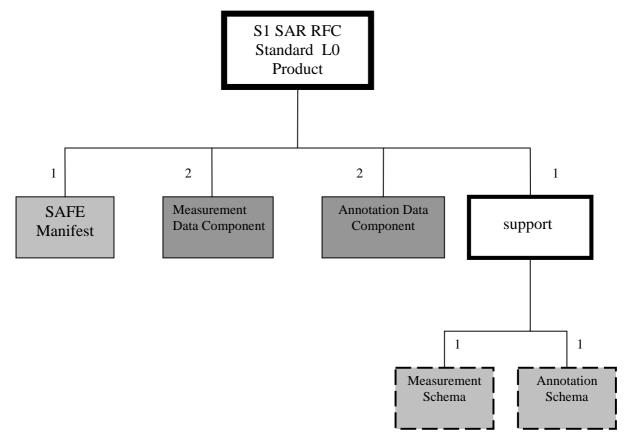


Fig. 5 - SAR RFC Standard L0 Product structure

For what concerns an estimation of the size for Sentinel-1 SAR RFC products, please refer to section 3.5 (in particular Table 28).













3.2.1.2 SAR L0 Cal Products structure

A Sentinel-1 SAR L0 Cal Product contains only the calibration pulses as extracted from the SAR ISPs stream; in this respect, its structure is very similar to that of a SAR Standard L0 Product (apart from the *Index Component*, not required due to the limited size of the *Measurement Data Component*), as shown in the following figure:

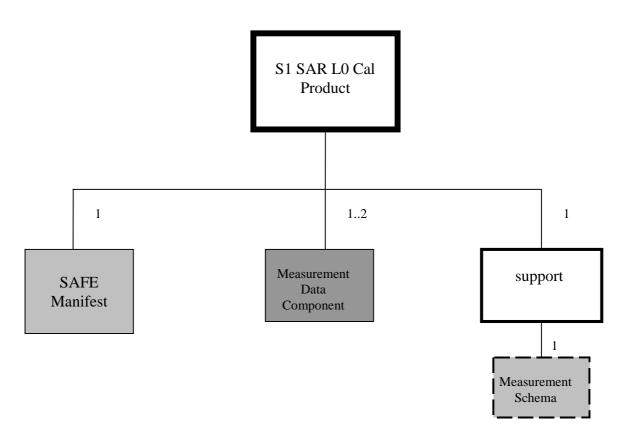


Fig. 6 - SAR L0 Cal Product structure

As described in the figure, this Product consists of the following components (same conventions as in section 3.2.1.1 apply):

- A *Manifest* (XML File) with a structure very similar to SAR Standard L0 product; it is described in more details in section 3.3.1.2.1;
- one or two *Measurement Data Components* (Binary Files), each containing the calibration pulses as extracted from a downlinked SAR ISPs stream. These files are 2 in the "complete dual polarisation" case, namely when (see also section 3.1) the source ISPs (from which calibration pulses are extracted) belongs











to a single SAR Standard L0 product that includes both polarisation combinations (one ISPs stream per combination). A more detailed description of these files is presented in section 3.3.1.2.2;

• one *Representation Data Component* (Measurement Schema); it is an XML Schema file, annotated with SDF mark-ups, that describes the Representation Information (format and content) of the *Measurement Data Component* of the Product, and is contained in a dedicated folder (named "support") within the product, as shown in Fig. 6.











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3.2.1.3 SAR L0 Noise Products structure

A Sentinel-1 SAR L0 Noise Product contains only the noise pulses as extracted from the SAR ISPs stream; in this respect, its structure is very similar to a SAR Standard L0 Product (except for the *Index Component*, not required due to the limited size of the *Measurement Data Component*), as shown in the following figure:

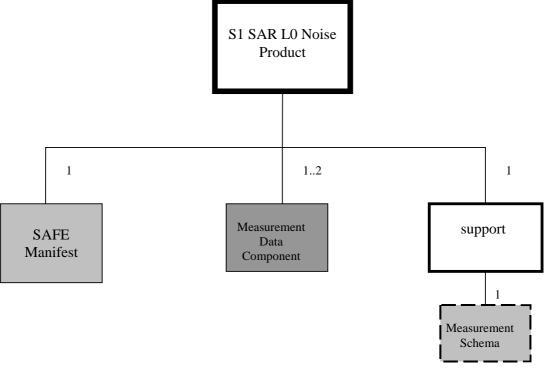


Fig. 7 - SAR L0 Noise Product structure

As described in the figure, this Product consists of the following components: A *Manifest* (XML File) with a structure very similar to SAR Standard L0 product; the Manifest is described in more details in section 3.3.1.2.1:

- one or two *Measurement Data Components* (Binary Files), each containing the noise pulses as extracted from a downlinked SAR ISPs stream. These files are 2 in the "complete dual polarisation" case, namely when (see also section 3.1) the source ISPs (from which noise pulses are extracted) belongs to a single SAR Standard L0 product that includes both polarisation combinations (one ISPs stream per combination). A more detailed description of these files is presented in section 3.3.1.2.2;
- one *Representation Data Component* (Measurement Schema); it is an XML Schema file, that describes the Representation Information (format and content) of the *Measurement Data Component* of the Product, and is contained in a dedicated folder (named "support") within the product, as shown in Fig. 7.









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3.2.1.4 SAR L0 Annotations Products structure

A Sentinel-1 SAR L0 Annotation Product contains the stream of ISPs primary and secondary headers, as extracted from the SAR ISPs stream; its structure is shown in the following figure:

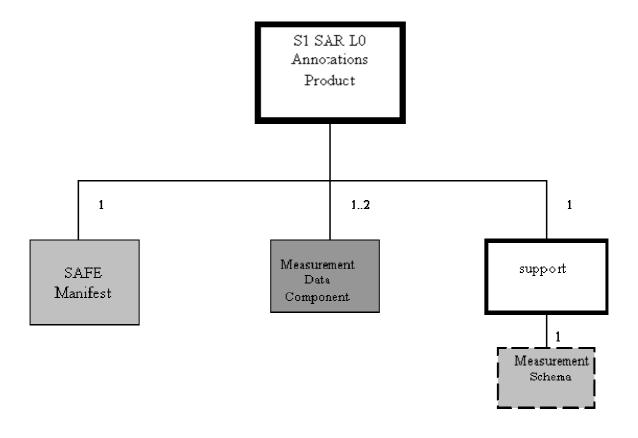


Fig. 8 – SAR L0 Annotations Product structure

As described in the figure, the Product consists of the following components:

• A *Manifest* (XML File) with a structure similar to the Manifest SAR Standard L0 product (see 3.3.1.4.1 for a detailed description).

As for all the other Sentinel-1 L0 Products, the Manifest is validated by an xfdu.xsd XML Schema, that is not included in the product, but is part of the XML Schemas distribution; the Manifest XML Schemas for SAR L0 Annotations Products are included in a folder provided as a zip archive **SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip**, together with the present document; the structure of the XML Schemas distribution is described in section 3.1.2;

• one or two *Measurement Data Components* (Binary Files), each containing the stream of ISPs primary and secondary headers, as stripped from the source complete ISPs stream; the same structure as in the original ISP is maintained (for example meaning that PVT/Attitude information are still multiplexed as in

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the secondary header); there are two such files in the "complete dual polarisation" case, namely when (see also section 3.1) the source ISPs (from which primary and secondary headers are extracted) belongs to a single SAR Standard L0 product that includes both polarisation combinations (one ISPs stream per combination);

• *Representation Data Component* (Measurement Schema); it is an XML Schema file that describes the Representation Information the *Measurement Data Component* of the Sentinel-1 L0 Product, and is contained in a dedicated folder (named "support") within the product, as shown in Fig. 8.













3.2.2 **GPS L0 Products structure**

A Sentinel-1 GPS L0 Product contains the measurement data generated by the GPRS; its structure is shown in the following figure:

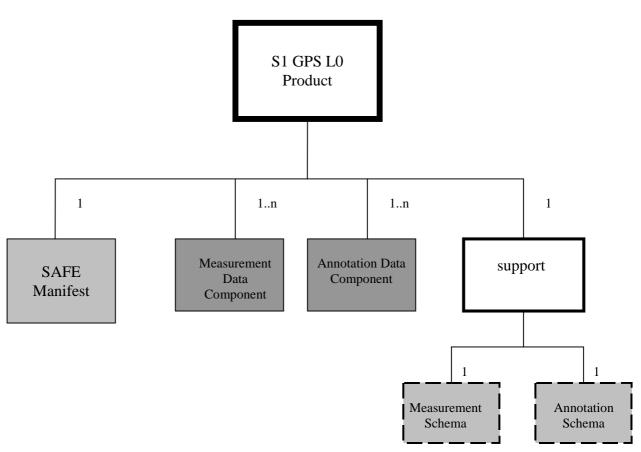


Fig. 9 - GPS L0 Product structure

As described in the figure, the Product includes of the following components:

- a Manifest (XML File) that contains the metadata that describes the context where the GPS product was . generated (platform, mission, instrumentation, product history, time, orbit) and describes the content and structure of the GPS L0 product, through references to all the remaining product components. The Manifest is described in more details in section 3.3.2.1;
- one or several Measurement Data Components (Binary Files); each of these Components is a binary file, . containing the measurement data generated by the GPRS in a given time window, in the form of the complete set of Measurement Data Records (MDRs) of a given type generated during that time window; MDRs are downlinked as a stream of Telemetry Packets (TP), each containing one or several MDRs: each







Component therefore consists of the complete set of TPs containing MDRs of a given type, arranged in the same temporal sequence as the original TPs stream; a more detailed description of the file is presented in section 3.3.2.2; for the description of the TP and of the different MDR types, refer to [TDB-32];

- one or several *Annotation Data Components* (Binary Files), each associated to one *Measurement Data Component*, and each composed by one record for each TP of the corresponding *Measurement Data Component*; each record contains annotations (related to TP timing and parameters of TP reconstruction process), partly extracted from the TP by the L0 Processor, and partly computed by the DFEP. A more detailed description of these files can be found in section 3.3.2.3;
- *Representation Data Components* (Measurement Schema, Annotation Schema); XML Schema files that describe the Representation Information of every *Data Component (Measurement or Annotation)* of the GPS L0 Product, in a dedicated folder (named "support") within the product, as shown in Fig. 9.

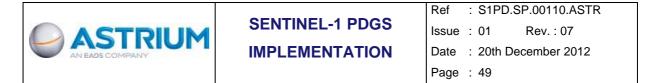
acs











3.2.3 HKTM L0 Products structure

A Sentinel-1 HKTM L0 Product contains the S1 X-Band Recorded HKTM data in the form of transfer frames TF; its structure is shown in the following figure:

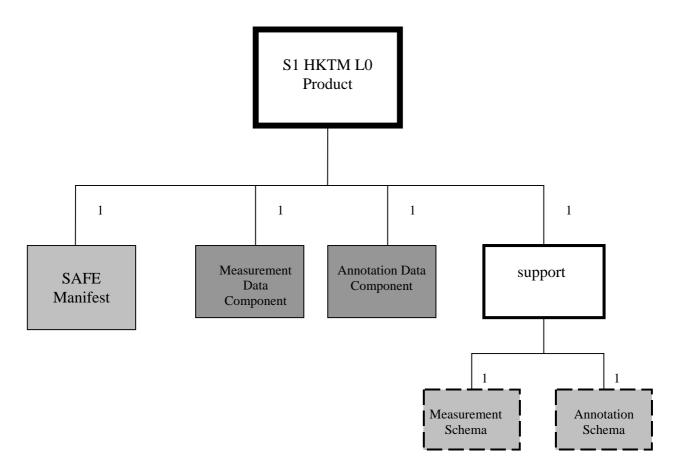


Fig. 10 – S1 HKTM L0 Product structure

As described in the figure, this Product consists of the following components:

- A *Manifest* (XML File) that includes metadata information describing the overall context where the HKTM data was generated (mission, product history, timing, orbit, etc.) and that provides the content and structure of the product, through references to the other components present in the product. The Manifest file is described in section 3.3.3.1;
- one *Measurement Data Component* (Binary File); it is a binary encoded file containing the stream of HKTM Transfer Frames TFs. A more detailed description of these files is presented in section 3.3.3.2;

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- one *Annotation Data Component* (Binary File); binary file composed by one record for each HKTM TF, containing the TF annotations computed by the DFEP; a more detailed description of this file can be found in section 3.3.3.3;
- *Representation Data Components* (Measurement Schema, Annotation Schema); XML Schema files that describe the Representation Information of every *Data Component* (*Measurement* or *Annotation*) of the L0 Product, in a dedicated folder (named "support") within the product, as shown in Fig. 10.













3.3 SENTINEL-1 L0 PRODUCTS COMPONENTS

This section provides a more detailed description of the components of the Sentinel-1 L0 Products; it is organized into sub-section, each dedicated to one of the following groups of Product Types (all Product Types within a group share a common structure and content):

- SAR Standard L0 products;
- SAR L0 Cal products;
- SAR L0 Noise products;
- SAR L0 Annotations products;
- GPS L0 Products;
- HKTM L0 Products.

3.3.1 SAR L0 Products Components

3.3.1.1 SAR Standard L0 Products components

3.3.1.1.1 Manifest

The *Manifest* file of a Sentinel-1 L0 Product is a SAFE Manifest, namely an XML file formatted according to SAFE Core Specifications [TDB-07], and it provides all the relevant product annotations, concerning the overall context where the product was generated and the product itself; as shown throughout the document and in the provided examples of Manifest XML Schemas, all additional metadata information, specific to Sentinel-1 L0, are defined as part of Sentinel-1 specific namespaces and integrated into the Manifest through the use of <safe:extension> element (similar to XFDU <extension> element, see [TDB-08]), so as to guarantee that the SAFE Sentinel-1 L0 specialisations are instances of SAFE and the Manifest are maintained fully compliant to SAFE Core and XFDU specifications.

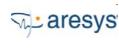
The Manifest is composed by three main sections, as shown in the following table:

Manifest section	Description
Information Package Map	Contains a high-level textual description of the product and references to all products components.
Metadata Section	Contains the product Metadata, including the L0 annotations that can be used for product identification and the resource references.
Data Object Section	Contains references to the physical location of each component file contained in the product, with a description of the file format, location, size and checksum.

Table 5 – Manifest file composing sections

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Table 7 and Table 8 detail the content and structure respectively of the *Metadata Section* and of the *Data Section* of the *Manifest* file, according to the following rules (also valid for the *Manifest* of all the Product Types described in section 3.3):

- each row describes one element (a tag or an attribute of a tag) of the *Manifest*; the element position in the first five columns corresponds to its position in the XML hierarchy, according to the following rules:
 - first column contains the Metadata Object ID or the Data Object ID (e.g., element "acquisitionPeriod" or "measurementFrameSet") and (between parenthesis, only if different) the name of the corresponding "xmlDataType" (XFDU type that contains all valid XML data that composes the Metadata or Data Object); the occurrence of the "xmlDataType" is also reported between parenthesis (if different from those of corresponding Matadata/Data Object ID).
 - second columns contains the name of the son of the Metadata Object or Data Object (e.g. element "/acquisition Period/startTime" in Xpath-like syntax);
 - analogously, the other columns contain the names of the other descendants (e.g. element "number" on third column indicates the element "/platform/instrument/familyName").
- if an element does not belong to the SAFE Core, but to one of the SAFE Specialisations for Sentinel-1, it is defined as part of a Sentinel1 specific namespace (e.g. "s1", "s1sar", "s1gps" etc.) and this namespace is indicated in the name (e.g. s1:startTimeANX).

