Sentinel-2 Products Specification Document

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Approval evidence is kept within the documentation management system.

Documentation Information

Submitted to ESA for

☐ Information ☐ Review ☒ Approval

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CHANGE RECORDS

ISSUE	DATE	§ CHANGE RECORDS	AUTHOR
01	13/01/2012	PDR Issue	ACS Team
02	15/03/2012	Delivery for PDR close-out	ACS Team
		Section 3.20.1: updated file naming convention relative to PDI HKTM as per **PDR-RID-26/FM-13** disposition.	
		The following sections have been updated as per **PDR-RID-70/EC-01** disposition: Section 1.6.5: clarified SAFE approach. Sections from 3.6 to 3.13: updated PDI's structure. Sections from 4.6 to 4.9: updated User Product structure.	
		The following sections have been updated as per **PDR-RID-73/EC-02** taking into account comments and discrepancies detected in the *rid73 Attachment.pdf* document. Section 1.4 Section 1.6.3 Section 1.6.4 Section 1.6.5 Section 2.6 Section 3.8.3.1 Section 3.8.4	
		As per **PDR-RID-75/EC-03** point 1: Specified in the Table 3-14, SENSING_TIME field as type date_time:AN_UTC_DATE_TIME. Corrected the corresponding Level-0 Granule schema annexed to this document in the [PSD]_S2-PDGS-TAS-DI-PSD_[02]_Schema.zip file. As per **PDR-RID-75/EC-03** point 2: Corrected section 4.6.7.3. As per **PDR-RID-75/EC-03** point 3: Added in the Table 3-16 and in the corresponding schema GRANULE_DIMENSIONS field.	
		As per **PDR-RID-84/EC-04** disposition: Clarified in the section 2.10 the metadata management.	
		Section 1.4: clarified schema management as required by **PDR-RID-166/JM-04.**	
		Sections 3.x.3 (x from 1 to 8) and section 1.4 have	

		been updated as per **PDR-RID-217/EC-08** request.	
		Sections 1.6.2.1 and 1.6.3: updated according to **PDR-RID-239/GV-04** disposition.	
		Sections 1.6.2.1, 1.6.3 and 1.6.4: updated as per **PDR-RID-240/GV-05** disposition.	
		Section 0: updated as per **PDR-RID-316/EC-24** disposition.	
		Section 4.6.7.1: as required by **PDR-RID-464/OC-22** this section has been updated providing a preliminary analysis of the product metadata elements to be handled by DAG.	
		Section 4.9.2.1: updated according to ESA response to **PDR-RID-465/BK-01**.	
		Section 2.8: clarified Level-2A product generation as required by **PDR-RID-467/BK-02**.	
		Section 1.3: updated clarifing the list of the applicable and reference documents mentioned in this document.	
		Added Section 3.2 to clarify the PDI naming convention.	
		Sections 3.x.3 (x from 1 to 8): for each Granule and Datastrip PDI the content of SAFE Manifest is fully described; an example of Manifest for each PDI is provided in the annexed [PSD]_S2-PDGS-TAS-DI-PSD_[02]_SAFE.zip file.	
		Added Sections 3.22 and 4.9.10 to describe TCI PDI definition and TCI End User Product..	
		Chapter 5: updated Internal Product Format Definition.	
03	06/04/2012	Delivery to include some ESA comments on the previous issue of the document.	ACS Team
		The following sections, figures and tables have been updated according to comments issued by ESA on the previous issue of the PSD delivered for PDR close-out: Section 1.3 Section 1.6.5 Section 3.8.3.1	

		Section 3.20.1 Section 4.6.7.1 Section 4.6.8 Table 3-6 Table 3-7 Figure 16	
		Added section 1.5.1 to give a Sentinel-2 product overview to better understand the purpose of the document.	
		Added sections 3.4and 3.4.2 to underlind the common structure at Granule and Datastrip level.	
		Updated section 3.1 to clarify *tar* organization and structure.	
		Updated section 3.6 regarding to the PDI Granule Level-0 organization and structure.	
04	09/07/2012	Delivery for CDR-4	
		Section 3.20.1: updated naming convention removing File instance ID mandatory prefix "ssss" (Site centre of the file originator) as required by the Panel Disposition of **PDR-RID-026/FM-13** and **S2PP/FM-13/1/PSD** (related to **S2PP/FM-09/1/P2FICD** and **PDR-RID-37/FM-09**).	
		Chapter 2: focusing on DIMAP implementation is provided.	
		Chapter 3: updated to complete and better document the PDI format specifications.	
		Chapter 4: updated to complete and better document the User Product format specifications.	
		The sections 4.3 and 4.6.7.1 (Table 4-12) clarify the processing performed by the DAG-C to compute the QIs at product level.	
		Sections 4.7.9, 4.8.8 and 4.9.9: added the description of *manifest* files for L1A, L1B and L1C user products.	
		Added Annex C to provide the OLQC_Report.xml report performed by OLQC processor consolidation.	
		Added *manifest.safe* files and corresponding XSD schemas relative to Level-1A, Level-1B and Level-1C	

		(cfr. [PSD]_S2-PDGS-TAS-DI-PSD_[05]_SAFE.zip annexed to this document).	
05	20/09/2012	This issue of the document includes the following main improvements: Chapters 1 and 2: updated to help the reader in the understanding of the document; Section 3.7: included latest feedback from Satellite Ancillary Data; Section 3.20: updated HKTM PDI defining it as a SAFE Product Data Item; Chapter 4: all metadata for user product level have been provided; All: consolidation of the file naming, including RID S2PP/FM-13/1/PSD (HKTM file naming now [EOFFS], ref added in applicable documents list); All: CDR-4 Batch 1 RID including ESA red marks taken into account throughout the doc; New version of the XSD schema set according to the document description. Algorithm to generate Product Level QIs as per PDR RID OC-22 agreement (see Table 4-12)	
06	28/11/2012	Section 1.3: updated applicable and reference documentation according to the new baseline documentation.	
		Section 3.2: Clarified the purpose of the PDI_ID definition as a logical and physical naming convention.	
		Section 3.7.3.1: 1. Minor changes on the Table 3-33: *Level-0 Datastrip – Image_Data_Info Description* to align the metadata description vs XSD schemas. 2. Updated Table 3-34: Level-*0 Datastrip – Satellite_Ancillary_Data _Info Description* according to the new issue of the applicable [PDD] and [GPP-IODD] and to align the metadata description vs XSD schemas. 3. Minor changes on the Table 3-32: *Level-0 Datastrip – Quality_Indicator_Info Description*	

		to add details on metadata description. 4. Updated Table 3-36 *Level-0 Datastrip – Auxiliary_Data_Info Description* to add the IERS_BULLETIN_FILENAME reference needed to fill the corresponding product level metadata.	
		Section 3.9.3.1: 1. Added POD_Info (Figure 34 and Table 3-44) according to the [PDD] description. 2. Updated Table 3-46 *Level-1A Datastrip – Auxiliary_Data_Info Description* to add the IERS Bulletin reference (IERS_BULLETIN_FILENAME) and the Image_Display_Order metadata (RED_CHANNEL, GREEN_CHANNEL, BLUE_CHANNEL).	
		Section 3.11.3.1: 1. Updated Table 3-53 *Level-1B Datastrip – Auxiliary_Data_Info Description* to add the IERS Bulletin reference (IERS_BULLETIN_FILENAME), the GRI data reference and the Image_Display_Order metadata.	
		Section 3.12.3.1: 1. Updated Figure 50 and Table 3-56 according to the applicable [PDD].	
		Section 3.13.3.1: 1. Updated Figure 56 and Table **3-61**: *Level-1C Datastrip – Auxiliary_Data_Info Description* to include ECMWF_DATA_REF, Image_Display_Order and QUANTIFIATION_VALUE metadata according to [PDD] description.	
		Sections 3.20 and 3.20.1: updated to describe the HKTM PDI as a SAFE product. The corresponding manifest.safe and SAFE schema have been added in the annexed zip file (S2-PDGS-TAS-DI-PSD_[V06]_SAFE.zip).	
		Section 4.4. 1. Updated according to the applicable [NGEO-EICD-S2].	

		Section 4.6.2.1: 2. Updated ISPs description;	
		Section 4.6.7.1: 1. Minor changes on the Table 4-9: *Level-0 Product_Metadata_File - General_Info Description* to add details on metadata description. Added *fileFormat* attribute for *IMAGE_DATA_ID* metadata. 2. Minor changes on the Table 4-10: *Level-0 Product_Metadata_File - Geometric_Info Description* to add details on metadata description.	
		Section 4.7.7.1: 1. Updated Figure 67 and added Table 4-17: *Level-1A Product_Metadata_File - General_Info Description to* include the Product_Image_Characteristics according to [PDD] description.	
		Section 4.8.7.1: 1. Updated Figure 75 and added Table 4-22: *Level-1B Product_Metadata_File – Auxiliry_Data_Info Description* to include the Restoration_Parameters and Equalization_Parameters according to [PDD] description.	
		Section 4.9.7.1: 1. Removed Radiometric_Info from Product_Metadata_File because, according to [PDD], this group of metadata is available at Datastrip level for each Datastrip composing the product. 2. Added Figure 79 and Table 4-23 to detail the general information provided throught the Level-1C_Product_Metadata_File.	
		Section 5.2.2.2: updated file naming for IPF products.	
		Updated in the whole the document the Processing Baseline definition and management.	
		Updated Annex D to define the OLQC reports naming convention.	

		SYS-1120 GML mask format: updated sections 3.4.1, 3.8.2, 3.10.2, 3.12.2. Added annex to describe the grouping strategy to have several masks in one physical GML file.	
		SYS-1121 PVI as optional file: updated section 0	
		SYS-1123 SAFE format approach packaging: updated section 4.2.	
		SYS-1124 Level-0 Granule Physical Format: updated section 3.6.2 and clarified in all the document that L0 Granules come with one image file per band and per detector.	
		SYS-1125 Level-0 User Product Data Organization: updated section 4.6.2.1.	
		SYS-1127 General Comment on the physical presentation: updated section 4 to include within the User Product physical format an UserProduct_index.html file.	
		SYS-1129 Readability of the Document: checked all cross-references and links to tables, figures and sections.	
		SYS-1130 SAD raw Data: updated section 4.6.3, Table 3-8 and Table 3-9.	
07	22/02/2013	CDR Delivery	
		Added [OLQC-TN] reference document.	
		Removed [CCTC-IPF] reference document because not available for the end user.	
		The obsolete section 1.4 Document Roadmap has been replaced with the section “How to Use this Document” to help the reader in navigating in the document.	
		Section 0: added AS-4 regarding raw SAD data organization.	
		Section 3: all PDI naming conventions and PDI_ID definitions have been updated according to [EOFFS-PDGS].	
		Section 3.6.3.2: updated IMG_DATA description.	
		Section 3.21 and 3.21.1: updated to describe the SAD files management as per AS-4.	

		Added at Datastrip level (Table 3-32) the following metadata: DATATAKE_SENSING_STOP DATASTRIP_SENSING_START DATASTRIP_SENSING_STOP Renamed SENSING_TIME metadata as DATATAKE_SENSING_START	
		As per RID/ESA-217, removed the metadata : - Corrected_Attitudes/Values/VELOCITY_VALUES - Corrected_Attitudes/Values/VELOCITY_ERRORS from the document (Table 3-34) and the corresponding XSD schema.	
		Removed DEGRADED_ANC_DATA_PERCENTAGE metadata from Granule level (Table 3-16, Table 3-28, Table 3-40, Table 3-50, Table 3-57). This information is available at Datastrip level through the “degradationPercentage” attribute.	
		Section 4: updated User Product structure to include the HTML folder containing a product presentation file (**SYS-1127)**.	
		Section 4.6.2.1: updated L0 Data Organization description.	
		Section 4.6.3: updated Ancillary Data description.	
		Removed all reference to DEM Quality Masks because no quality mask is available.	
		Removed section 5. INTERNAL PRODUCT FORMAT DEFINITION because not End User oriented. All information has been moved in the appropriate ICDs.	
		Added table in the Annex B to clarify the meaning and the applicability of each inventory metadata.	
		All: the document has been updated to clarify that there are not redundant metadata in the SAFE formatted User Product.	
		Modifies on XSD schemas: dimap.xsd: 1. removed VELOCITY_VALUES and VELOCITY_ERRORS metadata from	

		AN_ATTITUDE_DATA_INV complexType; 2. removed “bandId” attribute from A_GRANULE_FOOTPRINT complexType item.xsd: 1. updated all the regular expression according to the new PDI-ID naming conventions Inventory_Metadata.xsd: 1. updated all the regular expression according to the new PDI-ID naming conventions 2. added attotations to clarify the applicability for each metadata Added the following schames to validate the XML metadata files in case of User Product SAFE formatted: SAFE_user_product_Level-0.xsd SAFE_user_product_Level-1A.xsd SAFE_user_product_Level-1B.xsd SAFE_user_product_Level-1C.xsd	
08	17/05/2013	Delivery for CDR Close-out Batch1	
		ESA-681 *Metadata in case of AT granule aggregation*: updated section 4.7.8 to include • Details about Along-Track Granules Aggregation; • Aggregated Granule ID definition; • Aggregated Granule Physical Format description; • Aggregated Granule Metadata definition.	
		ESA-688 *GML mask generation strategy*: updated sections 3.8.2, 3.9.2 and 3.10.2 to clarify that the mask files are divided per band. The mask naming convention and the masks grouping strategy described in the Annex E of the document have been updated accordingly.	
		ESA-752: *tile conso approach vs PSD:* updated section4.9.8 to include the following information: • Description of the Tile Consolidation concept; • Tile consolidated ID definition;	

		• Tile consolidated metadata definition.	
		ESA-770: *Point and comments on the [PSD]*: the whole document has been updated to implement the comments listed in the RID PRO-19.pdf annexed to this issue.	
		ESA-836 *Download Options*: updated section 4.4 and Table 4-9 to align the download options as per [SAD] reference document. The User Product XSD schemas have been updated accordingly.	
		ESA-571 *Sentinel-SAFE Manifest and Product Organization:* updated all “SAFE Manifest synoptic table” sections and the example of the SAFE Manifest provided in the zip annexed to the document.	
		ESA-826 *Points on [PSD]*.: The whole document has been updated to implement the comments listed in the RID PRO-2.pdf annexed to this issue.	
		Updated section 3.7.3.1 - Table 3-34 to have the same Satellite_Ancillary_Data_Info for each level of processing.	
		ESA-751 *GID definition / Versioning* : updated section 4.2 removing the version id (_Cvvvv).	
		Added [OLQC-GIPP] reference document.	
		Annex B: updated Inventory_Metadata description	
		Annex D: updated OLQC report (XSD and XML)	
		A new directory "AUX_DATA" folder containing ECMWF dataset resampled in UTM projection has been added for L1c PDI (note that this modification will request an update of the ICD-IPF V11).	
09	14/06/2013	**ESA-751** *GID definition / Versioning* : updated section 0 and 0 to add the Processing Baseline in the Datatake_ID (and Group_ID) definition.	
		ESA-795 *No PDI definition for compression by-passed*: updated Table 3-33 to change the metadataLevel on ACTIVE_DETECTOR from *Expertise* to *Brief*; updated Figure 59 and Table 4-9 to add the ON_BOARD_COMPRESSION_MODE metadata; updated sections 3.6.3.2 and 4.6.1 to include the compression by-passed description.	
		Section 1.3: added [GRIB] reference document.	

		Section 0: updated to clarify which auxiliary data can be embedded in the User Product.	
		Section 0: updated to include ESA's comments on PSD V08 delivered for CDR Close-Out Batch1.	
		Section 3.9.3.1: updated Table 3-43 and Table 3-46 to move Image_Display_Order node from Auxiliary_Data_Info to Image_Data_Info.	
		Section 3.11.3.1: updated Table 3-51 and Table 3-53 to move Image_Display_Order node from Auxiliary_Data_Info to Image_Data_Info.	
		Section 3.13.3.1: updated Table 3-59 and Table 3-61 to move Image_Display_Order node and QUANTIFICATION_VALUE metadata from Auxiliary_Data_Info to Image_Data_Info.	
		Section 3.12.3.1: updated Table 3-56 to add detaild regarding EPSG codes.	
		Section 3.19: added details on ECMWF PDI.	
		Updated the following sections to align the User Product Quality Inticators to OLQC procedures, checks and checklist names consolidation: sections 4.3, 4.6.5, 4.6.7.1, 4.7.7.1, 4.8.7.1 and 4.9.7.1	
		Updated the following sections to add the *Processing_Specific_Parameters* field (optional field reserved for production chain only but not propagated to User Product): sections 3.4.1, 3.5.1, 3.6.3.1, 3.7.3.1, 3.8.3.1, 3.9.3.1, 3.10.3.1 and 3.12.3.1.	
		The section 4 has been updated to clarify the content of the GRANULE and DATASTRIP folders inside the User Product.	
		Removed all reference to Cloud Mask for Level-0 Datastrip PDI (see comments in RID ESA-770).	
		Renamed in the Table 3-33 the metadata NUMBER_OF_T00_DEGRADED_PACKETS as NUMBER_OF_TOO_DEGRADED_PACKETS	
		Annex C: updated figure and example in the *OLQC Report* as per OLQC checks and checklist name consolidation.	
		Annex F: updated mask files description.	
		All: renamed the PDI XSD schema.	

		All: updated to include ESA's comments on PSD V08 delivered for CDR Close-Out Batch1.	
10	12/07/2013	**ESA-795** *No PDI definition for compression by-passed*: updated sections 0 and 3.6.3.2.	
		Sections 3.12.2, 3.19: removed *.grib* extension for ECMWF data.	
		Sections 3.2, 3.15.1, 3.16.1, 3.17.1, 3.19.1: added "S2_" Mission ID applicable to the constellation and used by satellite independent files.	
		Section 3.2, Annex E : removed *General Parameters File* being an obsolete GIPP file.	
		Sections 3.14.1, 3.15.1, 3.16.1 : updated to set "MPC_" as unique site centre originator of GIPP/DEM/GRI data.	
		Section 3.21: updated to add DPC annotation to SAD packets.	
		Section 0: updated PVI format.	
		Section 3.19.1: updated ECMWF centre originator.	
		Section 4.6.2.1: updated DPC annotations.	
		Annex C: clarified that the *Inventory_Metadata.xml* file is only for internal usage.	
		Annex G: updated example of metadata file for a Granule Aggregation	
11	28/03/2014	Sections 3.4.1, 3.6.3.1, 3.8.3.1, 3.10.3.1, 4.7.8.3 : updated SENSING_TIME metadata definition.	
		Section 3.18 and Table 3-11 : updated POD file type and naming convention according to the applicable [POD-FFS].	
		Section 3.2, Table 3-4 : added new GIP_CONVER file type. This new GIPP file is used for L1C processing.	
		Section 4.9.1 : GS-CDR RID implementation (**SYS-2179** *missing QUANTIFICATION VALUE formula*).	
		Section 2.14 and entire section 4: replaced "Preview Image" with "Browse Image" in User Product context. Updated Browse Image in PNG format.	
		Section 4.2: added clarifications regarding	

		AUX_DATA content and Browse Image definition. Changed the Browse Image file type to reflect the new name used for the Browse Images in User Product context.	
		Section 3.12.2 : clarified PVI naming convention and corrected typo in the Figure 48.	
		Section 3.14 : updated GIPP PDI packaging definition.	
		Section 3.7.3.1, Table 3-34: updated QUATERNION_VALUES convention as (qv1 qv2 qv3 qs).	
		Section 3.6.3.2 : updated ISP annotations description.	
		Section 3.1: updated note about TAR packaging.	
		Section 3.19.1: removed incorrect reference to [EOFFS-PDGS].	
		Section 3.21: updated to remove *Inventory_Metadata.xml* file from SAD PDI.	
		Sections 3.6.3.1, 3.8.3.1 and 3.10.3.1: added QL_FOOTPRINT metadata in Granule *Geometric_Info* node.	
		Removed from the document the Annex C containing the *Inventory_Metadata.xml* definition. This file is not relevant to the User Product definition and it shall be described in the relevant internal ICDs.	
		Removed from the document the tables containing the obsolete assumptions and open points.	
		The Chapters 1 & 2 and the appendices of the document have been reorganized and streamlined to have a document more End User oriented. Main changes: - Removed Annex C (Inventory_Metadata) and Annex I (Logical Product) - Added list of Acronyms used in document - Added the section "Sentinel-2 Mission Overview" to merge some relevant high-level summary info & diagrams on the Mission and MSI description - Reshuffled the subsections of the Chapter 2	

		Sections 3.7.3.1, 3.9.3.1 and 4.6.7.1: removed DATATAKE_SENSING_STOP metadata because redundant with DATASTRIP_SENSING_STOP at Datastrip level and misleading at User Product Level.	
		Section 4.6.7.1: added PRODUCT_START_TIME and PRODUCT_STOP_TIME metadata to have at metadata level the actual start/stop time of the product.	
		Section 4.2 : clarified the meaning of the "Start time" and "Stop time" used in the User Product naming convention.	
		Sections 4.4 and 4.6.7.1: added the query option "Area_Of_Interest".	
		Section 3.7: updated the whole section to clarify that in QI_DATA folder there are five (5) Quicklook files in JP2 format.	
		Sections 3.7.3.1: updated to define the REF_QL_IMAGE metadata as the pointer to the folder (QI_DATA) containing the preliminary Quicklook files.	
		Sections 3.7 and 4: updated to clarify that the SAD raw data included in the L0 User Product shall taken from the last Datastrip selected to be included in the product.	
		Updated the document to : - further clarify the difference between SAD PDI & SAD files inside the L0 Datastrip PDI. - define the ANC_DATA_REF metadata as the pointer to the folder (inside the L0 Datastrip PDI) containing the SAD raw data files.	
		Section 3.9.3.1: corrected typo in Figure 35 and Table 3-45 to align the document to the actual XSD schema.	
		Section 3.11.3.1: corrected typo in Figure 45 and Table 3-52 to align the document to the actual XSD schema.	
		Section 3.13.3.1: corrected typo in Figure 55 and Table 3-60 to align the document to the actual XSD schema.	
12	10/09/2014	Section 1.3: updated according to the applicable	

		technical baseline documentation.	
		Sections 3.13.3.1 and 4.9.7.1: updated to add Reflectance Conversion information. The *metadataLevel* attribute has been defined as “Standard“ according to the PSD-XSD.	
		Section 3.7.3.1 and Figure 20: updated General_Info/Processing_Info definition.	
		Section 3.9.3.1 and Figure 32: updated General_Info/Processing_Info definition.	
		Section 3.7.3.1: updated the *metadataLevel* attribute (Expertise) related to the ACTIVE_DETECTOR metadata.	
		Section 3.7.3.1: Removed the fields: • Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/QUATERNION_STATUS • Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/QUATERNION_STATUS Renamed the field: • Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/ATTITUDE_QUALITY_INDICATOR as: • Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/ATTITUDE_QUALITY Added the field: • Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/ATTITUDE_QUALITY_INDICATOR	
		Section 3.7.3.1: added OPTIONAL node: • Satellite_Ancillary_Data_Info/Other_Ancillary_Data/CSM_Flags_List/Values/INUSE_FLAG	
		All: updated the document according to the CGS and PAC ID defined in [EOFFS-PDGS]	
		Section 1.3: Added the reference to [EOM-OGC] and [S2MSK-TN] documents.	

		Section 3.6.2 and Annex C: corrected typo error to align the L0 Granule checklist name to the Table 3-17.	
		Sections 3.5.1 and 4.6.7.3: clarified the meaning of the ANC_DATA_REF metadata inside a L0 Datastrip PDI and a L0 User Product.	
		Section 3.7.2: added the default values for the 5 limited band in the Datastrip QI_DATA folder.	
		Sections 4.1, 4.6.3 and 4.6.7.5: clarified the time coverage of the SAD data embedded inside the L0 User Product.	
		Section 3.2 : Updated Table 3-8 and Table 3-9.	
		Sections 3.7.2 and 3.21.1: clarified the extension " .bin" for the SAD files.	
		Section 3.6.3.1: clarified the EXT_POS_LIST definition.	
		Removed the obsolete reference document [GRI-TN] and added the applicable [GRI-FFS].	
		Section 3.16: modified section according to [GRI-FFS].	
		Section 3.16.1: modified section according to [GRI-FFS].	
13	12/10/2015	Section 4.9.7.1: Implemented the issue ESA-3174. Renamed the metadata ECMWF_FILENAME as ECMWF_DATA_REF	
		Updated Figure 56 and Table **3-61** to implement the issue ESA-3630	
		Updated Figure 48 to implement the issue ESA-3175	
		Updated Annex D to implement the issue ESA-3334	
		Updated Annex C to implement the issue ESA-4084	
		Removed [OLQC-TN] as applicable document and updated the Annex C to implement the issue ESA-3254.	
		Replaced the file type GIP_R2EQOB with file type GIP_R2EOB2 according to the issue OPS-469	
13.1	19/11/2015	This issue of the document does not contain any change respect to the previous one in version 13.0.	

		The version number has been updated only to mantain the alignment versus the PSD-XSD annexed to this document issued with version number 13.1.	
13.2	04/05/2016	Updated section 4.9.1, section 4.9.8 and Table 3-57 according to the issue [ESA-4232]	
14.0	15/07/2016	Updated section 4.4: with new download options by addition of: • *Compact Naming Convention* option (SAFE_COMPACT) • *Single Tile Product Packaging* • *Complete Single Tile* • *Spectral Band* updated to include option of TCI images "*as a band*"	
		Added section 4.2.1 to define the *Products Compact Naming* convention root directory for all product levels	
		Added section 4.9.10 to define the Level-1C *Product Compact Naming* convention for the other product components beyond the root directory	
		Added section 4.9.11 to define the Level-1C Single Tile User Product format which includes definition of the option for Complete tile	
		Added section 4.9.12, in replacement of former section 4.10 removed from this version of the document, to define the filename convention of the TCI "*as a band*"	
		Updated section 4.6.7 Table 4-9 defining the *General_Info* product metadata section driven by new download options defined in section 4.4; this metadata item defined in such section is common to all product levels.	
		Section 3.18 regarding POD PDI has been deleted (not applicable to the Sentinel-2 products definition).	
		New set of schemas attached which are aligned to the version of the document: • S2-PDGS-TAS-DI-PSD-V14_Schemas.zip • S2-PDGS-TAS-DI-PSD-V14_SAFE.zip	
14.1	30/09/2016	Update section 4.4 and 4.9.11.2 for Complete Single Tile aux data and BWI removed.	

		Update section 4.6.7.1: Add new possible value in case of ngEO not available for the fields : PREVIEW_IMAGE_URL and PREVIEW_GEO_INFO.	
14.2	24/10/2016	PSD : • Updated Table 4-9 for new management of Complete Single Tile inside Query_options tag. • All references to the land/water mask have been removed • Typos corrected Schemas : • Updated DICO/14/PDGS/dimap/dimap.xsd	14.2
14.3	27/09/2017	PSD : • Update of the Annex D (GIPPs) for removal of unused GIP_R2MACO and GIP_R2DEBA and correction of the appearance levels for other GIPPs • Update of the L1B and L1C PDI and EUP Auxiliary_Data_Info_Diagram schemas to indicate the new GRI_List node (sections 3.11.3, 3.13.3, 4.8.7.1, 4.9.7.1) • Updated section 4.9.11.2; Product discriminator definiton for the “complete single tile” products has been updated. • Removed section 4.9.11.3 • Changed Figure 64, Figure 70 and Table 4-12 according to new quality_inspections section • Updated table in 2.4 paragraph (MSI bands). • Changed Figure 46 and Figure 56. • In Table 4-12 updated description of the field quality_check/@check_type • Removed FLAG suffix from quality indicators checktype (Table 4-12, section 4.8.7.1, section 4.9.7.1) • Updated 4.3 paragraph, table 4-12 and 4.7.8.2 paragraph to include all OLQC report in the EUP. Schemas : • Updated DICO subdirectories names to PDI-V14	14.3

		and EUP-V14 and associated links in XSDs • Addition of the previously removed node Image_Refining after PSD V13 for PDI validation • Addition of the GRI_List node for L1B / L1C PDIs and EUPs as per IPFSPR-437 and IPFSPR-501 • ECMWF node now optionnal as per IPFSPR-383 • Modification of the Quality_Control_Checks as per US-526 • Removal of all references to GIP_R2DEBA and GIP_R2MACO	

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1. INTRODUCTION

1.1 Purpose of the document

The purpose of the Sentinel-2 Products Specification Document (PSD) is to describe in detail the mission User Products.

The Sentinel-2 mission User Products are: Level-0, Level-1A, Level-1B and Level-1C.

The specification of the Sentinel-2 User Products includes the description of the Product Data Items (PDI) composing them.

1.2 Document Overview

This document is structured as follows:

Chapter 1: *Introduction*, provides the purpose and this overview of the document, the list of applicable and reference documents, a roadmap to help the reader navigating through the document, the list of the used acronyms. In addition this chapter provides the high level description of the Sentinel-2 Mission and User Products characteristics.

Chapter 2: *Sentinel-2 Product Definitions*, provides terms and concepts used for the Sentinel-2 User Products definition.

Chapter 3: *PDI Format Definition*, provides the definition of the content and structure for each type of PDI, the elementary units composing the User Products.

Chapter 4: *User Product Physical Format Definition*, defines the physical format for all Sentinel-2 User Products.

Annexed to this document two zip files are provided:

1. S2-PDGS-TAS-DI-PSD-V14.2_Schema.zip
2. S2-PDGS-TAS-DI-PSD-V14.2_SAFE.zip

The first zip file contains the XSD schema describing the PDI and User Products (metadata and physical structure).
The second zip file includes an example of SAFE Manifest for each PDI and User Product and the corresponding xfdu.xsd schema used to validate them.

1.3 Applicable and Reference Documents

Applicable Documents mentioned in this document are listed hereafter.

Reflabel	Reference	Version	Date	Title
PDD	GMES-GSEG-EOPG-TN-09-0029	2.3	30/03/2012	S2 PDGS Products Definition
OCD	GMES-GSEG-EOPG-TN-09-0008	2.2	15/12/2011	S2 PDGS Operations Concept Document

Reference Documents mentioned in this document are listed hereafter.

Reflabel	Reference	Version	Date	Title
SAFE-SPEC	GAEL-P264-DOC-0001-01-01	1.3	26/06/2014	Sentinel Standard Archive Format for Europe (sentinel safe) Control Book – volume 1 – Core Specifications
HMA-GML	OGC 07-036		27/08/2007	Geography Markup Language (GML) 3.2.1 Encoding Standard
EC-INSPIRE-DIR	DIRECTIVE 2007/2/EC		14.03.2007	DIRECTIVE-2007-2-EC (INSPIRE) - Establishing an Infrastructure for Spatial Information
EC-INSPIRE-CR	REGULATION 2008/12/EC		24.12.2008	REGULATION-EC-1205-2008 (INSPIRE) - Implementing Directive 2007-2-EC as regards Metadata
SAFE	WEB			Standard Archive Format for Europe (SAFE), http://earth.esa.int /SAFE/
DIMAP	WEB			DIMAP Format Specifications, http://www.spotimage.fr/dimap/spec/dimap.htm
S2GICD	GS2.ICD.ASD.SY.00006	9.0	04.03.2014	Satellite to Ground Segment Interface Control Document
S2GICD-MSI	GS2.ICD.ASF.MSI.00008	8.0	15/01/2013	MSI Mission Data ICD
DFEP-ICD	DFEP-ICD-KSAC-ESA-1066	1.8	19/10/2012	Sentinel DFEP External ICD – Volume 2
S2GICD-SAD	GS2.ICD.ASD.SY.00012	9.0	15/04/2014	Sentinel 2 Satellite Ancillary Data Interface Control Document
L2A-PDD	S2PAD-VEGA-PD-0001	4.1	20/09/2012	Sentinel 2 MSI – Level 2A products definition
EOFFS-PDGS	GMES-GSEG-EOPG-TN-10-0099	1.2	25/06/2013	Earth Observation GS File Format Standard – Tailoring for the Sentinel Missions PDGS
EOFFS	PE-TN-ESA-GS-0001	2.0	07/03/2011	Earth Observation Ground Segment File Format Standard
MRD	EOP-SM/1163/MR-dr	2.1	08.03.2010	Mission Requirements Document

Reflabel	Reference	Version	Date	Title
DAP-R	GMES-PMAN-EOPG-RD-08-0002	1.2	31.12.2010	Data Access Portfolio Requirement Document (DAP/R)
ECMWF-FCAST	WEB			ECMWF Deterministic Atmospheric Model Products
GRIB	GRIB Edition 1			A GUIDE TO THE CODE FORM FM 92-IX Ext. http://www.wmo.int/pages/prog/www/WMOCodes/Guides/GRIB/GRIB1-Contents.html
ECMWF-PDGS-ICD	GMES-GSEG-EOPG-IC-11-0102	1.0		ECMWF to Sentinel-2 PDGS ICD
GPP-DEM	GS2-IF-GSGP-70-CNES	1.1	18/03/2010	System DEM Description (GLOBE, filtered SRTM) content and format
GRI-FFS	GMES-S2GS-EOPG-TN-13-0004	1.1	15/10/2014	Sentinel-2 GRI Format Specification Document
CCTS-US	S2-PDGS-TAS-DI-CCTS-US	07	22/11/2013	User Services Technical Specification Document (US-CCTS)
NGEO-EICD-S2	NGEO-13-ICD-DLR-066	1.4	2012-07-16	EXTERNAL ICD FOR SENTINEL-2
SAD	S2-PDGS-TAS-DI-SAD	08	14/12/2013	Sentinel-2 PDGS System Architecture Design Document
SRD	GMES-GSEG-EOPG-RD-09-0028	2.3	22/05/2013	S2 PDGS System Requirements Document
GPP-IODD	GS2-ICD-GS-80-CNES	1.12		GMES Sentinel2 Ground Prototype Processor – Interface Control Document (XSD Set.zip)
GMLJP2	OGC 05-047r3			GML in JPEG2000 for Geographic Imagery (GMLJP2) Encoding Specification http://www.opengeospatial.org/standards/gmljp2
JP2STD	ISO/IEC 15444-1		2004	JPEG 2000 standard part 1 and part 2, http://www.jpeg.org/jpeg2000
OLQC-GIPP	GAEL-P268-TCN-001	1.1	2012-12-11	OLQC-GIPP interface
POD-FFS	GMES-GSEG-EOPG-FS-10-0075	1.7	20/12/2013	GMES Sentinels Precise Orbit Determination (POD) Service: OFL POD Service and NRT POD Facility File Format Specifications
EOM-OGC	OGC 10-157r3	1.0	2011-12-01	Earth Observation Metadata profile of Observations & Measurements
S2MSK-TN	CS1106.Document.ref.000044	1.0	14/09/2012	S-2 Mask Solution with the HMA-FO NGEO-S2 updated schema TN

1.4 How to Use this Document

Purpose of the following tables is to help the reader in navigating in the document. The first one shows the document sections classified according to the different user types; the second one contains a short executive summary of the main contents of the document.

User Type	Pointers to the document section
End User	Roadmap: a) Chapter 1: to know the purpose of this document and to have a preliminary overview of the User Product format; b) Chapter 2: to learn the main product definitions and concepts; c) Chapter 3: to have a description of all possible elements that can be embedded in the User Product; d) Chapter 4: contains the User Product specifications that drive the User Product definition, its structure and its format; this chapter contains all the permanent links to the first three chapters of the document.
IPF Developers	All needed information is contained in the Chapter 3 of the document.
MPA Developers	All sections related to the quality indicators definition at PDI level and at User Product level. Roadmap: Section 3.4; Section 3.5 Table 4-12 Annex C for OLQC report schema

Executive Summary	Pointer to the document section
All terms and Definitions	They are collected in the section 2
Physical Format of a S2 User Product	Section 4.1
Naming Convention of a S2 User Product	Section 4.2
List of download option available for an End User	Section 4.4
Physical structure of a Product Data Item	L0 PDI: sections 3.6.2 and 3.7.2 L1A PDI: sections 3.8.2 and 3.9.2 L1B PDI: sections 3.10.2 and 3.11.2 L1C PDI: sections 3.12.2 and 3.13.2
Naming Convention of a Product Data Item	Section 3.2

1.5 Acronyms

Specific abbreviations used in this document are given below.

Acronym	Definition
AOCS	Attitude and Orbit Control System
CGS	Core Ground Segment
CNES	Centre National d'Études Spatiales
DAP	Data Access Portfolio
DEM	Digital Elevation Model
DIMAP	Digital Image MAP
DTED	Digital Terrain Elevation Data
ECMWF	European Centre for Medium-Range Weather Forecasts
ESA	European Space Agency
EO	Earth Observation
FEE	Front End Electronic
FPA	Focal Plane Assembly
GCP	Ground Control Point
GIPP	Ground Image Processing Parameters
GMES	Global Monitoring for Environment and Security
GML	Geography Markup Language
GPP	Ground Prototype Processor
GPS	Global Positioning System
GRI	Global Reference Images
HKTM	House Keeping Telemetry
IAD	Image Ancillary Data
IAS	Image Algorithm Software
ICD	Interface Control Document
IDP-SC	Instrument Data Processing Software Components
INSPIRE	Infrastructure for Spatial Information in Europe
IPF	Instrument Processing Facility
ISO	International Organization for Standardization
ISP	Instrument Source Packet
JPIP	JPEG Interactive Protocol
JP2	JPEG2000 format
MRD	Mission Requirements Document
MSI	Multi-Spectral Instrument
NRT	Near-Real-Time
NUC	Non-Uniformity Coefficients
OLIB	On-Line Image Browser
OLQC	On-Line Quality Control
PDI	Product Data Item
PDGS	Payload Data Ground Segment
PVI	PreView Image
QC	Quality-Control
QI	Quality Indicator
QL	Quick-Look
SAFE	Standard Archive Format for Europe
SRTM	Shuttle Radar Topographic Mission
SSD	Spatial Sampling Distance

SWIR	Short Wave Infra-Red
TBD	To Be Defined
TCI	True Colour Image
TDI	Time Delay and Integration
TOA	Top-Of-Atmosphere
US-MGRS	US-Military Grid Reference System
UTM	Universal Transverse Mercator
VNIR	Visible and Near Infrared
WGS	World Geodetic System
WICOM	Wavelet Image Compression Modules

1.6 Sentinel-2 Mission Overview

Sentinel-2 Mission is an European earth polar-orbiting satellite constellation (Sentinel-2A and 2B) designed to feed the GMES system with continuous and operational high-resolution imagery for the global and sustained monitoring of Earth land and coastal areas.

The Sentinel-2 system is based on the concurrent operations of two identical satellites flying on a single orbit plane but phased at 180º, each hosting a Multi-Spectral Instrument (MSI) covering from the visible to the shortwave infrared spectral range and delivering high spatial resolution imagery at global scale and with a high revisit frequency.

The MSI aims at measuring the earth reflected radiance through the atmosphere in 13 spectral bands spanning from the Visible and Near Infra-Red (VNIR) to the Short Wave Infra-Red (SWIR):

- 4 bands at 10m: blue (490nm), green (560nm), red (665nm) and near infrared (842nm).
- 6 bands at 20m: 4 narrow bands for vegetation characterisation (705nm, 740nm, 783nm and 865nm) and 2 larger SWIR bands (1610nm and 2190nm) for applications such as snow/ice/cloud detection or vegetation moisture stress assessment.
- 3 bands at 60m mainly for cloud screening and atmospheric corrections (443nm for aerosols, 945 for water vapour and 1375nm for cirrus detection).