S	String
Е	String enumerative
Т	xs:NMTOKEN
X	Xpath expression
I	Integer
UI	Positive integer
L	Long integer
D	Double
В	Boolean (FALSE or TRUE)
U	User-defined structure
UTC	String of the type yyyy-mm-ddThh:mm:ss.uuuuuuZ, representing the UTC date (year, month, day) and time (hours, minutes, seconds) separated by the character T, e.g. 2013-10-26T10:37:04.000000Z

• the following convention applies to the element data types:

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URI	URI string
GML	Coordinates expressed in GML notation

Table 6 – Data types for Manifest file elements

An example of the Manifest file and the corresponding Manifest XML Schemas for a SAR Standard L0 Product are included respectively in the zip archives:

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX1.zip

and

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip













Element name					Description	Data type	Occu rrenc e	Possible values
acquisition Period					Time extent of the data segment included in the Sentinel-1 L0 product	U	1	
	startTime				Start time of the Product, namely sensing time of first ISP of Measurement Data Component(s) contained in the Product	UTC	1	
	stopTime				Stop time of the Product, namely sensing time of last ISP of Measurement Data Component(s) contained in the Product	UTC	1	
	extension				XFDU extension type that provides additional info about the the data segment acquisition dates/times	U	1	
		s1:timeANX				U	1	
			s1:startTim eANX		Relative start time w.r.t. ANX time, namely time elapsed since orbit ascending node till start time (msecs)	D	1	
			s1:stopTime ANX		Relative stop time w.r.t. ANX time, namely time elapsed since orbit ascending node till stop time (msecs)	D	1	
platform					The platform identifies the mission that acquired the data segment included in S1 L0 product. This element contains sub- elements that unequivocally identify the platform/ sensor that acquired the data	U	1	
	nssdc Identifier				Univocally identifies the mission according to standard defined by the World Data Center for Satellite Information (WDC-SI), available at <u>http://nssdc.gsfc.nasa.gov/nmc/sc-</u> <u>query.html</u>	S	1	TBD
	familyName				The expanded mission name	S	1	SENTINEL-1
	number				An alphanumeric identifier of the platform within the mission	Е	1	A, B
	instrument				Information related to the instrument that acquired the data segment.	U	1	
		familyName			Instrument name	S	1	Synthetic Aperture Radar











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	Eleme	ent name			Description	Data type	Occu rrenc e	Possible values
		@abbreviatio n			An acronym for the instrument name	S	1	SAR
		extension			XFDU extension type that provides additional info about the instrument	U	1	
			s1sar:instru mentMode			U	1	
				s1sar:mo de	Instrument mode used to acquire the data segment	E	1	SM, EW, IW, WV, RF, -EN (Elevation Notch) , AN (Azimuth Notch) RF
				s1sar:sw athNum ber	Swath number used to acquire the data segment	E	01	1 to 6 (only applicable to SM and AN)
	extension				XFDU extension type that provides additional info about platform	U	01	
		s1:leapSecon dInformation				U	1	
			s1:utcTime OfOccurren ce		UTC time of occurrence of leap second (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second)	UTC	1	
			s1:sign		Sign of leap second	Е	1	+, -
generalProduc tInformation (s1sar:standAloneP roductInformation)					Contains information related to the data segment included in the Sentinel-1 L0 product (element created at Sentinel-1 SAR specialisation level)	U	1	
	s1sar:product Class				Product class (SAR L0 Standard)	S	1	S
	s1sar:product ClassDescript ion				Full textual description of the product class	S	1	SAR Standard L0 product
	s1sar:product Consolidation				Product consolidation status. representing the time-partiality of the product with respect to the complete segment (a segment is complete in time if it includes the full preamble and postamble expected for the product instrument mode)	Е	1	SLICE for nominal L0 SLICE PARTIAL for L0 product covering partial (in time)











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Element name	Descriptio	n Data type	Occu rrenc e	Possible values
				segment FULL for L0 product covering complete (in time) segment
s1sar:calISPP resent	Flag indicating whether contains calibration pulses	the product B	1	FALSE, TRUE
s1sar:noiseIS PPresent	Flag indicating whether contains noise pulses	the product B	1	FALSE, TRUE
s1sar:instrum entConfigura tionID	Identifies the on-board S configuration, applicable segment (see [CFI-06] and	to the data UI	1	1 to 2 ²⁴ - 1
s1sar:mission DataTakeID	Instrument data take, alo mission life, to which the belongs (see [CFI-06] and [e data segment UI CDB-03])	1	1 to 2 ²³ - 1
s1sar:circulat ionFlag	Target PDGS centre, set Mission planning for each [CFI-06] and [CDB-03])	data take (see UI	1	1 to 2 ⁴ - 1
s1sar:slicePro ductFlag	Flag indicating wether the is a slice (set to TRUE if t slice)	-	1	FALSE, TRUE
s1sar:sliceNu mber	Number of the slice within to which the slice belongs (a current L0 product is a slice)	applicable if the UI	01	> 0
s1sar:totalNu mberOfSlices	Total number of slices into segment (to which the slic split (applicable if the curren a slice)	e belongs) is UI	01	>= sliceNumber
s1sar:theoreti calSliceLengt h	Theoretical length (in secon The slice length is the leng L0 data required by the IPF L1 slice minus the slice over if the current L0 product is a	th of the input to generate the F lap (applicable	01	
s1sar:sliceOv erlap	Overlap (in seconds) of inp adjacent slices within the which the slice belongs (aj current L0 product is a slice)	L0 segment to F	01	
s1sar:dataTa keStartTime	Start time of the data take to belongs (applicable if the	UTC	01	











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Elem	ent name	Description	Data type	Occu rrenc e	Possible values
		product is a slice)			
s1sar:echoCo mpressionTy pe		Type of compression applied to the SAR echo pulses in the data segment (see [CFI- 06])	E	01	BAQ_3_BIT, BAQ_4_BIT, BAQ_5_BIT, FDBAQ_0, FDBAQ_1, FDBAQ_2
s1sar:noisCo mpressionTy pe		Type of compression applied to the SAR noise pulses in the data segment (see [CFI- 06])	Е	01	BYPASS, BAQ_3_BIT, BAQ_4_BIT BAQ_5_BIT
s1sar:calCom pressionType		Type of compression applied to the SAR calibration pulses	Е	01	BYPASS
s1sar:transmi tterReceiverP olarisation		Polarisation of the data segment contained in a Data Object	Е	12	НН, VV, HV, VH
	@dataObject ID	Attribute of tag <transmitterreceiverpolarisation> indicating the Data Object containing the data segment to which the tag refers</transmitterreceiverpolarisation>	S	1	
s1sar:packetS toreID		Id of the Packet Store allocated to the downlinked data	UI	12	0 to 49
	@dataObject ID	Attribute of tag <packetstoreid> indicating Id of the Data Object to which the tag refers</packetstoreid>	S	1	
s1:byteOrder		Byte ordering (little/big endian) used to represent the data in the <i>Data Component</i>	Е	06	LITTLE_ENDI AN, BIG_ENDIAN
	@dataObject ID	Attribute containing the Data Object Id of <byteorder></byteorder>	S	1	
s1:averageBit Rate		Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data	L	02	











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	Eleme	ent name	Description	Data type	Occu rrenc e	Possible values
			Component			
		@dataObject ID	Attribute containing the Data Object Id of <averagebitrate></averagebitrate>	S	1	
	s1sar:firstBur stCycleNumb er		Sequence number of first burst cycle (along a reference orbit) inside the product; valid only for instrument modes IW and EW	UI	01	1 to 3499
measurement OrbitReferenc e (orbitReference)			Contains information describing the orbit or the orbit range to which the data segment refers	U	1	
	orbitNumber		Absolute orbit number	UI	2 (both start and stop)	
		@type	Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest ISP in the L0 Product) or "stop" (the orbit number refers to the most recent ISP)</orbitnumber>	E	1	start, stop
	relativeOrbit Number		Relative orbit number	UI	2	
		@type	Attribute of tag <relativeorbitnumber>; same considerations apply as for attribute @type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	E	1	start, stop
	cycleNumber		Absolute sequence number of the mission cycle to which the oldest data in the segment refers	UI	1	
	phaseIdentifi er		Id of the mission phase to which the oldest data in the segment refers	Е	1	TBD











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Element name					Description	Data type	Occu rrenc e	Possible values
	extension				XFDU extension type that provides additional info about the orbit	U	1	
		s1:orbitPrope rties				U	1	
			s1:pass		Direction of the orbit (ascending, descending) for the oldest ISP in the product	E	1	ASCENDING, DESCENDING, UNKNOWN
			s1:ascendin gNodeTime		UTC time of the ascending node of the orbit	UTC	1	
processing					Product history described as the list of processing steps that resulted in the current L0 product. The processing steps sequence and relationship are described through an hierarchical structure, where each process takes its resources from the previous one and creates resources for the next	U	1 (1*)	
	@name				Explicit name of the processing step	S	1	
	@start				Date corresponding to the beginning of the described processing step.	UTC	01	
	@stop				Date corresponding to the end of the described processing step.	UTC	0 1	
	facility				Identifies an organization authority of a specific processing step.	U	0*	
		@country			Name of the country where the facility is located	S	0 1	
		@name			Name of the facility where the current processing step was performed	S	1	
		@organisatio n			Explicit name of the organization responsible for the facility.	S	0 1	
		@site			Geographical location of the facility	S	0 1	
	software				Reference to the software component used for the processing	U	0*	













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	Eleme	ent name		Description	Data type	Occu rrenc e	Possible values
		@name		Name of the software component	S	1	
		@version		Version or release identifier of the software component	S	01	
	resource			Reference to any resource that may be involved in the processing (data, documents, etc)	U	0*	
		@name		Name of the logged resource	S	1	
		@role		Role of the resource w.r.t. the processing (e.g. raw/auxiliary data, applicable/reference documents, etc)	S	1	Raw Data, Auxiliary Data, Applicable Document, Reference Document
		@version		Version of the resource	S	01	
		@href		URL of the resource	URI	01	
		processing		Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*	
measurement FrameSet (frameSet)				Geographical location of the instrument footprint, considered as a single frame.	U	1	
	frame						
		footPrint		The instrument footprint	U	1	
			coordinates	Coordinates of instrument footprint in GML notation (gml:coordinates type as defined in http://www.opengis.net/gml), namely string with 2 (for WV and RFC modes) or 4 or more (for other instrument modes, with last corner equal to the first one to form a GML Linear Ring type) couples of lat/long coordinates (nadir points are excluded by definition) separated by a blank char; corners are oriented counter-clockwise starting from the corner viewed at product start time, far range	GML	1	
measurement				Quality information of the data included in the L0 product	U	01 (12)	













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Element name			Description	Data type	Occu rrenc e	Possible values		
QualityInform ation(qualityInfor mation)								
	missingEleme nts				Describes each individual gap of missing ISPs	U	0*	
		location				U	01	
			path		Location of the gap (group of missing ISPs) in the data segment (relative Xpath expression)	X	1	
				@preced ing	Number of the first non-missing ISP immediately after the gap	UI	01	
				@followi ng	Number of the last non-missing ISP immediately before the gap	UI	01	
				@after	Indicates that the group of missing ISPs are located in a sequence after the ISP whose number is the attribute value	UI	01	
				@before	Indicates that the group of missing ISPs are located in a sequence before the ISP whose number is the attribute value	UI	01	
		count/@value			Number of missing ISPs in the gap	UI	01	
		cause/@type			Cause of missing ISPs (if known)	Е	01	
	corruptedEle ments				Describes each individual group of corrupted ISPs	U	0*	
		location				U	01	
			path		Location of corrupted ISPs group (relative Xpath expression)	Х	1	
				@preced ing	Number of the first non-corrupted ISP immediately after the corrupted ISPs group	UI	01	
				@followi ng	Number of the last non-corrupted ISP immediately before the corrupted ISPs group	UI	01	
				@after	Indicates that the group of corrupted ISPs are located in a sequence after the non- corrupted ISP whose number is the attribute value	UI	01	
				@before	Indicates that the group of corrupted ISPs are located in a sequence before the non-	UI	01	











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	Element name			Description	Data type	Occu rrenc e	Possible values	
					corrupted ISP whose number is the attribute value			
					value			
		count/@value			Number of corrupted ISPs in the group	UI	01	
		evidence/@ty pe			If known, the cause of the ISPs corruption	Е	01	
ex	xtension				XFDU extension type that provides additional info about the quality of the ISPs reconstruction process	U	01	
		s1:qualityPro perties				U	1	
			s1:dataObje ctID		Id of Data Object to which the <qualityinformation> tag refers</qualityinformation>	S	01	
			s1:numOfEl ements		Total number of ISPs in the Data Object	UI	01	
			s1:numOfM issingEleme nts		Total number of ISPs that are missing in the source data stream	UI	01	
			s1:numOf CorruptedE lements		Total number of ISPs in the Data Object that are corrupted (i.e. for which a CRC error has been detected)	UI	01	
			s1:numOfR SIncorrigibl eElements		Total number of ISPs contained in frames which were incorrigible with Reed- Solomon	UI	01	
			s1:numOfR SCorrected Elements		Total number of ISPs contained in TFs which corrected with Reed-Solomon	UI	01	
			s1:numOfR SCorrected Symbols		Total number of symbols corrected with Reed-Solomon in the Data Object	UI	01	

Table 7 - Content of Manifest Metadata Section for SAR Standard L0 Products













	Element name			Description	Data type	Occurrence	Possible values
Data Object				This element references the <i>Data Component</i> included in the L0 product.	U	1*	
	@ID			Data Component ID	S	1	
	@repID			List of IDs of all XML Schemas associated to Data Component	S	01	
	byte Stream			Pointer to the Data Component	U	1	
		@mimeType		The MIME type for the referenced Data Component	Е	1	Any of the allowed IANA (Internet Assigned Numbers Authority) MIME Type, see [TDB- 07] (e.g. "application/octet-stream", "text/xml" etc.)
		@ID		Byte stream ID	S	01	
		fileLocation		Describe the location of file	U	1	
			@locatorType	Type of the file location	S	1	URL, OTHER
			@ID	File location ID	S	01	
			@textInfo	Textual description of the Data Component	S	01	
			@href	Relative path of the file (in the file system) containing the referenced <i>Data Component</i>	URI	1	
		checksum		Checksum for the <i>Data</i> <i>Component</i>	S	1	
			@checksumName	Name of checksum algorithm used to compute checksum	Е	1	MD5
		@size		Size of Data Object in bytes	L	1	

Table 8 - Content of Manifest Data Object Section for SAR Standard L0 Product



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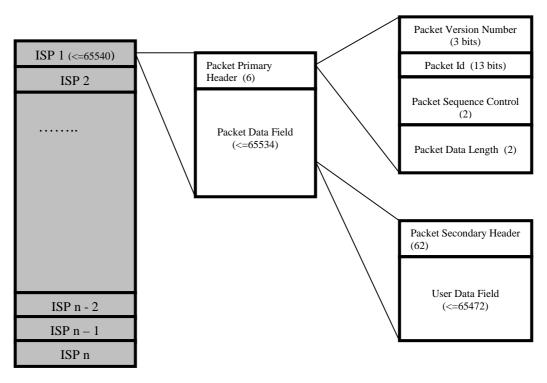
VEGA



3.3.1.1.2 Measurement Data Component

The *Measurement Data Component* is a binary file containing the raw data generated by the Sentinel-1 SAR instrument in the form of the original Instrument Source Packets (ISPs) stream; ISPs in the file are time-ordered (i.e. provided in the same order in which they were acquired). The binary data is stored in big-endian format (i.e. the byte order is from the most significant bit (MSB) to the least significant bit (LSB)).

The following figure provides a high-level overview of the structure and content of the file; for each of the elements composing the file, the name and the size in bytes (between brackets) are shown.



Measurement Data file

Fig. 11 – Structure (high-level) of Measurement Data Component for SAR Standard L0 Product

As shown in the figure, the Measurement Data Component is composed by a set of ISPs (total number n).

Each ISP contains the complete SAR data acquired in one PRI (echo, calibration, noise or testdata). The ISP content is the same as the ISP downlinked from the spacecraft platform to the receiving Ground Station; the figure only shows the ISP high-level decomposition into its main elements; for a fully detailed description of the structure and format of ISP, please refer to [CFI-06].











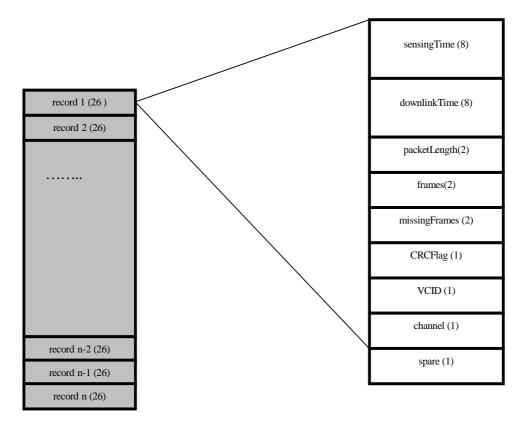


3.3.1.1.3 Annotation Data Component

The Annotation Data Component is a binary file associated to each Measurement Data Component file of the SAR Standard L0 Product, containing additional information for each ISP of the Measurement Data Component; this information is partly (ISP sensing time) extracted from the ISP by the L0 processor and the rest provided by the DFEP, corresponding exactly to the entire content of the Annotation pre-pended to the ISP by the DFEP and described in [CFI-14]; it has to be noted that, since the DFEP does not provide Reed-Solomon status for the ISP (see [CFI-14]), no RS related parameter appear either in the Annotation Data Component.

The file is organized as a sequence of records, each containing the above mentioned information associated to one ISP of the corresponding *Measurement Data Component;* these records are arranged in the same temporal sequence as the ISPs and their numbers is equal to the number of ISPs.

The following figure provides a graphical view of the structure and content of the *Annotation Data Component* file; for each of the elements composing the file, the name and the size in bytes (between brackets) are shown.



Annotation Data file

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Fig. 12 – Structure of Annotation Data Component for SAR Standard L0 Product



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The following table describes the contents of a generic record of the *Annotation Data Component* (the first column indicates which processing sub-system originates the information):

	Field I	D	D	escription	Data Type	Size
suoi			Acquisition time of the	Number of days elapsed since epoch (01-01-2000)	unsigned short	2 bytes
L0 annotations	sensingTime ¹		current ISP (UTC Time, expressed as MJD2000)	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes
				Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes
			Downlink time of first Transfer Frame containing	Number of days elapsed since epoch (01-01-2000)	unsigned short	2 bytes
	downlinkTime		part of current ISP (UTC time, expressed as	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes
			MJD2000)	Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes
	packetLength		ISP length, as in ISP Header		unsigned short	2 bytes
su	frames		Number of Transfer Frames co	ontaining the current ISP	unsigned short	2 bytes
tatio	missingFrames		Number of missing Transfer F	rames containing the current ISP	unsigned short	2 bytes
DFEP annotations	CRCFlag		CRC Error flag, indicating det to SAR (ISP does not include a	boolean	1 byte	
DFE	VCID	VCIDPre sentFlag	Set to 1 if VCID field contains		1 bit	
		spare	Spare field		1 bit	
		VCID	Virtual Channel Identifier for		6 bits	
	channel		Channel information: C1/C2.		2 bits	
		spare	Spare field		6 bits	
	spare		Spare field			1 byte

Table 9 - Content of Annotation Data Component record for SAR Standard L0 Product

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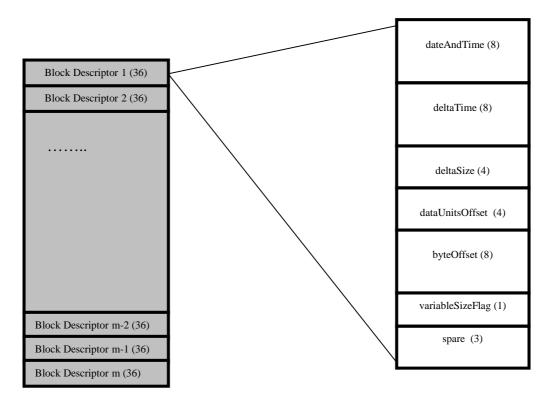


¹ The sensing time corresponds to the timestamp extracted from the Packet Secondary Header of the current ISP, after conversion from GPS reference time to UTC.



3.3.1.1.4 Index Data Component

The *Index Data Component* is a binary file associated to each *Measurement Data Component* file of the SAR Standard L0 Product, containing the description of the m logical blocks of data in which the corresponding *Measurement Data Component* can be divided; a block is intended as the data section between two indexes. The following figure provides a graphical view of the structure and content of the *Index Component* file; for each of the elements composing the file, the name and the size in bytes (between brackets) is shown.



Index Data file

Fig. 13 - Structure of Index Data Component for SAR Standard L0 Product

The *Index Data Component* is composed by a variable number of identical block descriptors. Each block descriptor describes completely one data block and contains all information to point to the block start within the corresponding *Measurement Data Component* file, namely:

- a pointer value;
- an offset of the first ISP of the block from the beginning of the *Measurement Data Component* (expressed both as number of ISPs and as number of bytes);









• the size of the ISP pointed by the index (with a flag indicating if the size is variable or fixed).

The following table describes the contents of a generic block descriptor of the *Index Data Component* (the content is the same as described in [TDB-07] and common to all SAFE Index Data Components, irrespective of mission and instrument) :

Field ID	Description	Data Type	Size (bytes)
dateAndTime	Date and Time of current block (UTC time, expressed in MJD 1950), as defined in [TDB-07], namely sensing time of the first ISP of the block	double	8
deltaTime	Delta time between ISPs (applicable within current block but variable among blocks) expressed in milliseconds and fractions	double	8
deltaSize	Size in bytes of the ISP pointed by the current index (valid for all the ISPs in the block if variableSizeFlag = 0, valid only for the first ISP if variableSizeFlag = 1 and its value is > 0)	unsigned int	4
dataUnitsOffset	Offset (expressed as number of ISPs) of the first ISP of the block from the beginning of Data Object	unsigned int	4
byteOffset	Offset (expressed as number of bytes) of the first ISP of the block from the beginning of Data Object	unsigned long	8
variableSizeFlag	Flag set to 1 if the ISP size is variable	bool	1
spare	To align the structure to 36 bytes		3

Table 10 - Index Component block descriptor content

The Index Component must contain at least two indexes, pointing to the first and to the last ISP of the *Measurement Data Component*; as well as one index at the beginning and one at the end of a corrupted or missing section of *Measurement Data* file (see description of *Quality Information* section in Table 7 for a description of missing or corrupted elements).

As the *Index Data Component* is mainly intended to be a pointer-extraction accelerator, the number of logical blocks is driven by the efficiency to point to the requested data portion and by the size of the *Measurement Data Component* file; for the same reason the *Index Component* file is written in binary format, big-endian.













3.3.1.1.5 XML Schemas

The *XML Schemas* are XML files that describe the structure and content of the Data Components of a Sentinel-1 L0 Product; each schema is associated to one type of *Data Components (Measurement, Annotation* or *Index)* of which it describes the format and content, through SDF markups.

The following tables represent the content of the Representation Schemas for the above-mentioned Data Components of SAR Standard L0, SAR L0 Cal and SAR L0 Noise Products; each row in each table represent one type in the Schema, corresponding to one field of the generic data unit (ISP, record or block descriptor) of the corresponding Data Component (according to the structure shown in Fig. 11, Fig. 12 and Fig. 13).

In the particular case of the Schema of the Measurement Data Component, only the information described in the Schema (actual field name in the schema, field size and field data type) plus the field name in Space Packet specifications (used as reference to [CFI-06]) has been shown; for additional information (textual description, range of values) refer to [CFI-06].

These XML Schemas, included in a folder with the structure described in section 3.1.2, are provided as a zip archive **SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX3.zip**, attached to the present document.

Field name	(in the Schema)	Field r	Field name (in Space Packet specs [CFI-06])				Size
primary Header		Packet Primary Header					
	packetVersion Number		Packet Version Number				3 bits
	packetType		Packet Type				1 bit
	secondaryheader Flag		Secondary Header Flag				1 bit
	PID		Process ID				7 bits
	РСАТ		Packet Category				4 bits
	sequenceFlag		Sequence Flags				11 bits
	packetSequenceCoun t		Packet Sequence Count				14 bits
	packetDataLength		Packet Data Length			ushort	2 bytes
secondary Header		Packet Secondary Header					
			Datation Service				
	coarseTime			Coarse Time		uint	4 bytes

Table 11 – Content of Representation Schema for Measurement Data Component











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fineTime		Fine Time	ushort	2 bytes
	Fixed Ancillary Data Service			
syncMarker		Sync Marker	Hex array	4 bytes
dataTakeID		Data Take ID	uint	4 bytes
ECCNumber		ECC Number	uchar	1 byte
firstSspareBit				1 bit
 testMode		Test Mode		3 bits
RXChannelID		RX Channel ID		4 bits
instrumentConfigura tionIID		Instrument Configuration ID	uint	4 bytes
	Sub-commutation Ancillary Data Service			
dataWordIndex		Sub-Commutated Ancillary Data Word Index	uchar	1 byte
dataWord		Sub-Commutated Ancillary Data Word	ushort	2 bytes
	Counters Service			
spacePacketCount		Space Packet Count	uint	4 bytes
priCount		Mode PRI Count	uint	4 bytes
	Radar Configuration Support Service			
firstSspare3Bit				3 bits
BAQMode		BAQMode		5 bits
BAQBlockLength		BAQ Block Length	uchar	1 byte
spareByte			uchar	1 byte
rangeDecimation		Range Decimation	uchar	1 byte
RXGain		RX Gain	uchar	1 byte
TXRampRate		TX Ramp Rate	ushort	2 bytes
TXPulseStart Frequency		TX Pulse Start Frequency	ushort	2 bytes
TXPulseLength		TX Pulse Start Length		3 bytes
secondSspare3Bit				3 bits
rank		Rank		5 bits
PRI		PRI	uint	3 bytes











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	SWST			SWST		uint	3 bytes
	SWL			SWL		uint	3 bytes
				SAS SSB Message			
	ssbFlag				SSB Flag		1 bit
	polarisation				Polarisation		3 bits
	temperature Compensation				Temp Comp		2 bits
	spare4BitfirstSpare2 Bit						4-2 bits
	elevationBeam Address				Elevation Beam Address or SASTest+CalTy pe ²		4 bits
	secondSpare2Bit						2 bits
	beamAddress				Azimuth Beam Address or Calibration Beam Address ³		10 bits
				SES SSB Message			
	calMode				Cal Mode		2 bits
	secondSpareBit				Spare		1 bit
1	TXPulseNumber				TX Pulse Number		5 bits
	signalType				Signal Type		4 bits
	thirdSpare3Bit				Spare		3 bits
	swap				Swap		1 bit
	swathNumber				Swath Number	uchar	1 byte
			Radar Sample Count Service				
	numOfQuads			NumberOf Quads		ushort	2 bytes
	fillerOctet			FillerOctet		uchar	1 byte
		User Data Field; the size is derived from the value of field "Packet Data					
userData	Length" (extracted from Primary Header through an Xquery), according to the formula [Packet Data Length + 1 – Packet Secondary Header length] (see [CFI-06])					array	65472)









 $^{^{2}}$ According to the value of SSBFlag, this field is to be interpreted as Elevation Beam Adress (SSBFlag = 0) or the combination of SASTest flag + Cal Type (SSBFlag = 1), see [CFI-06]

 $^{^{3}}$ According to the value of SSBFlag, this field is to be interpreted as Azimuth Beam Adress (SSBFlag = 0) or Calibration Beam Address (SSBFlag = 1), see [CFI-06]



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Table 12 - Content of Representation Schema for Annotation Data Component

Field Name (in the Schema)		Description	Data Type	Size
sensingTimeDays	Acquisition time of the	Number of days elapsed since epoch (01- 01-2000)	unsigned short	2 bytes
sensingTimeMillisecs	Acquisition time of the current ISP (UTC Time, expressed as MJD2000) Downlink time of first Transfer Frame containing part of current ISP (UTC time, expressed as MJD2000) Rumber of Transfer Frames current ISP, as in ISP Heat Number of Transfer Frames control Number of missing Transfer Frames CRC Error flag, indicating dete to SAR (ISP does not include at Set to 1 if VCID field contains V Spare field Virtual Channel Identifier for w	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes
sensingTimeMicrosecs		Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes
downlinkTimeDays		Number of days elapsed since epoch (01- 01-2000)	unsigned short	2 bytes
downlinkTimeMillisecs	TransferFramecontaining part of currentNuISP(UTCexpressed as MJD2000)Nu	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes
downlinkTimeMicrosecs		Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes
packetLength	Length of the ISP, as in ISF	ISP, as in ISP Header		2 bytes
frames	Number of Transfer Frames	s containing the current ISP	unsigned short	2 bytes
missingFrames	Number of missing Transfe	er Frames containing the current ISP	unsigned short	2 bytes
CRCFlag	· · ·	detection of CRC error in ISP; not applicable de a Packet Error Control field, see [CFI-06])	boolean	1 byte
VCIDPresentFlag	Set to 1 if VCID field conta	ains VCID, 0 otherwise		1 bit
VCIDSpare	Spare field			1 bit
VCID	Virtual Channel Identifier f	for which the ISP was multiplexed onto		6 bits
channel	Channel information: C1/C	2. 01 (binary): C1, 10 (binary): X2		2 bits
channelSpare	Spare field			6 bits
spare	Spare field			1 byte











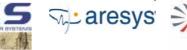


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Table 13 - Content of Representation Schema for Index Data Component

Field name (in the Schema)	Description	Data type	Size
dateAndTime	Acquisition time of the first ISP of the block (UTC Time, expressed as MJD 1950)	double	8
deltaTime	Delta time between ISPs (applicable within current block but variable among blocks) expressed in milliseconds and fractions	double	8
deltaSize	Size in bytes of the ISP pointed by the current index (valid for all the ISPs in the block if variableSizeFlag = 0, valid only for the first ISP if variableSizeFlag = 1 and its value is > 0)	unsigned int	4
dataUnitsOffset	Offset (expressed as number of ISPs) of the first ISP of the block from the beginning of Data Object	unsigned int	4
byteOffset	Offset (expressed as number of bytes) of the first ISP of the block from the beginning of data object	unsigned long	8
variableSizeFlag	Flag set to 1 if the ISP size is variable	bool	1
spare	To align the structure to 36 bytes		3













3.3.1.2 SAR L0 Cal Products components

3.3.1.2.1 Manifest

Since a Sentinel-1 L0 Cal Product contains only the calibration pulses as extracted from the original downlinked SAR ISPs stream, the product Manifest contains basically the same Metadata information types (namely the same sections and tags, not necessarily the same values) that apply to the original full ISPs stream, with some differences (e.g. the productClass> tag has a constant value of "C", no Index or Annotations Data Components are referenced by the Manifest Data Object, the processing> and <measurementQualityInformation> sections refer to the L0 Cal product and not to the original ISPs stream), as illustrated in the following table:

Table 14 - Content of Manifest Metadata Section for SAR L0 Cal Product

	Elen	ient name		Description	Data type	Occu rrenc e	Possible values
acquisition Period				Time extent of the data segment included in the S1 L0 product	U	1	
	startTime			Start time of the Product, namely sensing time of the first ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	stopTime			Stop time of the Product. namely sensing time of the last ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	extension			XFDU extension type that provides additional info about the the data segment acquisition dates/times	U	1	
		s1:timeANX			U	1	
			s1:startTim eANX	Relative start time w.r.t. ANX time, namely time elapsed since orbit ascending node till start time (msecs)	D	1	











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		1	-	r	1			1
			s1:stopTime ANX		Relative stop time w.r.t. ANX time, namely time elapsed since orbit ascending node till stop time (msecs)	D	1	
platform					The platform identifies the mission that acquired the data segment included in S1 L0 product. This element contains sub-elements that unequivocally identify the platform/ sensor that acquired the data	U	1	
	nssdc Identifier				Univocally identifies the mission according to the standard defined by the World Data Center for Satellite Information (WDC-SI), available at http://nssdc.gsfc.nasa.gov/nmc/sc- query.html	S	1	TBD
	familyName				The expanded mission name	S	1	SENTINEL-1
	number				An alphanumeric identifier of the platform within the mission	Е	1	A, B
	instrument				Information related to the instrument that acquired the data segment included in the S1 L0 product.	U	1	
		familyName			Instrument name	S	1	Synthetic Aperture Radar
		@abbreviat ion			An acronym for the instrument name	S	1	SAR
		extension			XFDU extension type that provides additional info about the instrument	U	1	
			s1sar:instru mentMode			U	1	
				s1sar:mod e	Instrument mode used to acquire the data segment	Е	1	SM, EW, IW, WV, RF
				s1sar:swat hNumber	Swath number used to acquire the data segment	E	01	1 to 6 (only applicable to SM)
	extension				XFDU extension type that provides additional info about platform	U	01	
		s1:leapSeco ndInformati on				U	1	











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generalProd uctInformat		s1:utcTime OfOccurren ce s1:sign	UTC time of occurrence of leap second (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second) Sign of leap second Contains information related to the data	UTC	1	+, -
ion (s1sar:standAlo neProductInfor mation)			segment included in the S1 L0 product (element created at Sentinel-1 SAR specialisation level)	U	1	
	s1sar:product Class		Product class (SAR L0 Cal)	S	1	С
	s1sar:product ClassDescript ion		Full textual description of the product class	S	1	SAR Calibration L0 product
	s1sar:product Consolidation		Product consolidation status. representing the time-partiality of the product with respect to the complete segment (a segment is complete in time if it includes the full preamble and postamble expected for the product instrument mode)	Е	1	SLICE for nominal L0 SLICE PARTIAL for L0 product covering partial (in time) segment FULL for L0 product covering complete (in time) segment
	s1sar:instrum entConfigura tionID		Identifies the on-board SAR instrument configuration, applicable to the data segment (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²⁴ - 1
	s1sar:mission DataTakeID		Instrument data take, along the whole mission life, to which the data segment belongs (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²³ - 1
	s1sar:circulat ionFlag		Target PDGS centre, set by S1 PDGS Mission planning for each data take (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ⁴ - 1
	s1sar:slicePro ductFlag		Flag indicating whether the current product is a slice (set to TRUE if the product is a slice)	В	1	FALSE, TRUE