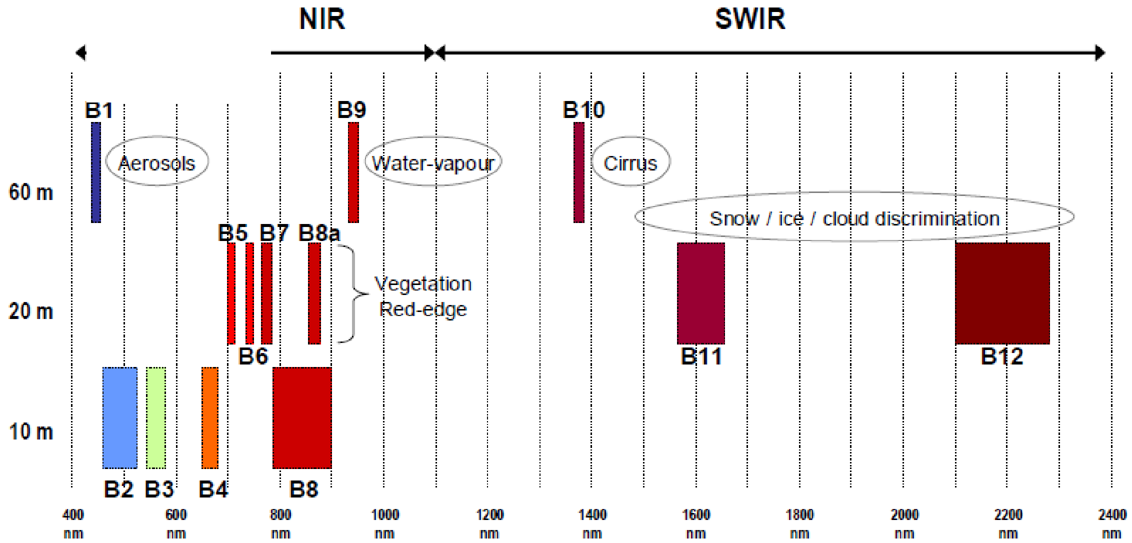


Figure 1: MSI Spectral-Bands versus Spatial Resolution

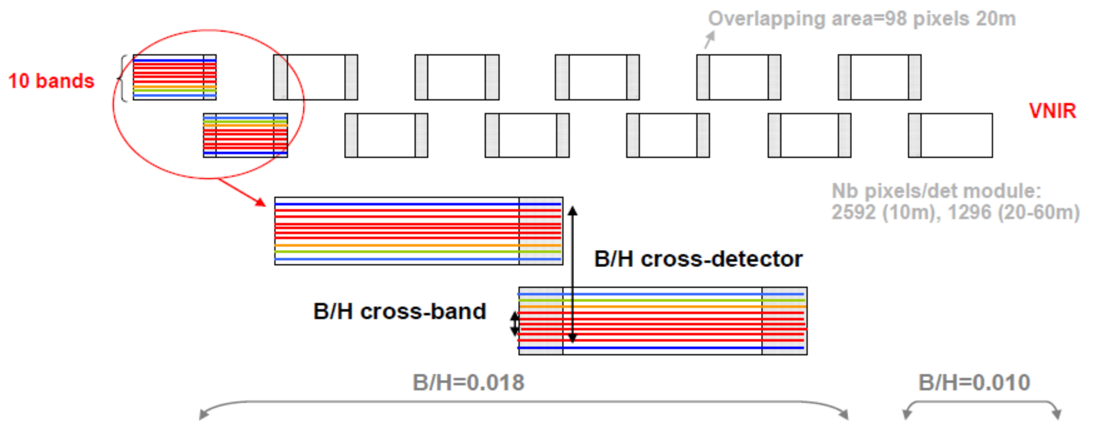
The MSI instrument design has been driven by the large swath requirements together with the high geometrical and spectral performance of the measurements.

It is based on a telescope feeding two focal planes spectrally separated.

Two distinct arrays of 12 optical detectors mounted on each focal plane cover respectively the VNIR and SWIR channels.

The 12 detectors on each focal plane are staggered-mounted to cover altogether the 20.6º instrument field of view resulting in a compound swath width of 290km on the ground-track.

As described in the following figure, because of the staggered positioning of the detectors on the focal planes, a parallax angle between the two alternating odd and even clusters of detectors is induced on the measurements resulting in a shift along-track of about 46km (maximum) inter-detector. Likewise, the hardware design of both the VNIR and SWIR detectors imposes a relative displacement of each spectral channel sensor within the detector resulting in an inter-band measurement parallax amounting to a maximum along-track displacement of about 14km.



Band	2	8	3	4	5	6	7	8a	1	9	10	11	12
Odd/even detector parallax angle (B/H)	0,022	0,026	0,030	0,034	0,038	0,042	0,046	0,051	0,055	0,059	0,030	0,040	0,050

10m 20m 60m

VNIR SWIR

Figure 2: Staggered detector configuration and inter-detector/inter-band parallax angles

The Sentinel-2 mission objectives include the operational supply of optical data, with high revisit frequency, coverage, timeliness and reliability, for services such as:

- Risk Management (floods and forest fires, subsidence and land slides)
- European Land Use/Land Cover State and Changes
- Forest Monitoring
- Food Security/Early Warning Systems
- Water Management and Soil Protection
- Urban Mapping
- Natural Hazards
- Terrestrial Mapping for Humanitarian Aid and Development

Sentinel-2 mission objectives present a new challenge requiring space and ground segment resources in terms of:

- Temporal coverage, which translated into the need for a short orbit repeat cycle (10-days) and for a dual spacecraft operations in twin configuration providing a 5-days revisit frequency;
- Large spatial coverage and high coverage frequency, which translated into the need for a with wide swath coverage (290 km) with capabilities of global land masses acquisitions;
- High operation time during the daylight portion of the orbit;
- Wide spectrum optical range (visible to short-wave infrared) including 13 spectral bands;
- Data accessibility to the large Sentinel-2 data volume.

Mission data users include:

- GMES Service Projects (GSPs) and European adding value industry
- National users
- Scientific users
- Operational Meteorological users
- ESA Climate Change Initiative Programme users
- Sentinel-2 calibration and validation users
- International partners with granted access to Sentinel-2 real-time data downlinks
- Other users supported by the ESA data policy

1.7 Sentinel-2 Product Overview

The Sentinel-2 **User Product** is defined by a collection of data items (image, ancillary, auxiliary data) and metadata describing all elements composing the product.

The product data items and the metadata are selectable through a user download options (cf. section 4.4).

The User Product physical structure is defined in the Chapter 4.

1.7.1 User Product General Description

The **User Product** is the product delivered to the user corresponding to:

- A user defined geographical Area-Of-Interest;
- A user defined selection of the User Product components specified as download options (cf. section 4.4) according to different user needs and authorizations.

The User Product is composed by a set of Granules (also called Tiles for L1C User Product)intersecting/touching the Area-Of-Interest defined by the user. A Granule is the minimum indivisible partition of a User Product (containing all possible spectral bands).

The following figure illustrates the User Product concept for the L1C User Product that aggregates all Tiles corresponding to the user defined Area-Of-Interest.

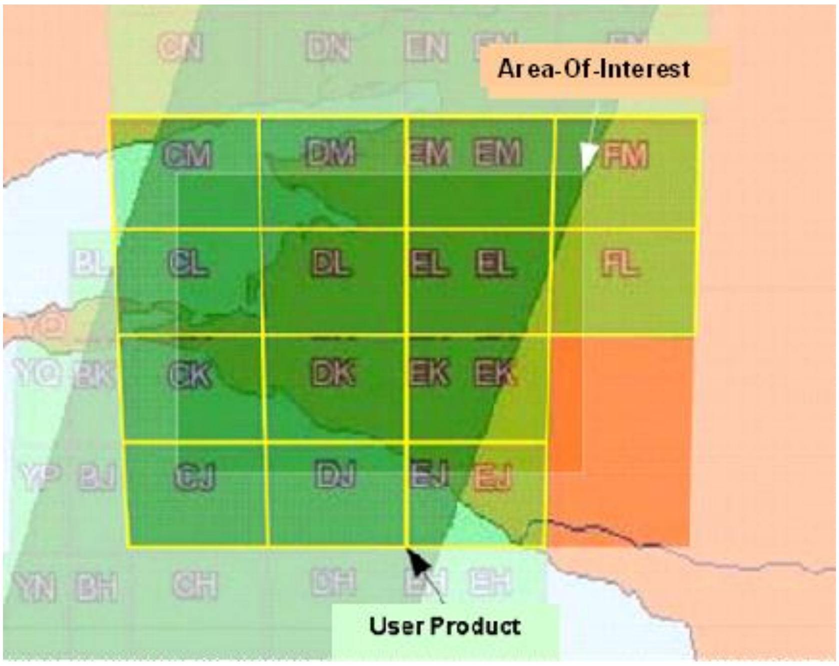


Figure 3: L1C User Product aggregating all Tiles intersecting a user defined Area-Of-Interest

The S2 User Products are hence composed by a compilation of physical product components referred as **Product Data Items** (PDI) corresponding to the minimum indivisible partition of one Sentinel-2 User Product.

A PDI is a self standing atomic piece of processing-related data:

- **self standing**: it is formed by data and metadata, the meta data fully describing the data allowing to handle it as a whole,
- **atomic**: a PDI is never split in smaller pieces until download time (where the user may decide to get only a subset of bands for instance),
- **processing-related data**: it can be of Granule type, Tile type, Datastrip type, Ancillary or Auxiliary data type (cf. section 3.1),
- **univocally identified**: a PDI is identified and referenced by a unique PDI ID.

Each PDI is composed by a set or an excerpt of PDI elements:

- Image data (MSI data);
- Image metadata;
- Image quality reports including quality data indicators and quality checks;
- Auxiliary data;
- Satellite Ancillary data;
- Preview Image data.

The User Product will include only the selected PDI elements.

1.7.2 User Product Format

The User Product is formatted by default as a **SENTINEL - SAFE** (Standard Archive Format for Europe) product.

The **SAFE** has been designed to act as a common format for archiving data within ESA Earth Observation archiving facilities and for distributing data to End Users.

SAFE benefits from the experience gathered while developing standards related to data formats.

SAFE intends to resolve the major challenges coming from the packaging and the long-term preservation of Earth Observation data. Special attention has been taken to ensure that SAFE conforms to the ISO 14721:2003 OAIS (Open Archival Information System) reference model and related standards such as the emerging CCSDS/ISO XFDU (XML Formatted Data Units) packaging format.

In order to address the specific needs of Sentinel data, a particular "version" of the SAFE format has been adopted, named "SAFE for Sentinels" (cf. [SAFE-SPEC]), developed to act as a standard format for Sentinels platform data; it can be defined a "SAFE - like" format, where a few new types specific to Sentinels and different constraints on existing types have been introduced.

In addition to the SAFE format used as baseline to package a S2 User Product, the user will have the possibility to select an other optional output format based on **DIMAP** (Digital Image MAP) format (cf. [DIMAP]).

In this document the S2 SAFE User Product format is presented and in Annex A the differences with respect to S2 DIMAP User Product format are described.

Finally, it is important to note that Sentinel-2 User Products is compliant to the **INSPIRE** (Infrastructure for Spatial Information in the European Community) Metadata regulation (cfr. [EC-INSPIRE-CR] and [EC-INSPIRE-DIR]).

INSPIRE is an European Union initiative to establish an infrastructure for spatial information in Europe that helps to make spatial or geographical information more accessible and interoperable for a wide range of purposes. The Sentinel-2 datasets in their inherent quality of describing spatial data are fully entitled to comply with the directive and hence the INSPIRE Metadata directive applies in entirety to the Sentinel-2 products. More details about INSPIRE Metadata regulation are in the Annex B of the document.

2. SENTINEL-2 PRODUCT DEFINITIONS

This section aims to presenting some general definitions regarding the User Products:

- Product Levels
- Processing Baseline
- Metadata Management
- Product Data Item (PDI)
- Timeliness definition

2.1 Orbit

The term **Orbit** used in this document refers to any specific Sentinel-2 spacecraft orbit.
Each satellite will operate in a reference sun-synchronous orbit with a repeat cycle of 10 days for the overall duration of the mission. Sentinel-2A and Sentinel-2B will be in the same orbit allowing a ground-track revisit frequency of 5 days for the dual-spacecraft constellation.

2.2 Datatake

The Sentinel-2 User Products will always refer to a given **Datatake.**
Datatake definition refers to a continuous acquisition of an image from one Sentinel-2 satellite in a given MSI imaging mode. The maximum length of an imaging Datatake is 15000 km (continuous observation from Northern Russia to Southern Africa) and this is the longest possible product that a user can ask for.

Datatake_ID identifies univocally a given Datatake.

Datatake_ID: GS[SS]_[YYYYMMDDTHHMMSS]_[RRRRRR]_N[xx.yy]

Field Name	Value/Meaning	Note
SS	*2A* *2B*	Identifies the Sentinel2 satellite
YYYYMMDDTHHMMSS	identifies the Datatake Start Time	Fourteen digits, date and time separated by the character T
RRRRRR	000001-999999	Identifies the Absolute Orbit Number
xx.yy	x,y = {0;9}	Processing Baseline (cf. further for the “Processing Baseline” definition). Note that a reprocessing production generates a new Datatake and consequently a

		new Datatake_ID.

Table 2-1: Datatake_ID Definition

Datatake_ID Template:
GS2B_20141104T134012_123456_N01.01

2.3 Datastrip

Within a given Datatake, a portion of sensed image downlinked during a pass to a given station is termed **Datastrip**. If a particular orbit is acquired by more than one station, a Datatake is composed of one or more Datastrips.

A Datastrip refers thus to all data corresponding to:

1. a single Datatake;
2. downlinked over a given ground station.

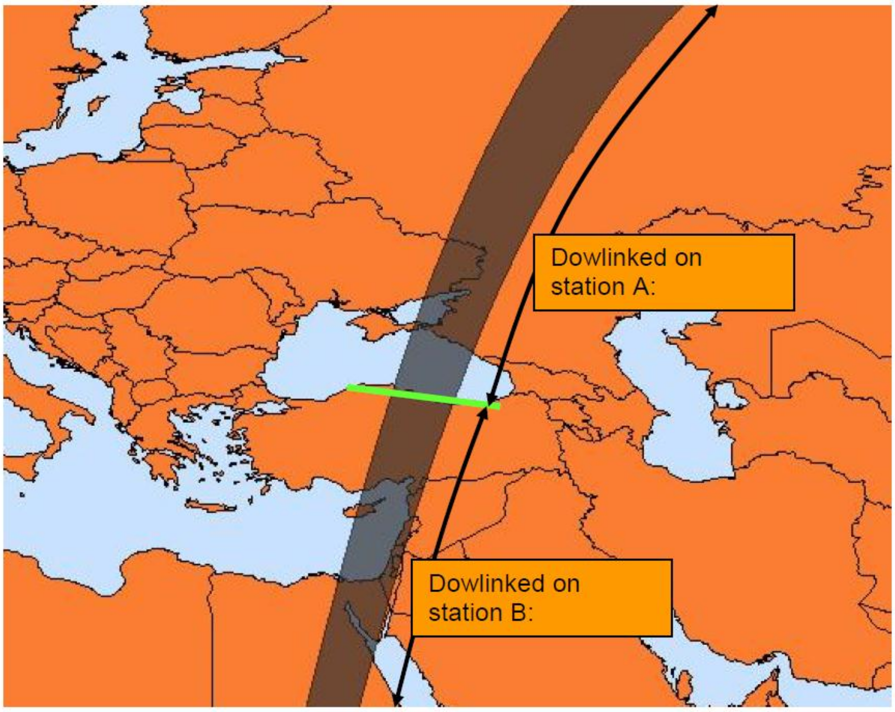


Figure 4: Datatake segmentation in Datastrips

<u>In terms of Datatake and Datastrips a Sentinel-2 User Product may therefore include one or more Datastrips belonging to the same Datatake.</u>

The minimum length of a Datastrip is 92 km corresponding to four on-board scenes (cf. further for the “scene” definition).

The maximum length of a Datastrip is theoretically the maximum length of a Datatake i.e. 15000 km (continuous observation from Northern Russia to Southern Africa).

The Datastrip identifier is a character string that identifies in a unique way a Sentinel-2 acquired Datastrip relatively to a given Datatake.

In the chapter 3, where the Datastrip Product Data Item is described, the Datastrip identifier is defined through the PDI_ID definition.

2.4 MSI Bands

The MSI **Spectral Bands** span from the Visible and the Near Infra-Red to the Short Wave Infra-Red:

- 4 bands at 10m;
- 6 bands at 20m;
- 3 bands at 60m.

The MSI spectral bands are identified by a single integer number. The correspondence between band name and band number is given in the following table.

	S2A		S2B		
Band Number	**Central wavelength (nm)**	**Bandwidth (nm)**	**Central wavelength (nm)**	**Bandwidth (nm)**	**Spatial resolution (m)**
1	443.9	27	442.3	45	60
2	496.6	98	492.1	98	10
3	560.0	45	559	46	10
4	664.5	38	665	39	10
5	703.9	19	703.8	20	20
6	740.2	18	739.1	18	20
7	782.5	28	779.7	28	20
8	835.1	145	833	133	10
8a	864.8	33	864	32	20
9	945.0	26	943.2	27	60
10	1373.5	75	1376.9	76	60
11	1613.7	143	1610.4	141	20
12	2202.4	242	2185.7	238	20

This convention is used to identify the spectral bands within the User Product.

2.5 MSI Detectors

The MSI includes two focal planes each one hosting two distinct arrays of 12 optical **Detectors** to cover respectively the VNIR and SWIR channels:

- a VNIR focal plane made of 12 staggered detector modules
- a SWIR focal plane made of 12 staggered detector modules.

From an image processing point of view the detectors are identified by 2 digits from 01 to 12. Detectors' images are numbered from 01 to 12 in the left to right order, i.e. from west to east in the case of a descending orbit.

2.6 MSI Scene

MSI image data is packaged on-board in a set of instrument source packets called "on-board scene" or "***scene***". This scene corresponds to a simultaneous observation of about 3.6 seconds for all bands and all detectors, which means an approximate coverage on ground of 23km along track, for each band.
Each scene consists then of a deterministic number of CCSDS source packets depending only on the geometric resolution as indicated in the following table:

SSD	Number of packets (strips) per detector and band	Number of detectors	Number of bands	Number of CCSDS packets	Bands
10 m	144	12	4	6912	B2, B8, B3, B4,
20 m	72	12	6	5184	B5, B6, B7, B8a, B11, B12
60 m	24	12	3	864	B1, B9, B10

The MSI instrument can be configured to have data in compressed or by-passed/uncompressed mode in order to fit the downlink bandwidth. Compression by-passed implies that data for only 4 detectors are provided (cf. section 3.6.3.2).

2.7 Product Granules

The Sentinel-2 User Product is composed by a set of Granules which are called Tiles for L1C User Product.

2.7.1 Granules

MSI products are provided as a compilation along a single orbit of elementary **Granules** of fixed size. In this respect, the product granularity corresponds to the minimum indivisible partition of one Sentinel-2 User Product.

For Level-0, 1A and 1B products, these Granules are sub-images in MSI sensor reference frame of a given number of lines along-track and detector separated.
Granules are defined further for each product level type.

All Granules intersecting/touching the Region of Interest of the user are provided into the final User Product.

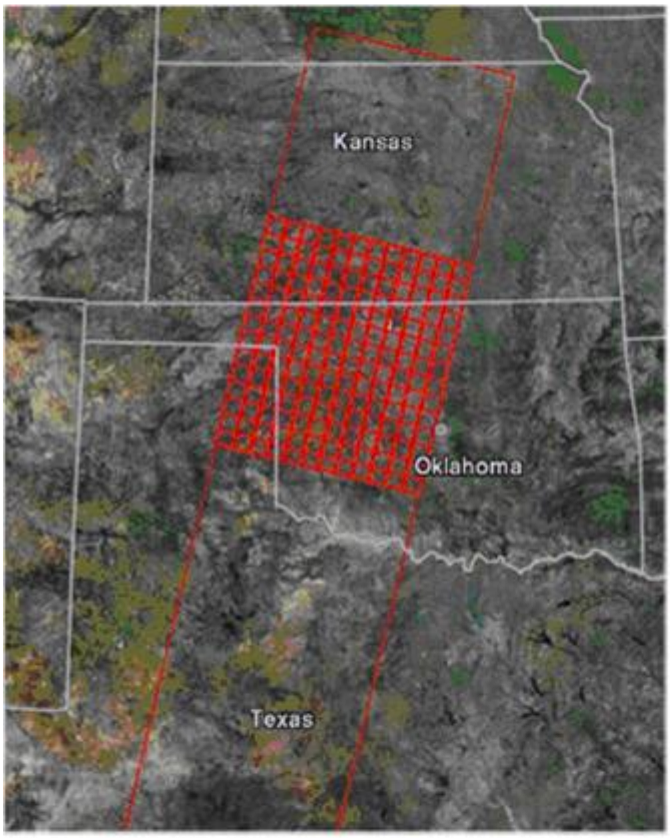


Figure 5: Example of Granules covering an Area-Of-Interest of the User

2.7.2 Tiles and UTM Tiled Grid

For ortho-rectified products (Level-1C), the Granules are called **Tiles**. A Tile consists of 100kmx100km squared ortho-images in cartographic reference frame UTM/WGS84 (Universal Transverse Mercator / World Geodetic System 1984) projection.

Ortho-rectified product are systematically projected on UTM-UPS/WGS84 projection and tiled. A UTM tiling following the US-MGRS (US-Military Grid Reference System) grid approach is proposed:

- The vertical UTM boundaries and horizontal latitudinal band boundaries define 6° X 8° Grid Zones.
- Each Grid Zone is filled by 100,000-meter grid squares.

The MGRS is derived from the UTM grid system and the UPS (Universal Polar Stereographic) grid system, but uses a different labelling convention. The MGRS is used for the entire earth.

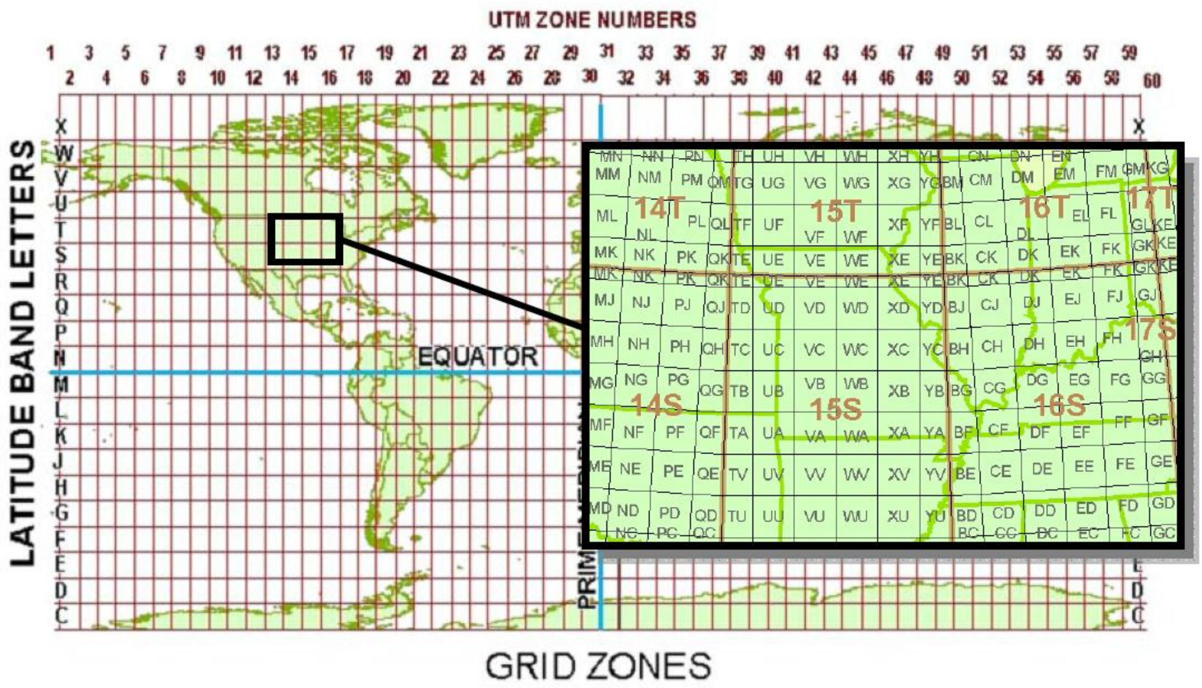


Figure 6: Example of tiling (100x100km²) within the UTM15 zone

Hence, the ortho-rectified products (Level-1C) are tiled according to this grid (approximately 100kmx100km). The UTM zone is selected according to each Tile of the product.

2.7.3 Granules Along-Track Aggregation

Granules Along-Track aggregation is a download option applicable to L1A and L1B User Products allowing the user to create for each detector one image grouping all single Granules along track. An image viewer may not support well the high number of Granules constituting the L1A/L1B S2 products therefore this option allows to produce at maximum 12 images per band, whatever is the Area-Of-Interest as illustrated in the following figure.

Figure 7: Granules aggregated along-track

2.7.4 Tile Consolidation

Due to the number of CGS in the PDGS system, a single Datatakes could be split in several Datastrip. For products in instrument geometry (L0, L1A, L1B), this does not raise any issues but for L1C, the tiles located at the end of a Datastrip and at the beginning of the consecutive one are complementary and uncompleted. Those tiles need to be consolidated to complete them as shown in the following figure:

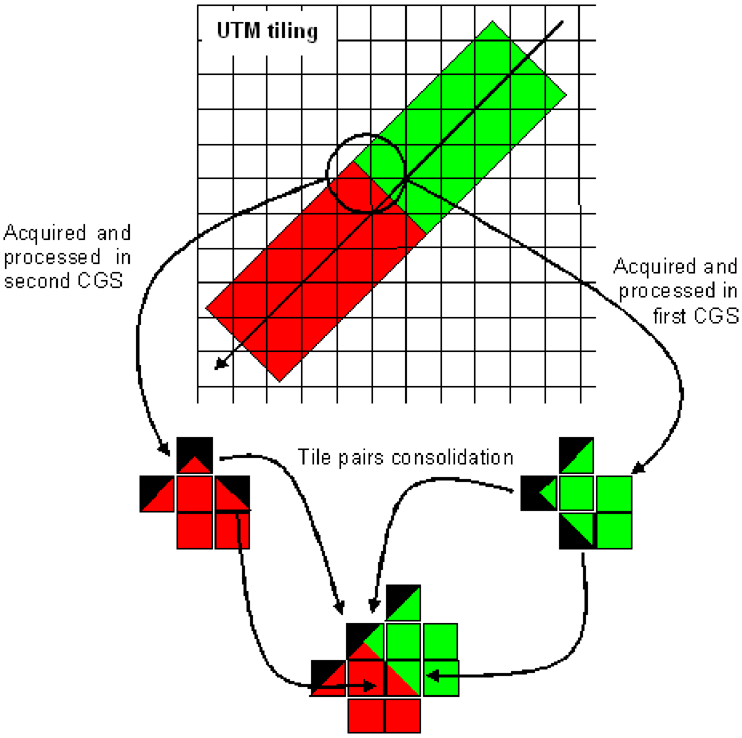


Figure 8: Tile pairs consolidation

2.8 Product Levels

All data acquired by the MSI from the Sentinel-2 constellation will be systematically processed from Level-0 up to Level-1C, as cascading from data reception on-ground in a systematic manner.

Level-0 data processing operations will be performed in real-time during the data-reception operations. They will consist in packaging the MSI and satellite ancillary raw-data supplied by the front-end CGS equipment, and in locally archiving it as Level-0 data files together with appropriate annotations and metadata to enable further processing.
The Level-0 consolidation processing will provide the preliminary quick-look and the ancillary data to be included inside the Level-0 consolidated product.

Level-1 processing includes the three-step processing to generate Level-1A, Level-1B and Level-1C data starting from the consolidated Level-0 data. These three levels correspond respectively to the S2MSI1A, S2MSI1B and S2MSI1C data-products.

The Sentinel-2 Product Levels are compliant with the definitions provided in the applicable documents [MRD] and [DAP-R] definitions.

- The **Level-0 (consolidated)** product corresponds to raw images still on board compressed.

- The **Level-1** products are generated from the Level-0 product:
  - Level-1A : "Raw Image" after decompression,
  - Level-1B : "Radiometrically corrected." product with geometric model refined appended but not applied,
  - Level-1C : Orthorectified product (geometric ortho-correction taking into account a DEM) providing Top Of Atmosphere Reflectances.
- The **Level-2A** prototype product is an orthorectified product providing Bottom-Of-Atmosphere reflectances, and basic pixel classification (including classes for different types of cloud) (cf. [L2A-PDD]). The generation of this prototype product will be triggered “interactively” by the PDGS users based on S2MSI1C products but it will not be systematically generated. This document does not cover the Level-2A product specifications.

This table outlines the Sentinel-2 User Products with the specification of the product type, level, a brief description and destination users. For completeness, in addition to the Level-0 and Level-1 products, the table contains also the S2HKTM product routed to FOS after their generation at CGS and the S2MSI2Ap prototype product.

Type	Processing Level	Outline Description	Granularity	Intended Users
S2HKTM	N/A	Sentinel-2 spacecraft Housekeeping telemetry in Transfer Frame format	One entire downlink pass (downlink dependent)	FOS
S2MSI0	0	MSI raw-image-data (compressed) in raw ISP format	Per detector and on-board scene 25km across-track 23km along-track	MSI instrument Experts PDGS internal users
S2MSI1A	1A	MSI uncompressed raw image data with spectral bands coarsely coregistered and appended Ancillary data	Per detector and along-track onboard scene size: 25km across-track 23km along-track Along-track band co-registration is performed	Not distributed to external users
S2MSI1B	1B	Radiometrically corrected (calibrated) MSI image data with spectral bands coarsely co-registered and refined geometric model appended but not applied		Expert End Users
S2MSI1C	1C	Ortho-rectified and UTM geo-coded Top-of- Atmosphere Reflectance with sub-pixel multispectral and multi-date registration	One 100x100km UTM Tile covered within one orbit	General End Users
S2MSI2Ap	2A	Bottom-of-Atmosphere multi-spectral reflectance in S2MSI1C geometry (orthorectified & UTM)		

Table 2-2: Sentinel-2 product levels and main characteristics

2.9 Processing Baseline

The Processing Baseline completely defines the processing environment baseline used at the time of the product generation in terms of:

- Processors version number;
- Static Auxiliary Data (e.g. DEM, GRI) each one with a version number;
- Dynamic Auxiliary Data (e.g. ECMWF data or POD data), each one with its associated version number,
- Processing Configuration files versions.

Processing Baseline = xx.yy where x,y = {0;9}

An increase of the Processing Baseline code is generated by a change of the elements listed above. A major change is traced by the “xx” digits, a minor change is traced by the “yy” digits.

Note: all the PDIs of a Datatake are always processed with the same Processing Baseline even if acquired in different stations.

For further details regarding the Processing Baseline management cf. [SAD].

2.10 Metadata

The metadata information included in the products (PDI and User Product) provides the requested level of information and referring all the product data items. In the chapter 3 and 4 all the metadata provided for each PDI (Granule and Datastrip) and User Product (L0/L1A/L1B/L1C) are detailed.

Each PDIs contains many metadata, each one being allocated a metadata level from general product information to detailed product indicators:

- ***Brief*** metadata provide to the user high level information and an overview of the product.
- ***Standard*** metadata are an extension of the previous one providing more detailed information on the delivered product. Additional information is then appended.
- ***Expertise*** metadata can be appended to the previous ones. Those metadata identifies a set of information accessible to expert users mainly for Cal/Val or expertise purposes e.g. for in flight commissioning or for image quality routine follow-up.

The classification Brief/Standard/Expertise is used to provide different level information to the user according to their permissions.

Each PDI metadata (cf. *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* annexed to this document) is labelled with a specific *metadataLevel* attribute. During the User Product assembling, this attribute is used to select, according to a download option (cf. section 4.4), the set of metadata that must be included in the product.

For these filtered fields, the *metadataLevel* attribute is not written in the User Product's metadata.

The schemas related to the PDIs provided with the zip file (*S2-PDGS-TAS-DI-PSD-V14_Schemas.zip*) annexed to this document, contains the *metadataLevel* attribute for each metadata describing the product data items.

2.11 Quality Indicator (QI) Data

Sentinel-2 products are annotated with Quality Indicators (QIs) in order to provide the user of a dataset the required information to assess its suitability for a certain use/application.

QIs are coming partly as result of the nominal production processing and partly from On Line Quality Control checks performed systematically after the nominal production processing.

Same examples of Quality Indicators are defective pixels mask, cloud masks, on-line quality control reports.

2.12 Satellite Ancillary Data

The Satellite Ancillary Data (SAD) are dumped at the end of each acquisition over a ground station. Sentinel-2 satellites provide Ancillary Data to feed the on-ground image data processing such as orbit position, velocity, time and attitude (generated by the Attitude and Orbit Control System).

The detailed content of the Satellite Ancillary Data source packets is provided in the Satellite Ancillary Data ICD (Interface Control Document) [S2GICD-SAD] and [SAD].

Note that the raw SAD which is a PDI itself (cf. section 3.21) cover one orbit; the decoded SAD, which is inside the product metadata, cover at most the full Datatake.

2.13 Auxiliary Data

Auxiliary Data identifies all auxiliary information to be used by the PDGS for the data-processing activities. The auxiliary data required by S2 data production are:

- Ground Image Processing Parameters (**GIPP**): set of **XML** files associated to each processing component to define a set of parameters and their values.

  According to a download option, the GIPP files can be embedded in the User Product.

- Digital Elevation Model (**DEM**): at low spatial resolution (GLOBE DEM in DTED-0 format) and at high spatial resolution (SRTM-based in DTED-1 format). For format details cf. [GPP-DEM].

  Due to huge volume of this auxiliary data, the DEM is never embedded in the User Product (no download option).

- Global Reference Image (**GRI**): set of unitary reference images covering one orbit. Each unitary reference image is a mono-spectral **Level-1B product**.

  Due to huge volume of this auxiliary data, the GRI data are never embedded in the User Product (no download option).

- European Centre for Medium-Range Weather Forecasts (**ECMWF**): Total Column Ozone (TCO3), Total Column Water Vapour (TCWV) and Mean Sea Level pressure (MSL)not required for data processing but appended to Level-1C User Products.

  Those auxiliary data, resampled in L1C geometry and generated in GRIB V1 format (cf. [GRIB]) are always providedas part of L1C Tiles. The raw ECMWF are never embedded in the User Product (no download option).

- International Earth Rotation & Reference Systems service (**IERS**): bulletins about Earth orientation and Terrestrial reference system (Earth Pole position, UT1-UTC,) published daily. These bulletins are required for the computation of the geometrical model.

  According to a download option, the IERS bulletins can be embedded in the User Product.

- Precise Orbit Determination (**POD**): an **XML** file, used in case of GPS data anomaly with the on-board navigation solution.

  Auxiliary data never embedded in the User Product (no download option).

2.14 Browse Image Data

The Browse Image in PNG format can be included in the User Product if required by the user (download option). The Browse Image corresponding to the entire product is based on the PVI extracted from the Level-1C Tiles (cf. section 3.12.2).

3. PDI FORMAT DEFINITION

This chapter describes the physical structure and content provided for each PDI-Type.

3.1 Type of PDI

The following type of PDIs has been identified:

- **PDI-type Granule**: *PDI Granule* contains image data and it is defined for each processing level, Level-0 (consolidated), Level-1A, Level-1B and Level-1C.
- **PDI-type Datastrip**: *PDI Datastrip* is defined for each processing level, Level-0 (consolidated), Level-1A, Level-1B and Level-1C.

PDI Granule and Datastrip will be stored as a **tar**[1] file identified by a unique PDI_ID (string label defined for each kind of PDI described in the next chapter).

NOTE: the PDI used to construct the End User Product will never be embedded as TAR but as folder containing the selected components to be included in the product.

- **PDI-type True Color Image**: TCI&PVI is always associated to a unique Level-1C product. The PDI related to the L1C product at Tile level, includes the Preview Image. For TCI (JPEG2000 with GML geo-referencing) a specific PDI is provided because can be needed to distributed it independently from the Level-1C Tile PDI.
- **PDI-type Auxiliary**: this type of PDI refers to each archived auxiliary data. In this case the PDI (where not otherwise specified) coincides with the aux data itself and the name of the auxiliary data represents the unique PDI_ID identifying univocally the auxiliary data. If the PDI is composed by a unique file (the auxiliary file), the PDI coincides with the file itself, otherwise the PDI is archived as a *tar* or *tgz* file.
- **PDI-type Ancillary**: similarly to the auxiliary data, this type of PDI (where not otherwise specified) is coincident with the ancillary file itself and it is uniquely identified by its file name (PDI_ID). If the PDI is composed by a unique file, the PDI coincides with the file itself, otherwise the PDI is archived as a *tar* file.

The following table resumes the type of PDI presented above:

PDI-type	PDI-subtype	Description
Granule	Granule Level-0	Level-0 Granule PDI.

[1] In order to avoid performance degradation of the Inventory application, the Inventory_Metadata.xml file is always in a fixed position and then, it must be the first in the tar. In general, the TAR shall be packaged to have all ASCII files followed by binary files.

	Granule Level-1A	Level-1A Granule PDI.
	Granule Level-1B	Level-1B Granule PDI.
	Tile Level-1C	Level-1C Tile PDI.
Datastrip	Datastrip Level-0	Level-0 Datastrip PDI. Level-0 refers to **consolidated** Level-0 PDI containing the **Quick Look** image.
	Datastrip Level-1A	Level-1A Datastrip PDI.
	Datastrip Level-1B	Level-1B Datastrip PDI.
	Datastrip Level-1C	Level-1B Datastrip PDI.
True Color Image	TCI	TCI PDI.
Auxiliary	GRI	The **GRI** files are stored with your PDI-id and the link to these aux files is set among the metadata at Datastrip level.
	DEM	The **DEM** is stored with your PDI-id and the link to these aux files is set among the metadata at Datastrip level.
	GIPP	The **GIPP** files are stored with own PDI-id and the link to these aux files is set among the metadata at Datastrip level.
	ECMWF	Raw **ECMWF** data containing Meteorological datasets. Resampled ECMWF data are always provided within L1C Tile PDI, in L1C product geometry.
	IERS Bulletin	The International Earth Rotation and Reference System Service (**IERS**) provides data on Earth orientation, on the International Celestial Reference System/Frame, on the International Terrestrial Reference System/Frame, and on geophysical fluids.
	POD	Precise Orbit Determination (**POD**): an XML file, used in case of contingency with the on-board navigation solution.
Ancillary	HKTM	PDI relative to housekeeping telemetry data.
	SAD	The SAD PDI is formatted as a tar file including a set of binary SAD files, each one corresponding to one SAD file type and covering one orbit ANX to ANX or shorter (current dump orbit).

Table 3-1: Type of PDI

3.2 PDI Naming Convention

PDI_ID is a logical and a physical naming convention defined to identify univocally each type of PDI. In fact, *PDI_ID* or *PDI_ID.tar* (where the tar compression is foreseen) represents the PDI physical name defined case by case in the document, but PDI_ID (without extension) represents also the logical convention used to reference each type of PDI in the archive.

The PDI_ID naming convention is described hereafter:

MMM_CCCC_TTTTTTTTTT_<Instance_id> where:

Part	Description	Comment
MMM	**Mission ID**	"S2A" or "S2B" "S2_" applicable to the constellation, used for satellite independent files.
CCCC	**File Class**	4 uppercase letters can contain digits. OPER for "Routine Operations" files. Note that the File Class will be set "OPER" for all products generated during the operation phase. During validation or for internal testing other values can be defined.
TTTTTTTTTT	**File Type** (File Category + File Semantic)	10 uppercase letters can contain digits and underscores.
<Instance ID>	**Instance Id**	Uppercase letters, digits and underscores.

Table 3-2: PDI File name decomposition

File Type is a 10 characters field either uppercase letters, digits or underscores "_". The File Type field is subdivided into two sub-fields as follows:

TTTTTTTTTT = FFFFDDDDDD where:

- FFFF = File Category;
- DDDDDD = Semantic Descriptor.

File Category sub-field is defined as the 4 initial characters of the File Type. The File Category is composed by 3 characters and an ending underscore "_" for separation with the Semantic Descriptor. This sub-field allows the definition of file groups characterised by related information / configuration information / generated data / usage of the data / etc.

Semantic Descriptor sub-field is composed by the 6 characters contiguous to the File Category sub-field. The Semantic Descriptor can be composed of uppercase letters, digits or underscores "_". This sub-field is unique for a given File Type and must be as descriptive as possible given the 6 character limitation to characterize the information contained by the file.