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s1sar:sliceNu mber			Number of the slice within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	UI	01	> 0
s1sar:totalNu mberOfSlices			Total number of slices into which the L0 segment (to which the slice belongs) is split (applicable if the current L0 product is a slice)	UI	01	>= sliceNumber
s1sar:theoreti calSliceLengt h			Theoretical length (in seconds) of the slice. The slice length is the length of the input L0 data required by the IPF to generate the L1 slice minus the slice overlap (applicable if the current L0 product is a slice)		01	
s1sar:sliceOv erlap			Overlap (in seconds) of input data between adjacent slices within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	F	01	
s1sar:dataTa keStartTime			Start time of the data take to which the slice belongs (applicable if the current L0 product is slice)	UTC	01	
s1sar:calCom pressionType			Type of compression applied to the SAR calibration pulses in the data segment, if present (see [CFI-06])	Е	01	BYPASS
s1sar:transmi tterReceiverP olarisation			Polarisation of the data segment	Е	12	HH,VV,HV, VH
	@dataObje ctID		Id of the Data Object containing the data segment to which the <transmitterreceiverpolarisation> tag refers</transmitterreceiverpolarisation>	s	1	
s1sar:packetS toreID			Id of the Packet Store allocated to the downlinked data	UI	12	0 to 49
	@dataObje ctID		Attribute containing the Data Object Id of <packetstoreid> tag</packetstoreid>	S	1	
s1:byteOrder			Byte ordering (little/big endian) used to represent the data in the <i>Data</i> <i>Component</i>	E	02	LITTLE_ENDI AN, BIG_ENDIAN











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	1	1	1	1		1	1	
		@dataObje ctID			Attribute containing the Data Object Id of <byteorder></byteorder>	S	1	
	s1:averageBit Rate				Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data Component	L	02	
		@dataObje ctID			Attribute containing the Data Object Id of <averagebitrate></averagebitrate>	S	1	
	s1sar:frstBur stCycleNumb er				Sequence number of first burst cycle (along a reference orbit) inside the product; valid only for instrument modes IW and EW	UI	01	1 to 3499
measureme ntOrbitRefe rence (orbitReference)					Contains information describing the orbit or the orbit range to which the data segment refers	U	1	
	orbitNumber				Absolute orbit number	UI	2	
		@type			Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest ISP in the L0 Product) or "stop" (the orbit number refers to the most recent ISP)</orbitnumber>	E	1	start, stop
	relativeOrbit Number				Relative orbit number	UI	2	
		@type			Attribute of tag <relativeorbitnumber>; same considerations apply as for attribute @type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	Е	1	start, stop
	cycleNumber				Absolute sequence number of the mission cycle to which the oldest data in the segment refers	UI	1	
	phaseIdentifi er				Identifier of mission phase to which the oldest data in the segment refers	Е	1	TBD
	extension				XFDU extension type that provides additional info about the orbit	U	1	











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		s1:orbitPro perties			U	1	
			s1:pass	Direction of the orbit (ascending, descending) for the oldest ISP in the product	Е	1	ASCENDING, DESCENDING, UNKNOWN
			s1:ascendin gNodeTime	UTC time of the ascending node of the orbit	UTC	1	
processing				Product history describes as the list of processing steps that resulted in the current S1 L0 product. The processing steps sequence and relationship are described through an hierarchical structure, where each process takes its resources from the previous one and creates resources for the next	U	1 (1*)	
	@name			Explicit name of the processing step	S	1	
	@start			Date corresponding to the beginning of the described processing step.	UTC	01	
	@stop			Date corresponding to the end of the described processing step.	UTC	0 1	
	facility			Identifies an organization authority of a specific processing step.	U	0*	
		@country		Name of the country where the facility is located	S	0 1	
		@name		Name of the facility where the current processing step was performed	S	1	
		@organisati on		Explicit name of the organization responsible for the facility.	S	0 1	
		@site		Geographical location of the facility	S	0 1	
	software			Reference to the software component used for the processing	U	0*	
		@name		Name of the software component	S	1	
		@version		 Version or release identifier of the software component	S	01	
	resource			Reference to any resource that may have been involved in the processing (data, documents, etc)	U	0*	
		@name		Name of the logged resource	S	1	













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		@role		Role of the resource w.r.t. the processing	S	1	Raw Data, Auxiliary Data, Applicable Document, Reference Document
		@version		Version of the resource	S	01	
		@href		URL of the resource	URI	01	
		processing		Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*	
measureme ntFrameSet (frameSet)				Geographical location of the instrument footprint, considered as a single frame.	U	1	
	frame						
		footPrint		The instrument footprint	U	1	
			coordinates	Coordinates of instrument footprint in GML notation (gml:coordinates type as defined in http://www.opengis.net/gml), namely string with 2 (for WV and RFC modes) or 4 or more (for other instrument modes, with last corner equal to the first one to form a GML Linear Ring type) couples of lat/long coordinates (nadir points are excluded by definition) separated by a blank char; corners are oriented counter-clockwise starting from the corner viewed at product start time, far range	GML	1	
measureme ntQuality Information (qualityInformat ion)				Quality information of the data included in the L0 product	U	01 (12)	













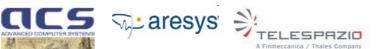
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missingElents	eme			Describes each individual gap of missing ISPs in the data segment (not applicable for SAR L0 Cal products)	U	0*
	location				U	01
		path		Location of the gap in the data segment (relative Xpath expression)	Х	1
			@precedi ng	Number of the first non-missing ISP immediately after the gap	UI	01
			@followin g	Number of the last non-missing ISP immediately before the gap	UI	01
			@after	Indicates that the group of missing ISPs are located in a sequence after the ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of missing ISPs are located in a sequence before the ISP whose number is the attribute value	UI	01
	count/@val ue			Number of missing ISPs in the gap	UI	01
	cause/@typ e			Cause of missing ISPs (if known)	Е	01
corrupted ments	Ele			Describes each individual group of corrupted ISPs	U	0*
	location			Location of the corrupted ISPs group (relative Xpath expression)	Х	01
		path		Location of corrupted ISPs group (relative Xpath expression)	Х	1
			@precedi ng	Number of the first non-corrupted ISP immediately after the corrupted ISPs group	UI	01
			@followin g	Number of the last non-corrupted ISP immediately before the corrupted ISPs group	UI	01
			@after	Indicates that the group of corrupted ISPs are located in a sequence after the non-corrupted ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of corrupted ISPs are located in a sequence before the non-corrupted ISP whose number is the attribute value	UI	01
	count/@vali e			Number of corrupted ISPs in the group	UI	01
	evidence/@t ype			If known, the cause of the ISPs	Е	01













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			corruption		1	
			L			
			 XFDU extension type that provides			
extension			additional info about the quality of the	U	01	
			ISPs reconstruction process			
			-			
	s1:qualityPr operties			U	1	
		s1:dataObje ctID	Id of Data Object to which the <qualityinformation> tag refers</qualityinformation>	S	01	
		s1:numOfEl ements	Total number of ISPs in the Data Object	UI	01	
		s1:numOfM issingEleme nts	Total number of ISPs that are missing in the source data stream (not applicable for SAR L0 Cal products)	UI	01	
		s1:numOfC orruptedEle ments	Total number of ISPs in the Data Object that are corrupted (i.e. for which a CRC error has been detected)	UI	01	
		s1:numOfR SIncorrigibl eElements	Total number of ISPs contained in frames which were incorrigible with Reed-Solomon	UI	01	
		s1:numOfR SCorrected Elements	Total number of ISPs contained in frames which have been corrected with Reed-Solomon	UI	01	
		s1:numOfR SCorrected Symbols	Total number of symbols corrected with Reed-Solomon in the Data Object	UI	01	

The Data Object Section of the Manifest is similar to the SAR Standard L0 Product (and therefore is represented by Table 8), with the only difference that no Index and Annotations Data Components are referenced, since a SAR L0 Cal Product does not contain any *Index* or *Annotations Data Component*.













3.3.1.2.2 Measurement Data Component

The *Measurement Data Component* is a binary file containing the calibration pulses as extracted from the downlinked SAR ISPs stream; in other terms, it is composed by all and only the ISPs of the original downlinked ISPs stream that are flagged as Calibration ISPs (through the "Signal Type" field of the ISP Packet Secondary Header, see [CFI-06], section 3.2.5.14.3); ISPs are time-ordered (i.e. provided in the same order in which they were acquired). The high-level structure and content is represented by figure Fig. 11, where the number "n" represents a fraction of the number of ISPs of the original ISPs stream.

3.3.1.2.3 XML Schemas

A Sentinel-1 L0 Cal Product contains only the *XML Schema* that describes the structure and content of the *Measurement Data Component*; the Schema includes exactly the same types shown in Table 11.





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3.3.1.3 SAR L0 Noise Products components

3.3.1.3.1 Manifest

Since a Sentinel-1 L0 Noise Product contains only the noise pulses as extracted from the original downlinked SAR ISPs stream, the product Manifest contains basically the same Metadata information types (namely the same sections and tags, not necessarily the same values) that apply to the original full ISPs stream, with some differences (e.g. the <productClass> tag has a constant value of "N", no Index or Annotations Data Components are referenced by the Manifest Data Object, the <processing> and <measurementQualityInformation> sections refer to the L0 Noise product and not to the original ISPs stream), as illustrated in the following table:

	Ele	ement name		Description	Data type	Occu rrenc e	Possible values
acquisition Period				Time extent of the data segment included in the S1 L0 product	U	1	
	startTime			Start time of the Product, namely namely sensing time of the first ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	stopTime			Stop time of the Product, namely sensing time of the last ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	extension			XFDU extension type that provides additional info about the the data segment acquisition dates/times	U	1	
		s1:timeANX			U	1	
			s1:startTim eANX	Relative start time w.r.t. ANX time, namely time elapsed since orbit ascending node till start time (msecs)	D	1	

Table 15 - Content of Manifest Metadata Section for SAR L0 Noise Product

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			s1:stopTime ANX		Relative stop time w.r.t. ANX time, namely time elapsed since orbit ascending node till stop time (msecs)	D	1	
platform					Identifies the mission that acquired the data segment included in the product. This element contains sub-elements that unequivocally identify the platform/sensor that acquired the data	U	1	
	nssdcIdentifie r				Univocally identifies the mission according to the standard defined by the World Data Center for Satellite Information (WDC-SI), available at http://nssdc.gsfc.nasa.gov/nmc/sc- query.html	S	1	TBD
	familyName				The expanded mission name	S	1	SENTINEL- 1
	number				An alphanumeric identifier of the platform within the mission	Е	1	A, B
	instrument				Information related to the instrument that acquired the data segment.	U	1	
		familyName			Instrument name	S	1	Synthetic Aperture Radar
		@abbreviatio			An acronym for the instrument name	S	1	SAR
		n extension			XFDU extension type that provides additional info about the instrument	U	1	
			s1sar:instru mentMode			U	1	
				s1sar:mode	Instrument mode used to acquire the data segment	Е	1	SM, EW, IW, WV, RF
				s1sar:swathN umber	Swath number used to acquire the data segment	Е	01	1 to 6 (only applicable to SM)
	extension				XFDU extension type that provides additional info about platform	U	01	
		s1:leapSecon dInformation				U	1	











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generalProd uctInformat		s1:utcTime OfOccurren ce s1:sign	UTC time of occurrence of leap second (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second) Sign of leap second	UTC E	1	+, -
ion (s1sar:standAlo neProductInfor mation)			data segment included in the S1 L0 product (element created at Sentinel-1 SAR specialisation level)	U	1	
	s1sar:product Class		 Product class (SAR L0 Noise)	S	1	N
	s1sar:product ClassDescript ion		Full textual description of the product class	S	1	SAR L0 Noise product
	s1sar:product Consolidation		Product consolidation status. representing the time-partiality of the product with respect to the complete segment (a segment is complete in time if it includes the full preamble and postamble expected for the product instrument mode)	Е	1	SLICE for nominal L0 SLICE PARTIAL for L0 product covering a partial (in time) segment FULL for L0 product covering complete (in time) segment
	s1sar:instrum entConfigura tionID		Identifies the on-board SAR instrument configuration, applicable to the data segment (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²⁴ - 1
	s1sar:mission DataTakeID		Instrument data take, along the whole mission life, to which the data segment belongs (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²³ - 1











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	1		T	1	· · · · · · · · · · · · · · · · · · ·
s1sar:circulat ionFlag		Target PDGS centre, set by S1 PDGS Mission planning for each data take (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ⁴ - 1
s1sar:slicePro ductFlag		Flag indicating whether the current product is a slice (set to TRUE if the product is a slice)	В	1	FALSE, TRUE
s1sar:sliceNu mber		Number of the slice within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	UI	01	> 0
s1sar:totalNu mberOfSlices		Total number of slices into which the L0 segment (to which the slice belongs) is split (applicable if the current L0 product is a slice)	UI	01	>= sliceNumber
s1sar:theoreti calSliceLengt h		Theoretical length (in seconds) of the slice. The slice length is the length of the input L0 data required by the IPF to generate the L1 slice minus the slice overlap (applicable if the current L0 product is a slice)	F	01	
s1sar:sliceOv erlap		Overlap (in seconds) of input data between adjacent slices within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	F	01	
s1sar:dataTa keStartTime		Start time of the data take to which the slice belongs (applicable if the current L0 product is slice)	UTC	01	
s1sar:noiseCo mpressionTy pe		Type of compression applied to the SAR noise pulses in the data product, if present (see [CFI-06])	Е	01	BYPASS, BAQ_3_BIT, BAQ_4_BIT BAQ_5_BIT
s1sar:transmi tterReceiverP olarisation		Polarisation of the data segment	Е	12	HH, VV,HV,VH
	@dataObject ID	Id of the Data Object containing the data segment to which the <transmitterreceiverpolarisation> tag refers</transmitterreceiverpolarisation>	s	1	
s1sar:packetS toreID		Id of the Packet Store allocated to the downlinked data	UI	12	0 to 49











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		@dataObject ID		Id of the Data Object to which the packetStoreID refers	S	1	
	s1:byteOrder			Byte ordering (little/big endian) used to represent the data in the Data Component	Е	02	LITTLE_EN DIAN, BIG_ENDI AN
		@dataObject ID		Attribute containing the Data Object Id of byteOrder>	S	1	
	s1:averageBit Rate			Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data Component	L	02	
		@dataObject ID		Attribute containing the Data Object Id of <averagebitrate></averagebitrate>	S	1	
	s1sar:firstBur stCycleNumb er			Sequence number of first burst cycle (along a reference orbit) inside the product; valid only for instrument modes IW and EW	UI	02	1 to 3499
measureme ntOrbitRefe rence (orbitReference)				Contains information describing the orbit or the orbit range to which the data segment refers	U	1	
	orbitNumber			Absolute orbit number	UI	2	
		@type		Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest ISP in the L0 Product) or "stop" (the orbit number refers to the most recent ISP)</orbitnumber>	E	1	start, stop
	relativeOrbit Number			Relative orbit number	UI	2	
		@type		Attributeoftag <relativeorbitnumber>;sameconsiderations apply as for attribute@type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	Е	1	start, stop
	cycleNumber			Absolute sequence number of the	UI	1	











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	Γ			mission cycle to which the oldest data			
				in the segment refers			
	phaseIdentifi er			Identifier of mission phase to which the oldest data in the segment refers	Е	1	TBD
	extension			XFDU extension type that provides additional info about the orbit	U	1	
		s1:orbitPrope rties			U	1	
			s1:pass	Direction of the orbit (ascending, descending) for the oldest ISP in the product		1	ASCENDING, DESCENDIN G, UNKNOWN
			s1:ascendin gNodeTime	UTC time of the ascending node of the orbit	UTC	1	
processing				Product history described as the list of processing steps that resulted in the current S1 L0 product. The processing steps sequence and relationship are described through an hierarchical structure, where each process takes its resources from the previous one and creates resources for the next	U	1 (1*)	
	@name			Explicit name of the processing step	S	1	
	@start			Beginning date of the described processing step.	UTC	01	
	@stop			End date of the described processing step.	UTC	0 1	
	facility			Organization authority of a specific processing step.	U	0*	
		@country		Name of the country where the facility is located	S	0 1	
		@name		Name of the facility where the current processing step was performed	S	1	
		@organisatio n		Explicit name of the organization responsible for the facility.	S	0 1	
		@site		Geographical location of the facility	S	0 1	
	software			Software component used for the processing	U	0*	
		@name		Name of the software component	S	1	
		@version		 Version or release identifier of the software component	S	01	











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				Reference to any resource involved in			
	resource				U	0*	
				the processing (data, documents, etc.)			
		@name		Name of the logged resource	S	1	
		@role		Role of the resource w.r.t. the processing	S	1	Raw Data, Auxiliary Data, Applicable Document, Reference Document
		@version		Version of the resource	S	01	
		@href		URL of the resource	URI	0 1	
		processing		Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*	
measureme ntFrameSet (frameSet)				Geographical location of the instrument footprint, considered as a single frame.	U	1	
	frame						
		footPrint		The instrument footprint	U	1	
			coordinates	Coordinates of instrument footprint in GML notation (gml:coordinates type as defined in http://www.opengis.net/gml), namely string with 2 (for WV and RFC modes) or 4 or more (for other instrument modes, with last corner equal to the first one to form a GML Linear Ring type) couples of lat/long coordinates (nadir points are excluded by definition) separated by a blank char; corners are oriented counter- clockwise starting from the corner viewed at product start time, far range	GML	1	
measureme ntQualityIn formation (qualityInformat ion)				Quality information of the data included in the L0 product	U	01 (12)	









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I I						
missingEleme nts				Describes each individual gap of missing ISPs in the data segment (not applicable for SAR L0 Noise products)	U	0*
	location				U	01
		path		Location of the gap in the data segment (relative Xpath expression)	Х	1
			@preceding	Number of the first non-missing ISP immediately after the gap	UI	01
			@following	Number of the last non-missing ISP immediately before the gap	UI	01
			@after	Indicates that the group of missing ISPs are located in a sequence after the ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of missing ISPs are located in a sequence before the ISP whose number is the attribute value	UI	01
	count/@value			Number of missing ISPs in the gap	UI	01
	cause/@type			Cause of missing ISPs (if known)	Е	01
corrupted Elements				Describes each individual group of corrupted ISPs	U	0*
	location				U	01
		path		Location of corrupted ISPs group (relative Xpath expression)	Х	1
			@preceding	Number of the first non-corrupted ISP immediately after the corrupted ISPs group	UI	01
			@following	Number of the last non-corrupted ISP immediately before the corrupted ISPs group	UI	01
			@after	Indicates that the group of corrupted ISPs are located in a sequence after the non-corrupted ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of corrupted ISPs are located in a sequence before the non-corrupted ISP whose number is the attribute value	UI	01
	count/@value			Number of corrupted ISPs in the group	UI	01











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	evidence/@ty pe		If known, the cause of the ISPs corruption	Е	01
extension			XFDU extension type that provides additional info about the quality of the ISPs reconstruction process	U	01
	s1:qualityPro perties			U	1
		s1:dataObje ctID	Id of Data Object to which the <qualityinformation> tag refers</qualityinformation>	S	01
		s1:numOfEl ements	Total number of ISPs in the Data Object	UI	01
		s1:numOfM issingEleme nts	Total number of ISPs missing in the source data stream (not applicable to SAR L0 Noise products)	UI	01
		s1:numOfC orruptedEle ments	Total number of ISPs in the Data Object that are corrupted (i.e. for which a CRC error was detected)	UI	01
		s1:numOfR SIncorrigibl eElements	Total number of ISPs contained in frames which were incorrigible with Reed-Solomon	UI	01
		s1:numOfR SCorrected Elements	Total number of ISPs in frames which were corrected with RS	UI	01
		s1:numOfR SCorrected Symbols	Total number of symbols corrected with Reed-Solomon in the Data Object	UI	01

The Data Object Section of the Manifest is similar to the SAR Standard L0 Product (and therefore it is represented by Table 8), with the only difference that no Index and Annotations Data Components are referenced, since a SAR L0 Noise Product contains neither Index nor Annotations Data Component.

3.3.1.3.2 Measurement Data Component

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The Measurement Data Component is a binary file containing the noise pulses as extracted from the downlinked SAR ISPs stream, namely all the ISPs of the original downlinked ISPs stream that are flagged as Noise ISPs (through the "Signal Type" field of the ISP Packet Secondary Header, see [CFI-06], section 3.2.5.14.3); ISPs are time-ordered (i.e. provided in the same order in which they were acquired). The high-level structure and content it is represented by figure Fig. 11, where the number "n" represents a fraction of the number of ISPs of the original ISPs stream.

3.3.1.3.3 XML Schemas

A Sentinel-1 L0 Noise Product contains only the XML Schema that describes the structure and content of the Measurement Data Component; the Schema includes exactly the same types shown in Table 11.

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3.3.1.4 SAR L0 Annotations Products components

3.3.1.4.1 Manifest

Since a L0 Annotations Product contains the ISPs primary and secondary headers, as extracted from the SAR ISPs stream, same considerations as in section 3.3.1.2.1 apply; namely, the Manifest contains the same information type (same sections and tags) as in the original ISPs, except for a few differences, as shown in the following table:

Table 16 - Content of Manifest Metadata Section for SAR L0 Annotations Product

	Eleme	nt name	Description	Data type	Occu rrenc e	Possible values	
acquisition Period				Time extent of the data segment included in the S1 L0 product	U	1	
	startTime			Start time of the Product, namely sensing time of the first ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	stopTime			Stop time of the Product, namely sensing time of the last ISP of the Measurement Data Component(s) contained in the Product	UTC	1	
	extension			XFDU extension type that provides additional info about the the acquisition dates/times	U	1	
		s1:timeAN X			U	1	
			s1:startTi meANX	Relative start time w.r.t. ANX time, namely time elapsed since orbit ascending node till start time (msecs)	D	1	
			s1:stopTi meANX	Relative stop time w.r.t. ANX time, namely time elapsed since orbit ascending node till stop time (msecs)	D	1	

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					The platform identifies the mission that			
1.46					acquired the data segment included in S1 L0			
platform					product. This element contains sub-elements	U	1	
					that unequivocally identify the platform/			
					sensor that acquired the data			
					Univocally identifies the mission according			
					to the standard defined by the World Data			
	nssdcIdentif				Center for Satellite Information (WDC-SI),	S	1	TBD
	ier				available at			
					http://nssdc.gsfc.nasa.gov/nmc/sc-query.html			
	familyName				The expanded mission name	S	1	SENTINEL-1
					An alphanumeric identifier of the platform			
	number				within the mission	Е	1	A,B
					Information related to the instrument that			
	instrument				acquired the data segment included in the S1	U	1	
					L0 product.			
		familyNa			Instrument name	S	1	Synthetic
		me			insu ument name	5	1	Aperture Radar
		@abbrevi ation			An acronym for the instrument name	S	1	SAR
					XFDU extension type that provides	U	1	
		extension			additional info about the instrument	C	-	
			s1sar:instr umentMo de			U	1	
				s1sar:mo de	Instrument mode used to acquire the data segment	Е	1	SM, EW, IW, WV, RF
				s1sar:sw	Swath number used to acquire the data			1 to 6 (only
				athNum ber	segment	Е	01	applicable to SM)
	extension				XFDU extension type that provides additional info about platform	U	01	
		s1:leapSec ondInfor mation				U	1	
					UTC time of occurrence of leap second (if			
			s1:utcTim		leap second occurred in the product time			
			eOfOccur		window); it represents the time after the leap	UTC	1	
			rence		second occurrence (i.e. midnight of day after			
					the leap second)			
			s1:sign		Sign of leap second	Е	1	+, -
generalProduc					Contains information related to the data	U	1	
8					segment included in the S1 L0 product			













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tInformation			(element created at Sentinel-1 SAR			
(s1sar:standAloneP			specialisation level)			
roductInformation)						
	s1sar:produ ctClass		Product class (L0 Annotations)	S	1	А
	s1sar:produ ctClassDesc ription		Full textual description of the product class	S	1	SAR L0 Annotations product
	s1sar:produ ctConsolida tion		Product consolidation status. representing the time-partiality of the product with respect to the complete segment (a segment is complete in time if it includes the full preamble and postamble expected for the product instrument mode)	E	1	SLICE for nominal L0 SLICE PARTIAL for L0 product covering partial (in time) segment FULL for L0 product covering complete (in time) segment
	s1sar:calIS PPresent		Flag indicating whether the product contains calibration pulses	В	1	FALSE, TRUE
	s1sar:noiseI SPPresent		Flag indicating whether the product contains noise pulses	В	1	FALSE, TRUE
	s1sar:instru mentConfig urationID		Identifies the on-board SAR instrument configuration, applicable to the data segment (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²⁴ - 1
	s1sar:missio nDataTakeI D		Instrument data take, along the whole mission life, to which the data segment belongs (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ²³ - 1
	s1sar:circul ationFlag		Target PDGS centre, set by S1 PDGS Mission planning for each data take (see [CFI-06] and [CDB-03])	UI	1	1 to 2 ⁴ - 1
	s1sar:sliceP roductFlag		Flag indicating whether the current product is a slice (set to TRUE if the product is a slice)	В	1	FALSE, TRUE
	s1sar:sliceN umber		Number of the slice within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	UI	01	> 0
	s1sar:totalN umbeOfSlic es		Total number of slices into which the L0 segment (to which the slice belongs) is split (applicable if the current L0 product is a slice)	UI	01	>= sliceNumber











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s1sar:theore ticalSliceLe ngth s1sar:sliceO verlap		Theoretical length (in seconds) of the slice. The slice length is the length of the input L0 data required by the IPF to generate the L1 slice minus the slice overlap (applicable if the current L0 product is a slice) Overlap (in seconds) of input data between adjacent slices within the L0 segment to which the slice belongs (applicable if the current L0 product is a slice)	F	01	
s1sar:dataT akeStartTi me		Start time of the data take to which the slice belongs (applicable if the current L0 product is slice)	UTC	01	
s1sar:echoC ompression Type		Type of compression applied to the SAR echo pulses in the data segment (see [CFI- 06])	Е	01	BAQ_3_BIT, BAQ_4_BIT, BAQ_5_BIT, FDBAQ_0, FDBAQ_1, FDBAQ_2
s1sar:noise Compressio nType		Type of compression applied to the SAR noise pulses in the data segment (see [CFI- 06])	Е	01	BYPASS, BAQ_3_BIT, BAQ_4_BIT BAQ_5_BIT
s1sar:calCo mpressionT ype		Type of compression applied to the SAR calibration pulses in the data segment (see [CFI-06])	Е	01	BYPASS
s1sar:trans mitterRecei verPolarisat ion		Polarisation of the data segment	Е	12	HH, VV,HV,VH
	@dataObj ectID	Id of the Data Object containing the data segment to which the <transmitterreceiverpolarisation> tag refers</transmitterreceiverpolarisation>	S	1	
packetStore ID		Id of the Packet Store allocated to the downlinked data	UI	12	0 to 49
	@dataObj ectID	Id of the Data Object to which the packetStoreID refers	S	1	
s1:byteOrde r		Byte ordering (little/big endian) used to represent the data in the <i>Data Component</i>	E	02	"LITTLE_END IAN","BIG_EN DIAN"











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		@dataObj ectID		Attribute containing the Data Object Id of byteOrder>	S	1	
	s1:averageB itRate			Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data Component	L	02	
		@dataObj ectID		Attribute containing the Data Object Id of <averagebitrate></averagebitrate>	S	1	
	s1sar:firstB urstCycleN umber			Sequence number of first burst cycle (along a reference orbit) inside the product; valid only for instrument modes IW and EW	UI	01	1 to 3499
measurement OrbitReferenc e (orbitReference)				Contains information describing the orbit or the orbit range to which the data segment refers	U	1	
	orbitNumbe r			Absolute orbit number	UI	2	
		@type		Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest ISP in the L0 Product) or "stop" (the orbit number refers to the most recent ISP)</orbitnumber>	E	1	start, stop
	relativeOrbi tNumber			Relative orbit number	UI	2	
		@type		Attribute of tag <relativeorbitnumber>; same considerations apply as for attribute @type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	Е	1	start, stop
	cycleNumbe r			Absolute sequence number of the mission cycle to which the oldest data in the segment refers	UI	1	
	phaseIdenti fier			Identifier of the mission phase to which the oldest data in the segment refers	Е	1	TBD
	extension			XFDU extension type that provides additional info about the orbit	U	1	











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		s1:orbitPr operties			U	1	
			s1:pass	Direction of the orbit (ascending, descending) for the oldest ISP in the product	Е	1	ASCENDING, DESCENDING, UNKNOWN
			s1:ascendi ngNodeTi me	UTC time of the ascending node of the orbit	UTC	1	
processing				Product history described as the list of processing steps that resulted in the current S1 L0 product. The processing steps sequence and relationship are described through an hierarchical structure, where each process takes its resources from the previous one and creates resources for the next		1 (1*)	
	@name			Explicit name of the processing step	S	1	
	@start			Beginning date of the described processing step.	UTC	01	
	@stop			End date of the described processing step.	UTC	0 1	
	facility			Identifies an organization authority of a specific processing step.	U	0*	
		@country		Name of the country where the facility is located	S	0 1	
		@name		Name of the facility where the current processing step was performed	S	1	
		@organisa tion		Explicit name of the organization responsible for the facility.	S	0 1	
		@site		Geographical location of the facility	S	0 1	
	software			Reference to the software component used for the processing	U	0*	
		@name		Name of the software component	S	1	
		@version		Version or release identifier of the software component	S	01	
	resource			Reference to any resource that may have been involved in the processing (data, documents, etc)	U	0*	
		@name		Name of the logged resource	S	1	
		@role		Role of the resource w.r.t. the processing (e.g. raw or auxiliary data, applicable or	s	1	Raw Data, Auxiliary Data, Applicable











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				reference documents)			Document, Reference Document
		@version		Version of the resource	S	01	
		@href		URL of the resource	URI	0 1	
		processing		Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*	
mesasurement FrameSet (frameSet)				Geographical location of the instrument footprint, considered as a single frame.	U	1	
	frame						
		footPrint		 The instrument footprint	U	1	
			coordinate s	Coordinates of instrument footprint in GML notation (gml:coordinates type as defined in http://www.opengis.net/gml), namely string with 2 (for WV and RFC modes) or 4 or more (for other instrument modes, with last corner equal to the first one to form a GML Linear Ring type) couples of lat/long coordinates (nadir points are excluded by definition) separated by a blank char; corners are oriented counter-clockwise starting from the corner viewed at product start time, far range	GML	1	
measurement QualityInform ation(qualityInfor mation)				Quality information of the data included in the L0 product	U	01 (02)	
	missingEle ments			Describes each individual gap of missing ISPs in the data segment	U	0*	
		location			U	01	
			path	Location of the gap in the data segment	Х	1	_













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I						
				(relative Xpath expression)		
			@preced ing	Number of the first non-missing ISP immediately after the gap	UI	01
			@followi ng	Number of the last non-missing ISP immediately before the gap	UI	01
			@after	Indicates that the group of missing ISPs are located in a sequence after the ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of missing ISPs are located in a sequence before the ISP whose number is the attribute value	UI	01
	count/@va lue			Number of missing ISPs in the gap	UI	01
	cause/@ty pe			Cause of missing ISPs (if known)	Е	01
corruptedH ements	2			Describes each individual group of corrupted ISPs	U	0*
	location			Location of the corrupted ISPs group (relative Xpath expression)	U	01
		path		Location of corrupted ISPs group (relative Xpath expression)	Х	1
			@preced ing	Number of the first non-corrupted ISP immediately after the corrupted ISPs group	UI	01
			@followi ng	Number of the last non-corrupted ISP immediately before the corrupted ISPs group	UI	01
			@after	Indicates that the group of corrupted ISPs are located in a sequence after the non-corrupted ISP whose number is the attribute value	UI	01
			@before	Indicates that the group of corrupted ISPs are located in a sequence before the non- corrupted ISP whose number is the attribute value	UI	01
	count/@va lue			Number of corrupted ISPs in the group	UI	01
	evidence/ @type			If known, the cause of the ISPs corruption	Е	01
extension				SAFE extension type that provides additional info about the quality of the ISPs reconstruction process	U	01
	s1:quality Properties				U	1
		s1:dataOb jectID		Id of Data Object to which the <qualityinformation> tag refers</qualityinformation>	S	01
		s1:numOf Elements		Total number of ISPs in the Data Object	UI	01













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M	1:numOf /IissingEl ments	Total number of ISPs that are missing in the source data stream	UI	01
Co	1:numOf Corrupted Clements	Total number of ISPs in the Data Object that are corrupted (i.e. for which a CRC error has been detected)	UI	01
R: gil	1:numOf SIncorri ibleElem nts	Total number of ISPs contained in frames which were incorrigible with Reed-Solomon	UI	01
R	1:numOf tSCorrect dElement	Total number of ISPs contained in frames which have been corrected with Reed- Solomon	UI	01
R	1:numOf tSCorrect dSymbols	Total number of symbols corrected with Reed-Solomon in the Data Object	UI	01

The Data Object Section of the Manifest file is similar to the other Sentinel-1 L0 Products (see Table 8) with the only difference that SAR L0 Annotations Product does not contain any Index Data Component or Annotation Data Component, and therefore these files are not referenced.