For the Granule (Tile), Datastrip and TCI PDI the following convention is used:

- File Category is set as **MSI_** constant string.
- Semantic Descriptor is composed of YYY_ZZ where :

Semantic Descriptor Sub-Field Name	Value/Meaning
YYY	• L0_ for Level 0 products • L1A for Level 1A products • L1B for Level 1B products • L1C for Level 1C and TCI products
ZZ	• GR (Granule) • DS (Datastrip) • TL (Tile) • TC (True Color Image)

The following table resumes the unique File Type for a given Granule (Tile), Datastrip and TCI PDI:

Type Of PDI	File Type (File Category + Semantic Descriptor)
Granule Level-0	MSI_L0__GR
Datastrip Level-0	MSI_L0__DS
Granule Level-1A	MSI_L1A_GR
Datastrip Level-1A	MSI_L1A_DS
Granule Level-1B	MSI_L1B_GR
Datastrip Level-1B	MSI_L1B_DS
Tile Level-1C	MSI_L1C_TL
Level-1C Tile Consolidated	MSI_L1C_CO
Datastrip Level-1C	MSI_L1C_DS
True Color Image	MSI_L1C_TC

Table 3-3: Granule (Tile), Datastrip and TCI PDI File Type

The following tables give a list of File Type assigned to each PDI - type GIPP, DEM, GRI, HKTM and SAD data.

Regarding the GIPP files listed in the table hereafter, note that the file types not highlighted corresponding to the GIPP files listed in the Annex D and detailed in the reference document [GPP-IODD]. The GIPP files highlighted in blue (foreseen for each level of processing) are not real GIPP files but general configuration files managed by the processing chains as the standard GIPP files.
GIP_OLQCPA GIPP file is detailed in the referenced document [OLQC-GIPP].

GIPP files	FileType (Category+Semantic)
IAS AnaTm image parameters file	GIP_ATMIMA
IAS AnaTm HK parameters file	GIP_ATMSAD
IAS Datation parameters file	GIP_DATATI

GIPP files	FileType (Category+Semantic)
LR Extraction parameters file	GIP_LREXTR
InitLoc Inv parameters file	GIP_INVLOC
Pixel line of sight for each bands in the focal plane reference frame	GIP_VIEDIR
Platform model	GIP_SPAMOD
List of blind pixels	GIP_BLINDP
CloudInv parameter file	GIP_CLOINV
InitLoc production parameters file	GIP_PRDLOC
RadioS2 parameters file	GIP_R2PARA
SWIR detectors arrangement parameters	GIP_R2SWIR
Radiometric equalization parameters on board (dark current, on-board inter pixel calibration)	GIP_R2EOB2
Radiometric equalization parameters on ground (on-ground correction)	GIP_R2EQOG
List of defective pixels	GIP_R2DEPI
Deconvolution filter for each deconvoluted band	GIP_R2DEFI
Wavelets filters	GIP_R2WAFI
Wavelets base	GIP_R2DEBA
L2 Norm coefficients (denoising)	GIP_R2L2NC
Denoising thresholds (denoising)	GIP_R2DENT
Threshold file for deconvolution through wavelet packets	GIP_R2DECT
Maximum signal coefficients (denoising)	GIP_R2MACO
Noise model (denoising)	GIP_R2NOMO
Absolute calibration parameters	GIP_R2ABCA
Binning for 60m bands parameters (filters and undersampling)	GIP_R2BINN
Crosstalk correction	GIP_R2CRCO
GeoS2 parameters file (preProc)	GIP_G2PARA
Geometric parameter to refine	GIP_G2PARE
Earth model	GIP_EARMOD
Global geometrical parameters	GIP_GEOPAR
Description of the inter detectors overlapping area	GIP_INTDET
TilingS2 parameters file	GIP_TILPAR
ResampleS2 parameters file (preProc)	GIP_RESPAR
MaskS2 parameters file	GIP_MASPAR
Compression JP2K parameters file	GIP_JP2KPA
ECMWF parameters file	GIP_ECMWFP
On board decompression parameters file	GIP_DECOMP
OLQC configuration parameters file	GIP_OLQCPA
Processing Baseline parameters	GIP_PROBAS
Mapping parameters from 16 to 18 bits	GIP_CONVER

Table 3-4: GIPP File Type

DEM files	FileType (Category+Semantic)
GLOBE DEM Format	DEM_GLOBEF
SRTM DEM Format	DEM_SRTMFO

Geoid File Format	DEM_GEOIDF

Table 3-5: DEM File Type

GRI files	FileType (Category+Semantic)
Global Reference Images	AUX_GRIxxx Where xxx = Relative Orbit (001-143)

Table 3-6: GRI File Type

HKTM files	FileType (Category+Semantic)
House Keeping Telemetry data	PRD_HKTM__

Table 3-7: HKTM File Type

The type of a SAD packet depends on its Process Identifiers (PRID) and on its Structure Identifier (SID). The following table resumes the values of SAD packets possibly received.

Unit		Process ID (PRID)	Structure ID (SID)
OBC CSW AOCS		11	105, 106, 107, 108, 109, 110-120, 121-122, 123, 124-126
STR	A	37	105, 106
	B	38	
	C	39	
GPS	A	48	215, 218, 223, 224, 225-227, 229-232, 234, 235
	B	49	215, 218, 219, 223-227, 229-232, 234, 235
OBC CSW MSIC		09	123

Table 3-8: SAD packet type possible values

The first line of the following table contains the File Type of each unitary Raw SAD files; the second line indicates the File Type of the SAD PDI, that is the File Type of the tar containing several unitary Raw SAD files.

SAD files	FileType (Category+Semantic)
SAD files inside the L0 PDI Datastrip: Raw SAD files (named also Measurement Data files) containing only SAD packets matching a single packet type. SAD files inside the L0 PDI Datastrip (cf. section 3.7) cover at most the **temporal extent of the full Datatake.** The naming of those unitary raw SAD files is in the	AUX_Sppnnn Where: nnn = SID, pp = PRID The possible value for SID and PRID parameters are in the table above.

section 3.21.1	
SAD PDI: SAD PDI (cf. section 3.21) consists in a single tar file containing one Raw SAD file per packet type and cover the **temporal extent of the full orbit**. The naming of the SAD PDI (SAD PDI_ID) is in the section 3.21.1	AUX_SADATA

Table 3-9: SAD File Type

IERS Bulletin A	FileType (Category+Semantic)
IERS Bulletin A	AUX_UT1UTC

Table 3-10: IERS Bulletin File Type

POD file	FileType (Category+Semantic)
Restituted precise orbit determination data	AUX_RESORB
Predicted precise orbit determination data	AUX_PREORB

Table 3-11: POD File Type

ECMWF file	FileType (Category+Semantic)
ECMWF global forecast dataset	AUX_ECMWFD

Table 3-12: ECMWF File Type

Instance ID is used to define several sub-fields within the filename according to the nature of the file. For usage for the Sentinel PDGS, Instance ID is decomposed into a set of mandatory sub-fields in the prefix, complemented by optional ones in the trailing portion of the filename.
The File Instance ID mandatory sub-fields are always placed on fixed positions within the filename for simple and unambiguous recognition. The mandatory part is subdivided into sub-fields as follows:

<Instance ID mandatory prefix> = ssss_YYYYMMDDThhmmss
where:

- ssss is the Site Centre of the file originator
- YYYYMMDDThhmmss is the Creation Date

The Site Centre is a 4 characters field defined by either, uppercase letters, digits or underscore “_”.
The Creation Date is a 15 characters field defined according composed of:

- 8 characters, all digits, for the date: “YYYYMMDD”
- 1 uppercase T: “T”
- 6 characters, all digits, for the time: “hhmmss”

As per the applicable [EOFFS-PDGS], the optional part of the Instance ID allows further characterisation about the scope of every file. The optional suffix is appended to the mandatory prefix and starts with an underscore character immediately followed by a one-character field defining the specific options:

<optional-suffix> = _Ivvvvvvvv…

where:

"I" is a one-character option Identifier (e.g. 'S', 'O', 'V', etc);

"vvvvvvvv" contains the trailing Option Value.

The following table lists all optional char ID used in this document:

Optional Suffix	Description	Template
Applicability Start: _**S**	_**S***YYYYMMDDTHHMMSS* Appends the Validity Start Time	_S20130401T123000
Orbit Period: _**O**	_**O***ffffff_llllll* – *ffffff* is the first Absolute Orbit Number reported in the file – *llllll* is the last Absolutr Orbit Number reported in the file Both first and last orbits shall be zero-padded with 6 overall digits.	_O123456_123457
Applicability Time Period: _**V**	_**V**yyyymmddThhmmss_YYYYMMDDTHHMMSS Appends the Validity Period Time fields (Start and Stop)	_V20091210T235134_20091210T235224
Detector ID: _**D**	_**D**xx xx = 01,…12	_D05
Absolute Orbit Number: _**A**	_**A**ffffff ffffff is the Absolute Orbit Number	_A123456
Relative Orbit Number: _**R**	_**R**zzz zzz is the Relative Orbit Number	_R123
Tile Number: _**T**	_**T**xxxxx xxxxx = fixed string	_T15SWC
Processing Baseline Number: _**N**	_**N**xx.yy x,y={0;9}, identifies the current processing baseline	_N01.01
Band Index ID: _**B**	_**B**xx xx is the band number	_B8A
Completeness ID: _**W**	_**W**x x = F for Full orbit	_WP

	x = P for Partial orbit	
Degradation ID: _**L**	_**L**y y = N for Nominal data y = D for Degraded data	_LN

The Instance ID optional part and the complete PDI_ID are defined case by case through out the document.

3.3 PDI Hierarchy

A PDI-type Granule contains among its metadata the PDI_ID (DATASTRIP_ID) related to the PDI-type Datastrip linked to the Granule. This link establishes the hierarchy between Granule vs Datastrip.
Moreover, each PDI-type Datastrip contains among its metadata the Datatake_ID and this link establishes the hierarchy between Granule/Datastrip vs Datatake.

3.4 Granule/Tile PDI Common Structure

Granule/Tile PDI is organized as shown in the following figure:

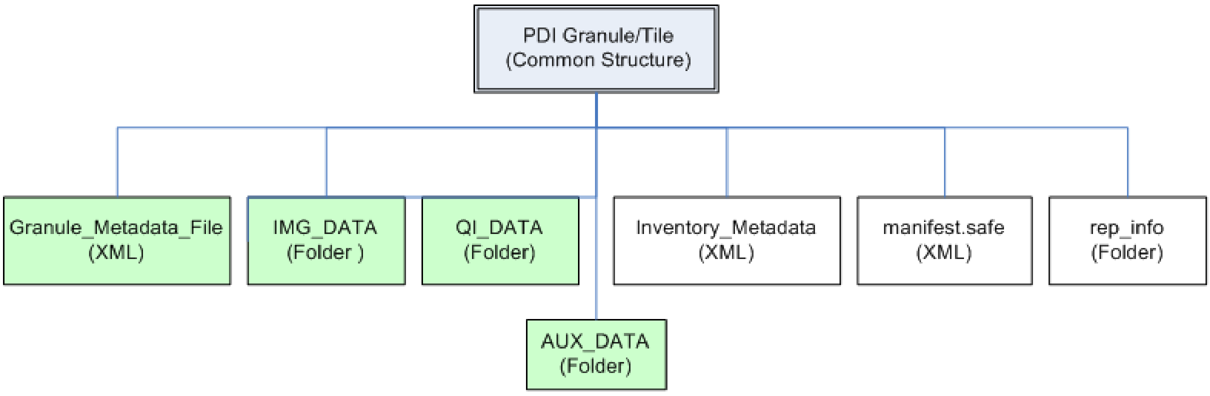


Figure 9: Granule / Tile Common Structure

1. **Granule_Metadata_File**: XML metadata file describing all the elements contained inthe Granule PDI;
2. **IMG_DATA**: folder containing the image data foreseen for each kind of Granule / Tile PDI;
3. **QI_DATA**: folder containing the XML reports including the quality control checks performed by OLQC processor (for each L0/L1A/L1B/L1C PDI) and the GML quality masks (for each L1A/L1B/L1C PDI). The XSD schema of OLQC reports is provided in Annex C, the masks files are listed in the Table 3-4. In addition, in case of L1C Tile, this folder contains the PVI file.
4. **AUX_DATA**: folder containing ECMWF dataset resampled in UTM projection. Note that this folder is provided only inside a Level-1C Tile PDI.
5. **Inventory_Metadata.xml**: inventory metadata file.
6. **manifest.safe**: XML SAFE Manifest file (cf. section 3.4.4).
7. **rep_info**: folder containing the available XSD schemas used to validate the Granule PDI components (cf. section3.4.4)

<u>Note that the *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are available inside a Granule/Tile PDI but they are removed when the PDI is included in the User Product.</u>

3.4.1 Granule_Metadata_File Structure

The Granule_Metadata_File is a single metadata file containing different types of information shown in the following figure.

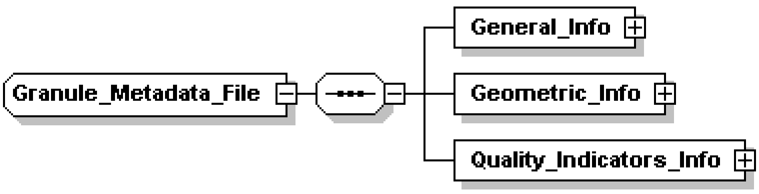


Figure 10: Granule_Metadata_File

The structure of the Granule_Metadata_File is common to all processing level (L0/L1A/L1B/L1C); the following tables summarize the Granule_Metadata_File content. For all details regarding the Granule metadata content, specific for each processing level (L0/L1A/L1B/L1C), refers to the dedicated section.

Info Type	Description	L0/L1A/L1B/L1C
General_Info	General information regarding Granule elements	Y
Geometric_Info	Geometric information providing the geolocation of the Granule	Y
Quality_Indicators_Info	Set of metadata providing information regarding all checks performed at Granule level for each processing level (cf. Table 3-2)	Y

Table 3-13: Granule / Tile Metadata Structure

Field Name	Description	L0/L1A/L1B	L1C
GRANULE_ID/TILE_ID	Unique Identifier of the Granule PDI (PDI_ID)	Y	Y
DETECTOR_ID	Detector Identifier	Y	N
DATASTRIP_ID	Unique Identifier of the Datastrip PDI (PDI_ID)	Y	Y
DOWNLINK_PRIORITY	Downlink priority flag, can be set to NOMINAL, NRT or RT	Y	Y
SENSING_TIME	Time stamp of the first line of the Granule, that is the Sensing Start Time of the Granule PDI.	Y	Y

	This metadata in L1C Tile PDI is defined as the Datastrip Start time.		
Archiving_Info	Archiving centre and time	Y	Y
Processing_Specific_Parameters	Optional field reserved for production chain only (i.e. DPC and/or IPF) and not propagated to User Product	Y	Y

Table 3-14: Granule / Tile PDI General_Info

Field Name	Description	L0	L1A/L1B	L1C
Granule_Footprint	Geolocation of the four corners of the Granule envelope (Lat, Lon, H coordinates with horizontal CRS as WGS84 and altitude given over EGM96).	Y	Y	N
Granule_Position	Position of the Granule in the Datatake.	Y	Y	N
Granule_Dimensions	Granule dimensions for each resolution band (10m, 20m and 60m).	N	Y	N
Tile_Geocoding	Coordinates of the Tile (in meters), the pixel dimensions within the Tile (in meters), the Tile size in number of lines/columns.	N	N	Y
Tile_Angles	Grid of sun and incidence angles.	N	N	Y

Table3-15: Granule / Tile PDI Geometric_Info

The following table summarizes the QIs provided through the Granule (Tile) metadata file. The green boxes indicate the QIs common to all processing levels.

GRANULE / TILE QUALITY INDICATORS							
Image Content Quality Indicators							
QI Type	**Description**	**Metatada Level**	**Metatada Field Name**	**L0**	**L1A**	**L1B**	**L1C**
Local cloud coverage indicator	Percentage of cloud coverage	Standard	CLOUDY_PIXEL_PERCENTAGE	Y	Y	Y	Y
List of source packets lost / degraded within the Granule	for each couple (band, detector) with the degradation type, the error type, the date of the first line of the scene which contains the lost / degraded source packet, the counter of the first source packet in error and the number of lost or degraded source packet	Standard	Lost_Source_Packet_List	Y	N	N	N
Local technical quality indicator	Percentage of degraded MSI and ancillary data	Standard	DEGRADED_MSI_DATA_PERCENTAGE	Y	Y	Y	Y

PIXEL LEVEL QUALITY INDICATORS								
Image Content Quality Indicators (MASK FILES)								
QI Type	**Description**	**Metatada Level**	**Metatada Field Name**	**Main File Type**	**L0**	**L1A**	**L1B**	**L1C**

Coarse cloud mask files	These vector files (derived from cloud detection using the preliminary quicklook images), contain a list of polygons in sensor geometry (Level-1A reference frame) indicating the presence of clouds on the images.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_CLOLOW	N	Y	Y	N
Finer cloud mask	A finer cloud mask is computed on final Level-1C images. It is provided in the final reference frame (ground geometry).	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_CLOUDS	N	N	N	Y
Technical quality mask files	These vector files contain a list of polygons in Level-1A reference frame indicating degraded quality areas in the image.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_TECQUA	N	Y	Y	Y
Detector footprint mask	A mask providing the ground footprint of each detector within a Tile.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_DETFOO	N	N	N	Y
Radiometric Quality Indicators (MASK FILES)								
QI Type	**Description**	**Metatada Level**	**Metatada Field Name**	**Main File Type**	**L0**	**L1A**	**L1B**	**L1C**

Radiometric quality masks	A defective pixels' mask, containing the position of defective pixels.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_DEFECT	N	Y	Y	Y
Radiometric quality masks	A saturated pixels' mask, containing the position of the saturated pixels in the full resolution image.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_SATURA	N	Y	Y	Y
Radiometric quality masks	A nodata pixels' mask, containing the position of pixels with no data.	Standard	Pixel_Level_QI Pointer to the Mask files contained in the QI_DATA folder.	MSK_NODATA	N	Y	Y	Y

Table 3-16: Granule / Tile PDI Quality Indicators

The mask files are vector files provided as GML format files (cf. [HMA-GML]).
The naming convention for the gml mask files is defined case by case in the sections 3.8.2, 3.10.2 and 3.12.2.
The grouping strategy to have several masks in one physical GML file is described in the Annex E.

In the frame of OLQC consolidation, the quality control checks performed by OLQC processor are included inside the XML reports (cf. Annex C) stored in the QI_DATA folder. In the following table, the quality control checks performed on the Granule metadata are provided.

Granule Quality control Checks Information (OLQC OUTPUT)

Check Name	Checklist Name	Description	L0	L1A	L1B	L1C
Missing_Lines	SENSOR_QUALITY	Number of missing lines	Y	Y	Y	Y
Corrupted_ISP	SENSOR_QUALITY	Corrupted ISP	Y	Y	Y	Y
Sensing_Time	SENSOR_QUALITY	Consistency of Sensing Time	Y	Y	Y	Y
Granule_Dimensions	GEOMETRIC_QUALITY	Consistency of Granule size	N	Y	Y	Y
Product_Footprint	GEOMETRIC_QUALITY	Consistency of Granule footprint wrt the expected geometry	N	Y	Y	Y
Geometric_Header	GEOMETRIC_QUALITY	Consistency of the Incidence and SunAngles	N	Y	Y	Y
Perc_Cloud_Coverage	GENERAL_QUALITY	Check the percentage of cloud coverage	N	Y	Y	Y
List_Fake_Decompression	GENERAL_QUALITY	Check the list of fake decompressed source frames	N	Y	Y	Y
Product_Syntax	FORMAT_CORRECTNESS	Check on Product components syntax & semantics correctness	Y	Y	Y	Y

Table 3-17: Granule Quality Control Checks

3.4.2 Granule/Tile PDI_ID Definition

PDI_ID is a string label identifying univocally the archived PDI. The PDI_ID (***tar*** file name) used for a Level-0/Level-1A/Level-1B Granule PDI and for a Level-1C Tile PDI is compliant to [EOFFS-PDGS] and follows the description provided in the section 3.2:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.tar

The sub-strings MMM (Mission ID), CCCC (File Class), and TTTTTTTTTT (File Type) are detailed in the section 3.2.

The Granule Instance_ID is defined hereafter.

<Instance_Id> = <Site Centre>_<Creation Date>_<Sensing Time>_<Detector ID>_<Processing Baseline>

<*Site Centre*> and <*Creation Date*> corresponding to the Instance_ID mandatory prefix (cf.section 3.2).

<*Site Centre*> (4 characters) is the centre where the PDI can be created (processing centre)

The others sub-fields are described in the following table:

Field Name	Value/Meaning	Note
Sensing Time	***S****YYYYMMDDTHHMMSS*	This time refers to the sensing time of the first line of the PDI at Granule level in UTC time. Fourteen digits, date and time separated by the character T.
Detector ID	***D****01…12*	The MSI detectors are identified by 2 digits, from 01 to 12
Processing Baseline	***N****xx.yy* xx.yy where x,y={0;9}, identifies the current processing baseline	The Processing Baseline refers to the processing configuration baseline used at the time of the Granules generation (cf. section 2.9). Note: all the PDIs of a Datatake are always processed with the same processing baseline even if acquired in different stations.

The Tile Instance_ID is defined hereafter.

<Instance_Id> = *<Site Centre>_<Creation Date>_<Abs Orbit>_<Tile>_<Processing Baseline>*

<*Site Centre*> and <*Creation Date*> are defined above, the others sub-fields are described in the following table:

Field Name	Value/Meaning	Note
Abs orbit	***A***zzzzzz zzzzzz = (000001-999999)	Absolute Orbit Number
Tile	***T***xxxxx Tile number where xxxxx is a fixed string of 5 characters	According to US-MGRS naming convention. See example of section 4.9.2
Processing Baseline	***N****xx.yy* xx.yy where x={0;9}, identifies the current processing baseline	See comment in the table above.

3.4.3 Granule/Tile PDI XSD Schemas

This section contains the list of the XSD schemas (annexed to the document) used to describe the physical structure and the metadata content of each Granule/Tile PDI:

1. *S2_PDI_Level-0_Granule_Structure.xsd*
2. *S2_PDI_Level-1A_Granule_Structure.xsd*
3. *S2_PDI_Level-1B_Granule_Structure.xsd*
4. *S2_PDI_Level-1C_Tile_Structure.xsd*

5. *S2_PDI_Level-0_Granule_Metadata.xsd*
6. *S2_PDI_Level-1A_Granule_Metadata.xsd*
7. *S2_PDI_Level-1B_Granule_Metadata.xsd*
8. *S2_PDI_Level-1C_Tile_Metadata.xsd*

The first set of the schemas (points 1 - 4) define the "physical organization" of the Granule/Tile PDI on the disk.

These schemas are "improperly" used to specify elements not envisaged by the XML such as folders, therefore it is actually not expected to be used for the validation of the corresponding XML file.

Oppositely, the second set of the schema (points 5 – 8) are used to validate the XML metadata file provided inside each Granule/Tile PDI.

3.4.4 Granule/Tile PDI SAFE Format Approach

Following the presentation in section 3.4 and the structure in the Figure 9, all SAFE Granule/Tile PDI include a ***manifest.safe*** file and a ***rep_info*** folder according to [SAFE-SPEC].

The *manifest.safe* is an XML file formatted according to [SAFE-SPEC] providing metadata (concerning the overall context where the PDI is generated and the PDI itself) and a map of the PDI content (consisting in a reference to all data components inside the PDI including measurement data files, ancillary and auxiliary data files, XSD schema, etc).

The *manifest.safe* is composed by three main sections:

Manifest sections	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 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 3-18:High Level Structure of SAFE Manifest File

More in details the *manifest.safe* provided for each PDI contains:

1. metadata information defined by [SAFE-SPEC] including not only the mandatory Metadata Sections (Platform and Processing sections) but, as added value, other relevant non mandatory Metadata Sections (e.g. acquisitionPeriod, measurementOrbitReference, measurementFrameSet),
2. a sub-set of metadata redundant respect to the mandatory XML Granule_Metadata_File included in the PDI,
3. the map of the complete content of the PDI, namely all the references to all the files contained in the PDI (including the reference to the XML main metadata file) with the description of each file (e.g. file type, file size, coding, etc...).

Note that the Granule_Metadata_File file groups all metadata regarding the PDI and the mission context, while the SAFE Manifest file contains, as added value, the exhaustive map of the PDI itself and a description of each file PDI component (e.g. file type, file size, coding, etc...).

In this respect, the present document provides, for each L0/L1A/L1B/L1C Granule/Tile PDI defined in this Section 3, the following information:

- A set of 3 tables (one for each of the three main sections), containing the list of fields (tags or attribute) to be included in the Safe Manifest file, and for each field:
    - the field name in the SAFE Manifest file (attributes names are in bold character);
    - only for the Metadata section, the corresponding field name in the Granule_Metadata_File schema; this column highlights the redundant sub-set of

metadata included both in the XML Granule_Metadata_File and in the XML SAFE Manifest file;
  - a brief textual description of the field;
  - the data type of the field;
  - the occurrence of the field (min/max occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory.

- A practical example of SAFE Manifest file containing the tags listed in the table mentioned above. Each tag is set to an indicative value, as realistic as possible; the compliance of the SAFE Manifest file to the SAFE specification has been verified by validating the Manifest file against the SAFE XSD schemas. All SAFE Manifest files and the schemas are provided in the zip file (S2-PDGS-TAS-DI-PSD_V14_SAFE.zip) annexed to this document. The XSD schemas are provided as a set of *xfdu.xsd* schemas located in the final leaf of the *resources* directory.

In addition to the mandatory SAFE Manifest file, according to the applicable document [SAFE-SPEC], a SAFE Granule PDI contains the *rep_info* folder (fixed folder name recommended by [SAFE-SPEC]) including all the available schemas describing the product component files. Those schemas are not mandatory but "may be provided" inside the PDI.

The XSD schemas provided inside the *rep_info* folder are referenced as internal product components by "metadataComponentSchemas" tag in the manifest file.

On the contrary, according to the SAFE specifications, the XSD schemas used to validate the SAFE manifest files are not included in the *rep_info* folder but they are external to the PDI.

3.5 Datastrip PDI Common Structure

Datastrip PDI is organized as shown in the following figure:

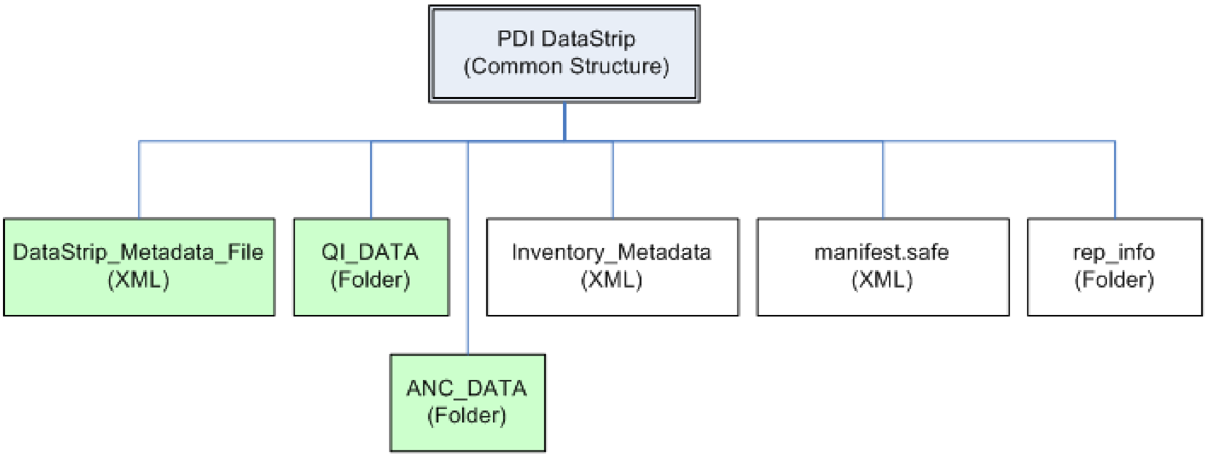


Figure 11: Datastrip Common Structure

1. **Datastrip_Metadata_File**: XML Metadata file describing all the elements contained in the Datastrip PDI;
2. **QI_DATA**: folder containing the XML reports including the quality control checks performed by OLQC processor (cf. XSD schema of the OLQC report in Annex C). In addition, in case of L0 Datastrip this folder contains the preliminary QuickLook files (five image files in JPEG2000 format),
3. **ANC_DATA**: folder containing SAD raw data as received from the DFEP. Note that this folder is provided only inside a Level-0 Datastrip PDI;
4. **Inventory_Metadata.xml**: inventory metadata file;
5. **manifest.safe**: XML SAFE Manifest file(cf. section 3.5.4);
6. **rep_info**: folder containing the available XSD schemas that describe each Datastrip PDI components (cf. section 3.5.4).

Note that the *ANC_DATA*, *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are available inside a Datastrip PDI but they are removed when the PDI is included in the User Product.

3.5.1 Datastrip_Metadata_File Structure

The Datastrip_Metadata_File is a single metadata file containing different types of information shown in the following figure.

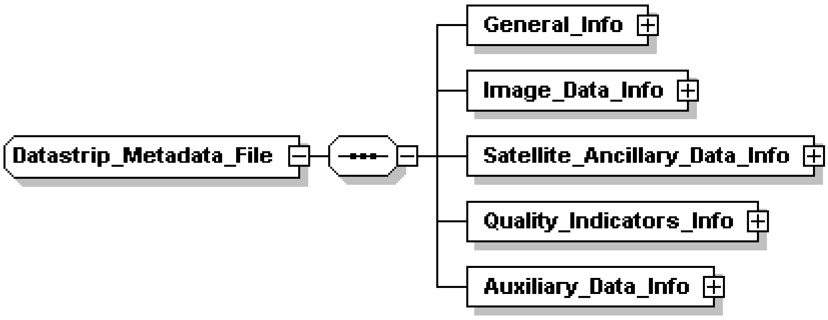


Figure 12: Datastrip_Metadata_File

The structure of the Datastrip_Metadata_File is common to all processing level (L0/L1A/L1B/L1C); the following tables summarize the Datastrip_Metadata_File content and specify the applicability to the processing level. For all details regarding the Datastrip metadata content, specific for each processing level (L0/L1A/L1B/L1C), refers to the dedicated section in this chapter.

Info Type	Description	L0/L1A/L1B/L1C
General_Info	General information characterizing the Product Data Item	Y
Image_Data_Info	Image data information from MSI telemetry	Y
Satellite_Ancillary_Data_Info	Ancillary data information from Satellite Ancillary Telemetry	Y
Quality_Indicators_Info	Results of all quality checks performed at Datastrip level.	Y
Auxiliary_Data_Info	Auxiliary data information	Y

Table 3-19: Datastrip Metadata Structure

Field Name	Description	L0/L1A/L1B/L1C
Datatake_Info	Identification of the source Datastrip acquisition. General information.	Y
Processing_Info	Datastrip production information	Y
Datastrip_Time_Info	Datastrip Sensing Time information	Y
Downlink_Info	S2 data downlink information	Y
Archiving_Info	S2 data archiving information	Y
Processing_Specific_Parameters	Optional field reserved for production chain only (i.e. DPC and/or IPF) and not propagated to User Product	Y

Table 3-20: Datastrip PDI General_Info

Field Name	Description	L0	L1A	L1B	L1C
Granules_Information	List of Granules composing the whole Datastrip.	Y	Y	Y	N
Tiles_Information	List of the tiles composing the whole Datastrip.	N	N	N	Y
Sensor_Configuration	MSI Sensor configuration (Information from MSI telemetry)	Y	Y	Y	Y
Geometric_Header_List	Geometric information	Y	Y	Y	N
Radiometric_Info	Radiometric Information	N	Y	Y	Y
List_Fake_Decompr_Source_Frames	List of the decompressed source frames	N	Y	N	N
Geometric_Info	Refined model information	N	N	Y	Y

Table 3-21: Datastrip PDI Image_Data_Info

The Satellite Ancillary Data information, available through the Datastrip metadata file, are retrieved from SAD raw data stored in archive with a specific filename defined in the section § 3.21.1.

Field Name	Description	L0/L1A/L1B/L1C
Time_Correlation_Data_List	Time Correlation Data (sampled at 1Hz)	Y
Ephemeris	Description of ephemeris data (filtered and raw)	Y
Attitudes	Description of attitudes data (filtered and raw)	Y
Thermal_Data	Thermal data acquired at 1 Hz	Y
Lost_Source_Packet_List	List of source packets	Y

	lost/degraded	
ANC_DATA_REF	Reference to folder including the SAD raw data used for the processing. The SAD raw Data are provided only inside the L0 Datastrip PDI. This metadata is not mandatory for L1 Datastrip PDI. Note: Since the ANC_DATA folder inside the L0 Datastrip PDI is removed during the L0 User Product generation(section4.6.7.3) the metadata ANC_DATA_REF inside the L0 User Product (defined at Datastrip level) refers to the mandatory folder ANC_DATA contained in the L0 User Product.	Y

Table 3-22: Datastrip PDI Satellite_Ancillary_Data_Info

The following table summarizes the QIs provided through the Datastrip metadata file.

DATASTRIP QUALITY INDICATORS						
Geometric Quality Indicators						
QI Type	**Description**	**Metatada Field Name**	**L0**	**L1A**	**L1B**	**L1C**
Absolute location assessment	Absolute location performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Absolute_Location	Y	Y	Y	Y
Planimetric stability assessment	A planimetric stability performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Planimetric_Stability	Y	Y	Y	Y
Ephemeris data quality	Ephemeris data quality retrieved from GPS Dilution of precision (DOP) information.	EPHEMERIS_QUALITY	Y	Y	Y	Y
Ancillary data quality	Ancillary data quality retrieved from GPS Dilution of precision (DOP) information.	ANCILLARY_QUALITY	Y	Y	Y	Y
Geometric refining quality	Available by Datastrip and only if geometric refining applied	Geometric_Refining_Quality	N	N	Y	Y
Multi-spectral registration performance assessment	3 values for 10, 20 and 60m bands (from GIPP data)	Multi_Spectral_Registration	N	N	Y	Y
Quicklook Info						
QI Type	**Description**	**Metatada Field Name**	**L0**	**L1A**	**L1B**	**L1C**
Quicklook information	Preliminary quicklook data provided for each Datastrip composing the product	Preliminary_QuickLook	Y	N	N	N
Radiometric Quality Indicators						

QI Type	Description	Metatada Field Name	L0	L1A	L1B	L1C
Radiometric quality indicators for each band (from GIPP data)	Alpha and Beta parameters providing the instrument noise as a function of the radiometric count X for Level-1B : Noise= square root(Alpha_X + Beta_X* X)	Noise_Model	N	Y	Y	Y
Radiometric quality indicators for each band (from GIPP data)	Absolute calibration accuracy provided as a percentage of accuracy	ABSOLUTE_CALIBRATION_ACCURACY	N	Y	Y	Y
Radiometric quality indicators for each band (from GIPP data)	Cross-band calibration accuracy provided as a percentage of accuracy	CROSS_BAND_CALIBRATION_ACCURACY	N	Y	Y	Y
Radiometric quality indicators for each band (from GIPP data)	Multi-temporal calibration accuracy provided as a percentage of accuracy	MULTI_TEMPORAL_CALIBRATION_ACCURACY	N	Y	Y	Y

Table 3-23: Datastrip PDI Quality Indicators

In the frame of OLQC consolidation, the quality control checks performed by OLQC processor are included inside the XML reports (cf. Annex C) stored in the QI_DATA folder. In the following table, the quality control checks performed on the Datastrip metadata are provided.

Datastrip Quality control Checks Information (OLQC OUTPUT)

Check Name	Checklist Name	Description	L0	L1A	L1B	L1C
Degraded_SAD	SENSOR_QUALITY	Check on the consistency of satellite ancillary data	Y	Y	Y	Y
Datation_Model	SENSOR_QUALITY	Check the correctness of the Datation Model	Y	Y	Y	Y
Relative_Orbit_Number	GENERAL_QUALITY	Check the consistency of the relative orbit number	Y	Y	Y	Y
Attitude_Quality_Indicator	GEOMETRIC_QUALITY	Check the admissibility of The Attidude Quality Indicator (QI)	Y	Y	Y	Y
Processor_Version	GENERAL_QUALITY	Check the consistency of the processor version	N	Y	Y	Y

Ephemeris_Planimetric_Stability	GEOMETRIC_QUALITY	Check the consistency of the Ephemeris and Planimetric Stability	N	Y	Y	Y
Absolute _Location_Value	GEOMETRIC_QUALITY	Check the consistency of the Absolute Location	N	Y	Y	Y
Geometric_Refining	GEOMETRIC_QUALITY	Check the correctness of the Geometric Refining process results	N	N	Y	Y
Radiometric_Quality_Indicators	RADIOMETRIC_QUALITY	Check the Radiometric Quality Indicators	N	N	Y	Y
Tile_position	GEOMETRIC_QUALITY	Check on the consistency of the product boundaries (ground coordinates)	N	N	N	Y
Product_Syntax	FORMAT_CORRECTNESS	Check on Product components syntax & semantics correctness	Y	Y	Y	Y
DS_Consistency	FORMAT_CORRECTNESS	Check on Datastrip consistency	Y	Y	Y	Y

Table 3-24: Datastrip Quality Control Checks

Field Name	Description	L0	L1A	L1B	L1C
IERS_Bulletin	IERS bulletin. These data are provided for the start acquisition date.	Y	Y	Y	Y
GIPP_List	Reference to the GIPP used: DEM, etc.	Y	Y	Y	Y
PRODUCTION_DEM_TYPE	DEM type used by the production process (GLOBE or SRTM for example)	Y	Y	Y	N
REFERENCE_BAND	Used Reference Band	Y	Y	Y	N

Table 3-25: Datastrip PDI Auxiliary_Data_Info

3.5.2 Datastrip PDI_ID Definition

The Datastrip PDI_ID used to identify a Level-0/Level-1A/Level-1B/Level-1C Datastrip PDI follows the same convention described in the section 3.4.2 except for the sub-filed “Detector ID” which is not relevant in case of a Datastrip PDI.

In this case the optional suffix <*Sensing Time*> refers to start time of the first Granule of the Datastrip.

3.5.3 Datastrip PDI XSD Schemas

This section contains the list of the XSD schemas (annexed to the document) used to describe the structure and the metadata content of each Granule/Tile PDI:

1. *S2_PDI_Level-0_Datastrip_Structure.xsd*
2. *S2_PDI_Level-1A_Datastrip _Structure.xsd*
3. *S2_PDI_Level-1B_Datastrip _Structure.xsd*
4. *S2_PDI_Level-1C_Datastrip _Structure.xsd*

5. *S2_PDI_Level-0_Datastrip _Metadata.xsd*
6. *S2_PDI_Level-1A_Datastrip _Metadata.xsd*
7. *S2_PDI_Level-1B_Datastrip _Metadata.xsd*
8. *S2_PDI_Level-1C_Datastrip _Metadata.xsd*

The first set of the schemas (points 1 - 4) define the "physical organization" of the Datastrip PDI on the disk.

These schemas are "improperly" used to specify elements not envisaged by the XML such as folders, therefore it is actually not expected to be used for the validation of the corresponding XML file.

Oppositely, the second set of the schema (points 5 – 8) are used to validate the XML metadata file inside each Datastrip PDI.

3.5.4 Datastrip PDI SAFE Format Approach

The SAFE Datastrip PDI definition is the same one described for the Granule/Tile PDI in the section 3.4.4.

3.6 Level-0 PDI Granule definition

Level-0 Granule PDI is defined as a **tar** file with the following structure:

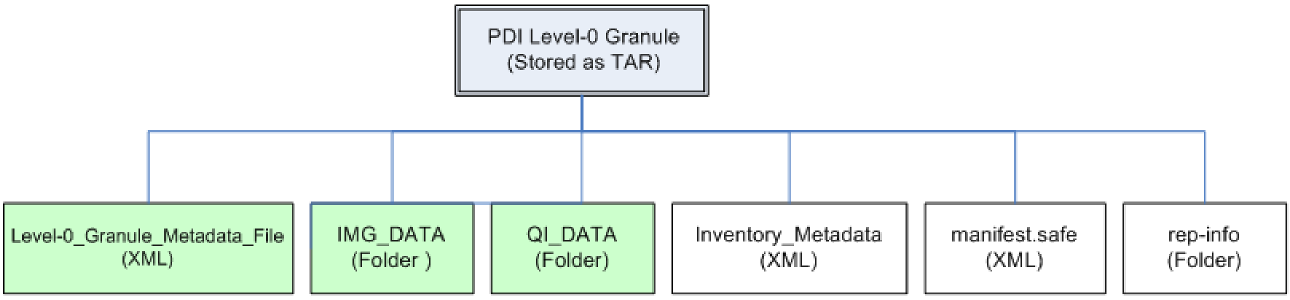


Figure 13: PDI Level-0 Granule Structure

The PDI Level-0 Granule consists of:

1. **Level-0_Granule_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Granule;
2. **IMG_DATA**: folder containing the mission data corresponding to one on-board scene for one detector and all spectral bands. The image data are provided as a set of 13 binary files, one for each spectral band, including all corresponding Image Source Packets (ISP) in the observation chronological sequence. The ISPs include their corresponding source packet annotations as a pre-pended header of each source packet;
3. **QI_DATA**: folder containing XML reports about Geometric quality, Image content quality, Quality control checks information;
4. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI;
5. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.4.4);
6. **rep_info**: folder containing the available XSD schemas that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.4.4).

3.6.1 PDI_ID definition

The PDI_ID (Granule ID) used to identify a Level-0 Granule PDI, follows the description provided in the section 3.4.2. File_Type is defined in the section 3.2, Table 3-3.

Level-0 Granule file template name (Granule ID):
S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar

Note that the PDI_ID.tar is the physical name of the Granule PDI after the tar compression.

3.6.2 Level-0 Granule Physical Format

The PDI_ID defined above represents the “Granule directory” name. Inside the Granule directory, there are the Granule components as in the Figure 13.

Inside that directory, the naming convention used to identify each real files follows the same convention used to define the Granule ID but without the Processing Baseline sub-string.

- **Level-0_Granule_Metadata_File (XML file):**
  Granule Metadata File Template name:
  S2A_OPER_MTD_L0__GR_MTI__20141104T134012_S20141104T134012_D01.xml

  The XSD schema which regulates the metadata file is *PDI_Level-0_Granule_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **IMG_DATA (folder):**
  Each file contained in the IMG_DATA folder (13 files, one image file per band) follows the naming convention defined hereafter:

  Image File naming convention = <PDI_ID*>_<Band_Index>.bin where:

Field Name	Value/Meaning	Note
*PDI_ID**	PDI_ID without Processing Baseline sub-string	
Band Index	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12	Field used to identify the spectral bands within the Granule.

  IMG_DATA/Level-L0 image file template name (binary file):
  S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_B03.bin

- **QI_DATA (folder):**
  QI_DATA folder contains the XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The *OLQC_Report.xsd* schema and the reports naming convention are in the Annex C of the document.

  File Template Name:
  *S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_SENSOR_QUALITY*_report.xml

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **manifest.safe (XML file):**
  XML file with fixed name *manifest.safe*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-0_Granule_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

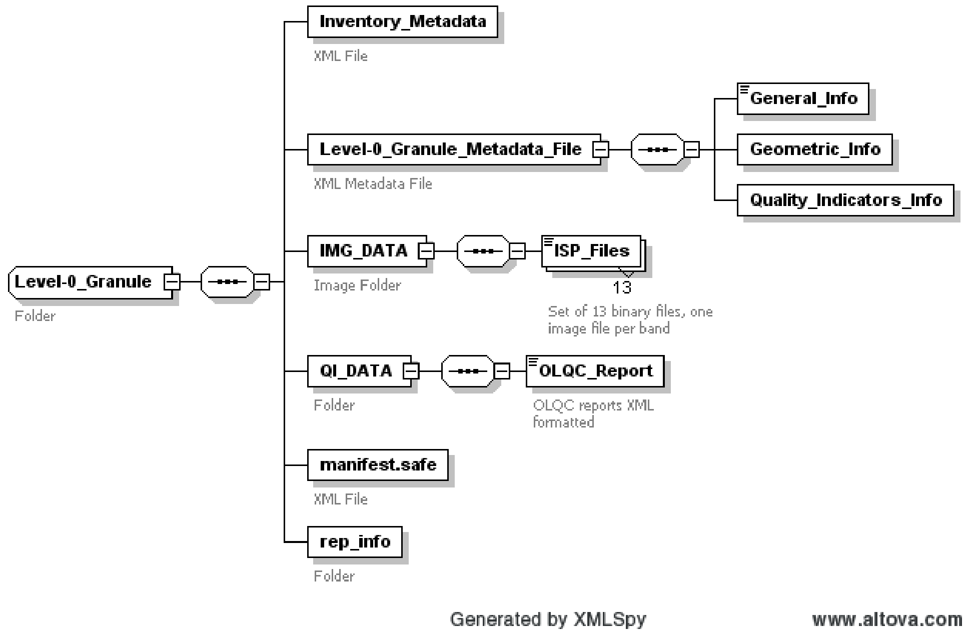
Level-0 Granule Physical Format template:

Level-0 Granule PDI_ID: ***S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12***
Inventory_Metadata.xml *S2A_OPER_MTD_L0__GR_MTI__20141104T134012_S20141104T134012_D01.xml* *manifest.safe* IMG_DATA *Appendix A : S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_B01.bin* S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_B02.bin . . . S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_B12.bin QI_DATA *S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_SENSOR_QUALITY*_report.xml rep_info *S2_PDI_Level-0_Granule_Metadata.xsd* *Inventory_Metadata.xsd* *OLQC_Report.xsd*

Figure 14: PDI Level-0 Granule Physical Format

3.6.3 Level-0 PDI Granule Structure

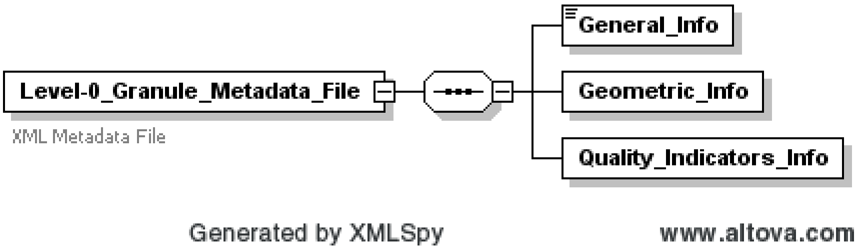
The *S2_PDI_Level-0_Granule_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-0 Granule PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 13.

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>children</td><td>Level-0_Granule_Metadata_File IMG_DATA QI_DATA Inventory_Metadata manifest.safe rep_info</td></tr>
<tr><td>annotation</td><td>The Level-0 Granule is defined as a folder containing:
1. Level-0_Granule_Metadata_File: XML Main Metadata File.
2. IMG_DATA: folder containing the 13 image data files, one per band and per detector
3. QI_DATA: folder containing XML reports including Quality Indicators
4. Inventory_Metadata: XML inventory metadata file
5. manifest.safe: XML SAFE Manifest file
6. rep_info: folder containing the XSD schemas provided inside a SAFE Level-0 Granule

<u>Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.</u></td></tr>
</table>

3.6.3.1 *Level-0_Granule_Metadata_File Schema*

Level-0_Granule_Metadata_File is the XML metadata file provided inside each Level-0 Granule. The schema used to validate it is *S2_PDI_Level-0_Granule_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc…) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Quality_Indicators_Info
annotation	The Level-0_Granule_Metadata_File is an XML file containing three groups of metadata describing the whole product data item. 1. **General_Info**: this group of metadata provides general information regarding the Level-0 Granule. The meaning for each metadata is shown in the following diagrams. 2. **Geometric_Info**: these metadata provide information describing the geolocation of the Granule. 3. **Quality_Indicators_Info**: these metadata provide information about cloud coverage assessment and technical quality assessment.

The following figures and tables give a complete overview of the Level-0_Granule_Metadata_File schema according the description provided in the section 3.4.1.

General_Info:

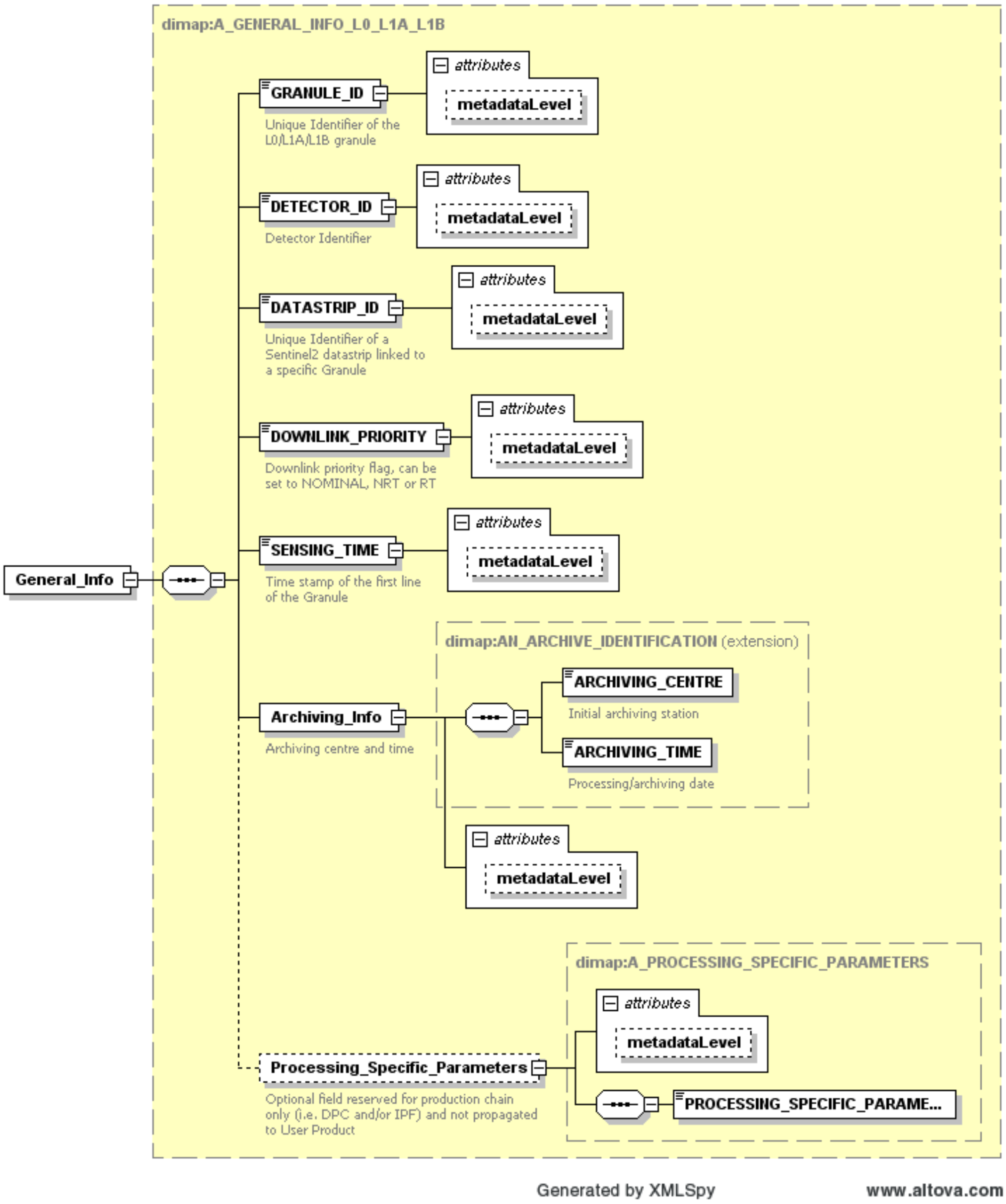


Figure 15 : Level-0_Granule_Metadata_File - General_Info Diagram

In the following tables, the third column provides the metadata level attribute for each metadata (cf. section 2.10).

General_Info		
Field Name	**Description**	**Metatada Level**
GRANULE_ID	Granule_Identifier metadata indicates the unique identifier of the Level-0 Granule. This parameter coincides with PDI_ID definition described in section 3.6.1 and univocally points a Granule PDI in the archive.	Brief
DETECTOR_ID	Detector identifier corresponding to the Granule	Brief
DATASTRIP_ID	Unique identifier of the L0 PDI Datastrip linked to L0 PDI Granule. This parameter coincides with the PDI_ID of the PDI Datastrp linked to the Granule. This link establishes the hierarchy Granule vs Datastrip (cf. section 3.3)	Brief
DOWNLINK_PRIORITY	Downlink priority flag. It can be set Nominal/NRT/RT	Standard
SENSING_TIME	Time stamp of the first line of the Granule, that is the Sensing Start Time of the Granule PDI	Standard
Archiving_Info/ARCHIVING_CENTRE	The starting point of the circulation data. The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_ • UPA_ • CDAM • MPC_	Expertise
Archiving_Info/ARCHIVING_TIME	Processing/archiving date (UTC data time)	Expertise
Processing_Specific_Parameters/PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-26: Level-0_Granule_Metadata_File - General_Info Description

Geometric_Info:

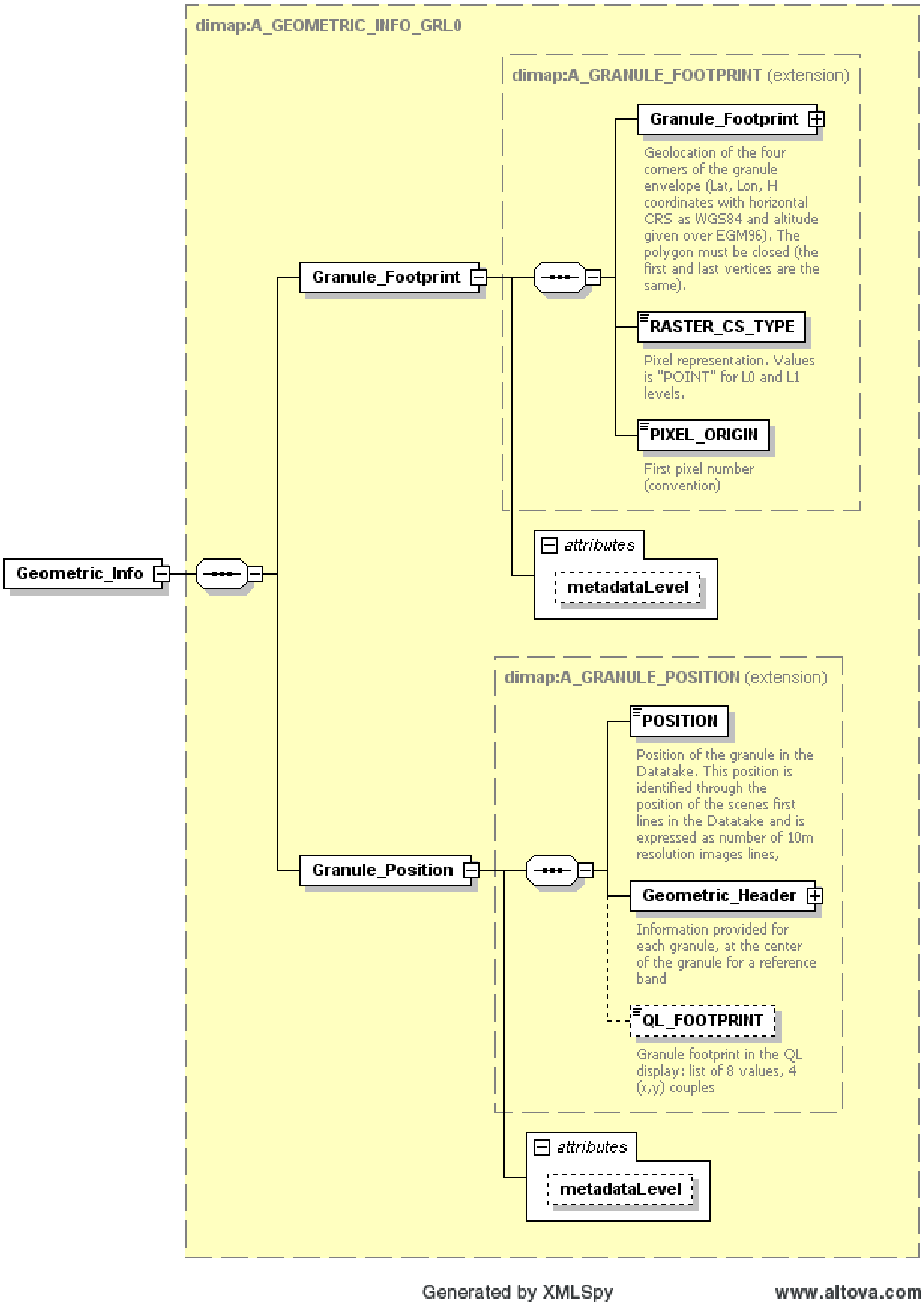


Figure 16: Level-0_Granule_Metadata_File - Geometric_Info Diagram

Geometric_Info/Granule_Footprint		
Field Name	**Description**	**Metatada Level**
Granule_Footprint/Footprint/EXT_POS_LIST	Geolocation of the four corners of the Granule envelope (Lat, Lon, H coordinates with horizontal CRS as WGS84 and altitude given over EGM96). Note: the polygon is defined as five points given counter-clockwise oriented with the first and last vertices identical.	Brief
Granule_Footprint/Footprint/INT_POS_LIST		Brief
RASTER_CS_TYPE	Pixel representation. Value is "POINT" for L0 and L1 levels.	Brief
PIXEL_ORIGIN	First pixel number (convention)	Brief
Geometric_Info/Granule_Position		
Field Name	**Description**	**Metatada Level**
POSITION	Granule_Position describes the position of the Granule in the origin Datatake. This position is identified through the position of the scenes first lines in the Datatake and is expressed as number of 10m resolution images lines). Moreover information for a reference band at the centre of the Granule (incidence angles and solar angles) are provided.	Standard
Geometric_Header/GROUND_CENTER	Information provided for a reference band, at the centre of the Granule, for each Granule. Geolocation of the Granule centre (Lat, Lon, H) Altitude is provided over the geoid.	Standard
Geometric_Header/QL_CENTER	The Granule centre in the QL display: 1 (r,c) point.	Standard
Geometric_Header/Incidence_Angles/ZENITH_ANGLE	Information provided for a reference band, at the centre of the Granule, for each Granule.	Standard

	Incidence angles corresponding to the centre of the Granule.	
Geometric_Header/Incidence_Angles/AZIMUTH_ANGLE	Information provided for a reference band, at the centre of the Granule, for each Granule. Incidence angles corresponding to the centre of the Granule.	Standard
Geometric_Header/Solar_Angles/ZENITH_ANGLE	Information provided for a reference band, at the centre of the Granule, for each Granule. Solar angles corresponding to the centre of the Granule.	Standard
Geometric_Header/Solar_Angles/AZIMUTH_ANGLE	Information provided for a reference band, at the centre of the Granule, for each Granule. Solar angles corresponding to the centre of the Granule.	Standard
QL_FOOTPRINT	Granule footprint in the QL display: list of 8 values, 4 (x,y) couples. Note: Metadata mandatory for L0c Granule.	Standard

Table 3-27: Level-0_Granule_Metadata_File - Geometric_Info Description

Quality_Indicators_Info:

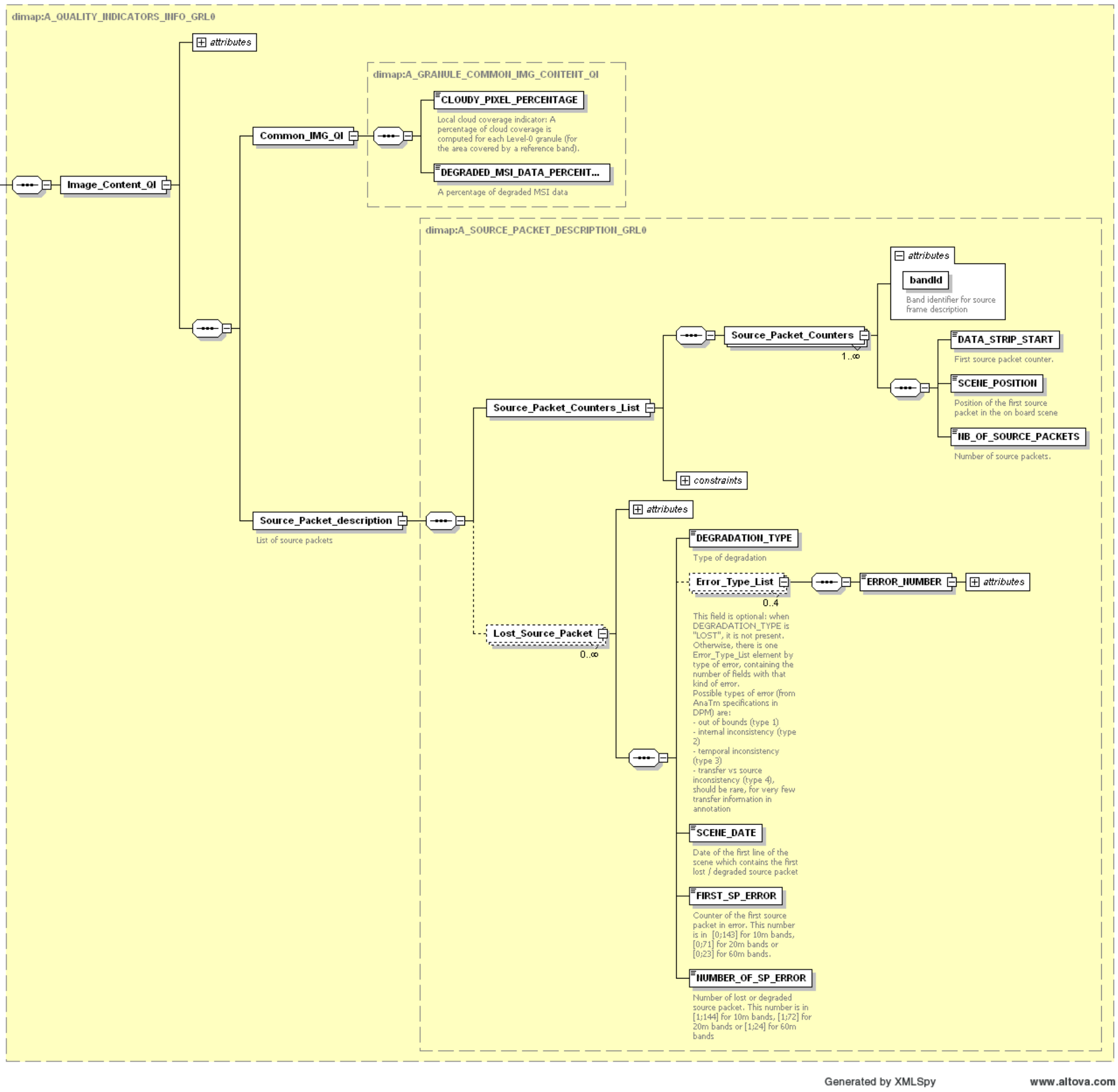


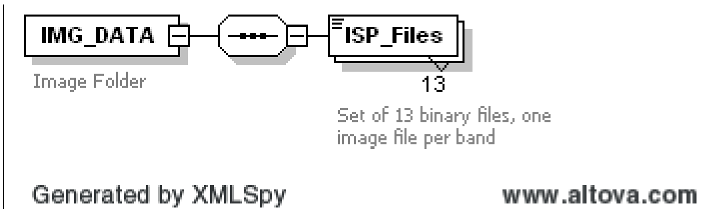
Figure 17: Level-0_Granule_Metadata_File - Quality_Indicators_Info Diagram

Quality_Indicators_Info/Image_Content_QI		
Field Name	**Description**	**Metatada Level**
CLOUDY_PIXEL_PERCENTAGE	Local cloud coverage indicator: A percentage of cloud coverage is computed for each Level-0 Granule (for the area covered by a **reference band**).	Standard
DEGRADED_MSI_DATA_PERCENTAGE	Local technical quality indicator: A percentage of degraded MSI data is provided for each Level-0 Granule.	Standard
Quality_Indicators_Info/Source_Packet_Description		
Field Name	**Description**	**Metatada Level**
Source_Packet_Counters_List/DATA_STRIP_START	First source packet counter	Standard
Source_Packet_Counters_List/SCENE_POSITION	Position of the first source packet in the on board scene	Standard
Source_Packet_Counters_List/NB_OF_SOURCE_PACKETS	Number of source packets	Standard
Lost_Source_Packet/DEGRADATION_TYPE	Type of degradation	Standard
Lost_Source_Packet/Error_Type_List/ERROR_NUMBER	Type of error (from AnaTm specifications) Attribute: errorType	Standard
Lost_Source_Packet/SCENE_DATE	Date of the first line of the scene which contains the first lost / degraded source packet	Standard
Lost_Source_Packet/FIRST_SP_ERROR	Counter of the first source packet in error. This number is in [0;143] for 10m bands, [0;71] for 20m bands or [0;23] for 60m bands.	Standard
Lost_Source_Packet/NUMBER_OF_SP_ERROR	Number of lost or degraded source packet. This number is in [1;144] for 10m bands, [1;72] for 20m bands or [1;24] for 60m bands	Standard

Table 3-28: Level-0 Granule - Quality_Indicators_Info Description

Note that, according to OLQC procedures consolidation, the results of all quality control checks performed by OLQC processor on Level-0 Granule are included in the XML reports stored in the QI_DATA folder (cf. § 3.4.1, Table 3-17).

3.6.3.2 IMG_DATA

diagram	
children	**ISP_Files**
annotation	IMG_DATA folder contains the mission data corresponding to one on-board scene for one detector and all spectral bands. The image data are provided as a set of 13 binary files, one for each spectral band, including all corresponding Image Source Packets (ISP) in the observation chronological sequence. The ISPs include their corresponding source packet annotations as a pre-pended header of each source packet. Note the following clarification: The ISPs include their corresponding source packet binary annotations as a pre-pended header of each source packet. A source packet header consists in: • an annotation computed during the L0 process (called DPC annotation). This annotation is 2 bytes long. It contains the following information: - the first bit indicates the global status of the ISP: should it be used (0) or not (1); - the second bit indicates if the packet is complete (0) or not (1); - the third bit indicates the packet integrity (0) or not (1); • - the 13 remaining bits are reserved; • the DFEP annotation (18 bytes) as received from the DFEP (cf. DFEP-ICD); it gives in particular the real size of the ISP and shall be used instead of the ISP packet length. The source packet header must be removed before uncompressing during L1 processing.

Compression and Compression by-passed modes:

According to the MSI instrument configuration, the ISPs can be compressed or not. Compression by-passed implies that data for only 4 detectors are provided.

In the nominal products the compression is enabled and all detectors are available; in case of calibration products or contingency acquisition the compression is by-passed and only a subset of detectors are active and therefore available in the product.

The instrument configuration implies that the number of the granules is variable and it is driven by the number of the active detectors.

Though the structure of the L0 PDI Granules is the same both for compression and by-passed compression, the L0 ISP semantics and data contents (CCSDS packet data field content including IAD (Image Ancillary Data) is different. They host different kind of data (compressed WICOM applied data and uncompressed raw image data) and the IAD is ordered differently (cf. [S2GICD-

MSI]). Within the processing chain, granules in compression bypass are dealt with a specific function in charge of dealing with the different format and perform additional processing tasks usually covered by the WICOM decompressor.

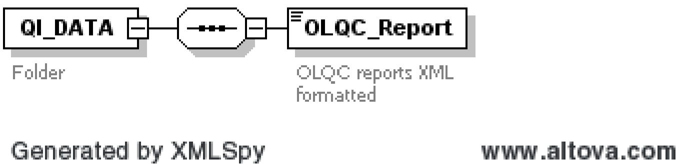
In order to allow properly handle L0 ISP data part, the following metadata are provided at Datastrip level:

- COMPRESS_MODE metadata (cf. section 3.7.3.1, Table 3-33)
- Active_Detectors_List metadata set (cf. section 3.7.3.1, Table 3-33).

To ensure the consistency / completeness of the L0 User Product with on-board compression by-passed a specific ON_BOARD_COMPRESSION_MODE metadata set at product level (cf. section 4.6.7.1, Table 4-9) indicates the compressed or by-passed compressed data content.

Note: all Datastrips in a product will always have the same compression mode. So when dealing with a User Product there is no need to check for the COMPRESS_MODE flag at Datastrip level.The ON_BOARD_COMPRESSION_MODE flag is sufficient to understand whether the product is relevant to compressed or uncompressed data.

3.6.3.3 QI_DATA

diagram	
children	**OLQC_Report**
annotation	QI_DATA folder contains XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The Annex C contains the description of OLQC reports.

3.6.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-0 PDI Granule level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- the Table 3-29 describing the content and structure of the Information Package Map section; consider that this section provides a logical hierarchical view of the product structure and content, reflecting the product organization, through a series of nested XFDU Content Unit elements; each Content Unit represents either a file or a directory contained in the product (except for the root Content Unit that represents the product itself); if it represents a directory, it nests one or more Content Units. In this way, all files of the product (Data Objects, Metadata Objects associated to Data Objects and XSD Schemas associated to Metadata Objects, with the exception of SAFE Manifest file itself) are pointed by the Information Package Map (each Data and Metadata Object by a Content Unit, each Schema by an attribute of the Content Unit);Note that for each product the table reflects exactly the product physical structure as graphically shown in the Figure 11 and Figure 12 (or analogous figures for the others PDI and User Product). The correspondences between elements in the figures 11 and 12 and the *contentUnits* in the table is provided in the "Description" column.

- for the Metadata section, Table 3-30 that lists the fields (tags) composing the section, providing, for each field:
    - the field name in the SAFE Manifest file (column "SAFE Manifest", divided into column "Metadata name", containing the name of the Metadata section of the manifest to which the field belongs, and "Name of tag or attribute" containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
    - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column "From S2_PDI_Level-0_Granule_Metadata.xsd");
    - a brief textual description of the field;
    - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
    - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
    - the allowed range of values of the field.

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-0 PDI Granule Product (with the exception of the Manifest file itself); this includes:
  - the XML Granule Metadata file;
  - the XML Inventory_Metadata file;
  - one file per spectral band, (up to a total of 13 files) in binary format, containing the ISPs corresponding to one detector and one band. in the observation sequence;
  - a set of Quality Indicator Data Files, including XML reports about Geometric quality, Image content quality, Quality control checks information

Name					Description	Data Type	Occ
contentUnit					Root Content Unit representing the whole PDI Granule product. (e.g. PDI Level-0 Granule box in Figure 11 or Level-0 Granule PDI_ID header in Figure 12)	U	1
	ID				Unique identifier of Content Unit	S	0..1
	unitType				Type of Content Unit	S	0..1
	textInfo				Textual description of the Component to which the Content Unit refers	S	0..1
	repID				Relate one or more XML Schema Components to a Data Object	S	0..1
	dmdID				Relates the Content Unit to the Platform Metadata Object and, if available, to the Acquisition Period Metadata Object (and to any additional Metadata Object).	S	0..1
	pdiID				Relates the Content Unit to the Processing Metadata Object	S	0..1
	contentUnit				Content Unit representing either a file or a directory of the PDI Granule Product (e.g. IMG_DATA box in Figure 11 or IMG_DATA icon in Figure 12)	U	1..*
		ID			Unique identifier of Content Unit	S	0..1
		unitType			Type of Content Unit	S	0..1
		textInfo			Textual description of the Component to which the Content Unit refers	S	0..1

		repID			Relate one or more XML Schema Components to a Data Object	S	0..1
		dmdID			Relates the Content Unit to the Platform Metadata Object and, if available, to the Acquisition Period Metadata Object (and to any additional Metadata Object).	S	0..1
		……..			Further level of nesting (if any) of Content Units		
		………			Further level of nesting (if any) of Content Units		
		contentUnit			Terminal leaf in the product structure hierarchy; this Content Unit represents a Data/Metadata Component file of the PDI Granule Product (e.g. *S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_B01.bin* file Ii Figure 12)		
			ID		Unique identifier of Content Unit	S	0..1
			unitType		Type of Content Unit	S	0..1
			textInfo		Textual description of the Component to which the Content Unit refers	S	0..1
			repID		Relate one or more XML Schema Components to a Data Object	S	0..1
			dmdID		Relates the Content Unit to the Platform Metadata Object and, if available, to the Acquisition Period Metadata Object (and to any additional Metadata Object).	S	0..1
			dataObjectPointer		Pointer to the Data/Metadata Component represented by the Content Unit	U	1
				dataObjectID	Identifier of Data/Metdata Componet in the Data Objects section of the SAFE Manifest	S	1

Table 3-29 – Content of Information Package Map for PDI Level-0 Granule SAFE Manifest

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data Center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->GRANULE_ID (substring <Mission ID>, cf. section 3.6.1)	The mission name of the platform		0..1	Sentinel
	number	General_Info->GRANULE_ID (substring <Mission ID>, cf.section 3.6.1)	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Vicarious_Calibration Raw_Measurement Test_Mode
	instrument->mode-> **identifier**	N.A.	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1A Datastrip Product
	start	General_Info->Archiving_Info -> ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info-> Archiving_Info ->ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_ UPA_ CDAM MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	processing-> resource>**role**	N.A.	Role of the resource	string	1	PDI Level-1A Granule Product
	resource-> processing		Description of the L0 to L1A Processing		0..*	
	resource-> processing->**name**	N.A.	Name of the L0 to L1A Processing	string	0..1	Processing of Level-0 Granule product

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	resource-> processing->**start**	General_Info-> GRANULE_ID (substring <Creation Date>, cf.section 3.6.1)	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing->facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing->facility-> **name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing->facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing->facility-> **site**	General_Info-> GRANULE_ID (substring <Site Centre>)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility-> **country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->	N.A.	Description of software component used for		0..*	

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	software		Processing			
	resource-> processing->facility-> software-> **name**	N.A.	Name of the software component	string	1	
	resource-> processing->facility-> software->**version**	N.A.	Version of the software component	string	0..1	
acquisitionPeriod					1	
	startTime	General_Info-> GRANULE_ID (substring <Sensing Time>, cf.section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Granule level, cf. section 3.6.1)	xs:dateTime	1	
measurementFrameSet					1	
	cloudVoteNotationSystem->**floor**	N.A.	Minimum value of cloud coverage index (Fixed value = 0.0)	double	0..1	0.0
	cloudVoteNotationSystem->**ceil**	N.A.	Maximum value of cloud coverage index (Fixed value = 100.0)	double	0..1	100.0
	frame	N.A.	The “frame” concept is used in SAFE to convey the cloud coverage information by sub-dividing the region of interest of the data into “frames”		0..13	

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			according to a World Reference System. In the case of Sentinel-2 L1C Products, a similar concept can be used, by associating one single "frame" to the area covered by the granuke (wth respect to the reference band)			
	frame->number	N.A.	Number of the frame	integer	0..1	1
	frame-center	Geometric_Info->Granule_Position->Geometric_Header->GROUND_CENTER (only lat/lon coordinates, not height)	The Granule centre on ground	gml:PointType	0..1	
	frame->footPrint	Derived fromGeometric_Info->Granule_Footprint	Granule footprint (namely imaged area corresponding to the Granule), corresponding to one detector and all bands	string (gml:linearRingType namely blank separated list of comma-separated long/lat coordinates of footprint closed polygon with last vertex equal to first)	0..1	
	frame→Tile	N.A.			1	One Tile for the frame
	frame→Tile->**row**	N.A.	The column index of the Tile. This index is numbered starting from 1.	integer	1	1 (since there is only one Tile)
	frame→Tile->**column**	N.A.	The row index of the Tile. This index is numbered starting from 1.	integer	1	1 (since there is only one Tile)

SAFE Manifest		From *S2_PDI_Level-0_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	frame→Tile->cloudVote	Derived from Quality_Indicators_Info->Image_Content_QI->Common_IMG_QI->CLOUDY_PIXEL_PERCENTAGE	Numeric notation qualifying the cloud coverage of the Tile	double	0..1	0 to 100
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..10	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-30 - Content of Metadata Section for PDI Level-0 Granule SAFE Manifest

Name				Description	Data Type	Occ
dataObject				This element references the Data Component included in the product.	U	1..*
	ID			Data Component;ID	S	1

	repId			List of IDs of all XML Schemas associated to Data Component	S	1
	byteStream			Pointer to the Data Component	U	1..*
		mimeType		The MIME type for the referenced Data Component	E	1
		size		The size in bytes of the Data Compionet	UI	1
		fileLocation		Location of file	U	1
			locatorType	Type of the file location	URI	1
			textInfo	Textual description of the Data Component	S	0..1
			href	Relative path of the file (in the file system) containing the referenced Data Component	URI	1
		checksum		Checksum value for the Data Component	U	1
			checksumName	Checksum type the Data Component (e.g. MD5)	E	1

Table 3-31 – Content of Data Object Section for PDI Level-0 Granule SAFE Manifest

3.7 Level-0 PDI Datastrip definition

Level-0 PDI Datastrip is defined as a **tar** file containing the following structure:

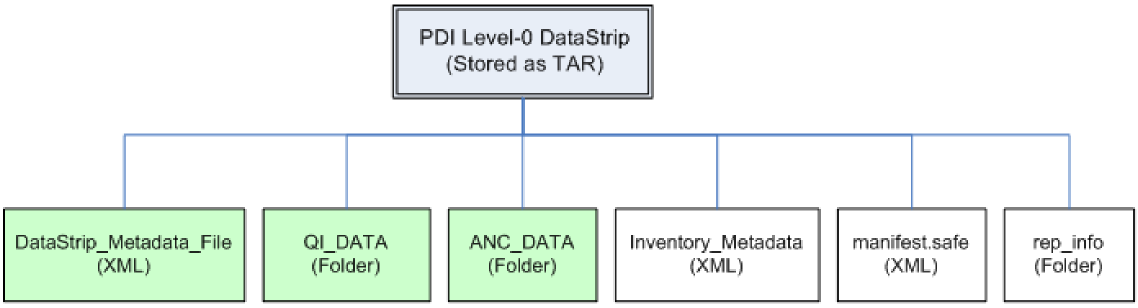


Figure 18: PDI Level-0 Datastrip Structure

The PDI Level-0 Datastrip consists of:

1. **Datastrip_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Datastrip;
2. **QI_DATA**: folder containing the preliminary QuickLook files in JP2 format and XML reports providing Quality control check results;
3. **ANC_DATA**: folder containing SAD raw data provided on temporal extent of the full Datatake if the Datastrip is the last one in a given Datatake, otherwise the SAD coverage is from the start of the Datatake (to which the Datastrip belongs to) to the stop of the Datastrip itself. SAD data are provided as a set of unitary Raw Data files each matching a single packet type;
4. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI;
5. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.7.4);
6. **rep_info**: folder containing the available XSD schema that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.4.4).

3.7.1 PDI_ID definition

Datastrip PDI_ID (Datastrip ID) is defined in the section 3.5.2. The File_Type is specified in the section 3.2, Table 3-3.

Level-0 Datastrip template Name (Datastrip ID):
S2A_OPER_MSI_L0__DS_SGS__20141104T134012_S20141104T134012_N01.12.tar

<u>Note that the PDI_ID.tar is the physical name of the Datastrip PDI after the tar compression.</u>

3.7.2 Level-0 Datastrip Physical Format

The PDI ID defined above represents the “Datastrip directory” name. Inside the Datastrip directory, there are the Datastrip components as in the Figure 18.

Inside that directory, the naming convention used to identify each real files follows the same convention used to define the Datastrip ID but without the Processing Baseline sub-string.

- **Datastrip_Metadata_File (XML file):**
  Datastrip_Metadata_File template name:
  S2A_OPER_MTD_L0__DS_SGS__20141104T134012_S20141104T134012.xml

  The XSD schema which regulates the metadata file is *S2_PDI_Level-0_Datastrip_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **QI_DATA (folder):**
  QI_DATA folder contains:
  – XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.

  File Template Name:
  *S2A_OPER_MSI_L0__DS_SGS__20141104T134012_S20141104T134012_GEOMETRIC_QUALITY*_report.xml

  – Five (5) Preliminary Quick Look files (JPEG2000 format). The number of files could be potentially less than 5 in degraded cases.

Naming convention = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.jp2

<Instance_Id> = <Site Centre>_<Creation Date>_<Sensing Time>_<Band Id>

MMM, CCCC, <Site Centre> and <Sensing Time> are taken from L0 Datastrip ID.

TTTTTTTTTT = QLK_L0__DS

<Band Id> = Bxx where xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12

The <Band Id> is configurable but the default values are: 01, 02, 03, 10 and 11

File Templete Name:
S2A_OPER_QLK_L0__DS_SGS__20141104T134012_S20141104T134012_B11.jp2

- **ANC_DATA (folder):**
  ANC_DATA folder contains:

– Raw Satellite Ancillary Data provided as a set of unitary Raw Data files each matching a single packet type.