An example of the Manifest file and the corresponding Manifest XML Schema for a SAR L0 Annotations Product are included respectively in the zip archives:

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX1.zip

and

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip













3.3.1.4.2 Data Component

This Data Component is a binary file containing the ISPs primary and secondary headers, as extracted from the source complete ISPs stream, arranged in the same time sequence.

The following figure shows the structure and contents of the Data Component:

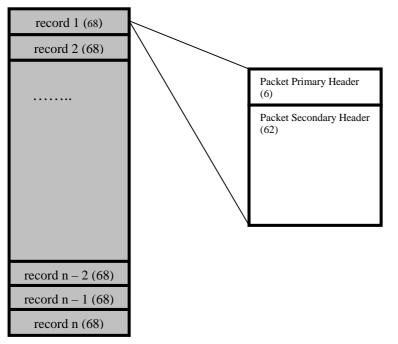


Fig. 14 - Structure (high-level) of the Data Component for a SAR L0 Annotations Product

As shown in the figure, the *Data Component* is composed by a set of records (total number n); each record contains the whole content of the Primary Header and the Secondary Header of one SAR ISP of the original full SAR ISPs stream; the figure only shows the Data Component high-level decomposition into its main elements; for a detailed description of Primary Header and the Secondary Header of the SAR ISP, please refer to [CFI-06].

3.3.1.4.3 XML Schemas

A Sentinel-1 L0 Annotation Product contains only the *XML Schema* that describe the structure and content of the *Measurement Data Component*; the Schema includes the same types shown in Table 11, except for the "userData" type.













3.3.2 GPS L0 Products Components

3.3.2.1 Manifest

The following table details the structure and content of the *Metadata Section* of the *Manifest* file for a GPS L0 Product:

Table 17 - Content of Manifest Metadata Section for GPS L0 Products

	Elen	ient name		Description	Data type	Occu rrenc e	Possible values
acquisition Period				Time extent of the GPSR measurement	U	1	
	startTime			Start time of the GPSR measurement	UTC	1	
	stopTime			Stop time of the GPSR measurement	UTC	1	
	extension			XFDU extension type that provides additional info about the the acquisition dates/times	U	1	
		s1:timeANX			U	1	
			s1:startTim eANX	Relative start time w.r.t. ANX time, namely time elapsed since orbit ascending node till start time (msecs)	D	1	
			s1:stopTime ANX	Relative stop time w.r.t. ANX time, namely time elapsed since orbit ascending node till stop time (msecs)	D	1	
platform				The platform identifies the mission that acquired the data included in S1 L0 product.	U	1	
	nssdcIdentifie r			Univocally identifies the mission according to the standard defined by the World Data Center for Satellite Information (WDC-SI), available at http://nssdc.gsfc.nasa.gov/nmc/sc-query.html	S	1	TBD
	familyName			The expanded mission name	s	1	SENTINE L-1
	number			An alphanumeric identifier of the platform within the mission	Е	1	A, B
	instrument			Information related to the instrument that	U	1	

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				acquired the data segment included in the S1 L0			
				product.			
		familyName		Instrument name	S	1	Global Positioning System Receiver
		abbreviatio n		An acronym for the instrument name	S	1	GPSR
	extension			XFDU extension type that provides additional info about platform	U	01	
		s1:leapSeco ndInformati on			U	1	
			s1:utcTime OfOccurren ce	UTC time of occurrence of leap second (if leap second occurred in the product time window); it represents the time after the leap second occurrence (i.e. midnight of day after the leap second)	UTC	1	<u> </u>
			s1:sign	Sign of leap second	Е	1	+, -
generalProd uctInformat ion (s1gps:standAlo neProductInfor mation)				Contains information related to the data segment included in the S1 L0 product (element created at Sentinel-1 GPS specialisation level)	U	1	
	s1gps:content			Describes the content of the measurement data component	S	1	GPSR Measurem ent Data
	s1gps:record Type			Type of Measurement Data Record included in each of the Data Component (expressed as Structure ID, ranging from 213 to 235, see [TDB-32])	ш	138	213 to 235
		dataObjectI D		Id of the Data Object to which the recordType refers	S	1	
	s1:byteOrder			Byte ordering (little/big endian) used to represent the data in the <i>Data Component</i>	Е	038	LITTLE_E NDIAN, BIG_ENDI AN"
		dataObjectI D		Attribute containing the Data Object Id of <byteorder></byteorder>	S	1	











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	s1:averageBit Rate	dataObjectI		Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data Component Attribute containing the Data Object Id of	L	019	
		D		<averagebitrate></averagebitrate>	S	1	
measureme ntOrbitRefe				Contains information describing the orbit or the			
rence				orbit range to which the data segment refers	U	1	
(orbitReference)							
	orbitNumber			Absolute orbit number	UI	2	
		@type		Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest ISP in the L0 Product) or "stop" (the orbit number refers to the most recent ISP)</orbitnumber>	Е	1	start, stop
	relativeOrbit Number			Relative orbit number	UI	2	
		@type		Attribute of tag <relativeorbitnumber>; same considerations apply as for attribute @type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	Е	1	start, stop
	cycleNumber			Absolute sequence number of the mission cycle to which the oldest data in the segment refers	UI	1	
	phaseIdentifi er			Identifier of the mission phase to which the oldest data in the segment refers	Е	1	TBD
	extension			XFDU extension type that provides additional info about the orbit	U	1	
		s1:orbitPro perties			U	1	
			s1:pass	Direction of the orbit (ascending, descending) for the oldest ISP in the product	Е	1	ASCENDIN G, DESCENDI NG, UNKNOWN











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				-			
			s1:ascendin gNodeTime	UTC time of the ascending node of the orbit	UTC	1	
processing				Product history describes as the list of processing steps that resulted in the current GPS L0 product; intended to collect historical information dedicated to the product maintenance and traceability. The processing steps sequence and relationship are described through an hierarchical structure, where each process takes its resources from the previous one and creates resources for the next	U	1 (1*)	
	@name @start			Explicit name of the processing step Date corresponding to the beginning of the	S UTC	1 01	
	@stop			described processing step. Date corresponding to the end of the described processing step.	UTC	0 1	
	facility			Identifies an organization authority of a specific processing step.	U	0*	
		@country		Name of the country where the facility is located	S	0 1	
		@name		Name of the facility where the current processing step was performed	S	1	
		@organisati on		Explicit name of the organization responsible for the facility.	S	0 1	
		@site		Geographical location of the facility	S	0 1	
	software			Reference to the software component used for the processing	U	0*	
		@name		Name of the software component	S	1	
		@version		Version or release identifier of the software component	S	01	
	resource			Reference to any resource that may have been involved in the processing (data, documents, etc.)	U	0*	
		@name		Name of the logged resource	S	1	
		@role		Role of the resource w.r.t. the processing (e.g. raw or auxiliary data, applicable or reference	S	1	Raw Data, Auxiliary











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					documents, etc.)			Data,
								Applicable Document, Reference Document
		@version			Version of the resource	S	01	
		@href			URL of the resource	URI	01	
		@processin g			Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*	
measureme								
ntQualityIn formation (qualityInformat ion)					Quality information of the data included in the L0 product	U	01 (119)	
	missingEleme nts				Describes each individual gap of missing TPs in the data segment	U	0*	
		location				U	01	
			path		Location of the gap in the data segment (relative Xpath expression)	Х	1	
				@precedi ng	Number of first non-missing TP immediately after the gap	UI	01	
				@followin g	Number of last non-missing TP immediately before the gap	UI	01	
				@after	Indicates that the group of missing TPs are located in a sequence after the TP whose number is the attribute value	UI	01	
				@before	Indicates that the group of missing TPs are located in a sequence before the TP whose number is the attribute value	UI	0,,1	
		count/@val ue			Number of missing TPs in the gap	UI	01	
		cause/@typ e			Cause of missing TPs (if known)	Е	01	
	corruptedEle ments				Describes each individual group of corrupted TPs	U	0*	
		location				U	01	
			path		Location of corrupted TPs group (relative Xpath	Х	1	











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expression) @precedi Number of the first non-corrupted TP UI 0..1 immediately after the corrupted TPs group ng @followin Number of the last non-corrupted TP UI 0..1 immediately before the corrupted TPs group g @after Indicates that the group of corrupted TPs are located in a sequence after the non-corrupted TP UI 0..1 whose number is the attribute value @before Indicates that the group of corrupted TPs are located in a sequence before the non-corrupted UI 0..1 TP whose number is the attribute value count/@val Number of corrupted TPs in the group UI 0..1 ue evidence/@t If known, the cause of the TPs corruption Е 0..1 ype SAFE extension type that provides additional info about the quality of the ISPs reconstruction U 0..1 extension process s1:qualityPr U 1 operties s1:dataObje Id of Data Object to which the S 0..1 ctID <qualityinformation> tag refers Total number of Telemetry Packets TPs in the s1:numOfEl UI 0..1 ements Data Object s1:numOfM Total number of TPs that are missing in the issingEleme UI 0..1 source data stream nts s1:numOfC Total number of TPs in the Data Object that are orruptedEle corrupted (i.e. for which a CRC error has been UI 0..1 detected) ments s1:numOfR Total number of TPs contained in frames which UI SIncorrigibl 0..1 were incorrigible with Reed-Solomon eElements s1:numOfR Total number of TPs contained in frames which UI SCorrected 0..1 have been corrected with Reed-Solomon Elements s1:numOfR Total number of symbols corrected with Reed-SCorrected UI 0..1 Solomon in the Data Object Symbols

The Data Object Section of the Manifest file is similar to the other Sentinel-1 L0 Products (see Table 8).













An example of the Manifest file and corresponding Manifest XML Schemas for a GPS L0 Product are included respectively in the zip archives:

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX1.zip

and

SD-60_S1PD.SP.00110.ASTR_1.6.17_L0FICD_ANNEX2.zip.













3.3.2.2 Measurement Data Component

The Measurement Data Components for a GPS L0 Product are binary files containing the measurement data generated by the GPRS, represented by Measurements Data Records (MDRs), collected and downlinked in X-band as a stream of Telemetry Packets TPs.

During a given time period, the GPRS instrument generates several types of MDRs, each type with a different structure and with individual but constant size, that are all downlinked as a single main stream of TPs (of variable length); each Measurement Component contains the TPs sub-stream, extracted from the main TPs stream, including all and only the MDRs of a given type; in the Measurement Data Component, TPs are time-ordered (i.e. provided in the same order in which they were acquired).

The following table lists the possible types of MDRs (described in [TDB-32])) contained in the various Measurement Data Components of a GPS L0 Product.

Measurement Data Record Type
Navigation Solution Data Record
Satellites In View Status Record
Time Correlation Data Record
Constellation Status Record
Tracking State Data Record
Channel Status Record
Carrier Phase Data Record
Carrier Amplitude Data Record
Code Phase Data Record
Noise Histogram Data Record
AGC Status Data Record
GPS NAV Almanac Data Record
GPS NAV Ephemeris Data Record
GPS NAV UTC and Ionosphere Data Record
GPS CNAV Group Delay Data Record
Minimum Navigation Solution Data Record
IMT/GPST Correlation Data Record
Auxiliary Data Record
Housekeeping Parameter Data Record

Table 18 - MDRs types in a Sentinel-1 GPS L0 Product











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The following figure provides a high-level overview of the structure and content of a Measuremenet Data Component file; only the first-level decomposition into TPs is shown; the structure and content of a generic TP, as well as the list and description of the different MDRs types are fully detailed in [TDB-32]:

TP 1
TP 2
TP n-2
TP n-1
TP n

Measurement Data file

Fig. 15 - Structure (high-level) of a Measurement Data Component for GPS L0 Product











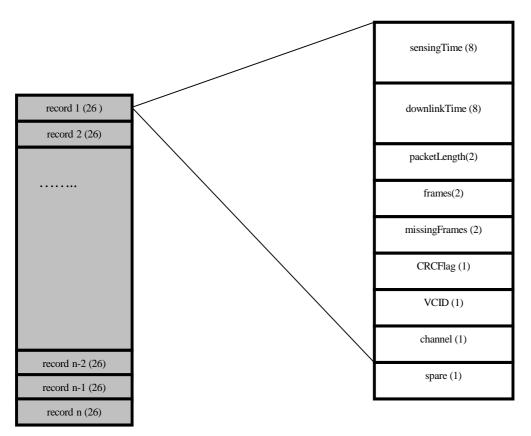


3.3.2.3 Annotation Data Component

The *Annotation Data Component* is a binary file associated to each *Measurement Data Component* of the GPS L0 Product, containing additional information for each Telemetry Packet of the *Measurement Data Component*; this information is partly (the TP sensing time) extracted from the TP by the L0 processor and partly (the TP downlink time, the parameters of the TP reconstruction process, the Virtual Channel ID etc.) provided by the Demodulator and Front End Processor, corresponding exactly to the entire content of the Annotation pre-pended to the TP by the DFEP and described in [CFI-14].

The Annotation Data file is organized as a sequence of records, each containing the above mentioned information associated for one TP of the corresponding *Measurement Data Component*; the records are organized in the same temporal sequence as the TPs and their numbers is equal to the number of TPs.

The following figure provides a graphical view of the structure and content of the *Annotation Data Component* file:



Annotation Data file

Fig. 16 - Structure of Annotation Data Component for GPS L0 Product

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The following table describes the contents of a generic record of the *Annotation Data Component* (first column indicates which processing sub-systems originates the information):

	Field ID		D	escription	Data Type	Size	
suoi			Acquisition time of the	Number of days elapsed since epoch (01-01-2000)	unsigned short	2 bytes	
L0 annotations	sensingTime ⁴		current TP (UTC Time, expressed as MJD2000)	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes	
L0 a				Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes	
			Downlink time of first Transfer Frame containing	Number of days elapsed since epoch (01-01-2000)	unsigned short	2 bytes	
	downlinkTime	part of current TP (UTC	part of current TP (UTC time, expressed as	Number of integer milliseconds elapsed since the beginning of day	unsigned int	4 bytes	
			MJD2000)	Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes	
	packetLength		Telemetry Packet (TP) length,	unsigned short	2 bytes		
ons	frames		Number of Transfer Frames co	unsigned short	2 bytes		
otati	missingFrames		Number of missing Transfer F	unsigned short	2 bytes		
ann	CRCFlag		CRC Error flag, indicating det	ection of CRC error in TP	boolean	1 byte	
DFEP annotations	VCID	VCIDPre sentFlag	Set to 1 if VCID field contains	VCID, 0 otherwise		1 bit	
	VCID	spare	Spare field			1 bit	
		VCID	Virtual Channel Identifier for	which the TP was multiplexed onto		6 bits	
	channel	channel	Channel information: C1/C2.	Channel information: C1/C2. 01 (binary): C1, 10 (binary): X2			
		spare	Spare field			6 bits	
	spare		Spare field		1 byte		

Table 19 - Content of Annotation Data Component record for GPS L0 Product











⁴ The sensing time corresponds to the timestamp extracted from the Packet Secondary Header of the current ISP



3.3.2.4 XML Schemas

Similarly to the other Sentinel-1 L0 Products, the *XML Schemas* for GPS L0 Products are XML files that describe the structure and content of the Product Data Components; each schema is associated to one type of the *Data Components (Measurement* or *Annotation*) of which it describes the format and content, through SDF markups.













3.3.3 HKTM L0 Products Components

The HKTM L0 Product is a particular type of Sentinel-1 L0 Product since the data (X-Band recorded HKTM data) are included in the product in the form of transfer frames, instead of ISPs (as further detailed in section 3.3.3.2.)