File template name (cf. section 3.21.1):
S2A_OPER_AUX_S11125_SGS__YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_A012631_WF_LN.bin

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-0_Datastrip_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

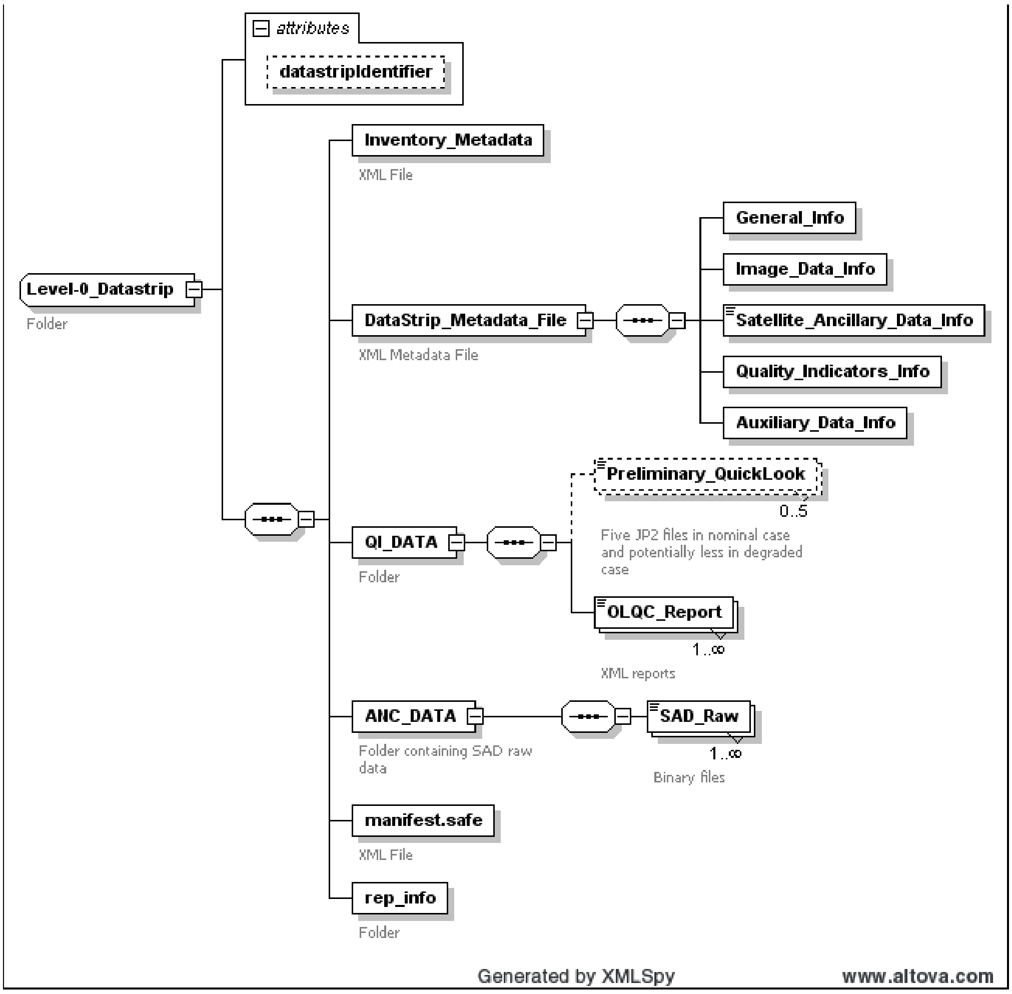
Level-0 Datastrip Physical Format template:

Level-0 Datastrip PDI_ID ***S2A_OPER_MSI_L0__DS_SGS__20141104T134012_S20141104T134012_N01.12***
Inventory_Metadata.xml
S2A_OPER_MTD_L0__DS_SGS__20141104T134012_S20141104T134012.xml
manifest.safe
QI_DATA
S2A_OPER_MSI_L0__DS_SGS__20141104T134012_S20141104T134012_GEOMETRIC_QUALITY_report.xml
S2A_OPER_QLK_L0__DS_SGS__20141104T134012_S20141104T134012_B11.jp2
ANC_DATA
S2A_OPER_AUX_S11125_SGS__YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_A012631_WF_LN.bin
rep_info
S2_PDI_Level-0_Datastrip_Metadata.xsd
Inventory_Metadata.xsd
OLQC_Report.xsd

Figure 19: PDI Level-0 Datastrip Physical Format

3.7.3 Level-0 PDI Datastrip Structure

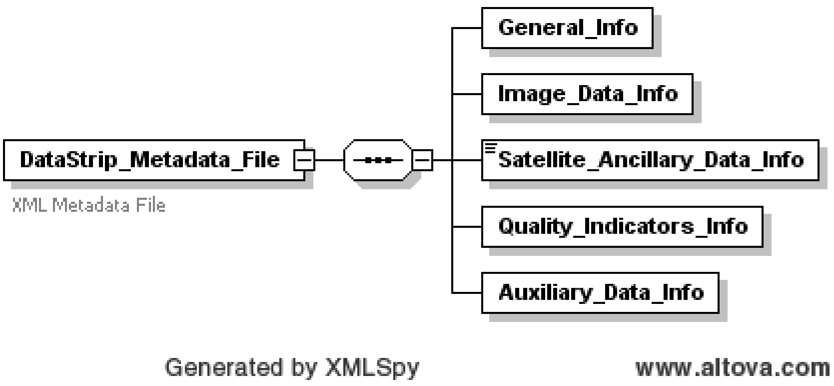
The *S2_PDI_Level-0_Datastrip_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-0 Datastrip PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 18.

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>children</td><td>Datastrip_Metadata_File QI_DATA Inventory_Metadata manifest.safe rep_info</td></tr>
<tr><td>annotation</td><td>The Level-0 Datastrip is defined as a folder containing:
1. Datastrip_Metadata_File: XML Main Metadata File.
2. QI_DATA: folder containing XML reports including Quality Indicators and Preliminary QuickLook image files in JP2 format
3. ANC_DATA: folder containing SAD raw data
4. Inventory_Metadata: XML inventory metadata file
5. manifest.safe: XML SAFE Manifest file</td></tr>
</table>

	6. **rep_info**: folder containing the XSD schemas provided inside a SAFE Level-0 Datastrip Note that ANC_DATA, Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.

3.7.3.1 Datastrip_Metadata_File Schema

Level-0 Datastrip_Metadata_File is the XML metadata file provided inside each Level-0 Datastrip. The schema used to validate it is *S2_PDI_Level-0_Datastrip_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc…) refers to the XSD file.

diagram	
children	General_Info Image_Data_Info Satellite_Ancillary_Data_Info Quality_Indicators_Info Auxiliary_Data_Info
annotation	The structure of the Datastrip_Matadata_File is common to all processing level (cfr. § 3.5.1) The Datastrip_Metadata_File is an XML file containing all the metadata describing the whole product data item. 1. **General_Info**: This group of metadata provide general information characterizing the source Datastrip acquisition. 2. **Image_Data_Info**: Image data information from MSI telemetry. 3. **Satellite_Ancillary_Data_Info**: Ancillary data information from Satellite Ancillary Telemetry. 4. **Quality_Indicators_Info**: Results of all quality checks performed at Datastrip level. 5. **Auxiliary_Data_Info**: Auxiliary data information.

The following tables and figures give a complete overview of the Level-0 Datastrip_Metadata_File schema according the description provided in the section 3.5.1.

General_Info:

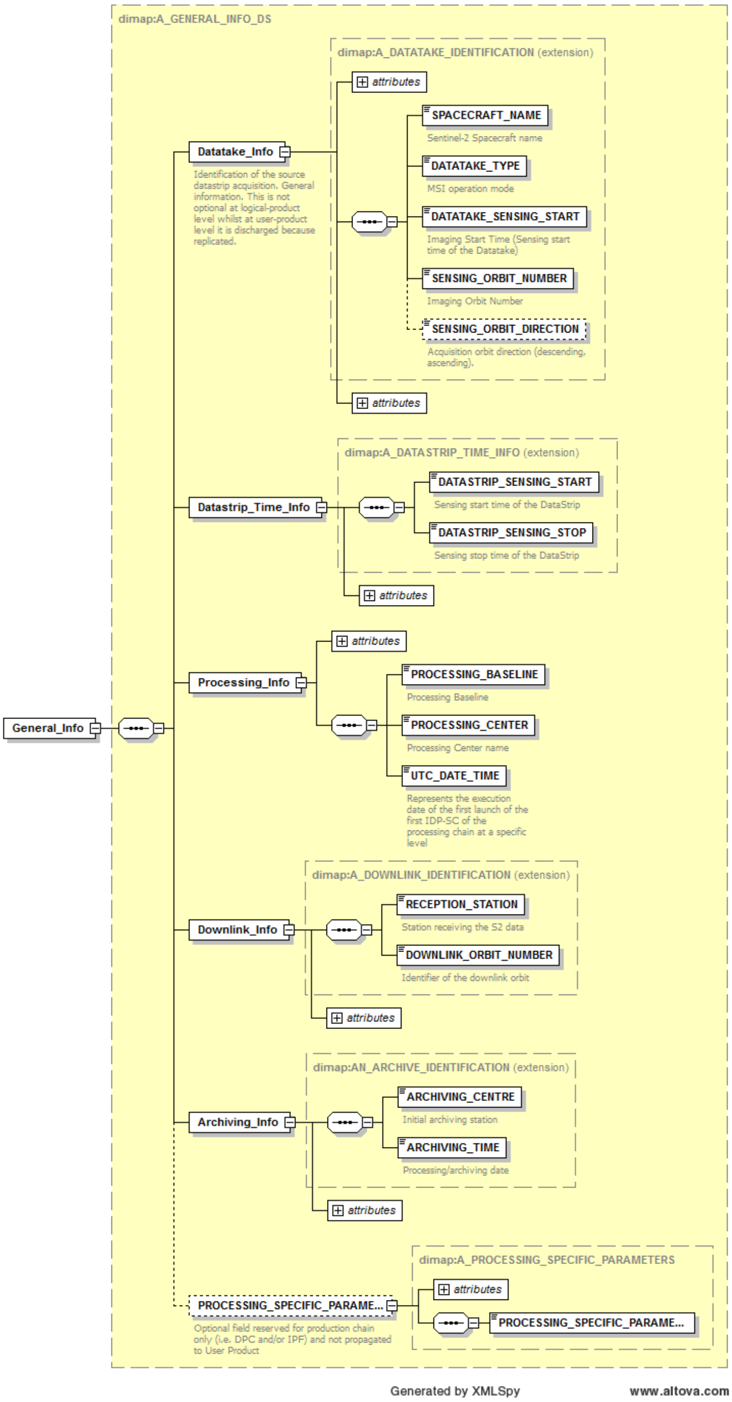


Figure 20: Level-0 Datastrip - General_Info Diagram

In the following tables, the third column provide the metadata level attribute for each metadata (cf. section 2.10).

General_Info/Datatake_Info		
Field Name	**Description**	**Metatada Level**
SPACECRAFT_NAME	Sentinel-2 Spacecraft name: Sentinel-2A, Sentinel-2B	Brief
DATATAKE_TYPE	MSI operation mode	Brief
DATATAKE_SENSING_START	Imaging Start Time (Sensing start time of the Datatake)	Brief
SENSING_ORBIT_NUMBER	Imaging Orbit Number ESA confirms that SENSING_ORBIT_NUMBER has to be filled by the 'Relative' orbit number which is computed from the Absolute as reported in DPM-IAS02.	Brief
SENSING_ORBIT_DIRECTION	Imaging Orbit Direction (Default = Ascending)	Brief
General_Info/Datastrip_Time_Info		
Field Name	**Description**	**Metatada Level**
DATASTRIP_SENSING_START	Sensing start time of the Datastrip	Brief
DATASTRIP_SENSING_STOP	Sensing stop time of the Datastrip	Brief
General_Info/Processing_Info		
Field Name	**Description**	**Metatada Level**
PROCESSING_BASELINE	The processing baseline (cf. section 2.9) refers to the configuration baseline used at the time of the product generation in term of processor software version and major GIPP version.	Expertise

	Note: all the PDIs of a Datatake are always processed with the same processing baseline even if acquiered in different stations	
UTC_DATA_TIME	This data time represents the execution date of the first run of the first IDP-SC of the processing chain at a specific level	Expertise
PROCESSING_CENTER	Production centre: • SGS_ • MPS_ • MTI_ • EPA_ • MPC_ • UPA_ • XXXX • EDRS • zzzL (zzz = first three characters of the LGS location)	Expertise
General_Info/Downlink_Info		
Field Name	**Description**	**Metatada Level**
RECEPTION_STATION	Reception stations: • SGS_ • MPS_ • MTI_	Standard
DOWNLINK_ORBIT_NUMBER	Identifier of the downlink orbit	Standard
General_Info/Archiving_Info		
Field Name	**Description**	**Metatada Level**
ARCHIVING_CENTRE	The allowed values are: • SGS_ • MPS_ • MTI_	Expertise

	• EPA_ • UPA_ • CDAM • MPC_	
ARCHIVING_TIME	Archiving date (UTC data time). Date updated at the end of inventory process	Expertise
Processing_Specific_Parameters/PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-32: Level-0 Datastrip - General_Info Description

Image_Data_Info:

The exploited Image_Data_Info diagram is too complex to be inserted in the document. The following figure shows the high-level diagram, for more details refers to the S2_PDI_Level-0_Datastrip_Metadata.xsd contained in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* annexed to this document. The table hereafter describes all the Image Data Information.

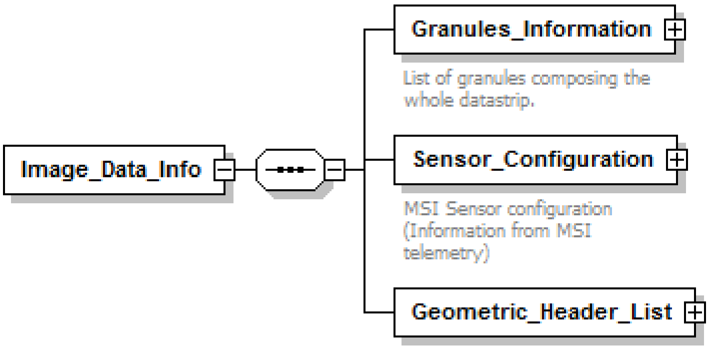


Figure 21 : Level-0 Datastrip – Image_Data_Info Diagram

Image_Data_Info/Granules_Information		
Field Name	**Description**	**Metatada Level**
/Detector_List/…/POSITION	This branch of the schema provides information regarding all Granules, for each detector, composing the whole Datastrip. Each Granule composing the Datastrip is univocally identified through a unique Granule identifier (PDI_ID at granul level). For each Granule the Position of the Granule is provided. This position is identified through the position of the scenes first lines in the Datastrip and is expressed as number of 10m resolution images lines.	Standard
Image_Data_Info/Sensor_Configuration		
Field Name	**Description**	**Metatada Level**
Acquisition_Configuration/COMPRESS_MODE	Flag to indicate if compress mode is by passed	Expertise
Acquisition_Configuration/EQUALIZATION_MODE	Flag to indicate if equalization is active	Expertise
Acquisition_Configuration/NUC_TABLE_ID	In-flight Non Uniform Correction table ID defined by 10 bits. This ID is uniform for all transmitted bands. It identifies the correction coefficients table used in-flight	Expertise
Acquisition_Configuration/Active_Detectors_List/ACTIVE_DETECTOR	On board active Detectors (in case of compression by-passed) Note: Metadata classified *Brief* (always provided) in order to have always available in the L0 User Product the list of active detectors for each MSI mode.This to ensure the consistency/completeness of the L0 User Product with on-board compression by-passed or not. The list of active detectors is variable and this metadata drives the list of the L0 Granule PDI available in the L0 User Product	Expertise

Acquisition_Configuration/TDI_Configuration_List/TDI_CONFIGURATION	On board TDI configuration, for B3, B4, B11 and B12 only.	Standard
Acquisition_Configuration/Spectral_Band_Info/PHYSICAL_GAINS	Physical Gain for each band	Standard
Acquisition_Configuration/Spectral_Band_Info/COMPRESSION_RATE	On-board compression rates for each band	Expertise
Acquisition_Configuration/Spectral_Band_Info/INTEGRATION_TIME	On-board integration time for each band	Expertise
Source_Packet_Description/Source_Packet_Counters_List/Detector_List/Band_List/Band/DATA_STRIP_START	First source packet counter	Standard
Source_Packet_Description/Source_Packet_Counters_List Detector_List/Band_List/Band/SCENE_POSITION	Position of the first source packet in the on board scen	Standard
Source_Packet_Description/Source_Packet_Counters_List/ Detector_List/Band_List/Band/NB_OF_SOURCE_PACKETS	Number of source packets.	Standard
Source_Packet_Description/Degradation_Summary Attribute: degradationPercentage	Percentage of lost or degraded (either too degraded or not) ancillary data packets in the Datastrip	-
Source_Packet_Description/Degradation_Summary/NUMBER_OF_LOST_PACKETS	Number of lost packets for the whole Datastrip	Standard
Source_Packet_Description/Degradation_Summary/NUMBER_OF_TOO_DEGRADED_PACKETS	Number of too degraded packets (i.e. erroneous packets not trustworthy, meaning they will not be used by further processing) for the whole Datastrip	Standard
Source_Packet_Description/Degradation_Summary/NUMBER_OF_KEPT_DEGRADED_PACKETS	Number of degraded packets (i.e. erroneous packets but trustworthy, meaning they will be used by further processing) for the whole Datastrip	Standard
Time_Stamp/LINE_PERIOD	Line period for the acquisition of line of 10 m full-resolution image data	Standard
Time_Stamp/Band_Time_Stamp/Detector/REFERENCE_LINE	Datation model for each couple band, detector. Line number corresponding to the time stamp	Standard
Time_Stamp/Band_Time_Stamp/Detector/GPS_TIME	Datation model for each couple band, detector. Time stamp.	Standard
Time_Stamp/GPS_SYNC	Flag (Boolean) to indicate if MSI is synchronize with GPS time	Standard
Time_Stamp/THEORETICAL_LINE_PERIOD	Theoretical line period for the acquisition of line of 10 m full-resolution image data	Standard
Time_Stamp/Quality_Indicators/Global/RMOY	GPS time quality indicator. Optional. Created when datation models are estimated	Standard

	through linear regression.	
Time_Stamp/Quality_Indicators/GSP_List/GSP/RMOY	Optional. Created when datation models are estimated through linear regression.	Standard
Image_Data_Info/Geometric_Header_List		
Field Name	**Description**	**Metatada Level**
Geometric_Header_List/Geometric_Header/GPS_TIME	A GPS date-time value = TAI format	Standard
Geometric_Header_List/Geometric_Header/LINE_INDEX	Line index (Integer)	Standard
Geometric_Header_List/Geometric_Header/Pointing_Angles/Satellite_Reference/ROLL	double value expressed in degree	Standard
Geometric_Header_List/Geometric_Header/Pointing_Angles/Satellite_Reference/PITCH	double value expressed in degree	Standard
Geometric_Header_List/Geometric_Header/Pointing_Angles/Satellite_Reference/YAW	double value expressed in degree	Standard
Geometric_Header_List/Geometric_Header/Pointing_Angles/Image_Reference/PSI_X	Along lines	Expertise
Geometric_Header_List/Geometric_Header/Pointing_Angles/Image_Reference/PSI_Y	Along columns	Expertise
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/ORIENTATION	Track orientation. Also called "CAPE". The range of the angle is into [0,360°[	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Incidence_Angles/ZENITH_ANGLE	incidence zenith angle	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Incidence_Angles/ZENITH_ANGLE	incidence azimuth angle	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Solar_Angles/ZENITH_ANGLE	solar azimuth angle	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Solar_Angles/ZENITH_ANGLE	solar azimuth angle	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Pixel_Size/ALONG_TRACK	pixel size along track	Standard
Geometric_Header_List/Geometric_Header/Located_Geometric_Header/Pixel_Size/ACROSS_TRACK	pixel size across track	Standard

Table 3-33: Level-0 Datastrip – Image_Data_Info Description

Satellite_Ancillary_Data_Info:

The expanded Satellite_Ancillary_Data_Info diagram is too complex to be inserted in the document. The following figure shows the high-level diagram, for more details refers to the *S2_PDI_Level-0_Datastrip_Metadata.xsd* contained in the S2-PDGS-TAS-DI-PSD-V14_Schemas.zip annexed to this document.

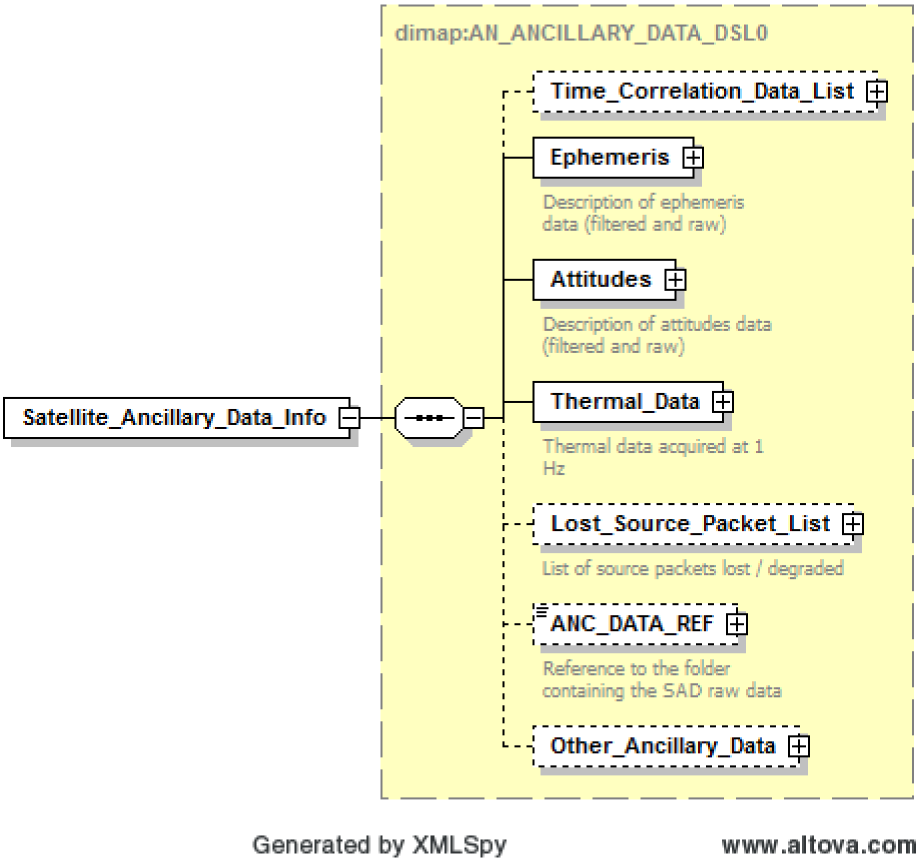


Figure 22: Level-0 Datastrip – Satellite_Ancillary_Data_Info Diagram

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/NSM	Navigation Solution Method	Standard
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/QUALITY_INDEX	Time quality index	Standard
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/TDOP	Time dilution of precision.	Standard
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/IMT	Instrument measurement time representation of the synchronisation time stamp.	Standard
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/GPS_TIME	GPS time representation of the synchronisation time stamp.	Standard
Satellite_Ancillary_Data_Info/Time_Correlation_Data_List/Time_Correlation_Data/UTC_TIME	UTC time representation of the synchronisation time stamp.	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Number_List/Gps_Number/GPS_TIME_START	GPS time value. This field must be filled by the processor according to each GPS time period.	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Number_List/Gps_Number/GPS_TIME_END	GPS time value. This field must be filled by the processor according to each GPS time period.	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/POSITION_VALUES	Dated positions (X, Y, Z) from GPS in millimeters	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/POSITION_ERRORS	Position errors (dX, dY, dZ) from GPS in millimeters	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/VELOCITY_VALUES	Dated velocities (Vx, Vy, Vz) from GPS in millimeters per seconds	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/VELOCITY_ERRORS	Velocity errors (dVx, dVy, dVz) from GPS in millimeters per seconds	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/GPS_TIME	GPs Time value	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/NSM	Navigation Solution Method	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/QUALITY_INDEX	Position quality index	Standard

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/GDOP	Quality index (Geometrical dilution of precision)	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/PDOP	Quality index (Position dilution of precision)	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/TDOP	Quality index (Time dilution of precision)	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/NOF_SV	The number of Space Vehiculess (SVs) the receiver was able to use for the Navigation Solution computation, i.e. SVs for which code and carrier phase measurements and Ephemeris data were available.	Standard
Satellite_Ancillary_Data_Info/Ephemeris/GPS_Points_List/GPS_Point/TIME_ERROR	GNSS system time error	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/VALID_FLAG	When 1 : ephemeris is valid	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/OPSOL_QUALITY	0: solution is valid / 1: solution propagated / 2: cyclic position update available	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/POSITION_VALUES	Dated positions (X, Y, Z) from AOCS	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/VELOCITY_VALUES	Dated velocities (Vx, Vy, Vz) from AOCS	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/GPS_TIME	GPs Time value	Standard
Satellite_Ancillary_Data_Info/Ephemeris/AOCS_Ephemeris_List/AOCS_Ephemeris/ORBIT_ANGLE	Orbit angle wrt WGS84	Standard
Satellite_Ancillary_Data_Info/Ephemeris/POD_Info/POD_FLAG	Flag to indicate if POD (Precise Orbit Determination) data has been used for product generation Note: POD_Info optional node is not relevant in case of L0 and L1C processing but it is included here to have the same Satellite_Ancillary_Data information for all level of processing.	Standard
Satellite_Ancillary_Data_Info/Ephemeris/POD_Info/POD_FILEN	POD filename. If applicable, reference to the file containing POD	Standard

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
AME	data used.	
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/QUATERNION_VALUES	Space separated list of 4 quaternion values ordered as Q0 Q1 Q2 Q3 (qv1 qv2 qv3 qs)	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/QUATERNION_VALIDITY	When 1 : quaternion is valid	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/GPS_TIME	GPs Time value	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/INUSE_FLAGS	List of 11 boolean flags separated by whitespace: STR1 STR2 STR3 GPSR-A GPSR-B VCU-A VCU-B IMU-1 IMU-2 IMU-3 IMU-4	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/AOCS_MODE	AOCS Mode	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/AOCS_SUBMODE	AOCS submode	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/INNOVATION_STR1	Difference Between GSE filter estimate and second in-use STR measurement	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/INNOVATION_STR2	Difference Between GSE filter estimate and second in-use STR measurement	Standard
Satellite_Ancillary_Data_Info/Attitudes/Corrected_Attitudes/Values/ATTITUDE_QUALITY_INDICATOR	Attitude quality indicators	Standard
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/QUATERNION_VALUES	Space separated list of 4 quaternion values ordered as (Q0 Q1 Q2 Q3) = (qv1 qv2 qv3 qs) (inertial attitude J2000).	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/ANGULAR_RATE	Angular rate (X, Y, Z) in BRF in deg/s	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/GPS_TIME	Time stamp of the center of integration associated with the attitude (with a precision up to 2pow-16 seconds). This field is computed from the centerOfIntegrationTimeStamp value provided in the data block	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/JULIAN_DATE	Julian date used for precession correction (if enabled); specified in number of days since the epoch date of the built-in star catalog; day 0 corresponds to JD 2451545	Expertise

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/ATTITUDE_QUALITY_INDICATOR	Attitude Quality	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/RATE_QUALITY	Rate Quality	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Attitude_Data_List/Attitude_Data/VALIDITY_RATE	if set to 1, the rate information is valid (i.e. derived from current measurements)	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/OP_MODE	STR operating mode	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/TEC_MODE	Thermo electric cooler mode	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/TARGET	Target temperature for temperature control	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/DETECTOR	Detector temperature	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/OPTICS	Optics temperature	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/HOUSING	Housing temperature	Standard
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/SYNC_SOURCE	The source selected for external synchronization	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/SECONDS_SINCE_TIME_SYNC	The number of seconds since the latest received time synchronization; saturates at 63 seconds	Expertise

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/TRACKABLE_STARS	Number of trackable stars	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/TRACKED_STARS	Number of stars tracked	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/IDENTIFIED_STARS	Number of identified stars	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/USED_STARS	Number of stars used for attitude determination	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/ATT_RESULT	Last result of attitude determination	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/STR_List/STR/Status_And_Health_Data_List/Status_And_Health_Data/ID_RESULT	Last result of star identification error	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/FILTERED_ANGLE	IMU filtered data are angle increments	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/RAW_ANGLE	IMU raw data are angle increments	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/GPS_TIME	GPS time value	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/ORGANISER	Organiser temperature	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/SIA	Sagnac Interferometer Assembly temperature	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/OPTICAL_SOURCE	Optical Source temperature	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/I	Board temperature	Expertise

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
MU/Value/Temperatures/BOARD		
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/VOLTAGE_OFFSET	Temperature reference voltage offset	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/VOLTAGE	Temperature reference voltage	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/ACQUISITION	0:not acquired, 1:acq failed, 2:acquired	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/VALIDITY	Acquisition validity flag	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/Temperatures/TIME	Time corresponding to the measurements	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/TIME	10PPS time corresponding to the measurements (provided by CSW)	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/ACQUISITION	0:not acquired, 1:acq failed, 2:acquired	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/VALIDITY	Acquisition validity flag	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/HEALTH_STATUS_BITS	16 Bits (0/1) sequence as defined in the IMU interface	Expertise
Satellite_Ancillary_Data_Info/Attitudes/Raw_Attitudes/IMU_List/IMU/Value/HEALTH_STATUS_BITS_VALIDITY	1 when all health status validity flag are ok(0)/ 0 otherwise	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/FPA_List/FPA/Value/T	FPA temperature information (thermal control and monitoring, relevant to the detector transmission VNIR or SWIR)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/FPA_List/FPA/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/FPA_List/FEE/Value/T	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/FPA_List/FEE/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/Mirror_List/Mirror/Value/T	List of temperatures for each mirror	Expertise

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Thermal_Data/Mirror_List/Mirror/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/ThSensor_List/ThSensor/Value/T	List of temperatures for each sensor on telescope	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/ThSensor_List/ThSensor/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/Splitter_List/Value/T	List of temperatures for each splitter	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/SplitterList/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/CSM_Diffuser_List/ Value/T	List of temperatures for each diffuser	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/CSM_Diffuser_List/ Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/IMU_Sensorplate_List/IMU_Sensorplate/Value/T	Imu sensor plate temperatures	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/IMU_Sensorplate_List/IMU_Sensorplate/Value/GPS_TIME	Thermal Data info. (Data are acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Sensorplate_List/STR_Sensorplate/Value/T	List of temperatures for each STR sensorplate	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Sensorplate_List/STR_Sensorplate/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Baseplate_List/STR_Baseplate/Value/T	STR base plate temperatures	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Baseplate_List/STR_Baseplate/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Backplate_List/STR_Backplate/Value/T	STR back plate temperatures.	Expertise
Satellite_Ancillary_Data_Info/Thermal_Data/STR_Backplate_List/STR_Backplate/Value/GPS_TIME	Thermal Data info (Data acquired at 0.1 Hz)	Expertise
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/Lost_Source_Packet/DEGRADATION_TYPE	Type of degradation	Standard

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/Lost_Source_Packet/ERROR_BEGINNING_DATE	error begin time	Standard
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/Lost_Source_Packet/ERROR_ENDING_DATE	error end time	Standard
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/ Degradation_Summary Attribute: degradationPercentage	Percentage of lost or degraded packets for the Datatake	-
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/ NUMBER_OF_LOST_PACKETS	number of lost packets for the whole Datatake	Standard
Satellite_Ancillary_Data_Info/Lost_Source_Packet_List/ NUMBER_OF_DEGRADED_PACKETS	number of degraded packets for the whole Datatake	Standard
Satellite_Ancillary_Data_Info/ANC_DATA_REF	Reference to the folder (ANC_DATA) including the SAD raw data	Standard
Satellite_Ancillary_Data_Info/Other_Ancillary_Data/CSM_Flags_List/Values/INUSE_FLAG	Flag used to specify if the CSM information are useable or not	Expertise

Table 3-34: Level-0 Datastrip – Satellite_Ancillary_Data _Info Description

Quality_Indicators_Info:

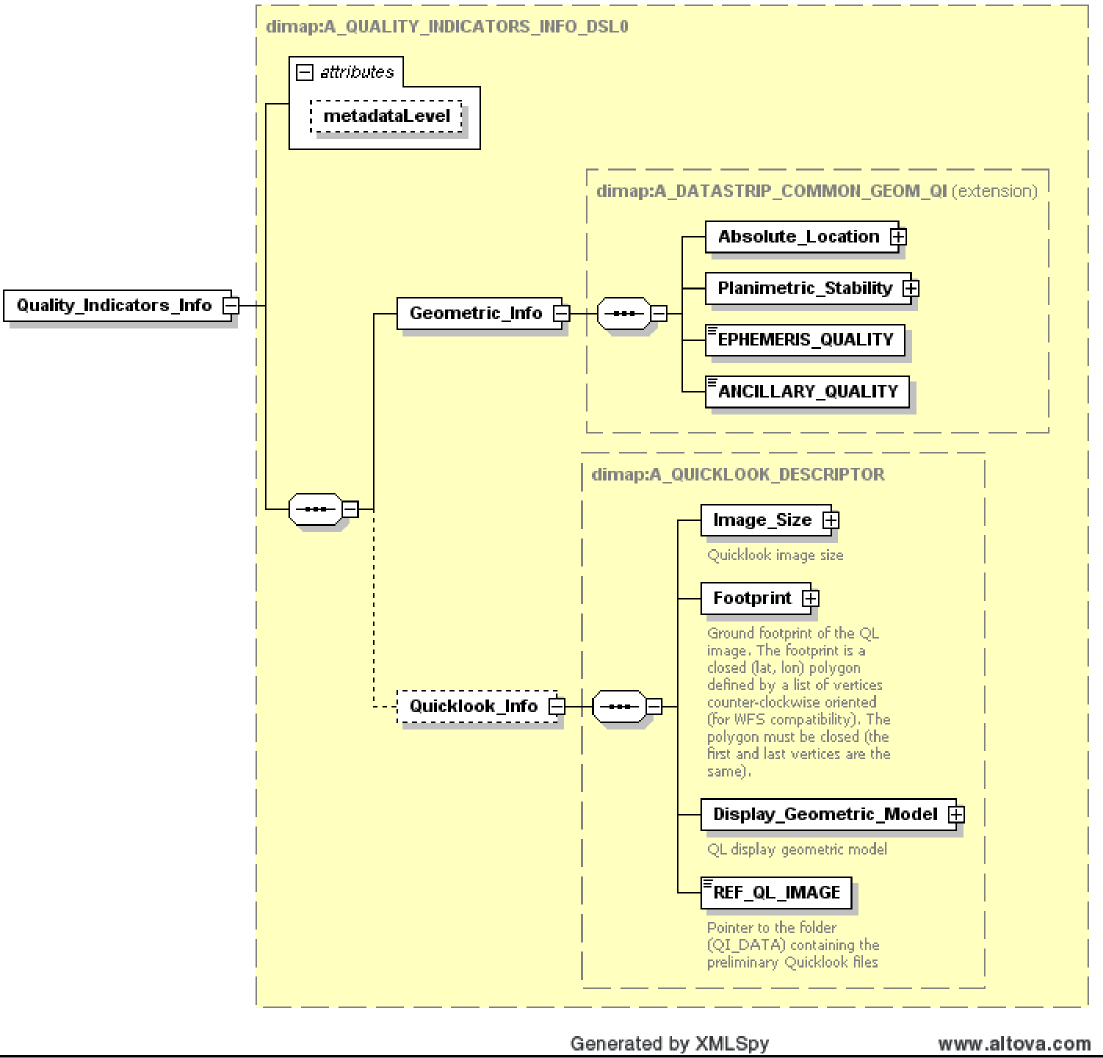


Figure 23 : Level-0 Datastrip – Quality_Indicators_Info Diagram

Quality_Indicators_Info/Geometric_Info		
Field Name	**Description**	**Metatada Level**
Absolute_Location	An absolute location performance for the Datastrip is given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Planimetric_Stability	Planimetric stability assessment: A planimetric stability performance for the Datastrip is given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data	Brief
EPHEMERIS_QUALITY	Ephemeris data quality retrieved from GPS Dilution of precision (DOP) information	Brief
ANCILLARY_QUALITY	Aancillary data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Quality_Indicators_Info/Quicklook_Info		
Field Name	**Description**	**Metatada Level**
Image_Size/NCOLS	Quicklook image size. Number of columns.	Brief
Image_Size/NROWS	Quicklook image size. Number of rows.	Brief
Footprint/EXT_POS_LIST	Ground footprint of the QL image. The footprint is a closed (lat, lon) polygon defined by a list of vertices counter-clockwise oriented (for WFS compatibility). The polygon must be closed (the first and last vertices are the same). Point list. The coordinates of the points are entered as pairs of latitude and longitude values, or X and Y, or other	Brief
Footprint/INT_POS_LIST	Ground footprint of the QL image. The footprint is a closed (lat, lon) polygon defined by a list of vertices counter-clockwise oriented (for WFS compatibility). The polygon must be closed (the first and last vertices are the same).	Brief

	Point list. The coordinates of the points are entered as pairs of latitude and longitude values, or X and Y, or other	
Display_Geometric_Model/Datation_Model/L0	Line number of the first line	Brief
Display_Geometric_Model/Datation_Model/T0	Date of the first line	Brief
Display_Geometric_Model/Datation_Model/TE	Theoretical line period	Brief
Display_Geometric_Model/Viewing_Directions/NB_OF_PIXELS	Number of pixels	Brief
Display_Geometric_Model/Viewing_Directions/TAN_PSI_X_LIST	List of Tangent Psi X in the image order (there is one data by pixel)	Brief
Display_Geometric_Model/Viewing_Directions/TAN_PSI_Y_LIST	List of Tangent Psi Y in the image order (there is one data by pixel)	Brief
Display_Geometric_Model/Connect_col_List/CONNECT_COL	The 12 detectors are assembled and resampled in a monolithic quicklook image. This block gives, in the quicklook geometry, the connection columns number (last column) for each detectors (the first 11 detectors for compressed mode and 4 for uncompressed mode).	Brief
Display_Geometric_Model/Piloting_To_Msi_Frame/R1	First rotation (angles around an axis)	Brief
Display_Geometric_Model/Piloting_To_Msi_Frame/R2	Second rotation (angles around an axis)	Brief
Display_Geometric_Model/Piloting_To_Msi_Frame/R3	Third rotation (angles around an axis)	Brief
Display_Geometric_Model/Piloting_To_Msi_Frame/SCALE_FACTOR	A scale factor on Z axis (in order to model the focal length deformation)	Brief
Display_Geometric_Model/Piloting_To_Msi_Frame/COMBINATOR_ORDER	The combination order between rotation and scale factor transformations	Brief
REF_QL_IMAGE	Pointer to the folder (QI_DATA) containing the preliminary Quicklook image files	Brief

Table 3-35: Level-0 Datastrip – Quality_Indicators_Info Description

Auxiliary_Data_Info:

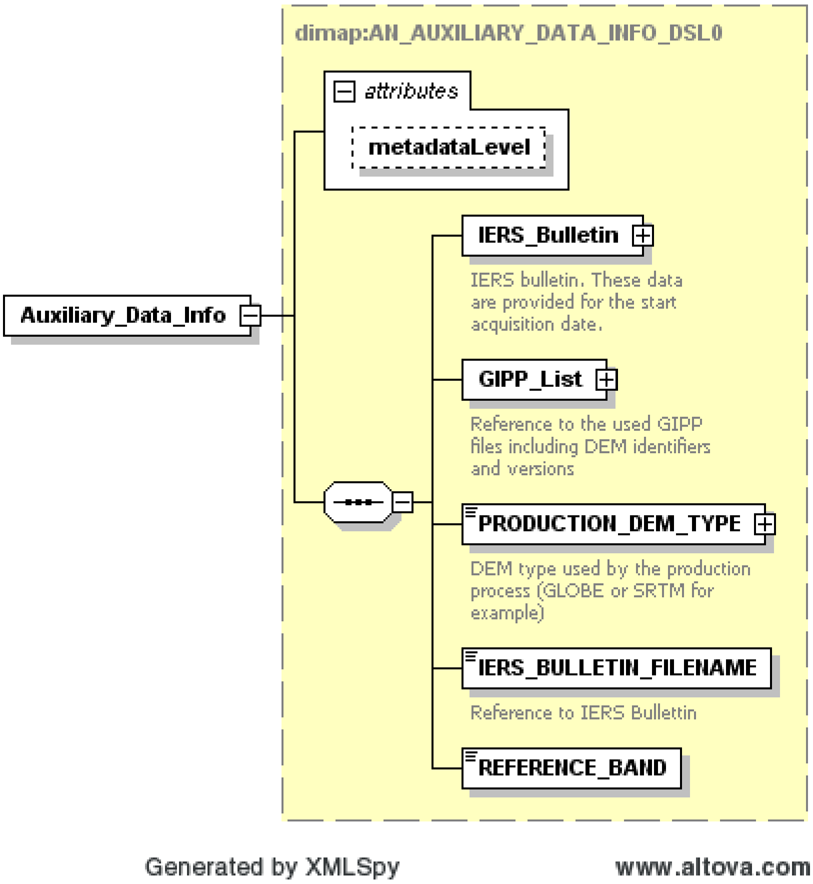
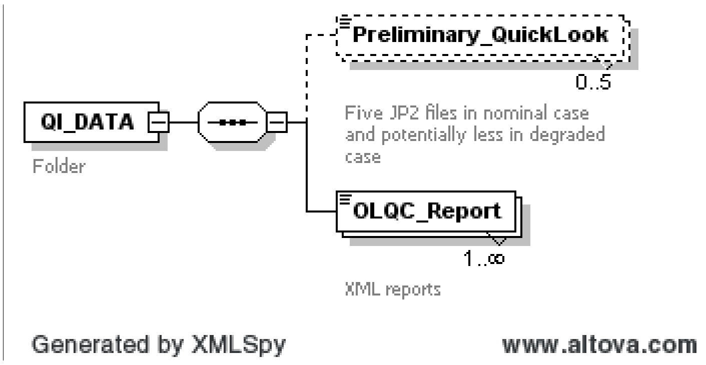


Figure 24 : Level-0 Datastrip – Auxiliary_Data_Info Diagram

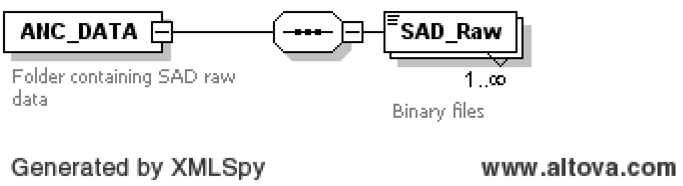
Auxliary_Data_Info/IERS_Bulletin		
Field Name	**Description**	**Metatada Level**
UT1_UTC	UT1 –-UTC in [-0.9;0.9] seconds	Standard
GPS_TIME_UTC	GPS_time – UTC = in number of seconds	Standard
GPS_TIME_TAI	GPS_time – TAI	Standard
POLE_U_ANGLE	U angle pole motion (in arcsec)	Standard
POLE_V_ANGLE	V angle pole motion (in arcsec)	Standard
Auxliary_Data_Info/GIPP_List		
Field Name	**Description**	**Metatada Level**
GIPP_FILENAME	Reference to the used GIPP files.	Standard
PRODUCTION_DEM_TYPE	DEM type used by the production process (GLOBE or SRTM for example)	Standard
IERS_BULLETIN_FILENAME	Filename of the used IERS Bulletin	Standard
Auxliary_Data_Info/REFERENCE_BAND		
Field Name	**Description**	**Metatada Level**
REFERENCE_BAND	Used reference band for datation	Standard

Table 3-36: Level-0 Datastrip – Auxiliary_Data_Info Description

3.7.3.2 QI_DATA

diagram	
children	Preliminary_QuickLook OLQC_Report
annotation	QI_DATA folder contains: - XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The Annex C contains the description of OLQC reports. - preliminary QuickLook image files in sensor geometry (5 files in JP2 format in nominal case, less than 5 in degraded case).

3.7.3.3 ANC_DATA

diagram	
children	SAD_Raw
annotation	ANC_DATA folder contains: - SAD raw data as received from the DFEP. Note: SAD coverage is equal to the Datatake coverage only for the last Datastrip in a given Datatake. Otherwise, the SAD coverage is from the start of the Datatake (to which the Datastrip belongs to) to the stop of the Datastrip itself.

3.7.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-0 PDI Datastrip level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;
- For the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:
  - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
  - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-0_Datastrip_Metadata.xsd);
  - a brief textual description of the field;
  - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
  - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
  - the allowed range of values of the field.

  In particular, the satellite ancillary data files (e.g. the SAD Raw Data file) and the auxiliary data files used for Level-0 processing (e.g. GIPP files, DEM, IERS Bulletin), are external to the product and are referenced in the Metadata of Manifest file Section (as “resources” in the “processing” section).

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-0 PDI Datastrip Product (with the exception of the Manifest file itself); this includes:
  - the XML Metadata file;
  - the XML Inventory_Metadata file;
  - a set of Quality Indicator Data Files, including a OLQC Report file (XML format) and five Preliminary Quick Look files (in JPEG2000 format).

An example of Manifest file for the Level-0 Datastrip PDI containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->Datatake_Info->SPACECRAFT_NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	General_Info->Datatake_Info->SPACECRAFT_NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement Test_Mode
	Instrument->mode->**identifier**	General_Info->Datatake_Info->DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-0 Granule Product
	start	General_Info->Archiving_Info->ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info->Archiving_Info->ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_ UPA_

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
						CDAM MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	PDI Level-0 Datastrip Product
	resource-> processing		Description of the L0 Processing		0..*	
	resource-> processing->**name**		Name of the L0 Processing	string	0..1	L0 Processing of Raw Data
	resource-> processing->**start**	General_Info->Processing_Info ->UTC_DATE_TIME	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing-> facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing-> facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing-> facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing-> facility-> **site**	General_Info->Processing_Info-> PROCESSING_CENTER	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->software	N.A.	Description of software component used for Processing		0..*	
	resource-> processing-> facility->resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are not provided with the product.		0..*	
	resource-> processing-> facility->resource->**name**	Satellite_Ancillary_Data_Info-> ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Auxiliary_Data_Info->IERS_Bulletin Auxiliary_Data_Info->GIPP_List->	Absolute path name of the auxiliary or ancillary file/folder	string	1	

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
		GIPP_FILENAME				
	resource-> processing-> facility->resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	
	acquisitionPeriod ->startTime	Datastrip->L0_Datastrip_PDI_ID (substring <Sensing Time>, cf. section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Datastrip level, cf. section 3.6.1)	xs:dateTime	1	
measurementOrbitReference						
	orbitNumber	General_Info->Datatake_Info-> DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values "start" or "stop"). Set to "start" since the absolute orbit number refers to the first line of the Datastrip		0..1	start
	orbitNumber-> **groundTrackDirection**	General_Info->Datatake_Info-> SENSING_ORBIT_DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to		0..1	ascending, descending

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			orbitNumber->type (start or stop)			
	relativeOrbitNumber	General_Info->Datatake_Info->SENSING_ORBIT_NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber->**type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..4	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-37 - Content of Metadata Section for PDI Level-0 Datastrip SAFE Manifest

3.8 Level-1A PDI Granule definition

Level-1A PDI Granule level is defined as a **tar** file with the following structure:

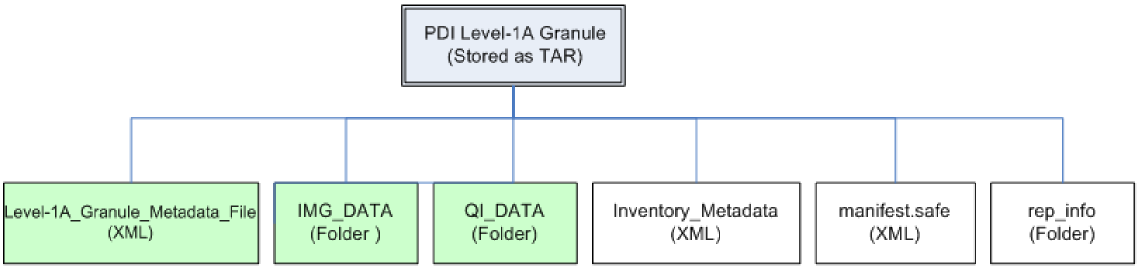


Figure 25: PDI Level-1A Granule Structure

The PDI Level-1A Granule consists of:

1. **Level-1A_Granule_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Granule,
2. **IMG_DATA**: folder containing image data compressed using the JPEG2000 algorithm, one file per spectral band.
3. **QI_DATA**: folder containing XML reports including Quality control checks and Quality Mask files;
4. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI;
5. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.8.4);
6. **rep_info**: folder containing the available XSD schemas that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.4.4)

3.8.1 PDI_ID definition

The PDI_ID (Granule ID) used to identify a Level-1A Granule PDI, follows the description provided in the section 3.4.2. File_Type is defined in the section 3.2, Table 3-3.

Level-1A Granule template Name (Granule ID):
S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_N01.12.tar

<u>Note that the PDI_ID.tar is the physical name of the Granule PDI after the tar compression.</u>

3.8.2 Level-1A Granule Physical Format

The PDI_ID defined above represents the "Granule directory" name. Inside the Granule directory, there are the Granule components as in the Figure 25.

Inside that directory, the naming convention used to identify each real files follows the same convention used to define the Granule ID but without the Processing Baseline sub-string.

- **Level-1A_Granule_Metadata_File (XML file):**
  Granule Metadata File Template name:
  S2A_OPER_MTD_L1A_GR_MTI__20141104T134012_S20141104T134012_D03.xml

  The XSD schema which regulates the metadata file is *S2_PDI_Level-1A_Granule_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **IMG_DATA (folder):**
  The naming convention used to identify the image files contained in the IMG_DATA folder is defined hereafter:

Image File naming convention = *<PDI_ID*>_<Band_Index>.jp2*

where:

Field Name	Value/Meaning	Note
*PDI_ID**	PDI_ID without Processing Baseline sub-string	
Band Index	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12	Field identifying the spectral bands

IMG_DATA/Level-1A image file template name:
S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_B03.jp2

- **QI_DATA (folder):**
  QI_DATA folder contains:
  - XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.

  File Template Name:
  *S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_GEOMETRIC_QUALITY*_report.xml

  - Quality_Masks (one for each type, GML/JPEG2000).

The naming used for the mask files follows the same convention defined for the L1A Granule ID (cf. section 3.4.2) except for the additional <Product Type> filed.

Mask files naming convention = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.gml

L1A masks main file types (TTTTTTTTTT) are in the Table 3-16 and listed again hereafter

1. MSK_CLOLOW (Coarse cloud mask files)
2. MSK_TECQUA (Technical quality mask files)
3. MSK_DEFECT (Radiometric quality masks)
4. MSK_SATURA (Radiometric quality masks)
5. MSK_NODATA (Radiometric quality masks)

<Instance_Id> = <Site Centre>_<Creation Date>_<Sensing Time>_<Detector ID>_<Band ID>_<Product_Type>

Where <Site Centre>, <Creation Date>, <Sensing Time> and <Detector ID> are inherited from the L1A Granule ID, <Product Tipe> = “MSIL1A” and <Band ID>:

Band ID	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12

Template masks filename are:
S2A_OPER_MSK_TECQUA_MTI__20141104T134012_S20141104T134012_D03_B03_MSIL1A.gml
S2A_OPER_MSK_SATURA_MTI__20141104T134012_S20141104T134012_D03_B03_MSIL1A.gml

The grouping strategy to have several masks in one physical GML file is described in the Annex E.

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **manifest.safe (XML file):**
  XML file with fixed name *manifest.safe*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1A_Granule_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1A Granule Physical Format template:

Level-1A Granule PDI_ID: ***S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_N01.12***
Inventory_Metadata.xml

S2A_OPER_MTD_L1A_GR_MTI__20141104T134012_S20141104T134012_D03.xml
manifest.safe
IMG_DATA
- *S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_B01.jp2*
- *S2A_OPER_MSI_L1A_GR _MTI__20141104T134012_S20141104T134012_D03_B02.jp2*
- *S2A_OPER_MSI_L1A_GR _MTI__20141104T134012_S20141104T134012_D03_B03.jp2*
- .
- .
- .
- *S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_B12.jp2*

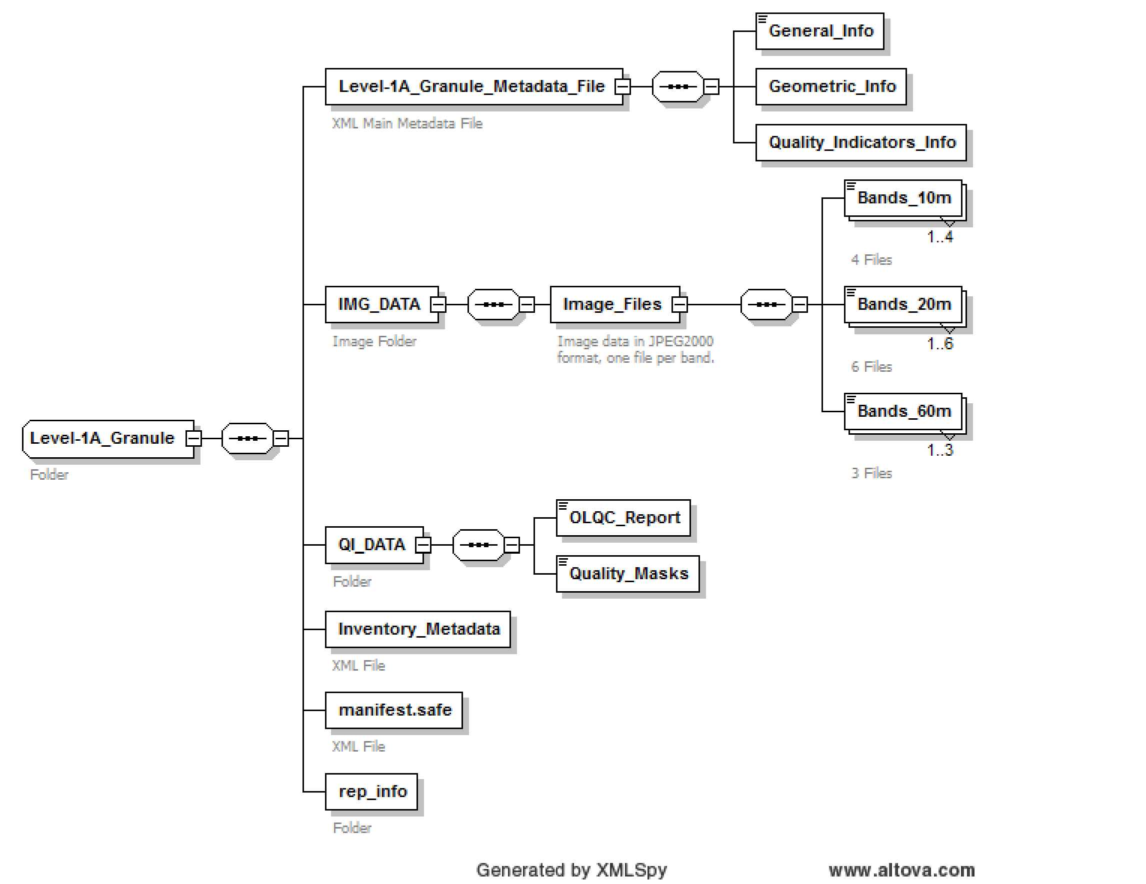
QI_DATA
- *S2A_OPER_MSI_L1A_GR_MTI__20141104T134012_S20141104T134012_D03_GEOMETRIC_QUALITY_report.xml*
- *S2A_OPER_MSK_TECQUA_MTI__20141104T134012_S20141104T134012_D03_B03_MSIL1A.gml*
- *S2A_OPER_MSK_SATURA_MTI__20141104T134012_S20141104T134012_D03_B03_MSIL1A.gml*

rep_info
- *S2_PDI_Level-1A_Granule_Metadata.xsd*
- *Inventory_Metadata.xsd*
- *OLQC_Report.xsd*

Figure 26: PDI Level-1A Granule Physical Format

3.8.3 Level-1A PDI Granule Structure

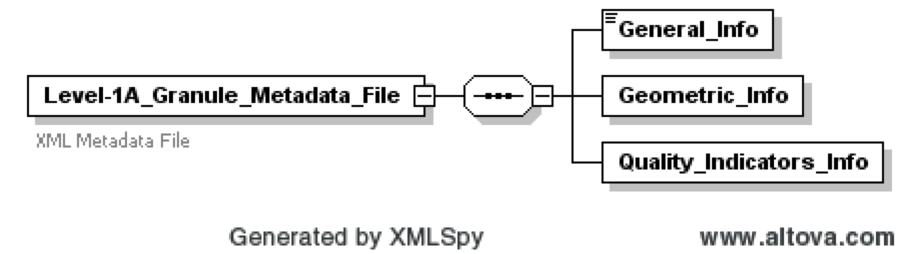
The *S2_PDI_Level-1A_Granule_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1A Granule PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file**.** The diagram reflects exactly the Figure 25.

diagram	
children	Level-1A_Granule_Metadata_File IMG_DATA QI_DATA Inventory_Metadata manifest.safe rep_info
annotation	The Level-1A Granule is defined as a folder containing: 1. **Level-1A_Granule_Metadata_File**: XML main metadata file. 2. **IMG_DATA**: Folder containing Image data in JPEG2000 format, one file per band. 3. **QI_DATA**: Folder containing XML reports including Quality Indicators and GML Quality Mask files 7. **Inventory_Metadata**: XML inventory metadata file 8. **manifest.safe**: XML SAFE Manifest file 9. **rep_info**: folder containing the XSD schemas provided inside a SAFE Level-1A Granule PDI Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is

	included in the User Product.

3.8.3.1 *Level-1A_Granule_Metadata_File Schema*

Level-1A_Granule_Metadata_File is the XML metadata file provided inside each Level-1A Granule. The schema used to validate it is *S2_PDI_Level-1A_Granule_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Quality_Indicators_Info
annotation	The Level-1A_Granule_Metadata_File is an XML file containing metadata regarding: 1. **General_Info**: this group of metadata provides general information regarding the Granule. 2. **Geometric_Info**: these metadata provide information describing the geolocation of the Granule. 3. **Quality_Indicators_Info**: this metadata values provide information about image content quality indicators and quality control checks information.

The following figures and tables give a complete overview of the Level-1A_Granule_Metadata_File schema according the description provided in the section 3.4.1.

General_Info:

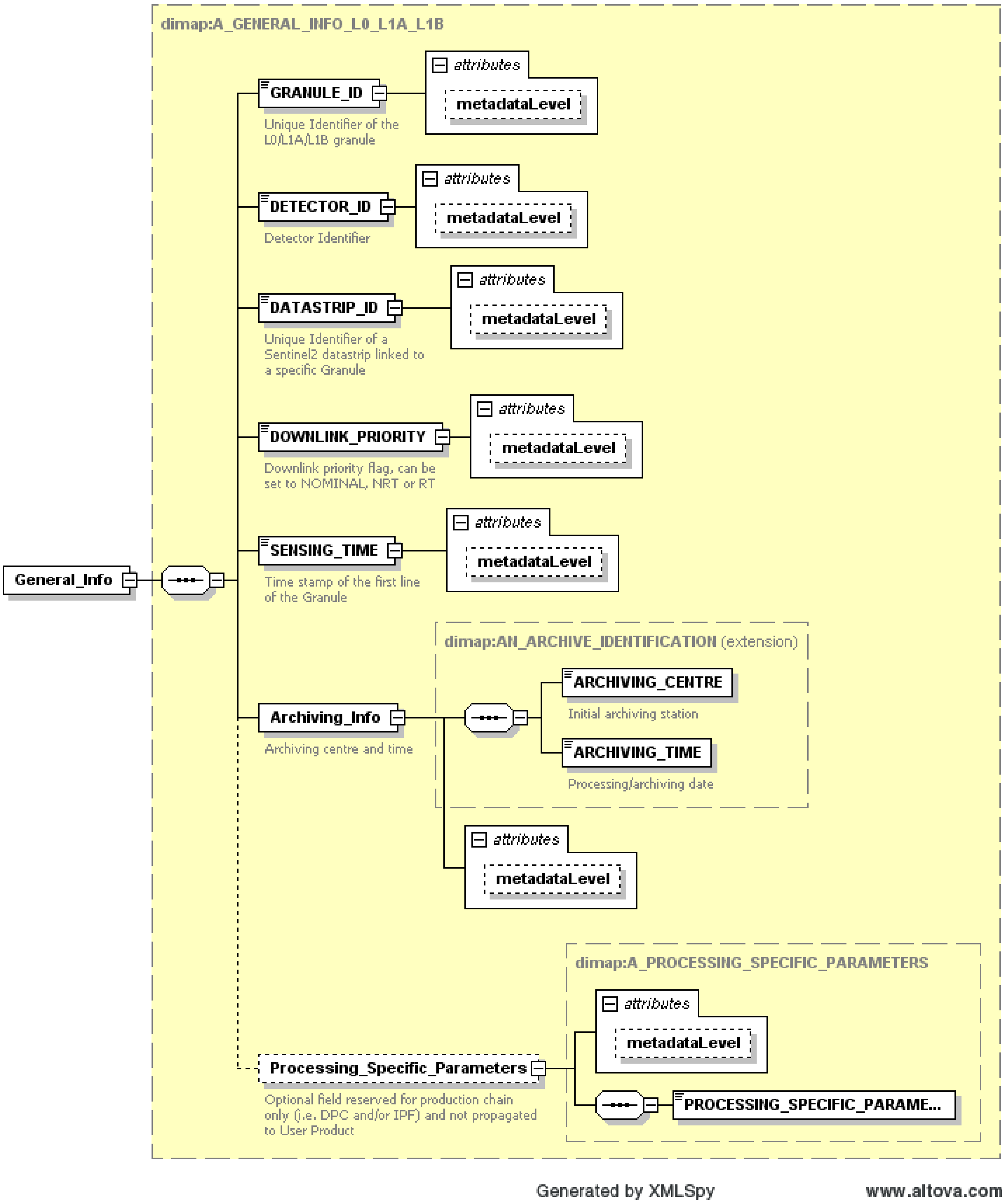


Figure 27: Level-1A_Granule_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Metatada Level**
GRANULE_ID	Granule_Identifier metadata indicates the unique identifier of the Level-1A Granule. This parameter coincides with PDI_ID definition described in section 3.6.1 and univocally points a Granule PDI in the archive.	Brief
DETECTOR_ID	Detector identifier corresponding to the Granule	Brief
DATASTRIP_ID	Unique identifier of the L1A PDI Datastrip linked to L1A PDI Granule. This parameter coincides with the PDI_ID of the PDI Datastrp linked to the Granule. This link establishes the hierarchy Granule vs Datastrip (cf. section 3.3)	Brief
DOWNLINK_PRIORITY	Downlink priority flag. It can be set Nominal/NRT/RT.	Standard
SENSING_TIME	Time stamp of the first line of the Granule, that is the Sensing Start Time of the Granule PDI. Note: for L1A Granule the first line timing shall be taken from one reference band due to the coarse registration applied at Level 1A which makes the first line time different amongst the bands.	Standard
Archiving_Info/ARCHIVING_CENTRE	The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_ • UPA_ • CDAM • MPC_	Expertise
Archiving_Info/ARCHIVING_TIME	Processing/archiving date (UTC data time)	Expertise

Processing_Specific_Parameters/ PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-38: Level-1A_Granule_Metadata_File - General_Info Description

Geometric_Info:

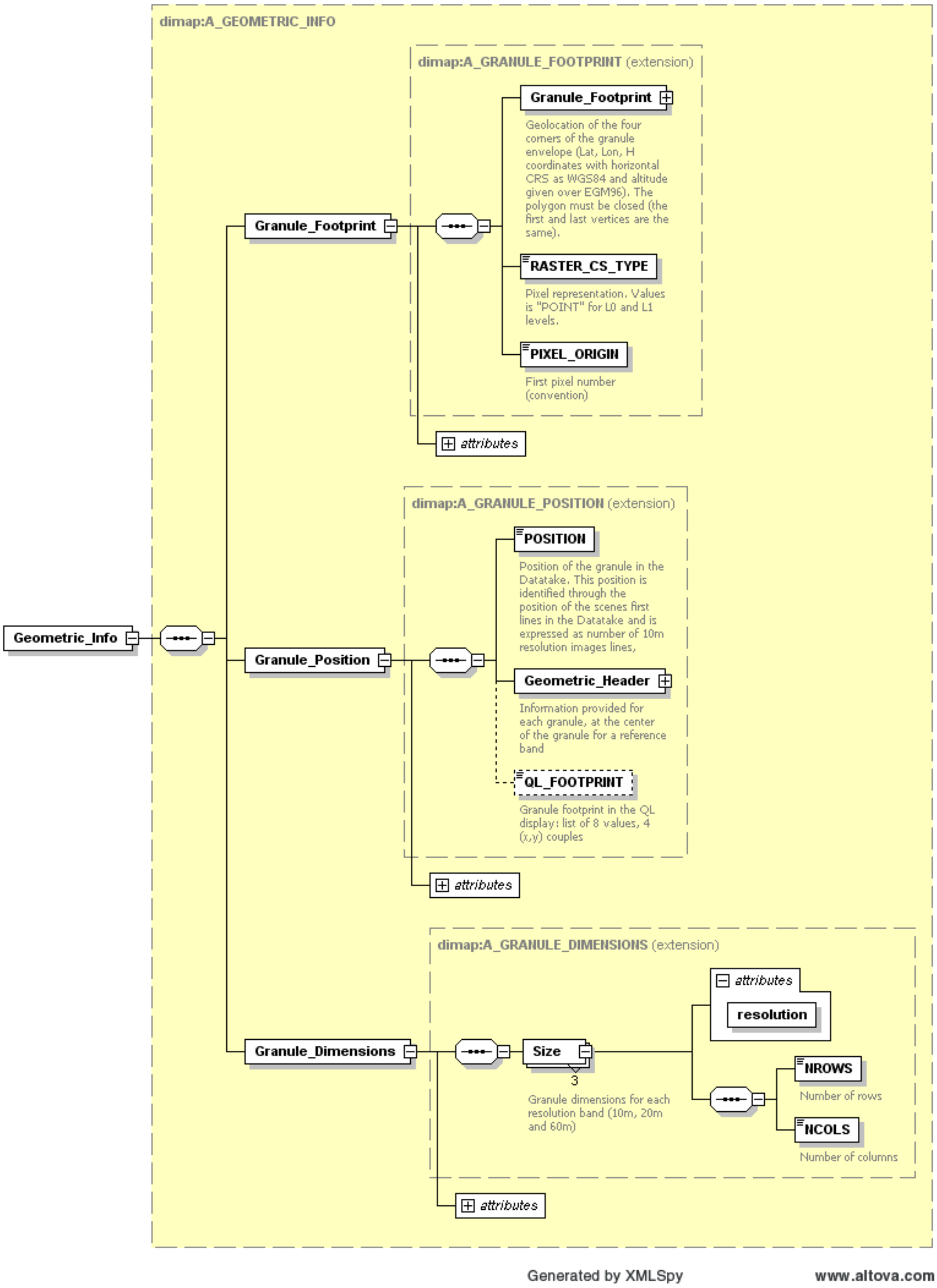


Figure 28: Level-1A_Granule_Metadata_File - Geometric_Info Diagram

Geometric_Info/Granule_Footprint		
Field Name	**Description**	**Metatada Level**
Granule_Footprint	Geolocation of the four corners of the Granule envelope (Lat, Lon, H coordinates with horizontal CRS as WGS84 and altitude given over EGM96).	Brief
RASTER_CS_TYPE	Pixel representation. Values is "POINT" for L0 and L1 levels.	Brief
PIXEL_ORIGIN	First pixel number (convention)	Brief
Geometric_Info/Granule_Position		
Field Name	**Description**	**Metatada Level**
Position	Granule_Position describes the position of the Granule in the origin Datatake. This position is identified through the position of the scenes first lines in the Datatake and is expressed as number of 10m resolution images lines). Moreover information for a reference band at the centre of the Granule (incidence angles and solar angles) are provided.	Standard
Geometric_Header/GROUND_CENTER	Information provided for a reference band, at the centre of the Granule, for each Granule. Geolocation of the Granule centre (Lat, Lon, H) Altitude is provided over the geoid.	Standard
Geometric_Header/QL_CENTER	The Granule centre in the QL display: 1 (r,c) point.	Standard
Geometric_Header/Incidence_Angles	Information provided for a reference band, at the centre of the Granule, for each Granule. Incidence angles corresponding to the centre	Standard

	of the Granule.	
Geometric_Header/Solar_Angles	Information provided for a reference band, at the centre of the Granule, for each Granule. Solar angles corresponding to the centre of the Granule.	Standard
QL_FOOTPRINT	Granule footprint in the QL display: list of 8 values, 4 (x,y) couples. Note: For L1A Granule this metadata is NOT mandatory.	Standard
Geometric_Info/Granule_Dimension		
Field Name	**Description**	**Metadata Level**
Size/NROWS	Granule dimensions provided for each resolution band (10m, 20m and 60m) Number of Row	Standard
Size/NCOLS	Granule dimensions provided for each resolution band (10m, 20m and 60m) Number of Columns	Standard

Table 3-39: Level-1A_Granule_Metadata_File - Geometric_Info Description

Quality_Indicators_Info:

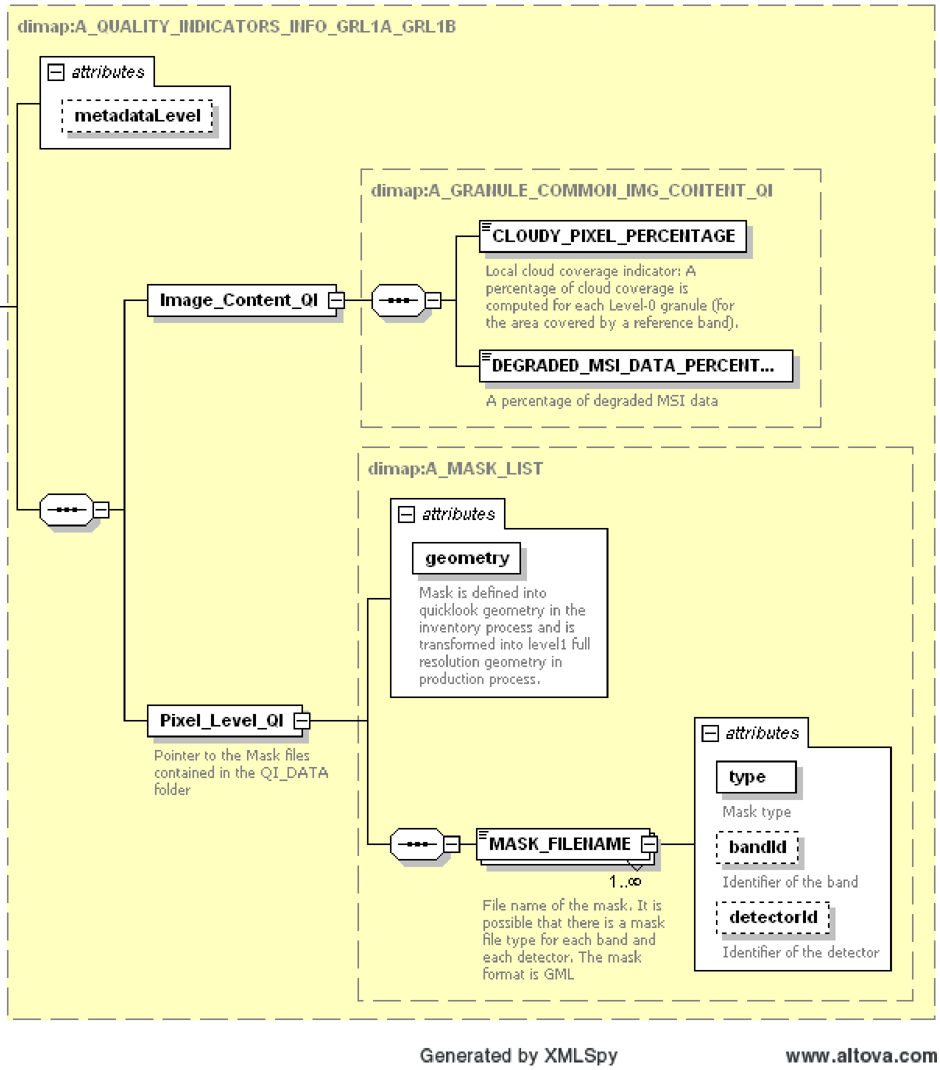


Figure 29: Level-1A_Granule_Metadata_File – Quality_Indicators_Info Diagram

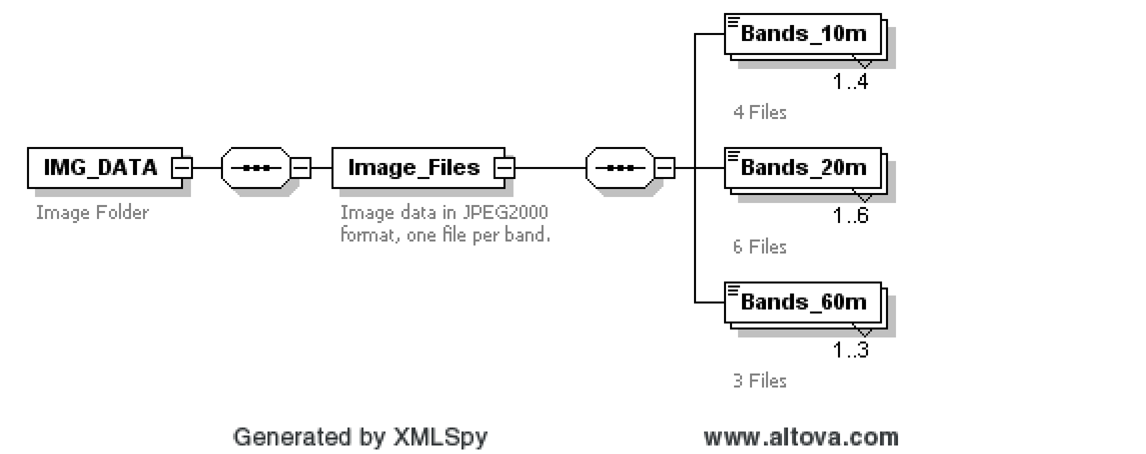
According to the content of the Table 3-4, the following table describes the Quality Indicators provided for a PDI Granule Level-1A.

Quality_Indicators_Info/Image_Content_QI		
Field Name	**Description**	**Metatada Level**
CLOUDY_PIXEL_PERCENTAGE	Local cloud coverage indicator: A percentage of cloud coverage is computed for each Level-1A Granule (for the area covered by a reference band).	Standard
DEGRADED_MSI_DATA_PERCENTAGE	Local technical quality indicator: A percentage of degraded MSI data is provided for each Level-1A Granule.	Standard
Quality_Indicators_Info/Pixel_Level_QI		
Field Name	**Description**	**Metatada Level**
MASK_FILENAME	Pointer to the mask files contained in the QI_DATA folder: - Coarse cloud mask files - Technical quality mask files - Radiometric quality masks	Standard

Table 3-40: Level-1A_Granule_Metadata_File – Quality_Indicators_Info Description

Note that, according to OLQC procedures consolidation, the results of all quality control checks performed by OLQC processor on Level-1A Granule, are included in the XML reports stored in the QI_DATA folder (cf. § 3.4.1, Table 3-17).

3.8.3.2 IMG_DATA

diagram	
children	**Image_Files**
annotation	Folder containing image data compressed using the JPEG2000 algorithm, one file per spectral band (13 files).

3.8.3.3 QI_DATA

diagram	
children	**OLQC_Report Quality_Masks**
annotation	QI_DATA folder contains the XML reports including the quality control checks performed by OLQC processor and the GML quality masks. The Annex C contains the description of OLQC reports, the masks files are listed in the Table 3-16 .

3.8.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1A PDI Granule level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;

- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:

    - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
    - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-1A_Granule_Metadata.xsd”);
    - a brief textual description of the field;
    - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
    - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
    - the allowed range of values of the field.

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-1A PDI Granule Product (with the exception of the Manifest file itself); this includes:
    - the XML Granule Metadata file;
    - the Inventory_Metadata.xml file;
    - a set of image files in JPEG2000 format (one file per spectral band, up to a total of 13 files);
    - a set of Quality Indicator Data Files, including a OLQC Report file and one or more pixel-level Quality Mask files.

An example of Manifest file for the Level-1A Granule PDI containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip.

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info-> GRANULE_ID (substring <Mission ID>, cf. section 3.6.1)	The mission name of the platform		0..1	Sentinel
	number	General_Info-> GRANULE_ID (substring <Mission ID>, cf. section 3.6.1)	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument-> **abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Test_Mode
	Instrument->mode-> **identifier**	N.A.	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1A Datastrip Product
	start	General_Info-> Archiving_Info ->ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	facility->**site**	General_Info-> Archiving_Info ->ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_ UPA_ CDAM MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	processing->resource-> **role**	N.A.	Role of the resource	string	1	PDI Level-1A Granule Product
	resource-> processing		Description of the L0 to L1A Processing		0..*	
	resource-> processing-> **name**	N.A.	Name of the L0 to L1A Processing	string	0..1	Processing of Level-0 Granule product
	resource-> processing-> **start**	General_Info-> GRANULE_ID (substring <Creation Date> cf. section 3.6.1)	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing-> facility	N.A.	Description of Processing Centre		0..*	

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	resource-> processing-> facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing-> facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing-> facility-> **site**	General_Info-> GRANULE_ID (substring <Site Centre>)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->software	N.A.	Description of software component used for Processing		0..*	
	resource-> processing-> facility->software-> **name**	N.A.	Name of the software component	string	1	
	resource-> processing-> facility->software-> **version**	N.A.	Version of the software component	string	0..1	
acquisitionPeriod					1	

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	startTime	General_Info-> GRANULE_ID (substring <Sensing Time> cf. section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Granule level, cf. section 3.6.1)	xs:dateTime	1	
measurementFrameSet					1	
	cloudVoteNotationSystem->**floor**	N.A.	Minimum value of cloud coverage index (Fixed value = 0.0)	double	0..1	0.0
	cloudVoteNotationSystem->**ceil**	N.A.	Maximum value of cloud coverage index (Fixed value = 100.0)	double	0..1	100.0
	frame	N.A.	The “frame” concept is used in SAFE to convey the cloud coverage information by sub-dividing the region of interest of the data into “frames” according to a World Reference System. In the case of Sentinel-2 L1C Products, a similar concept can be used, by associating one single “frame” to the area covered by the granuke (wth respect to the reference band)		0..13	
	frame->number	N.A.	Number of the frame	integer	0..1	1

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	frame-center	Geometric_Info->Granule_Position->Geometric_Header->GROUND_CENTER (only lat/lon coordinates, not height)	The Granule centre on ground	gml:PointType	0..1	
	frame->footPrint	Derived from Geometric_Info->Granule_Footprint	Granule footprint (namely imaged area corresponding to the Granule), corresponding to one detector and all bands	string(gml:linearRingType i.e. blank separated list of comma-separated lon/lat coordinates of footprint closed polygon with last vertex equal to first)	0..1	
	frame→Tile	N.A.			1	One Tile for the frame
	frame→Tile->**row**	N.A.	The column index of the Tile. This index is numbered starting from 1	integer	1	1 (since there is only one Tile)
	frame→Tile->**column**	N.A.	The row index of the Tile. This index is numbered starting from 1	integer	1	1 (since there is only one Tile)
	frame→Tile->cloudVote	Derived from Quality_Indicators_Info->Image_Content_QI->CLOUDY_PIXEL_PERCENTAGE	Numeric notation qualifying the cloud coverage of the Tile	double	0..1	0 to 100
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..10	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata		0..2	

SAFE Manifest		From *S2_PDI_Level-1A_Granule_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			files included in the product (e.g. the XML Metadata file Schema)			

Table 3-41- Content of Metadata Section for PDI Level-1A Granule SAFE Manifest

3.9 Level-1A PDI Datastrip definition

Level-1A PDI Datastrip is defined as a **tar** file containing the following structure:

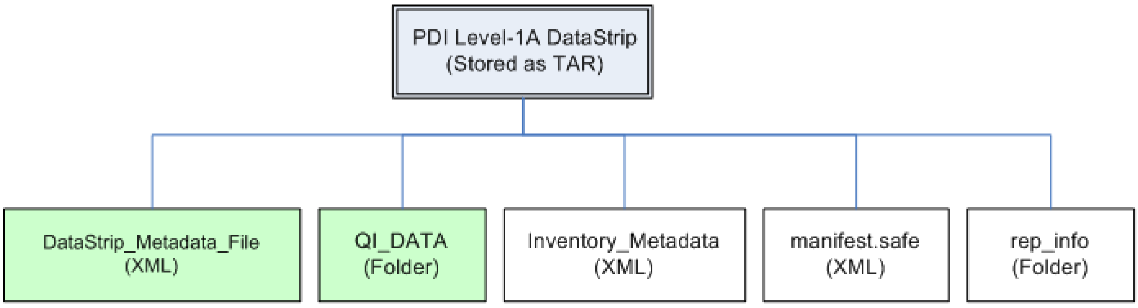


Figure 30: PDI Level-1A Datastrip Structure

The PDI Level-1A Datastrip consists of:

1. **Datastrip_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Datastrip,
2. **QI_DATA**: folder containing XML reports about Quality control checks information,
3. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI,
4. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.5.4),
5. **rep_info**: folder containing the available XSD schemas that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.5.4).