3.3.3.1 Manifest

The following table details the structure and content of the *Metadata Section* of the *Manifest* file for a HKTM L0 Product:

	Element name		Description	Data type	Occu rrenc e	Possible values	
acquisition Period			Downlink period of the HKTM transfer frames in the measurement data component	U	1		
	startTime			Downlink start time	UTC	1	
	stopTime			Downlink stop time	UTC	1	
platform	atform		Mission that acquired the HKTM transfer frames included in measurement data component	U	1		
	nssdc Identifier			Univocally identifies the mission according to the standard defined by the World Data Center for Satellite Information (WDC-SI)	S	1	TBD
	family Name			The expanded mission name	S	1	SENTINE L-1
	number			An alphanumeric identifier of the platform within the mission	Е	1	A, B
ion		Contains information related to the data segment included in the S1 L0 product (element created at Sentinel-1 HKTM specialisation level)	U	1			

Table 20 - Content of Manifest Metadata Section for HKTM L0 Products













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							X-Band
	s1hktm:con tent			Describes the content of the measurement data component.	S	1	Recorded HKTM transfer frames
	s1hktm:con tentType			Type of data included in the measurement data component	s	1	Transfer frames
	s1:byteOrd er			Byte ordering (little/big endian) used to represent the data in the <i>Data Component</i>	Е	02	"LITTLE_ ENDIAN", "BIG_EN DIAN"
		@dataObjec tID		Attribute containing the Data Object Id of Attribute containing the Data Object Id of	s	1	
	s1:average BitRate			Average instrument bit rate, expressed in bits per seconds, and computed as ratio (8 * Measurement Data Object size in bytes) / (Delta time between start and stop sensing time). Relevant only for Measurement Data Component	L	01	
		@dataObjec tID		Attribute containing the Data Object Id of <averagebitrate></averagebitrate>	S	1	
measureme ntOrbitRefe rence (orbitReference)				Contains information describing the orbit at downlink start time.	U	1	
	orbitNumb er			Absolute orbit number at downlink start/stop time	UI	12	
		@type		Attribute of tag <orbitnumber> with possible values: "start" (indicates that the orbit number refers to the oldest Transfer Frame in the L0 Product) or "stop" (the orbit number refers to the most recent TF)</orbitnumber>	Е	1	start, stop
	relativeOrb itNumber			Relative orbit number at downlink start/stop time	UI	12	
		@type		Attribute of tag <relativeorbitnumber>; same considerations apply as for attribute @type of tag <orbitnumber></orbitnumber></relativeorbitnumber>	Е	1	start, stop
	cycleNumb er			Mission cycle	UI	1	











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-							
	phase Identifier			Identifier of the mission phase	Е	1	
processing	processing		Product history describes as the list of processing steps that resulted in the current S1 L0 product; intended to collect historical information dedicated to the product maintenance and traceability.	U	1 (1*)		
	@name			Explicit name of the processing step	S	1	
	@start			Date corresponding to the beginning of the described processing step.	UTC	01	
	@stop			Date corresponding to the end of the described processing step.	UTC	01	
	facility			Identifies an organization authority of a specific processing step.	U	0*	
		@country		Name of the country where the facility is located	Т	0 1	
		@name		Name of the facility where the current processing step was performed	S	1	
		@organisati on		Explicit name of the organization responsible for the facility.	S	01	
		@site		Geographical location of the facility	S	01	
	software			Reference to the software component used for the processing	U	0*	
		@name		Name of the software component	S	1	
		@version		Version or release identifier of the software component	S	01	
	resource			Reference to any resource that may have been involved in the processing	U	0*	
		@name		Name of the logged resource	S	1	
		@role		Role of the resource w.r.t. the processing (e.g. raw data, applicable or reference documents, etc)	S	1	Raw Data, Applicable Document, etc.











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		1	1	1		[
		@version			Version of the resource	S	01
		@href			URL of the resource	URI	01
		processing			Child node of tag <resource> indicating the processing step that orignated the resource itself</resource>	U	0*
measureme ntQualityIn formation (qualityInformat ion)					Quality information of the data included in the L0 product	U	01 (1)
	missingEle ments				Describes each individual gap of missing TFs in the source TFs stream	U	0*
		location				U	01
			path		Location of the gap in the source TFs stream (relative Xpath expression)	Х	1
				@precedi ng	Number of the first non-corrupted TF immediately after the corrupted TFs group	UI	01
				@followin g	Number of the last non-corrupted TF immediately before the corrupted TFs group	UI	01
				@after	Indicates that the group of corrupted TFs are located in a sequence after the non-corrupted TF whose number is the attribute value	UI	01
				@before	Indicates that the group of corrupted TFs are located in a sequence before the non-corrupted TF whose number is the attribute value	UI	01
		count/@valu e			Number of missing TFs in the gap	UI	01
		cause/@type			Cause of missing TFs (if known)	Е	01
	extension				SAFE extension type that provides additional info about the quality of the ISPs reconstruction process	U	01
		s1:qualityPr operties				U	1
			s1:dataOb jectID		Id of Data Object to which the <qualityinformation> tag refers</qualityinformation>	S	01
			s1:numOf Elements		Total number of Transfer Frames TFs in the Data Object	UI	01
			s1:numOf MissingEl ements		Total number of TFs that are missing in the source TFs stream	UI	01













I I	s1:numOf RSCorrect edElement s	Total number of TFs corrected with Reed- Solomon	UI	01	
I I	s1:numOf RSCorrect edSymbols	Total number of symbols corrected with Reed- Solomon	UI	01	

The Data Object Section of the Manifest file is similar to the other L0 Products (see Table 8).

3.3.3.2 Measurement Data Component

The Measurement Data Component is a single binary file, including X-Band Recorded HKTM data in the form of transfer frames according to the following specification.

- The binary file includes HKTM transfer frames as received in X-Band from the 4 on-board memory Packet Stores allocated to HKTM storage.
- The transfer frames sequence is as per Packet Stores downlink order, starting with the PS with associated lower VC ID.
- Transfer frames do not include the Attached Synchronisation Marker (ASM) and the Reed-Solomon (R-S) code block (a single transfer frame is 1912 octets).
- Transfer frames are concatenated with no separator between consecutive frames.
- Transfer frames are not randomised.
- Only transfer frames that have passed the R-S decoding are included in the binary file.

The following figure provides an overview of the structure and content of the file:













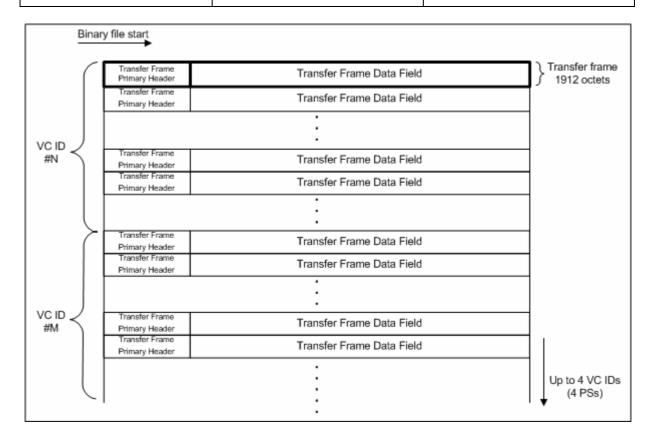


Fig. 17 – Structure of Measurement Data Component for HKTM L0 Product

3.3.3.3 Annotation Data Component

The *Annotation Data Component* is a binary file associated to the *Measurement Data Component* of the HKTM L0 Product, containing additional information (provided by the DFEP) for each Transfer Frames TF of the *Measurement Data Component* (the TF downlink time, the Frame Synchronizer status and the downlink channel identification); this information corresponds exactly to the entire content of the Annotation pre-pended to the TF by the DFEP, in the operational configuration, and described in [CFI-14]); considering that only TFs that have passed the R-S decoding are included in the Measurement Data component, the full Reed-Solomon status (enabled only for troubleshooting, as clarified in [CFI-14]), is not reported in the Annotation Data.

The file is organized as a sequence of records, each containing the above mentioned information associated to one TF of the corresponding *Measurement Data Component*; these records are organized in the same temporal sequence as the TFs and their numbers is equal to the number of TFs.

The following figure provides a graphical view of the structure and content of the *Annotation Data Component* file; for each of the elements composing the file, the name and the size in bytes (between brackets) are shown:

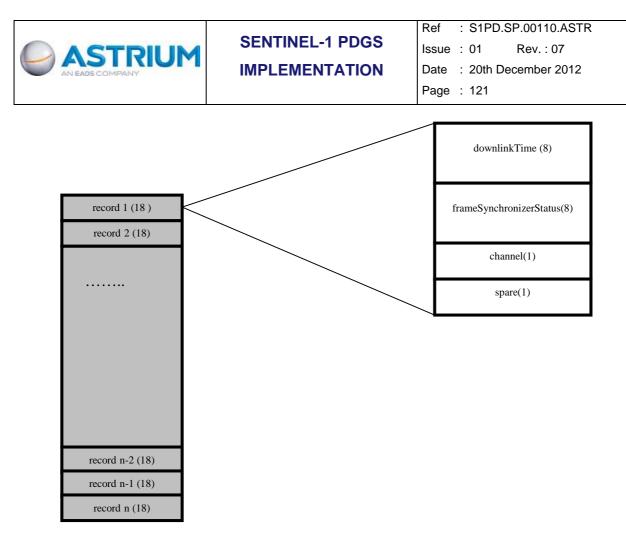












Annotation Data file







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The following table describes the contents of a generic record of the Annotation Data Component:

			Data	
	Field ID	Description	Туре	Size
		Time of the downlink onNumber of days elapsed since epoch (01-01-2000)	unsigned short	2 bytes
downlinkTime		ground of the Number of integer milliseconds Transfer frame (UTC time,	unsigned int	4 bytes
		expressed as Number of microseconds elapsed since the last millisecond	unsigned short	2 bytes
	SCLFStatus	Status of SCLF state machine (sclf=00 : SEARCH mode. sclf=01 : CHECK mode. sclf=10 : LOCK mode. sclf=11 : FLYWHEEL mode)		2 bits
	invertedFrameFlag	Frame inverted flag (0 : no, 1 : inverted)		1 bit
	frameCRCErrorFlag	Frame CRC error flag (0 : no, 1 : yes)		1 bit
	bestMatchFlag	Best match (0 : No. 1 : Yes. Another sync mark was seen that invalidated the sync mark at the beginning of this frame)		1 bit
frameSynchronizer	flushFrameFlag	Flush frame (0 : No. 1 : Yes 0 . Input data stream abruptly stopped in the middle of the frame. When this occurs, the current frame is filled out to the frame length with the last byte received)		1 bit
Status	slipFrame	Slip frame (0 : No. 1 : Yes. Some bites were lost or gained during transmission of the data stream)		1 bit
	slipDirection	Slip direction (0 : Backward 1 : Forward)		1 bit
	numOfBitSlips	Number of bit slips that occurred		3 bits
	numOfSyncErrors	Number of sync errors found in sync mark		5 bits
	frameLength	Length of current frame	unsigned short	2 bytes
	boundaryBytes1	Boundary bytes between current frame and last frame output	unsigned short	2 bytes
	boundaryBytes2	Boundary bytes between last frame and current frame. This word of status duplicates the boundary bytes (bytes 5 and 6) of the previous frame.	unsigned short	2 bytes
channel	channel	Channel information: C1/C2. 01 (binary): C1, 10 (binary): X2		2 bits
	spare	Spare field		6 bits
spare		Spare field		1 byte

Table 21 - Content of Annotation Data Component record for HKTM L0 Product













3.3.3.4 XML Schemas

Similarly to the other Sentinel-1 L0 Products, the *XML Schemas* for HKTM L0 Products are XML files that describe the structure and content of the Product Data Components; each schema is associated to one type of the *Data Components (Measurement* or *Annotation*) of which it describes the format and content, through SDF markups.













3.4 SENTINEL-1 L0 PRODUCT NAMING CONVENTION

This section defines the naming convention for the Sentinel-1 L0 Products.

A Sentinel-1 L0 product is designed to be stored on hard disk or any other file system device through one of a several possible packaging methods: a directory, a tar or zip archive or any others.

In this respect, the name of the Sentinel-1 L0 Product is the name of the directory or the tar/zip archive that contains the product components. The following sections define the naming convention for both the Product folder and the contained files.

3.4.1 Product

The Product folder name is composed by upper-case alphanumeric characters separated by an underscore, according to the following specification:

MMM_BB_TTTR_LFPP_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_OOOOOO_DDDDDDD_CCCC.EEEE

Two examples of the folder name (for a SAR Standard L0 Product and a GPS L0 Product respectively) follow:

S1A_EW_RAW__0SHH_20100412T031153_20100412T035852_013834_008912_1D47.SAFE

SAR Standard L0 Product

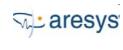
S1A_GP_RAW_0__20100412T031153_20100412T035852_013834____A27E.SAFE

GPS L0 Product

The following table defines the folder name composing elements:

Pattern	Description	Range
МММ	Mission identifier	S1A, S1B
BB	Mode identifier (for SAR standard products) or identifier of the type of data (for non-SAR product)	S# (for Stripmap mode, where # = 16), EW, IW, EW, WV, N# (for Azimuth Notch mode, where # = 16), EN (for Elevation Notch mode), RF for SAR L0 products













		or GP, -HK for GPS and HKTM L0				
		Products respectively				
TTT	Product type	RAW				
R	Resolution class	Only used by L1 Products; N.A. for L0				
K	Resolution class	products (underscore "_")				
L	Processing level	0				
		C (L0 Cal Products), N (L0 Noise				
		Products), S (SAR L0 Standard Products),				
F	Product class	A (L0 Annotations Products) or				
		underscore "_" if not relevant (GPS and				
		HKTM L0 Products).				
		SH (Single HH polarisation),				
		SV (Single VV polarisation),				
		HH (HH polarisation for dual polarisation				
		acquisition),				
		VV (VV polarisation for dual-pol)				
		HV (HV polarisation for dual-pol)				
РР	Polarisation combination	VH (VH polarisation for dual-pol)				
		DH (dual pol, polarisation combinations				
		HH and HV),				
		DV (dual pol, polarisation combinations				
		VV and VH)				
		or underscores "" if not relevant (for				
		GPS and HKTM L0 Products).				
		Fourteen digits representing the date and				
YYYYMMDDTHHMMSS	Product start or stop date and time	time separated by the character T				
000000	Absolute orbit number at product start time	000001-999999				
		Hexadecimal value 000001-FFFFFF for				
		SAR or underscores "" if not				
DDDDDD	Mission data take identifier (see [CDB-03])	relevant (like for GPS and HKTM L0				
		Products).				
	Checksum calculated with CRC-16 computed on the					
	entire SAFE Manifest File (Unique file name					
сссс	identifier that ensures the uniqueness of the product					
	name in the case of repetitive generation of the same					
	product)					
EEEE	Product format extension	SAFE				













Table 22 - Sentinel-1 L0 Product Folder naming convention

The Sentinel-1 L0 Product name can be logically seen as the combination of the following main information:

- Mission identifier (pattern "MMM");
- Product Type code defined in Table 4 (pattern "BB_TTTR_LF"), except for Stripmap mode where BB in the filename corresponds to S# swath number;
- Product Instance identifier (pattern "PP_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_000000_ DDDDDD_CCCCC"), that ensure the uniqueness of the product name.

3.4.2 Manifest file

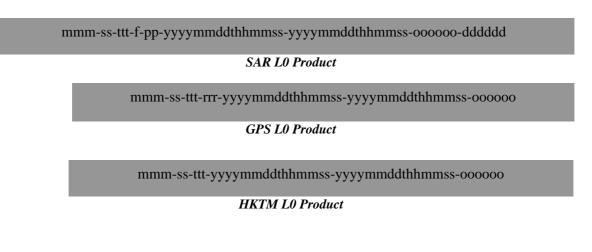
The name of the manifest file is:

manifest.safe

3.4.3 Data files

This section defines the naming standard common to all the Data Components of a Sentinel-1 L0 Product, namely the *Measurement Data File*, the *Annotation Data File* and the *Index Data File*.

The file name is composed by a common root, containing lower-case alphanumeric characters, separated by a hyphen "-", in accordance to the following specifications (respectively for SAR L0 Products, GPS L0 Products and HKTM L0 Products):



A suffix "-index" (for the *Index Data File*) or "-annot" (for the *Annotation Data File*) and the appropriate extension (".dat", ".xsd") is added to this common root, in order to compose the full file name.