3.9.1 PDI_ID definition

Datastrip PDI_ID (Datastrip ID) is defined in the section 3.5.2. The File_Type is specified in the section 3.2, Table 3-3.

Level-1A Datastrip Template Name (Datastrip ID):
S2A_OPER_MSI_L1A_DS_SGS__20141104T134012_S20141106T134012_N02.10.tar

Note that the PDI_ID.tar is the physical name of the Datastrip PDI after the tar compression.

3.9.2 Level-1A Datastrip Physical Format

The PDI ID defined above represents the "Datastrip directory" name. Inside the Datastrip directory, there are the Datastrip components as in the Figure 30.

Inside that directory, the naming convention used to identify each real files, follows the same convention used to define the Datastrip ID but without the Processing Baseline sub-string.

- **Datastrip_Metadata_File (XML file):**
  Datastrip_Metadata_File template name:
  S2A_OPER_MTD_L1A_DS_SGS__20141104T134012_S20141106T134012.xml

  The schema which regulates the metadata file is the one named *S2_PDI_Level-1A_Datastrip_Metadata.xsd* and included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **QI_DATA (folder):**
  QI_DATA folder contains XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.

  File Template Name:
  *S2A_OPER_MSI_L1A_DS_SGS__20141104T134012_S20141106T134012*_GEOMETRIC_QUALITY_report.xml

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1A_Datastrip_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1A Datastrip Physical Format template:

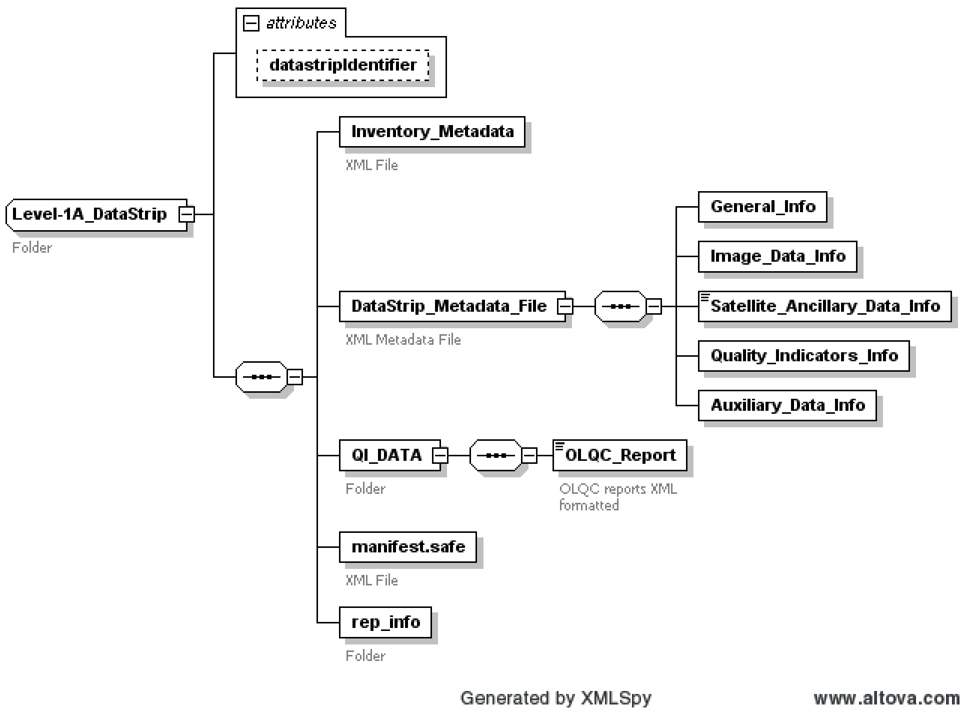
Level-1A Datastrip PDI_ID: ***S2A_OPER_MSI_L1A_DS_SGS__20141104T134012_S20141106T134012_N02.10***
Inventory_Metadata.xml
S2A_OPER_MTD_L1A_DS_SGS__20141104T134012_S20141106T134012.xml
manifest.safe
QI_DATA
S2A_OPER_MSI_L1A_DS_SGS__20141104T134012_S20141106T134012_GEOMETRIC_QUALITY_report.xml

rep_info
- *S2_PDI_Level-1A_Datastrip_Metadata.xsd*
- *Inventory_Metadata.xsd*
- *OLQC_Report.xsd*

Figure 31: PDI Level-1A Datastrip Physical Format

3.9.3 Level-1A PDI Datastrip Structure

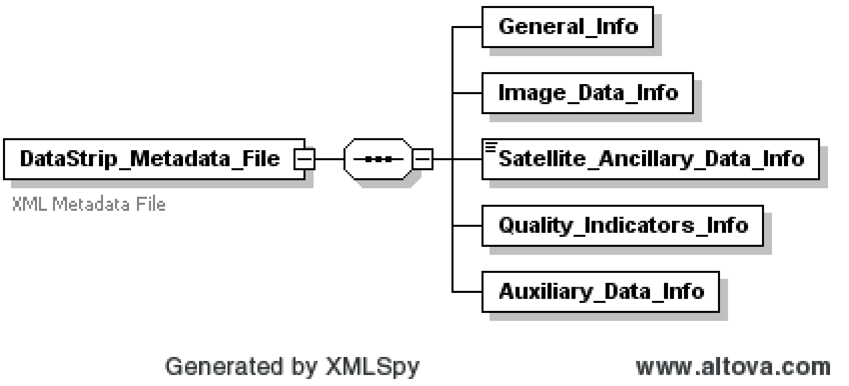
The *S2_PDI_Level-1A_Datastrip_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1A Datastrip PDI on. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 30.

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>children</td><td>Datastrip_Metadata_File QI_DATA Inventory_Metadata manifest.safe rep_info</td></tr>
<tr><td>annotation</td><td>The Level-1A Datastrip is defined as a folder containing:
1. Datastrip_Metadata_File: XML Main Metadata File containing the requested level of information and referring all the PDI elements.
2. QI_DATA: folder containing XML reports including Quality Indicators
3. Inventory_Metadata: XML inventory metadata file
4. manifest.safe: XML SAFE Manifest file
5. rep_info: folder containing the XSD schemas provided inside a SAFE Level-1A Datastrip PDI

Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.</td></tr>
</table>

3.9.3.1 Datastrip_Metadata_File Schema

Level-1A Datastrip_Metadata_File is the main XML metadata file provided inside each Level-1A Datastrip. The schema used to validate it is *S2_PDI_Level-1A_Datastrip_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	Datastrip_Metadata_File QI_DATA Inventory_Metadata manifest.safe rep_info
annotation	The structure of the Datastrip_Matadata_File is common to all processing level (cfr. § 3.5.1) The Datastrip_Metadata_File is an XML file containing all the metadata describing the whole product data item. 1. **General_Info**: This group of metadata provide general information characterizing the source Datastrip acquisition. 2. **Image_Data_Info**: Image data information from MSI telemetry. 3. **Satellite_Ancillary_Data_Info**: Ancillary data information from Satellite Ancillary Telemetry. 4. **Quality_Indicators_Info**: Results of all quality checks performed at Datastrip level. 5. **Auxiliary_Data_Info**: Auxiliary data information.

The following tables and figures give a complete overview of the Level-1A Datastrip_Metadata_File schema according the description provided in the section 3.5.1.

The General_Info provided through the Level-1A DataSrip_Metadata_File are the same described in the Figure 20 and Table 3-32.

General_Info:

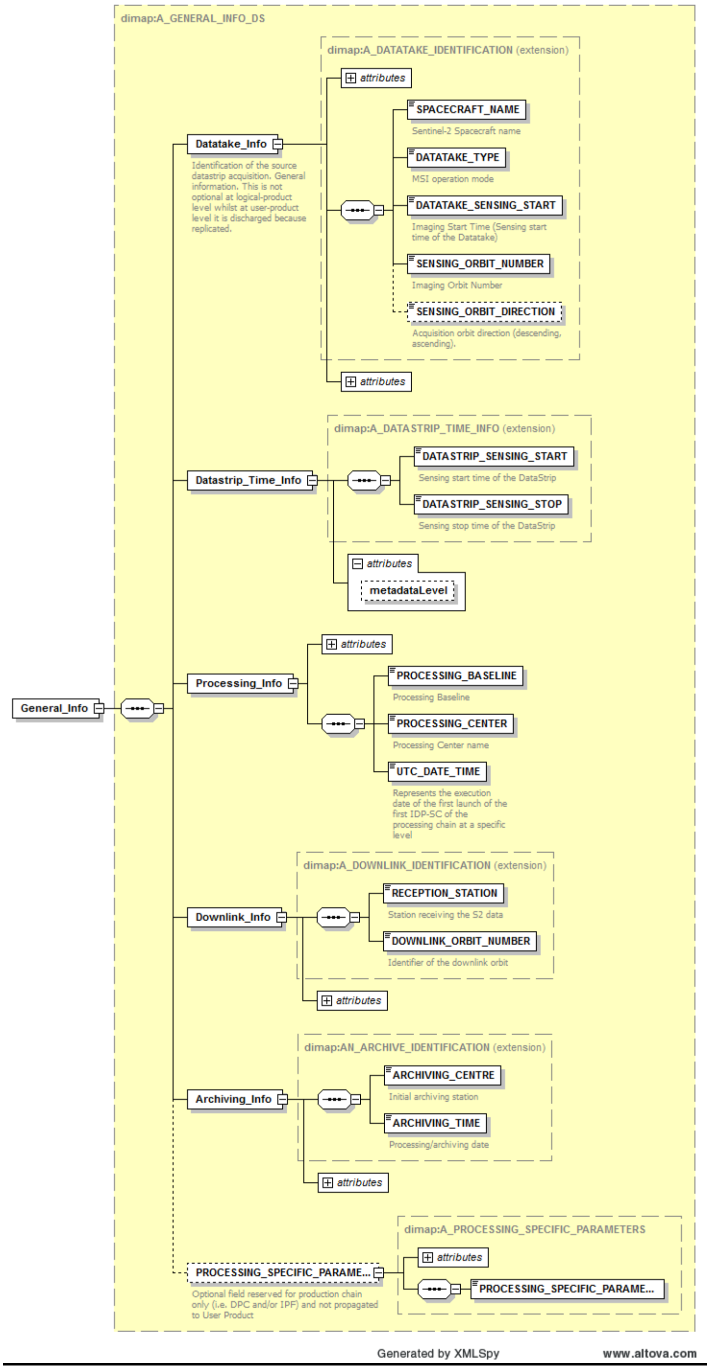


Figure 32: Level-1A Datastrip - General_Info Diagram

General_Info/Datatake_Info		
Field Name	**Description**	**Metatada Level**
SPACECRAFT_NAME	Sentinel-2 Spacecraft name: Sentinel-2A, Sentinel-2B	Brief
DATATAKE_TYPE	MSI operation mode	Brief
DATATAKE_SENSING_START	Imaging Start Time (Sensing start time of the Datatake)	Brief
SENSING_ORBIT_NUMBER	Imaging Orbit Number	Brief
SENSING_ORBIT_DIRECTION	Imaging Orbit Direction (Default = Ascending)	Brief
General_Info/Datastrip_Time_Info		
Field Name	**Description**	**Metatada Level**
DATASTRIP_SENSING_START	Sensing start time of the Datastrip	Brief
DATASTRIP_SENSING_STOP	Sensing stop time of the Datastrip	Brief
General_Info/Processing_Info		
Field Name	**Description**	**Metatada Level**
PROCESSING_BASELINE	The processing baseline refers to the configuration baseline used at the time of the generation in term of processor software version and major GIPP version (cf. section 2.9). Note: all the PDIs of a Datatake are always processed with the same processing baseline even if acquiered in different stations	Brief
UTC_DATA_TIME	This data time represents the execution date of the first run of the first IDP-SC of the processing chain at a specific level	Expertise
PROCESSING_CENTER	Production centre: • SGS_ • MPS_ • MTI_ • EPA_	Expertise

	• MPC_ • UPA_ • XXXX • EDRS • zzzL (zzz = first three characters of the LGS location)	
General_Info/Downlink_Info		
Field Name	**Description**	**Metatada Level**
RECEPTION_STATION	Reception stations: • SGS_ • MPS_ • MTI_	Standard
DOWNLINK_ORBIT_NUMBER	Identifier of the downlink orbit	Standard
General_Info/Archiving_Info		
Field Name	**Description**	
ARCHIVING_CENTRE	The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_ • UPA_ • CDAM • MPC_	Expertise
ARCHIVING_TIME	Processing/archiving date (UTC data time)	Expertise
Processing_Specific_Parameters/ PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-42: Level-1A Datastrip - General_Info Description

Image_Data_Info:

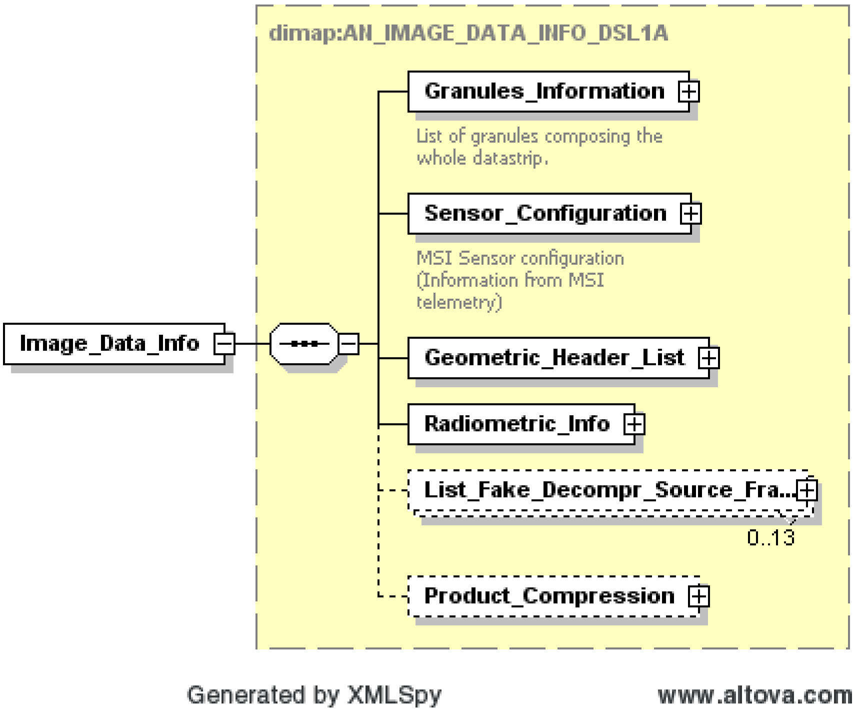


Figure 33 : Level-1A Datastrip – Image_Data_Info Diagram

Image_Data_Info/Granules_Information		
Field Name	**Description**	**Metatada Level**
Detector_List/Detector/Granule_List/Granule/POSITION	This branch of the schema provides information regarding all Granules, for each detector, composing the whole Datastrip. Each Granule composing the Datastrip is univocally identified trough a unique Granule identifier (PDI_ID at granul level). For each Granule the Position of the Granule is provided. This position is identified through the position of the scenes first lines in the Datastrip and is expressed as number of 10m resolution images lines.	Standard
Image_Data_Info/Sensor_Configuration (inherited from Level-0 metadata)		
Field Name	**Description**	**Metatada Level**
Acquisition_Configuration/COMPRESS_MODE	Flag to indicate if compress mode is by passed	Expertise
Acquisition_Configuration/EQUALIZATION_MODE	Flag to indicate if equalization is active	Expertise
Acquisition_Configuration/NUC_TABLE_ID	In-flight Non Uniform Correction table ID defined by 10 bits. This ID is uniform for all transmitted bands. It identifies the correction coefficients table used in-flight	Expertise
Acquisition_Configuration/Active_Detectors_List	On board active Detectors (in case of compression by-passed)	Expertise
Acquisition_Configuration/TDI_Configuration_List	On board TDI configuration, for B3, B4, B11 and B12 only.	Standard
Acquisition_Configuration/Spectral_Band_Info/PHYSICAL_GAIN	Physical Gain for each band	Standard
Acquisition_Configuration/Spectral_Band_Info/COMPRESSION_RATE	On-board compression rates for each band	Expertise
Acquisition_Configuration/Spectral_Band_Info/INTEGRATION_TIME	On-board integration time for each band	Expertise
Source_Packet_Description	Source packet information for each band	Standard
Time_Stamp/LINE_PERIOD	Line period for the acquisition of line of 10 m full-	Standard

	resolution image data	
Time_Stamp/Band_Time_Stamp/Detector	Datation model for each couple band, detector.	Standard
Time_Stamp/GPS_SYNC	Flag (Boolean) to indicate if MSI is synchronize with GPS time	Standard
Time_Stamp/THEORETICAL_LINE_PERIOD	Theoretical line period for the acquisition of line of 10 m full-resolution image data	Standard
Time_Stamp/Quality_Indicators	Optional. Created when datation models are estimated through linear regression.	Standard
Image_Data_Info/Geometric_Header_List(inherited from Level-0 metadata)		
Field Name	**Description**	**Metatada Level**
Geometric_Header_List	Geometric information. For all details see Table 3-33, section “Image_Data_Info/Geometric_Header_List”	Standard Expertise
Image_Data_Info/Radiometric_Info		
Field Name	**Description**	**Metatada Level**
SWIR_REARRANGEMENT_PROC	SWIR pixels re-arrangement (only for level 1A production but SWIR rearrangement information shall be preserved in L1B and L1C): A 'true' value indicates that data extraction and SWIR pixels re-arrangement have been processed.	Standard
DEFECTIVE_PIXELS_PROC	Defective pixels processing. A 'true' value indicates that defective pixels have been detected and processed, a 'detection'' value indicates that defective pixels have been only detected (only for level 1A production), a 'false'' value indicates that defective pixels have been neither detected nor processed.	Standard
PIXELS_NO_DATA_PROC	Management of NO_DATA pixels. A 'true' value indicates that NO_DATA pixels have been detected and processed, a 'detection'' value	Standard

	indicates that NO_DATA pixels have been only detected (only for level 1A production), a 'false" value indicates that NO_DATA pixels have been neither detected nor processed.	
SATURATED_PIXELS_PROC	Management of saturated pixels. A 'true' value indicates that saturated pixels has been processed.	Standard
Spectral_Information_List/Spectral_Informatio/RESOLUTION	(OPTIONAL branch) Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION Spatial resolution	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/MIN	Minimum wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/MAX	Maximum wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/CENTRAL	Central wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Spectral_Response/STEP	Step of spectral response	Standard
Spectral_Information_List/Spectral_Informatio/Spectral_Response/VALUES	List of measures	Standard
Image_Display_Order/RED_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Display_Order/GREEN_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Display_Order/BLUE_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Data_Info/List_Fake_Decompr_Source_Frames		
Field Name	**Description**	**Metatada Level**
List_Fake_Decompr_Source_Frames	List of the decompressed sources frames This field will be better specify as soon as the MRCPBG CFI documentation is available.	Standard
Image_Data_Info/Product_Compression (OPTIONAL BRANCH)		
Field Name	**Description**	**Metatada**

		Level
COMPRESSION	Product Compression. The compression may be: - None. - LOSSLESS: Lossless compression, use reversible JPEG2000 compression. - LOSSY: Lossy compression, use compression that ensures that JPEG2000 compression has a negligible effect on image quality.	Standard

Table 3-43: Level-1A Datastrip – Image_Data_Info Description

Satellite_Ancillary_Data_Info:

Satellite_Ancillary_Data_Info are the same provided for a L0 Datastrip (cfr. Figure 22 and Table 3-34).

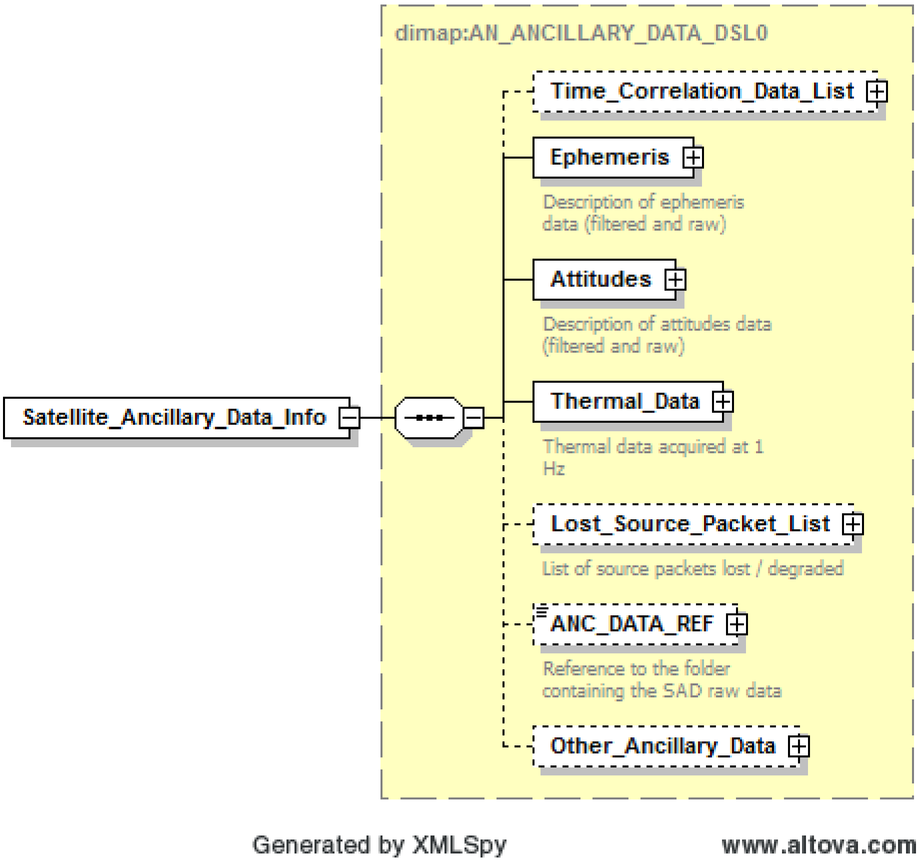


Figure 34: Level-1A Datastrip – Satellite_Ancillary_Data_Info Diagram

Satellite_Ancillary_Data_Info		
Field Name	**Description**	**Metatada Level**
Satellite_Ancillary_Data_Info	Inherited ftom Level-0 (cf. Table 3-34)	§ Table 3-34

Table 3-44: Level-1A Datastrip – Satellite_Ancillary_Data _Info Description

Quality_Indicators_Info:

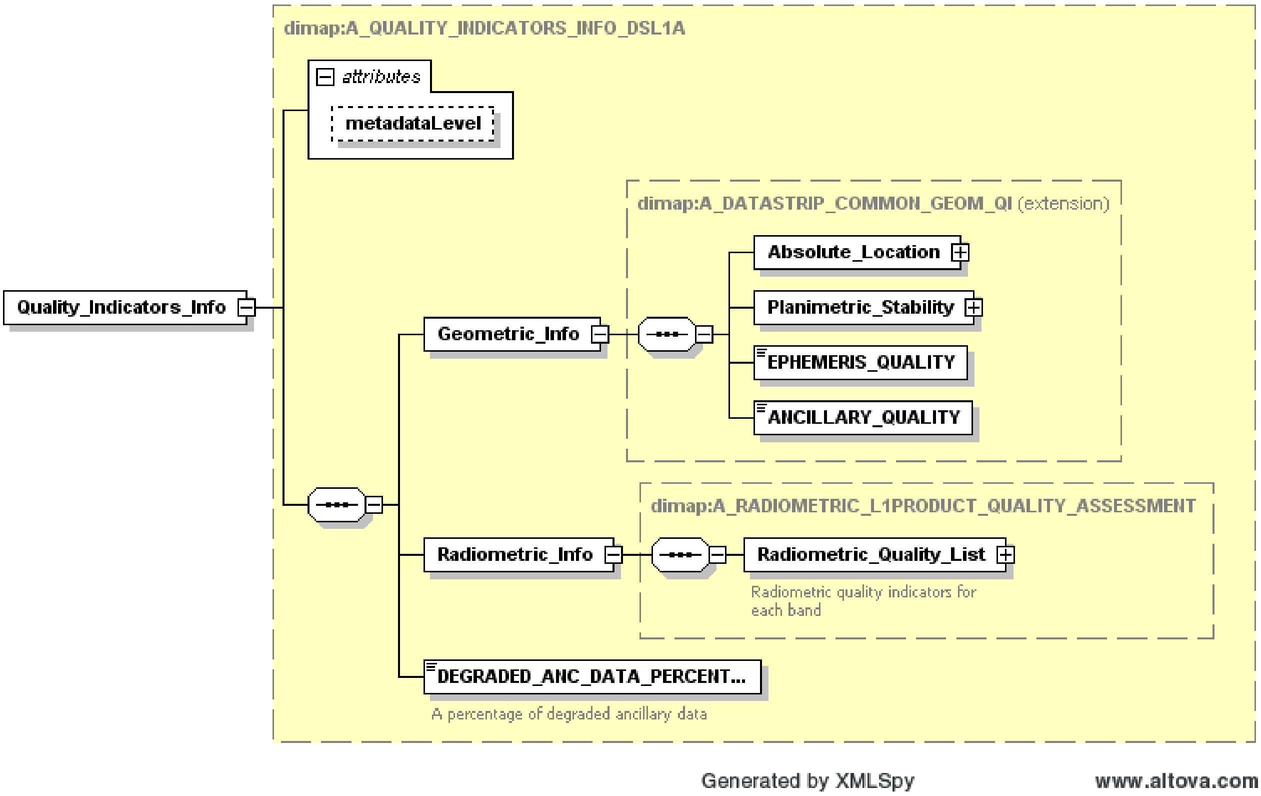


Figure 35 : Level-1A Datastrip – Quality_Indicators_Info Diagram

Quality_Indicators_Info/Geometric_Info		
Field Name	**Description**	**Metatada Level**
Absolute_Location	An absolute location performance for the Datastrip is given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Planimetric_Stability	Planimetric stability assessment: A planimetric stability performance for the Datastrip is given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data	Brief
EPHEMERIS_QUALITY	Ephemeris data quality retrieved from GPS Dilution of precision (DOP) information	Brief
ANCILLARY_QUALITY	Ancillary data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Quality_Indicators_Info/Radiometric_Info		
Field Name	**Description**	**Metatada Level**
Noise_Model	Alpha and Beta parameters providing the instrument noise as a function of the radiometric count X for Level-1B : Noise= square root(Alpha_X + Beta_X*	Brief

	X)	
ABSOLUTE_CALIBRATION_ACCURACY	Absolute calibration accuracy provided as a percentage of accuracy	Brief
CROSS_BAND_CALIBRATION_ACCURACY	Cross-band calibration accuracy provided as a percentage of accuracy	Brief
MULTI_TEMPORAL_CALIBRATION_ACCURACY	Multi-temporal calibration accuracy provided as a percentage of accuracy	Brief
DEGRADED_ANC_DATA_PERCENTAGE	Percentage of degraded ancillary data	Brief

Table 3-45: Level-1A Datastrip - Quality_Indicators_Info Description

Auxiliary_Data_Info:

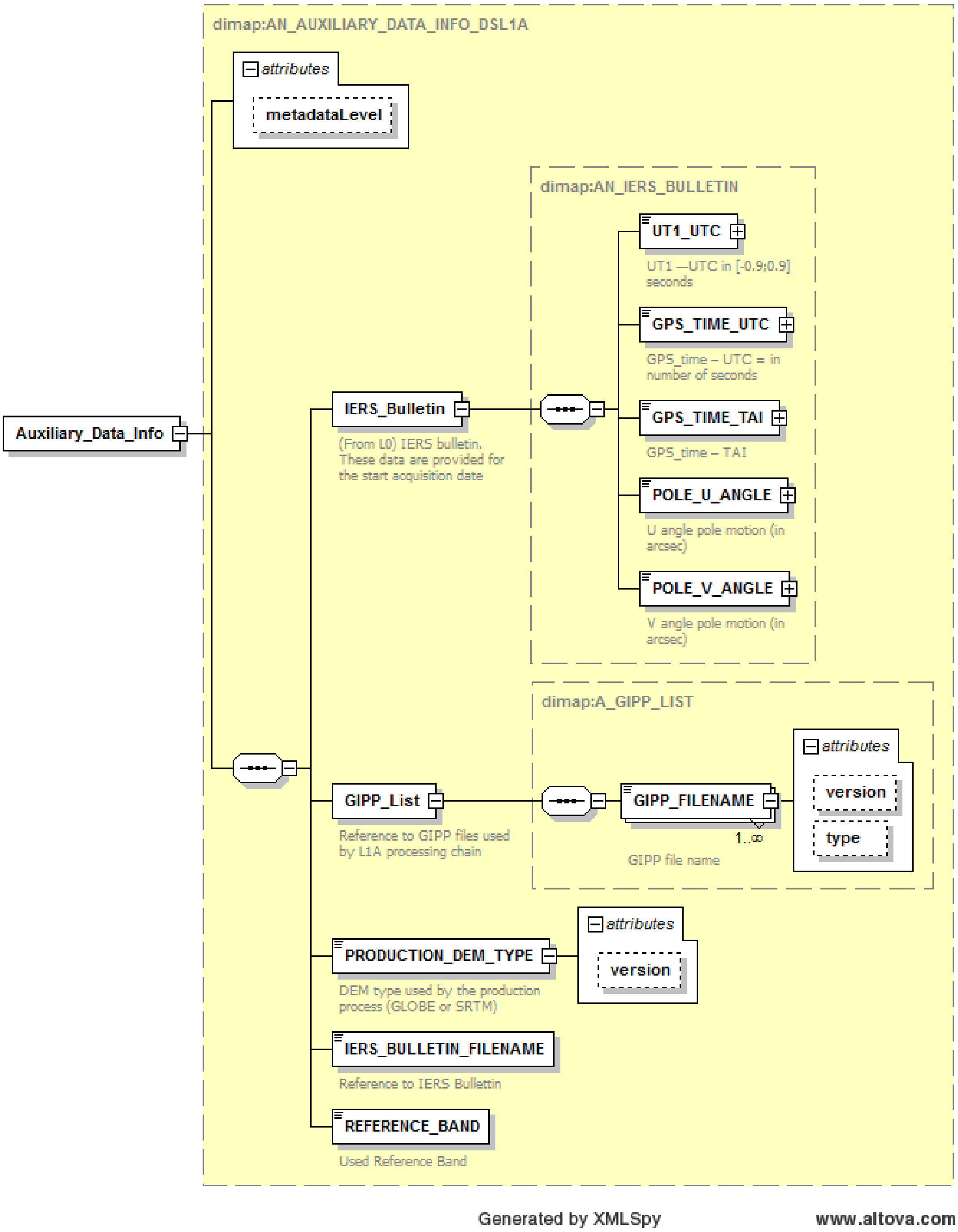
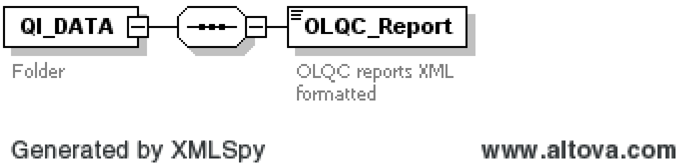


Figure 36 : Level-1A Datastrip – Auxiliary_Data_Info Diagram

Auxliary_Data_Info/IERS_Bulletin (aux info from Level-0)		
Field Name	**Description**	**Metatada Level**
UT1_UTC	UT1 –-UTC in [-0.9;0.9] seconds	Standard
GPS_TIME_UTC	GPS_time – UTC = in number of seconds	Standard
GPS_TIME_TAI	GPS_time – TAI	Standard
POLE_U_ANGLE	U angle pole motion (in arcsec)	Standard
POLE_V_ANGLE	V angle pole motion (in arcsec)	Standard
Auxliary_Data_Info (aux data used by the processing)		
Field Name	**Description**	**Metatada Level**
GIPP_Filename	Reference to the GIPP files used by the L1A processing.	Standard
PRODUCTION_DEM_TYPE	DEM type used by the production process (GLOBE or SRTM for example)	Standard
IERS_BULLETIN_FILENAME	Filename of the used IERS Bulletin	Standard
Auxliary_Data_Info (others aux info)		
Field Name	**Description**	**Metatada Level**
REFERENCE_BAND	Used reference band for datation	Standard

Table 3-46: Level-1A Datastrip – Auxiliary_Data_Info Description

3.9.3.2 QI_DATA

diagram	
children	OLQC_Report
annotation	QI_DATA folder contains XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The Annex C contains the description of OLQC reports.

3.9.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1A PDI Datastrip level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;

- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:

    - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
    - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-1A_Datastrip_Metadata.xsd);
    - a brief textual description of the field;
    - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
    - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
    - the allowed range of values of the field.

  In particular, the satellite ancillary data files (e.g. the SAD Raw Data file) and the auxiliary data files used for Level-1A processing (e.g. GIPP files, DEM, IERS Bulletin), are external to the product and are referenced in the Metadata of Manifest file Section (as “resources” in the “processing” section).

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-1A PDI Product (with the exception of the Manifest file itself); this includes:
    - the XML Metadata file;
    - the XML Inventory_Metadata file;
    - a set of Quality Indicator Data Files, including a OLQC Report file (XML format) and five Preliminary Quick Look files (in JPEG2000 format).

An example of Manifest file for the Level-1A Datastrip PDI containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip); the Manifest is provided as an example, but its compliancy to the SAFE specification has been verified by validating the Manifest file against the SAFE XSD schema.

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->Datatake_Info-> SPACECRAFT_NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	General_Info->Datatake_Info-> SPACECRAFT_NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement Test_Mode
	Instrument->mode->**identifier**	General_Info->Datatake_Info-> DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
						INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1A Granule Product
	start	General_Info->Archiving_Info-> ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info->Archiving_Info -> ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
						UPA_ CDAM MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	PDI Level-1A Granule Product
	resource-> processing		Description of the L0 to L1A Processing		0..*	
	resource-> processing->**name**		Name of the L0 to L1A Processing	string	0..1	Processing of Level-0 Datastrip product
	resource-> processing->**start**	General_Info->Processing_Info-> UTC_DATE_TIME	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing-> facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing-> facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing-> facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing-> facility-> **site**	General_Info->Processing_Info->	Acronym of the Processing center	string enum	0..1	SGS_ MPS_

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
		PROCESSING_CENTER				MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->software		Description of software component used for Processing		0..*	
	resource-> processing-> facility->resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc. and of SAD Raw Data file containing the satellite ancillary telemetry; these files are not provided with the product.		0..*	
	resource-> processing-> facility->resource->**name**	Satellite_Ancillary_Data_Info-> ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Auxiliary_Data_Info->IERS_Bulletin	Absolute path name of the auxiliary or ancillary file/folder	string	1	

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
		Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME				
	resource-> processing-> facility->resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	
	acquisitionPeriod ->startTime	Datastrip->L1A_Datastrip_PDI_ID (substring <Sensing Time>, cf. section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Datastrip level, cf. section 3.6.1)	xs:dateTime	1	
measurementOrbitReference						
	orbitNumber	General_Info->Datatake_Info-> DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	orbitNumber->**groundTrackDirection**	General_Info->Datatake_Info->SENSING_ORBIT_DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to orbitNumber->type (start or stop)		0..1	ascending, descending
	relativeOrbitNumber	General_Info->Datatake_Info->SENSING_ORBIT_NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber->**type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..4	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-47 - Content of Metadata Section for PDI Level-1A Datastrip SAFE Manifest

3.10 Level-1B PDI Granule definition

Level-1B PDI Granule level is defined as a **tar** file with the following structure:

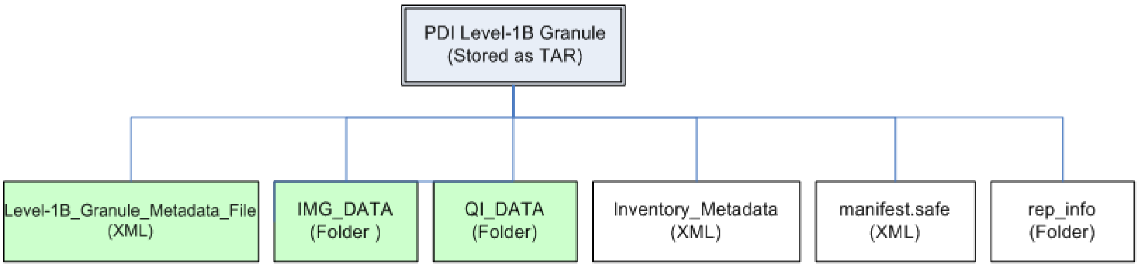


Figure 37: PDI Level-1B Granule Structure

The PDI Level-1B Granule consists of:

1. **Level-1B_Granule_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Granule,
2. **IMG_DATA**: folder containing the mission data corresponding to one on-board scene for one detector and all spectral bands,
3. **QI_DATA**: folder containing XML reports including Quality control checks and Quality Mask files;
4. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI;
5. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.10.4);
6. **rep_info**: folder containing the available XSD schema that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.4.4).

3.10.1 PDI_ID definition

The PDI_ID (Granule ID) used to identify a Level-1B Granule PDI, follows the description provided in the section 3.4.2. File_Type is defined in the section 3.2, Table 3-3.

Level-1B Granule Template Name (Granule ID):

S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_N05.22.tar

Note that the PDI_ID.tar is the physical name of the Granule PDI after the tar compression.

3.10.2 Level-1B Granule Physical Format

The PDI_ID defined above represents the "Granule directory" name. Inside the Granule directory, there are the Granule components as in the Figure 37:

Inside that directory, the naming convention used to identify each real files, follows the same convention used to define the Granule ID except for the Processing Baseline sub-string.

- **Level-1B_Granule_Metadata_File (XML file):**
  Granule Metadata File Template name
  S2A_OPER_MTD_L1B_GR_MTI__20141104T134012_S20141104T134012_D11.xml

  The XSD schema which regulates the metadata file is the *S2_PDI_Level-1B_Granule_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **IMG_DATA (folder):**
  The naming convention used to identify the image files contained in the IMG_DATA folder is defined hereafter:

  Image File naming convention = *<PDI_ID*>_<Band_Index>.jp2*

  where:

Field Name	Value/Meaning	Note
*PDI_ID**	PDI_ID without Processing Baseline sub-string	
Band Index	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12	Field identifying the spectral bands

  IMG_DATA/Level-1B image file template name:
  S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_B08.jp2

- **QI_DATA (folder):**
  QI_DATA folder contains:
  \- XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex D of the document.

  File Template Name:
  *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_GEOMETRIC_QUALITY*_report.xml

  \- Quality_Masks (one for each type, GML/JPEG2000).

The naming used for the mask files follows the same convention defined for the L1B Granule ID (cf. section 3.4.2) except for the additional <Product Type> filed.

Mask files naming convention = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.gml

L1B masks main file types (TTTTTTTTTT) are in the Table 3-16 and listed again hereafter

1. MSK_CLOLOW (Coarse cloud mask files)
2. MSK_TECQUA (Technical quality mask files)
3. MSK_DEFECT (Radiometric quality masks)
4. MSK_SATURA (Radiometric quality masks)
5. MSK_NODATA (Radiometric quality masks)

<Instance_Id> = <Site Centre>_<Creation Date>_<Sensing Time>_<Detector ID>_<Band ID>_<Product_Type>

Where <Site Centre>, <Creation Date>, <Sensing Time> and <Detector ID> are inherited from the L1B Granule ID, <Product Tipe> = “MSIL1B” and <Band ID>:

Band ID	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12

Template masks filename are:
S2A_OPER_MSK_TECQUA_MTI__20141104T134012_S20141104T134012_D11_B08_MSIL1B.gml
S2A_OPER_MSK_SATURA_MTI__20141104T134012_S20141104T134012_D11_B08_MSIL1B.gml

The grouping strategy to have several masks in one physical GML file is described in the Annex E.