The elements composing the name common root are defined in the following tables, respectively for SAR L0, GPS L0 and HKTM L0 Products:

Pattern	Description	Range
mmm	Mission identifier	s1a, s1b
ss	s1, s2, s3, s4, s5, s6, iw, ew, wv, rf n3, n4, n5, n6 (for Azimuth Notch n en (for Elevation Notch mode)	
ttt	Product type	raw
f	Product class	c (L0 Cal Products), n (L0 Noise Products), s (SAR L0 Standard Products), a (L0 Annotations Products)
рр	Polarisation	hh, hv, vv, vh
yyyymmddthhmmss	Product start or stop date and time.	
000000	Absolute orbit number at product start time	000001-999999
ddddd	Mission data take identifier (see [CDB-03])	000001-FFFFF

Table 23 – SAR L0 Products Data Files naming convention

Pattern	Description	Range
mmm	Mission identifier	s1a, s1b
SS	Identifier of the type of product	gp
ttt	Product type	raw
rrr	Record type	Type of GPSR Measurement Data Record, expressed by GPSR Structure ID SID, ranging from 213 to 235, see [TDB-32]; mapping between SID and record types.
yyyymmddthhmmss	Product start or stop date and time.	
000000	Absolute orbit number at product start time	000001-999999

Table 24 – GPS L0 Products Data Files naming convention













Pattern	Description	Range
mmm	Mission identifier	s1a, s1b
SS	Identifier of the type of product	hk
ttt	Product type	raw
yyyymmddthhmmss	Product start or stop date and time.	Fourteen digits representing the date and time separated by the character t
000000	Absolute orbit number at product start time	000001-999999

Table 25 - HKTM L0 Products Data Files naming convention

Examples of the common root (for a SAR Standard , HKTM L0 and GPS L0 Products respectively) follow:

s1a-iw-raw-s-hh-20110904t140822-20110904t141618-025436-008912

s1a-hk-raw-20110904t140822-20110904t141618-025436

s1a -gp-raw-213-20110904t140822-20110904t141618-175-025436

3.4.3.1 Measurement Data files

The Measurement file name is composed by adding the extension ".dat" (indicating a binary file) to the common root defined in section 3.4.3, as in the following example:

s1a - iw - raw - s - hh - 20110904t140822 - 20110904t141618 - 025436 - 008912 . dat

3.4.3.2 Index Data files

The Index Data file name is composed by adding the prefix "-index" to the name of the associated *Measurement Data* file, as in the following example:

s1a-iw-raw-s-hh-20110904t140822-20110904t141618-025436-008912-index.dat













3.4.3.3 Annotation Data files

The Annotation Data file name is composed by adding the prefix "-annot" to the name of the associated *Measurement Data* file, as in the following example:

s1a - iw - raw - s - hh - 20110904t140822 - 20110904t141618 - 025436 - 008912 - annot. dat

3.4.4 XML Schemas files

This section defines the naming convention for the *Representation Data Components* (also named *XML Schemas Files*) contained in a Sentinel-1 L0 Product.

The name of the XML Schema file is composed of lower-case alphanumeric characters, separated by a hyphen "-", according to the following specification:

mm-level-0-xxxxx.eee

The following table defines the variable elements composing the name:

aresys'

Pattern	Description	Range
mm	Mission identifier	sl
xxxxx	Data File ID; it univocally identifies the Data File to which the XML schema applies; maximum length 5 chars	"index", "annot" or empty string, according to the type of Data Component to which it refers (Index, Annotation or Measurement Data Component respectively)
eee	File extension	xsd

Table 26 - XML Schemas naming convention











Unlike Measurement Data Files names, XML Schemas file names do not include a polarisation identifier, since a Schema applies to all relevant files within the product (e.g. a single Schema for all Measurement Data files, another Schema for all Annotation Data files etc.).

Examples of the names for the XML Schemas associated respectively to a Measurement Data file and to the corresponding Annotation and Index Data files follow:

s1-level-0.xsd

s1-level-0-index.xsd

s1-level-0-annot.xsd





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3.4.5 **Product Naming examples**

This section provides, as a summary, a graphical view of the content of a sample Sentinel-1 L0 Product for each of the five Product Types groups defined in section 3.1; the names of the folder and of the composing files are written in accordance to the file naming specifications defined in the previous sections.

3.4.5.1 SAR L0 Products

The following figures show the content of two sample SAR L0 Products (SAR Standard L0 and SAR L0 Cal):

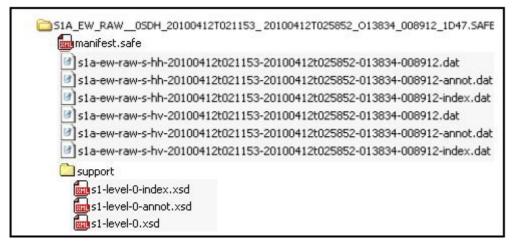


Fig. 19 – Content of a sample SAR Standard L0 Product

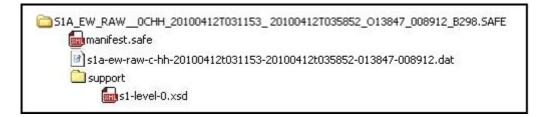


Fig. 20 - Content of a sample SAR L0 Cal Product, single-pol











3.4.5.2 GPS L0 Products

The following figure shows the content of a sample GPS L0 Products:

SIA_GP	RAW_0_	_20100412T021153	20100412T0258	52_013834	A27E.SAFE
En m	anifest.safe				
🕑 st	la-gp-raw-21	3-20100412t021153-	20100412t025852	2-013834.dat	
🕑 st	la-gp-raw-21	3-20100412t021153-	20100412t025852	2-013834-annot.dat	
🕑 st	1a-gp-raw-21	4-20100412t021153-	20100412t025852	2-013834.dat	
₿ st	la-gp-raw-21	4-20100412t021153-	20100412t025852	2-013834-annot.dat	
🕑 st	1a-gp-raw-22	3-20100412t021153-	20100412t025852	2-013834.dat	
Ø]s!	1a-gp-raw-22	3-20100412t021153-	20100412t025852	2-013834-annot.dat	
🛄 si	upport				
	s1a-level	-0.xsd			
	🚮 s1a-level	-0-annot.xsd			

Fig. 21 - Content of a sample GPS L0 Product

3.4.5.3 HKTM L0 Products

The following figure shows the content of a sample HKTM L0 Product:

51A_HK_RAW_020100412T031153_20100412T035852_013847	B23A.SAFE
📾 manifest.safe	
📝 s1a-hk-raw-20100412t031153-20100412t035852-013847.dat	
📝 s1a-hk-raw-20100412t031153-20100412t035852-013847-annot.dat	
C support	
🞰 s1a-level-0.xsd	
📶 s1a-level-0-annot.xsd	

Fig. 22 - Content of a sample HKTM product













3.5 SENTINEL-1 L0 PRODUCTS SIZE

This section provides an estimation of the average size of the Sentinel-1 L0 Products, based on the description of the products structure and composition provided in the previous sections and on the information extracted from [TDB-21], [TDB-31] and [CDB-03], as summarized in the following list.

The estimation is based on the following information and assumptions:

- for SAR Standard L0 Products (only for echo pulses) the SAR average data rates after on-board FDBAQ compression, derived from Fig.4-1 of [CDB-03]; the estimation is made with respect to the same conditions and limitations under which these data rates have been originally evaluated (see section 4.2.2 of [CDB-03]), related to the dependance of FDBAQ bits per sample rate on the local ground backscattering behaviour, and therefore represents a "mean" value; a more accurate estimation, based on a precise modelling of ground backscattering properties, is beyond the scope of the present analysis;
- for SAR Azimuth Notch Mode (N1 to N6), as these mode has the same characteristics as the Stripmap Mode (S1 to S6), including the instrument data rate (see [RD-01], requirement GMES-S1-PDGS-0662), the estimation made in the previous point for SAR Stripmap Standard L0 Products applies, meaning that in Table 28, the rows relative to Stripmap also apply to Azimut Notch Mode, for the corresponding swath and polarisation; for Elevation Notch Mode, a similar assumption is not confirmed, and the estimation is left TBD;
- for SAR RF Characterization Mode Standard L0 Products, (for which there is no quantisation, namely BYPASS Mode is applied), the nominal sequence for RFC mode (as defined in TDB-21) is assumed; the mode is assumed to be operated once per orbit;
- for SAR L0 Cal and L0 Noise Products the estimation depends on the timeline of the particular SAR Measurement Mode (e.g. number of calibration cycles); a rough estimation of the percentage of ISPs of type Calibration and Noise over the total number of ISPs of the original SAR ISPs stream, is 0.8% (for Cal ISPs) and 0.2% (for Noise ISPs);
- for GPSR, the downlink data rate estimation is 4 kbps;
- for HKTM data, the downlink data rate estimation is 6 kbps (at Transfer Frame level);
- for GPS and HKTM L0 Products, estimation is expressed as MB per orbit (5924.57 seconds), since GPS and HKTM are downlinked once per orbit;
- for SAR L0 Products, an overhead w.r.t. the ISP size is considered, in order to account for the various annotations added to each ISP and composing the Annotation Data Component (for an estimated percentage of 0.2% over the ISP size) and for the additional components (Manifest, XML schemas and Index Data Component for a total of ~200 KB for the whole Sentinel-1 L0 Product, corresponding to ~20 KB per minute, based on an estimated average data sensing time of 10 minutes per product);

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- for GPS L0 Product, a similar overhead w.r.t. the Telemetry Packets TP size is considered due to TP annotations (estimated percentage of 0.2% over the TP size) and for the additional components (Manifest and XML schemas) for a total of ~10 KB for the whole GPS L0 Product;
- for SAR L0 Annotations Product the estimation is based on the values of PRF for each SAR Measurement Mode, extracted from [TDB-31] and summarized in the following table:

SAR Measurement Mode	PRF value (Hz)	Origin
Stripmap Mode (SM) Swath #1	1870.66	
Stripmap Mode (SM) Swath #2	1612.80	
Stripmap Mode (SM) Swath #3	1924.96	Values for each of the 6 Stripmap Swaths extracted from
Stripmap Mode (SM) Swath #4	1650.17	Table 7 in [TDB-31] (relative to 698 km sensor altitude)
Stripmap Mode (SM) Swath #5	1899.14	-
Stripmap Mode (SM) Swath #6	1663.48	-
Interferometric Wide Swath Mode (IW)	1618.19	Computed as average of the 3 values for IW1, IW2, IW3 (see Table 17 in [TDB-31]).
Extra Wide Swath Mode (EW)	1752.71	Computed as average of the 5 values for EW1, EW2, EW3, EW4, EW5 (see Table 29 in [TDB-31]).
Wave Mode (WV)	1650.17	Value extracted from Table 37 in [TDB-31].

Table 27 – PRF values for SAR Measurement Modes

Based on the previous points, the calculation method used to derive the product size is summarized in the following:

• for SAR L0 Standard Product, the estimated size is computed by multiplying the "Data Rate" corresponding to the nominal FDBAQ compression (extracted from from Fig.4-1 of [CDB-03], for Single or Dual Polarisation according to the case, divided by 8 and multiplied by 60 in order to express it in MB per minute) by 1.002 (0.2% overhead due to various annotations added to each ISP and composing the Annotation Data Component) and adding 20 KB per minute (to account for Manifest, XML Schemas and Index Data Component), namely by applying the formula:

Data Rate[MBpm] = DataRate[Mbps] / 8 * 60 * 1.002 + 20[kB] / 1024

 for the particular case of SAR RF Characterization Mode Standard L0 Products, the size is computed by multiplying the RF Characterisation sequence (defined in [TDB-21] and consisting in 1123 pulses) by an estimated size of each packet corresponding to one pulse (ca. 16 KB, including annotations of the Annotation Data Components), namely:

Data Rate[MB per orbit] = 1123 * 16[kB] / 1024

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for SAR L0 Calibration and Noise Product, the computation is based on the assumption that (for a given SAR Measurement Mode with a given "Data Rate" in Fig.4-1 of [CDB-03]) the number of Calibration or Noise ISPs is a fraction of the total number of ISPs in the ISPs stream (0.8 % and 0.2 % respectively for Calibration and Noise ISPs) and that the ISP size is comparable, leading to the the formulas:

Calibration Data Rate[MBpm] = 0.008 * (DataRate[Mbps] / 8 * 60 * 1.002) + 20[kB] / 1024 Noise Data Rate[MBpm] = 0.002 * (DataRate[Mbps] / 8 * 60 * 1.002) + 20[kB] / 1024

 for SAR L0 Annotations Product, the estimated size is computed by multiplying the Annotation Product "Record Size" (ISP Primary + Secondary Header size, equal to 68 bytes) by the PRF for the corresponding SAR Measurement Mode, extracted from [TDB-31] and adding 10 KB per minute (to account for Manifest and XML Schema), namely by applying the formula:

Annotation Data Rate[MBpm] = RecordSize[Bytes] * PRF * 60 / (1024*1024) + 10[kB] / 1024

 for GPSR and HK L0 Products, the estimated size is computed by multiplying the estimated "Downlink Data Rate" (4 and 6 kbps respectively) by the duration of the reference orbit (5924.57 secs) and adding 10 Kbytes (to account for Manifest and XML Schemas), namely by applying the formula:

Data Rate[MB per orbit] = DownlinkDataRate[kbps] / 8 * 5924.57 / 1024 + 10[kB] / 1024

The following Table 28 and Table 29 collect the results of the computation, respectively for Sentinel-1 SAR L0 Products and RFC/GPS/HKTM L0 Products; being the computation based on average values of the composing parameters (in particular the sensing and downlink data rates), the computed sizes are always intended as "mean" sizes.

Each cell of Table 28 contains the estimated size (expressed in MB per minute of sensing time) for SAR L0 Products (except for RFC mode) corresponding to the combination of the following 2 elements:

- SAR Measurement Mode + Swath number (if applicable, namely for Stripmap and Azimuth Notch Mode) + polarisation (first column);
- SAR Product Class (the remaining columns).













	SAR LO	SAR LO	SAR LO	SAR LO
Mode/Polarisation/Swath	Standard	Cal	Noise	Annotations
Number	Stanuaru	Cal	INDISE	Annotations
	Estimat	ed product	size (MB p	er minute)
Stripmap Mode ⁵ , Stripmap1, Single Pol	2097.697	16.80	4.21	7.29
Stripmap Mode, Stripmap2, Single Pol	1747.265	14.00	3.51	6.29
Stripmap Mode, Stripmap3, Single Pol	1769.855	14.18	3.56	7.50
Stripmap Mode, Stripmap4, Single Pol	1464.235	11.73	2.95	6.43
Stripmap Mode, Stripmap5N, Single Pol	1559.209	12.49	3.14	7.40
Stripmap Mode, Stripmap5S, Single Pol	1549.177	12.41	3.12	7.40
Stripmap Mode, Stripmap6, Single Pol	1381.54	11.07	2.78	6.48
Stripmap Mode, Stripmap1, Dual Pol	4195.373	33.58	8.41	14.58
Stripmap Mode, Stripmap2, Dual Pol	3494.51	27.98	7.01	12.57
Stripmap Mode, Stripmap3, Dual Pol	3539.69	28.34	7.10	15.00
Stripmap Mode, Stripmap4, Dual Pol	2928.45	23.45	5.88	12.86
Stripmap Mode, Stripmap5N, Dual Pol	3118.399	24.97	6.26	14.80
Stripmap Mode, Stripmap5S, Dual Pol	3098.334	24.81	6.22	14.80
Stripmap Mode, Stripmap6, Dual Pol	2763.06	22.12	5.55	12.96
Interferometric Wide Swath Mode, Single Pol	1552.84	12.44	3.13	6.31
Interferometric Wide Swath Mode, Dual Pol	3105.65	24.86	6.23	12.62
Extra Wide Swath Mode, Single Pol	477.77	3.84	0.98	6.83
Extra Wide Swath Mode, Dual Pol	955.52	7.66	1.93	13.66
Wave Mode, Single Pol	114.85	0.94	0.25	6.43

Table 28 – Estimated size for SAR L0 Products

⁵ Same values of estimated product size for SAR Stripmap Standard products also apply to SAR Azimuth Notch mode products (for the same combination of swath number and polarisation)











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The following table summarizes the estimated size (expressed as MB per orbit) for SAR RFC Mode, GPS L0 and HKTM L0 Products:

L0 Product	Estimated product size (MB per orbit)
SAR RF Characterisation Mode	17.55
GPSR L0	2.90
HKTM L0	4.35

Table 29 - Estimated size for GPS and HKTM L0 Products













DISTRIBUTION LIST

	Corporate use	Project Limited
Internal Classification		

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