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **manifest.safe (XML file):**
  XML file with fixed name *manifest.safe*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1B_Granule_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1B Granule Physical Format template:

Level-1B Granule PDI_ID: ***S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_N05.22***
Inventory_Metadata.xml

S2A_OPER_MTD_L1B_GR_MTI__20141104T134012_S20141104T134012_D11.xml
manifest.safe
IMG_DATA
- *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_B01.jp2*
- *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_B02.jp2*
- *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_B03.jp2*
- .
- .
- .
- *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_B12.jp2*

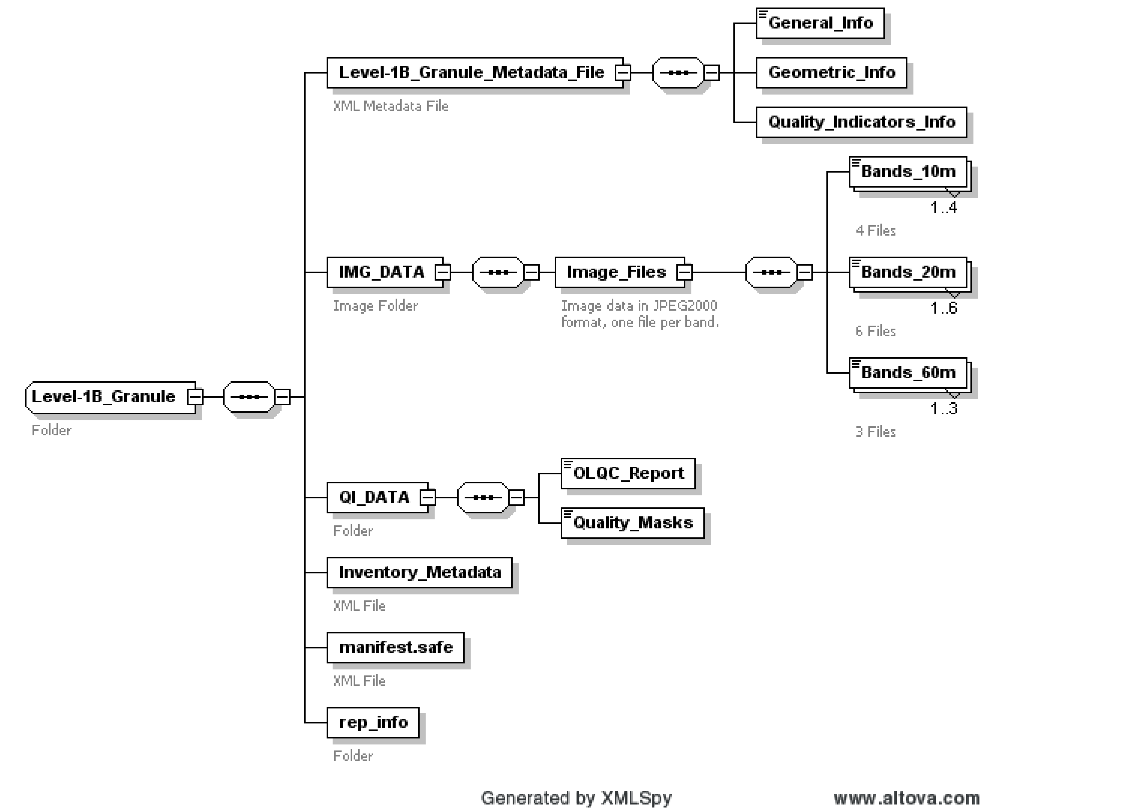
QI_DATA
- *S2A_OPER_MSI_L1B_GR_MTI__20141104T134012_S20141104T134012_D11_GEOMETRIC_QUALITY_report.xml*
- *S2A_OPER_MSK_TECQUA_MTI__20141104T134012_S20141104T134012_D11_ B08_MSIL1B.gml*
- *S2A_OPER_MSK_SATURA_MTI__20141104T134012_S20141104T134012_D11_ B08_MSIL1B.gml*

rep_info
- *S2_PDI_Level-1B_Granule_Metadata.xsd*
- *Inventory_Metadata.xsd*
- *OLQC_Report.xsd*

Figure 38: PDI Level-1B Granule Physical Format

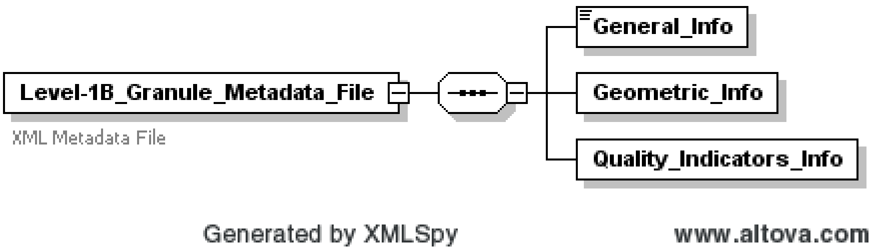
3.10.3 Level-1B PDI Granule Structure

The *S2_PDI_Level-1B_Granule_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1B Granule PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 37.

diagram	
children	Level-1B_Granule_Metadata_File IMG_DATA QI_DATA Inventory_Metadata manifest.safe rep_info
annotation	The Level-1B Granule is defined as a folder containing: 1. **Level-1B_Granule_Metadata_File**: XML main metadata file describing the Granule. 2. **IMG_DATA**: folder containing Image data in JPEG2000 format, one file per band. 3. **QI_DATA**: folder containing XML reports including Quality Indicators and GML Quality Mask files 4. **Inventory_Metadata**: XML inventory metadata file 5. **manifest.safe**: XML SAFE Manifest file 6. **rep_info**: folder containing the XSD schemas provided inside a SAFE Level-1B Granule PDI Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.

3.10.3.1 *Level-1B_Granule_Metadata_File Schema*

Level-1B_Granule_Metadata_File is the XML metadata file provided inside each Level-1B Granule. The schema used to validate it is *S2_PDI_Level-1B_Granule_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Quality_Indicators_Info
annotation	The Level-1B_Granule_Metadata_File is an XML file containing metadata regarding: 1. **General_Info**: this group of metadata provides general information regarding the Granule. 2. **Geometric_Info**: these metadata provide information describing the geolocation of the Granule. 3. **Quality_Indicators_Info**: this metadata values provide information about image content quality indicators and quality control checks information.

The following figures and tables give a complete overview of the Level-1B_Granule_Metadata_File schema according the description provided in the section 3.4.1.

General_Info:

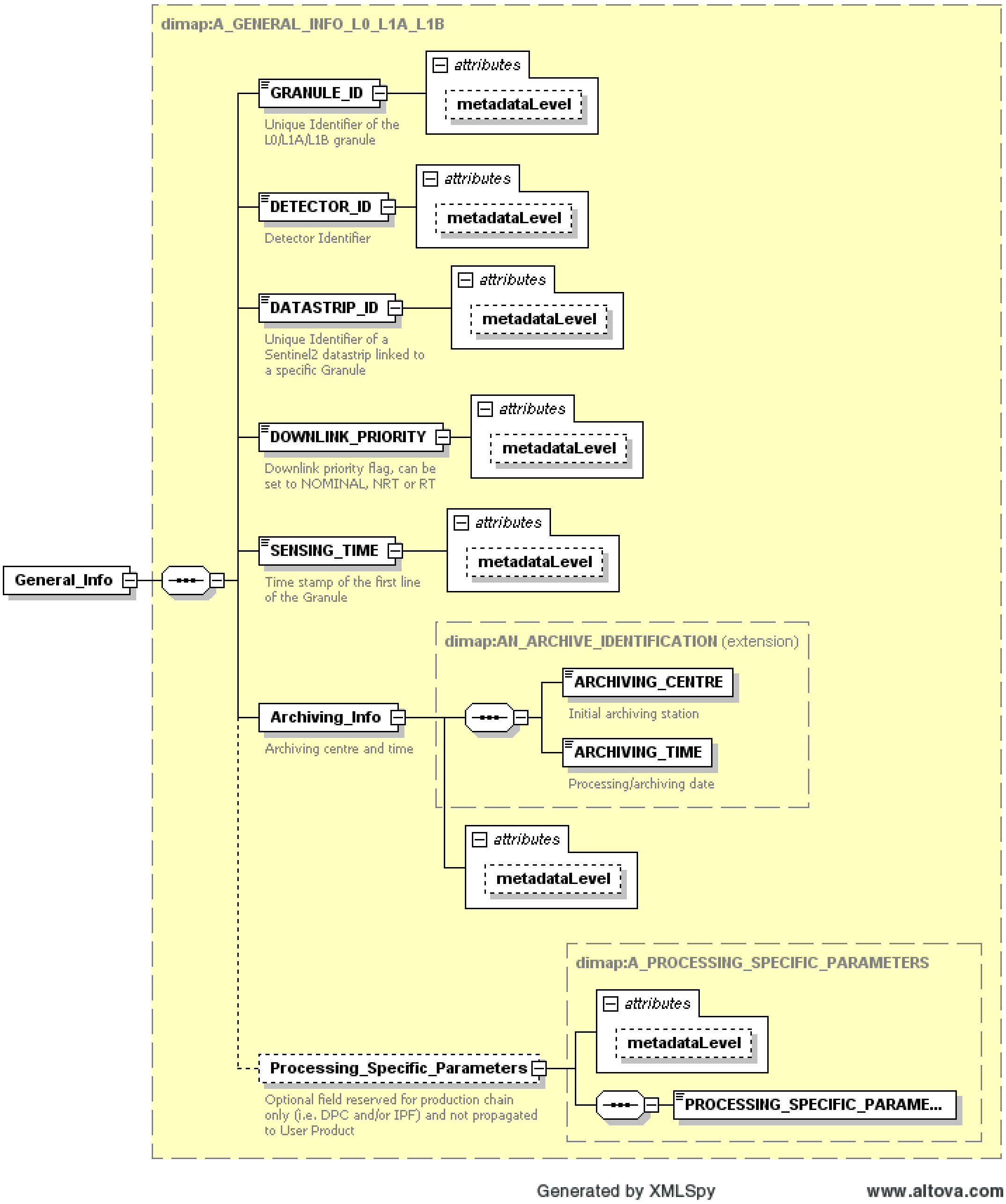


Figure 39: Level-1B_Granule_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Metatada Level**
GRANULE_ID	Granule_Identifier metadata indicates the unique identifier of the Level-1B Granule. This parameter coincides with PDI_ID definition described in section 3.6.1 and univocally points a Granule PDI in the archive.	Brief
DETECTOR_ID	Detector identifier corresponding to the Granule	Brief
DATASTRIP_ID	Unique identifier of the L1B PDI Datastrip linked to L1A PDI Granule. This parameter coincides with the PDI_ID of the PDI Datastrp linked to the Granule. This link establishes the hierarchy Granule vs Datastrip (cf. section 3.3)	Brief
DOWNLINK_PRIORITY	Downlink priority flag. It can be set Nominal/NRT/RT.	Standard
SENSING_TIME	Time stamp of the first line of the Granule, that is the Sensing Start Time of the Granule PDI. Note: for L1A Granule the first line timing shall be taken from one reference band due to the coarse registration applied at	Standard

	Level 1A which makes the first line time different amongst the bands.	
Archiving_Info/ARCHIVING_CENTRE	The starting point of the circulation data. The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_ • UPA_ • CDAM • MPC_	Expertise
Archiving_Info/ARCHIVING_TIME	Processing/archiving date (UTC data time)	Expertise
Processing_Specific_Parameters/ PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-48: Level-1B_Granule_Metadata_File - General_Info Description

Geometric_Info:

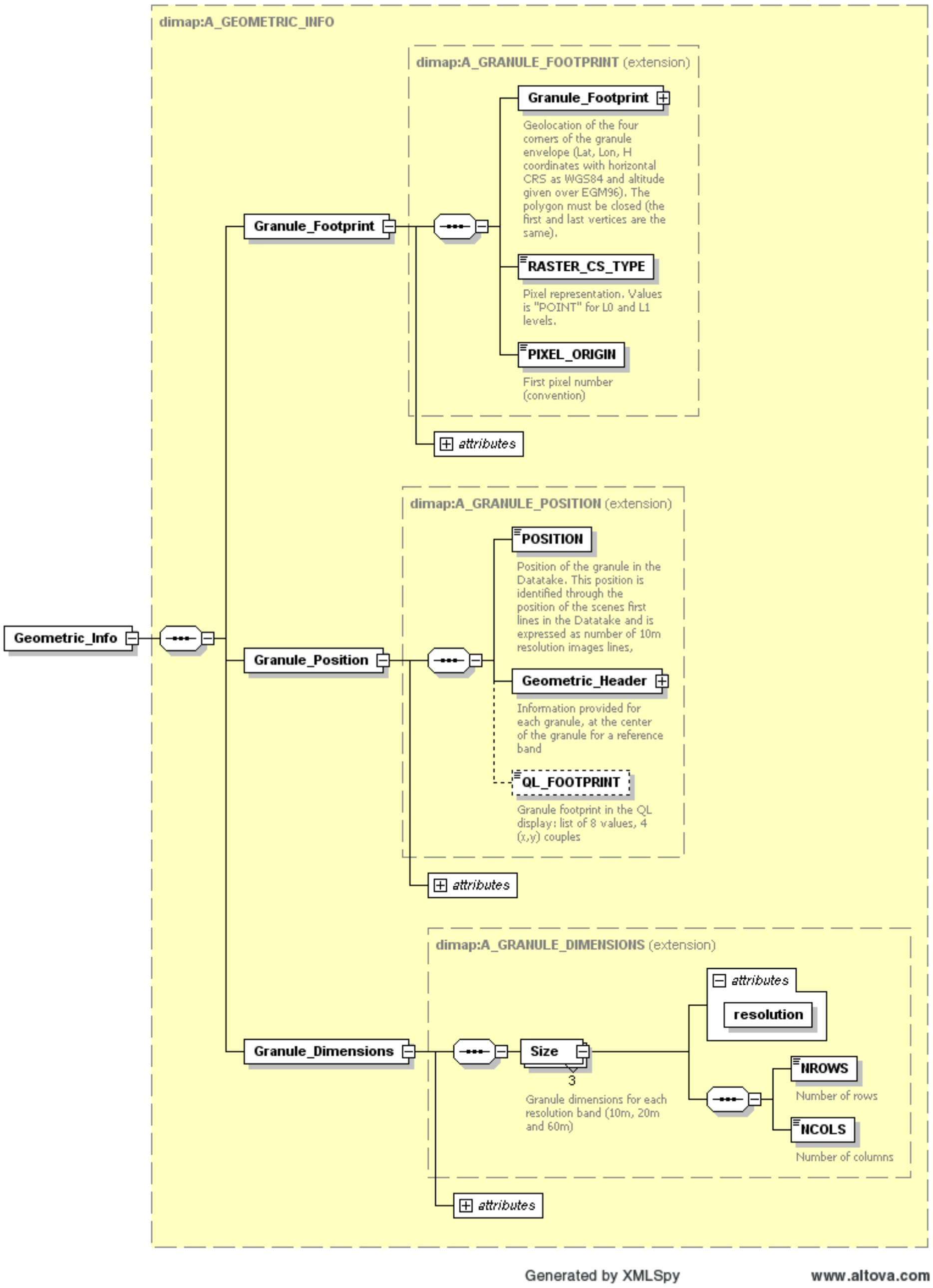


Figure 40: Level-1B_Granule_Metadata_File - Geometric_Info Diagram

Geometric_Info/Granule_Footprint		
Field Name	**Description**	**Metatada Level**
Granule_Footprint	Granule geolocation updated for the Level-1B Granules (same information as Level-1A updated for Level-1B Granules).	Brief
RASTER_CS_TYPE	Pixel representation. Values is "POINT" for L0 and L1 levels.	Brief
PIXEL_ORIGIN	First pixel number (convention)	Brief
Geometric_Info/Granule_Position		
Field Name	**Description**	**Metatada Level**
Position	Position of the Granule in the Datatake (from Level-1A Granule Standard metadata),	Standard
Geometric_Header/GROUND_CENTER	Updated geometric header for the Level-1B Granules (same information as Level-1A updated for Level-1B Granules). Information provided for a reference band, at the centre of the Granule, for each Granule. Geolocation of the Granule centre (Lat, Lon, H) Altitude is provided over the geoid.	Standard
Geometric_Header/QL_CENTER	Updated geometric header for the Level-1B Granules (same information as Level-1A updated for Level-1B Granules). The Granule centre in the QL display: 1 (r,c) point.	Standard
Geometric_Header/Incidence_Angles	Updated geometric header for the Level-1B Granules (same information as Level-1A updated for Level-1B Granules).	Standard

	Information provided for a reference band, at the centre of the Granule, for each Granule. Incidence angles corresponding to the centre of the Granule.	
Geometric_Header/Solar_Angles	Updated geometric header for the Level-1B Granules (same information as Level-1A updated for Level-1B Granules). Information provided for a reference band, at the centre of the Granule, for each Granule. Solar angles corresponding to the centre of the Granule.	Standard
QL_FOOTPRINT	Granule footprint in the QL display: list of 8 values, 4 (x,y) couples. Note: For L1B Granule this metadata is NOT mandatory.	Standard
Geometric_Info/Granule_Dimension		
Field Name	**Description**	**Metatada Level**
Size	Granule dimensions provided for each resolution band (10m, 20m and 60m)	Standard

Table 3-49: Level-1B_Granule_Metadata_File - Geometric_Info Description

Quality_Indicators_Info:

The Quality Indicators provided for a PDI Granule L1B are the same provided for L1A.

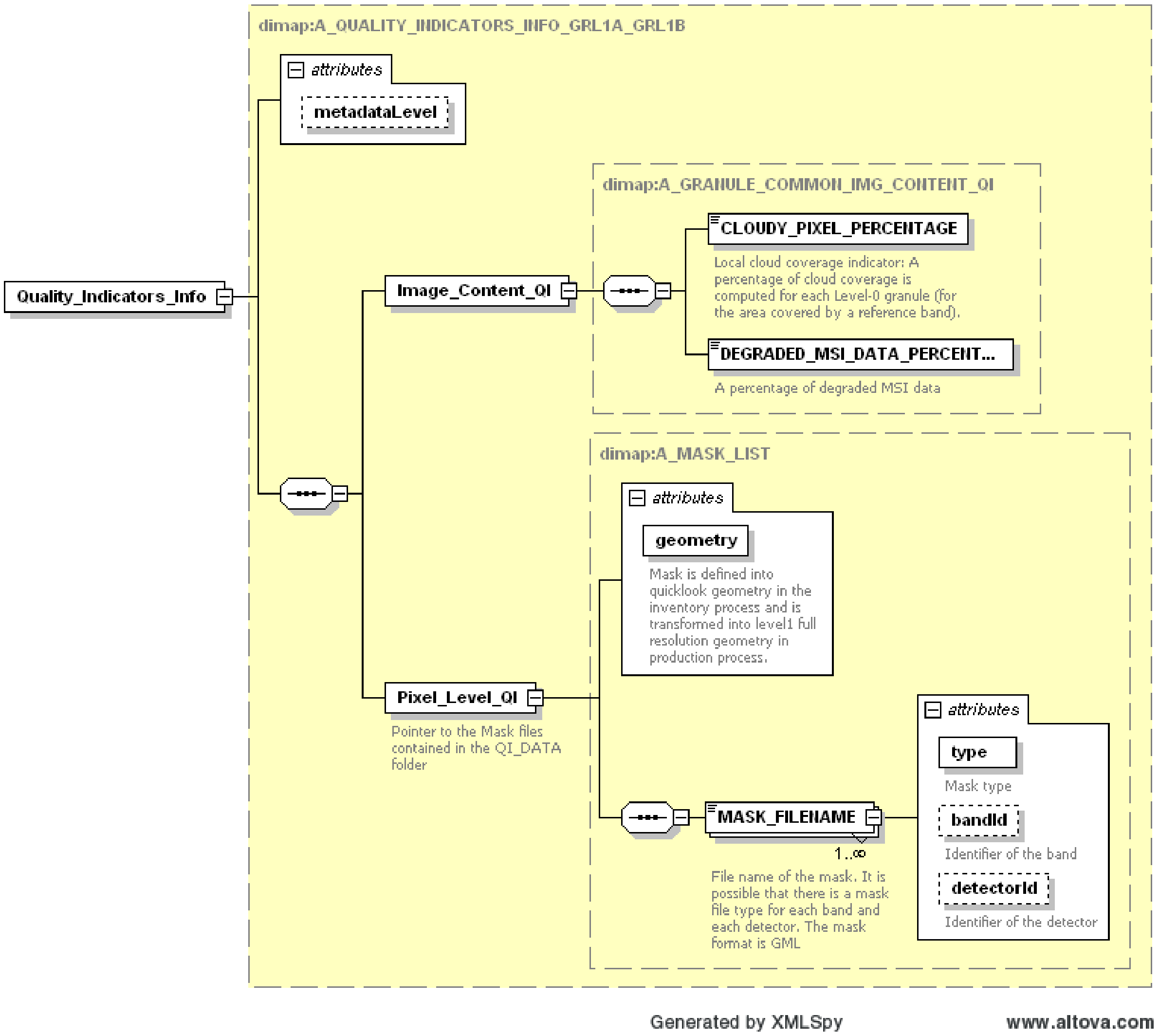


Figure 41: Level-1B_Granule_Metadata_File – Quality_Indicators_Info Diagram

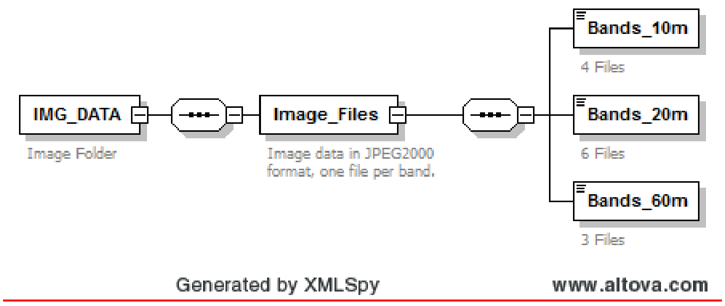
According to the content of the Table 3-4, the following table describes the Quality Indicators provided for a PDI Granule Level-1B.

Quality_Indicators_Info/Image_Content_QI		
Field Name	**Description**	**Metatada Level**
CLOUDY_PIXEL_PERCENTAGE	Local cloud coverage indicator: A percentage of cloud coverage is computed for each Level-1B Granule (for the area covered by a reference band).	Standard
DEGRADED_MSI_DATA_PERCENTAGE	Local technical quality indicator: A percentage of degraded MSI data is provided for each Level-1B Granule.	Standard
Quality_Indicators_Info/Pixel_Level_QI		
Field Name	**Description**	**Metatada Level**
MASK_FILENAME	Pointer to the mask files contained in the QI_DATA folder: - Coarse cloud mask files - Technical quality mask files - Radiometric quality masks	Standard

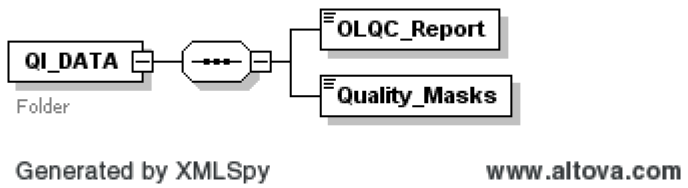
Table 3-50: Level-1B_Granule_Metadata_File – Quality_Indicators_Info Description

Note that, according to OLQC procedures consolidation, the results of all quality control checks performed by OLQC processor on Level-1B Granule, are included in the XML reports stored in the QI_DATA folder (cf. section 3.4.1, Table 3-17).

3.10.3.2 IMG_DATA

diagram	
children	**Image_Files**
annotation	Folder containing image data compressed using the JPEG2000 algorithm, one file per spectral band (13 files).

3.10.3.3 QI_DATA

diagram	
children	**OLQC_Report Quality_Masks**
annotation	QI_DATA folder contains the XML reports including the quality control checks performed by OLQC processor and the GML quality masks. The Annex C contains the description of OLQC reports and the masks files are listed in the Table 3-16.

3.10.4 SAFE Manifest synoptic table

The content of the SAFE Manifest for the Level-1B PDI Granule level, is the same as for the Level-1A PDI Granule level (except for a few specific text string in the “processing” section) and can be exhaustively described through Table 3-29, Table 3-41and Table 3-31.

3.11 Level-1B PDI Datastrip definition

Level-1B PDI Datastrip is defined as a **tar** file containing the following structure:

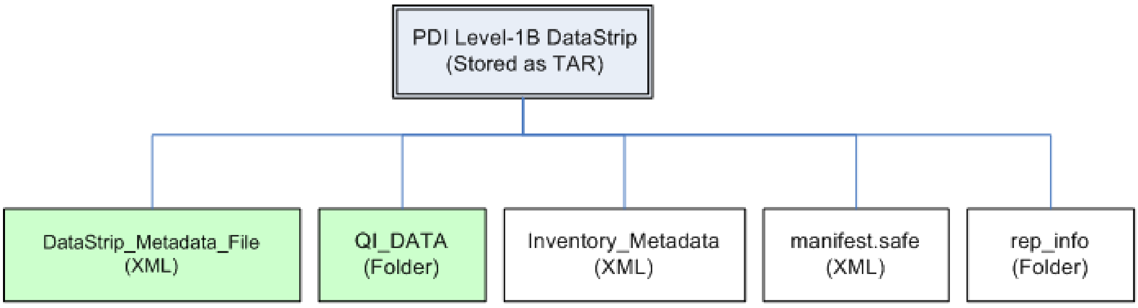


Figure 42: PDI Level-1B Datastrip Structure

The PDI Level-1B Datastrip consists of:

1. **Datastrip_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Datastrip,
2. **QI_DATA**: folder containing XML reports including Quality control checks information,
3. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI,
4. **manifest.safe**: XML SAFE Manifest file(mandatory, cf. section 3.5.4),
5. **rep_info**: folder containing the available XSD schemas that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.5.4).

3.11.1 PDI_ID definition

Datastrip PDI_ID (Datastrip ID) is defined in the section 3.5.2. The File_Type is specified in the section 3.2, Table 3-3.

Level-1B Datastrip Template Name (Datastrip ID):
S2A_OPER_MSI_L1B_DS_SGS__20141104T134012_S20141104T134012_N10.10.tar

Note that the PDI_ID.tar is the physical name of the Datastrip PDI after the tar compression.

3.11.2 Level-1B Datastrip Physical Format

The PDI ID defined above represents the “Datastrip directory” name. Inside the Datastrip directory, there are the Datastrip components as in the Figure 42:

Inside that directory, the naming convention used to identify each real files follows the same convention used to define the Datastrip ID but without the Processing Baseline sub-string.

- **Datastrip_Metadata_File (XML file):**
  Datastrip_Metadata_File template name:
  S2A_OPER_MTD_L1B_DS_SGS__20141104T134012_S20141104T134012.xml

  The XSD schema which regulates the metadata file is *S2_PDI_Level-1B_Datastrip_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **QI_DATA (folder):**
  QI_DATA folder contains:
  – XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.

  File Template Name:
  *S2A_OPER_MSI_L1B_DS_SGS__20141104T134012_S20141104T134012_GEOMETRIC_QUALITY*_report.xml

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1B_Datastrip_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1B Datastrip Physical Format template:

Level-1B Datastrip PDI_ID: ***S2A_OPER_MSI_L1B_DS_SGS__20141104T134012_S20141106T134012_N10.10***
Inventory_Metadata.xml *S2A_OPER_MTD_L1B_DS_SGS__20141104T134012_S20141104T134012.xml* *manifest.safe* QI_DATA

S2A_OPER_MSI_L1B_DS_SGS__20141104T134012_S20141104T134012_GEOMETRIC_QUALITY_report.xml

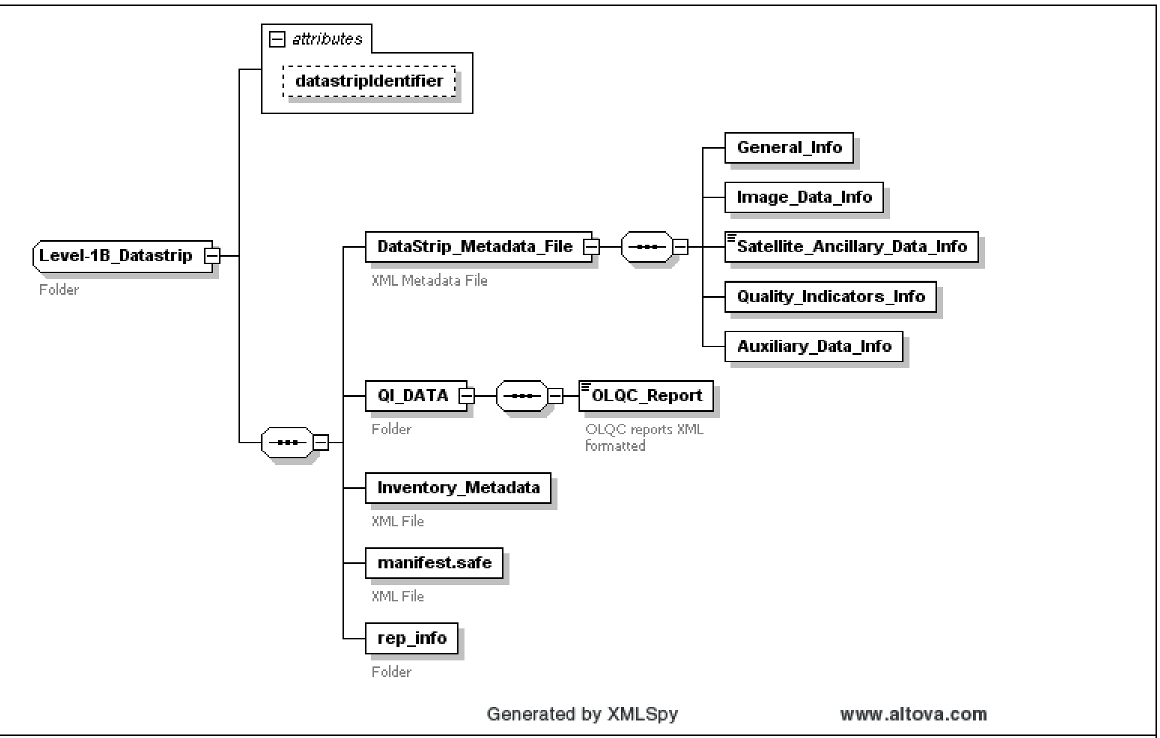
rep_info

- *S2_PDI_Level-1B_Datastrip_Metadata.xsd*
- *Inventory_Metadata.xsd*
- *OLQC_Report.xsd*

Figure 43: PDI Level-1B Datastrip Physical Format

3.11.3 Level-1B PDI Datastrip Structure

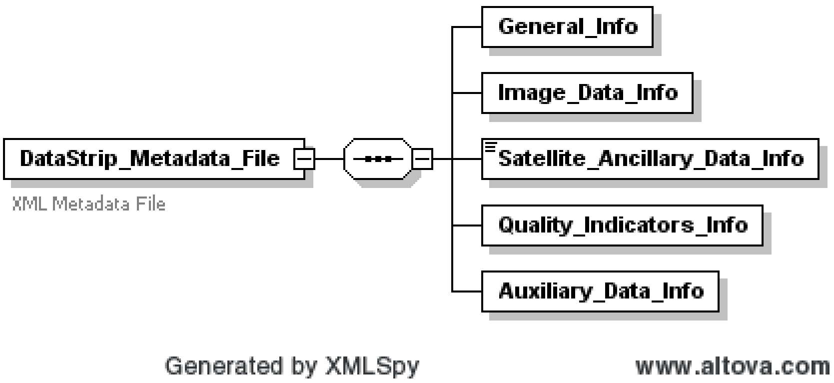
The *S2_PDI_Level-1B_Datastrip_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1B Datastrip PDI on. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 42.

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>children</td><td>Datastrip_Metadata_File QI_DATA Inventory_Metadata manifest.safe rep_info</td></tr>
<tr><td>annotation</td><td>The Level-1B PDI Datastrip is defined as a folder containing:
1. Datastrip Metadata_File: XML Main Metadata File containing the requested level of information and referring all the PDI elements
2. QI_DATA: folder containing XML reports including Quality Indicators
3. Inventory_Metadata: XML inventory metadata file
4. manifest.safe: XML SAFE Manifest file
5. rep_info: folder containing the XSD schemas provided inside a SAFE Level-1B Datastrip PDI

Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.</td></tr>
</table>

3.11.3.1 Datastrip_Metadata_File Schema

Level-1B Datastrip_Metadata_File is the XML metadata file provided inside each Level-1B Datastrip. The schema used to validate it is *S2_PDI_Level-0_Datastrip_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Image_Data_Info Satellite_Ancillary_Data_Info Quality_Indicators_Info Auxiliary_Data_Info
annotation	The structure of the Datastrip_Matadata_File is common to all processing level (cfr. § 3.5.1) The Datastrip_Metadata_File is an XML file containing all the metadata describing the whole product data item. 1. **General_Info**: This group of metadata provide general information characterizing the source Datastrip acquisition. 2. **Image_Data_Info**: Image data information from MSI telemetry. 3. **Satellite_Ancillary_Data_Info**: Ancillary data information from Satellite Ancillary Telemetry. 4. **Quality_Indicators_Info**: Results of all quality checks performed at Datastrip level. 5. **Auxiliary_Data_Info**: Auxiliary data information.

The following tables and figures give a complete overview of the Level-1B Datastrip_Metadata_File schema according the description provided in the section 3.5.1.

General_Info:

The General_Info provided through the Level-1B DataSrip_Metadata_File are the same described in the Figure 20 and Table 3-32.

Image_Data_Info:

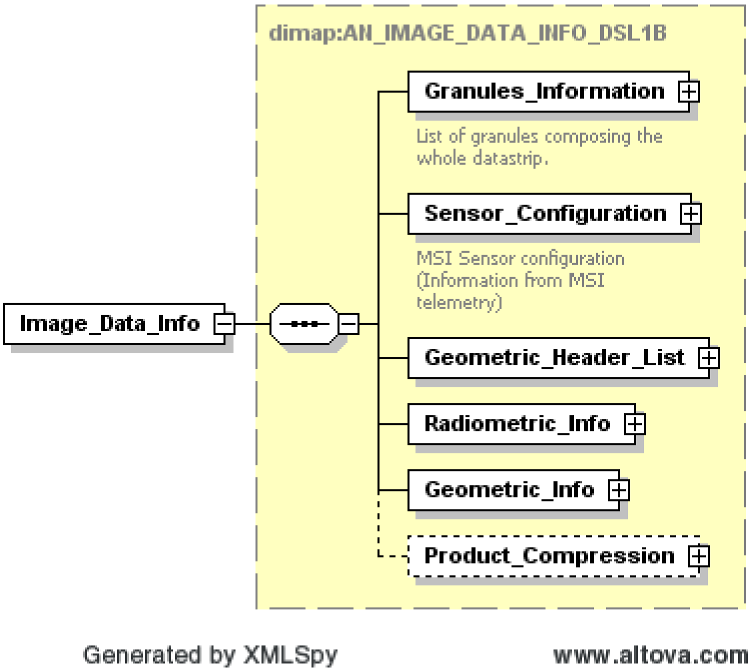


Figure 44 : Level-1B Datastrip – Image_Data_Info Diagram

Image_Data_Info/Granules_Information		
Field Name	**Description**	**Metadata Level**
/Detector_List/…/POSITION	This branch of the schema provides information regarding all Granules, for each detector, composing the whole Datastrip. Each Granule composing the Datastrip is univocally identified trough a unique Granule identifier (PDI_ID at granul level). For each Granule the Position of the Granule is provided. This position is identified through the position of the scenes first lines in the Datastrip and is expressed as number of 10m resolution images lines.	Standard
Image_Data_Info/Sensor_Configuration (inherited from Level-0 metadata)		
Field Name	**Description**	**Metatada Level**
Acquisition_Configuration/COMPRESS_MODE	Flag to indicate if compress mode is by passed	Expertise
Acquisition_Configuration/EQUALIZATION_MODE	Flag to indicate if equalization is active	Expertise
Acquisition_Configuration/NUC_TABLE_ID	In-flight Non Uniform Correction table ID defined by 10 bits. This ID is uniform for all transmitted bands. It identifies the correction coefficients table used in-flight	Expertise
Acquisition_Configuration/Active_Detectors_List	On board active Detectors (in case of compression by-passed)	Expertise
Acquisition_Configuration/ TDI_Configuration_List	On board TDI configuration, for B3, B4, B11 and B12 only.	Standard
Acquisition_Configuration/Spectral_Band_Info/PHYSICAL_GAIN	Physical Gain for each band	Standard
Acquisition_Configuration/Spectral_Band_Info/COMPRESSION_RATE	On-board compression rates for each band	Expertise
Acquisition_Configuration/Spectral_Band_Info/INTEGRATION_TIME	On-board integration time for each band	Expertise
Source_Packet_Description	Source packet information for each band	Standard
Time_Stamp/LINE_PERIOD	Line period for the acquisition of line of 10 m full-	Standard

	resolution image data	
Time_Stamp/Band_Time_Stamp/Detector	Datation model for each couple band, detector.	Standard
Time_Stamp/GPS_SYNC	Flag (Boolean) to indicate if MSI is synchronize with GPS time	Standard
Time_Stamp/THEORETICAL_LINE_PERIOD	Theoretical line period for the acquisition of line of 10 m full-resolution image data	Standard
Time_Stamp/Quality_Indicators	Optional. Created when datation models are estimated through linear regression.	Standard
Image_Data_Info/Geometric_Header_List		
Field Name	**Description**	**Metatada Level**
Geometric_Header_List	Geometric information For all details see Table 3-33, section "Image_Data_Info/Geometric_Header_List"	Standard Expertise
Image_Data_Info/Radiometric_Info		
Field Name	**Description**	**Metatada Level**
SWIR_REARRANGEMENT_PROC	SWIR pixels re-arrangement (only for level 1A production but SWIR rearrangement information shall be preserved in L1B and L1C): A 'true' value indicates that data extraction and SWIR pixels re-arrangement have been processed.	Standard
Equalization	On ground equalization of the image using an optimized polynomed correction (only for level 1B production)	Standard
CROSSTALK_OPTICAL_PROC	Optical crosstalk correction (only for level 1B production). A 'true' value indicates that optical crosstalk correction has been processed.	Standard
CROSSTALK_ELECTRONIC_PROC	Electronic crosstalk correction (only for level 1B production). A 'true' value indicates that electronic crosstalk correction has been	Standard

	processed.	
REMOVE_BLIND_PIXELS_PROC	Blind pixel remonving (only for level 1B production). A 'true' value indicates that Blind pixel remonving has been processed.	Standard
DEFECTIVE_PIXELS_PROC	Defective pixels processing. A 'true' value indicates that defective pixels have been detected and processed, a 'detection" value indicates that defective pixels have been only detected (only for level 1A production), a 'false" value indicates that defective pixels have been neither detected nor processed.	Standard
Restoration	Restoration and levelling of the product to 12 bits (only for level 1B production)	Standard
BINNING_PROC	Binning for 60m bands (only for level 1B production). A 'true' value indicates that binning for 60m bands has been processed.	Standard
PIXELS_NO_DATA_PROC	Management of NO_DATA pixels. A 'true' value indicates that NO_DATA pixels have been detected and processed, a 'detection" value indicates that NO_DATA pixels have been only detected (only for level 1A production), a 'false" value indicates that NO_DATA pixels have been neither detected nor processed.	Standard
SATURATED_PIXELS_PROC	Management of saturated pixels. A 'true' value indicates that saturated pixels has been processed.	Standard
Spectral_Information_List/Spectral_Informatio/RESOLUTION	(OPTIONAL BRANCH) Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION Spatial resolution	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/MIN	Minimum wavelenght	Standard

Spectral_Information_List/Spectral_Informatio/Wavelength/MAX	Maximum wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/CENTRAL	Central wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Spectral_Response/STEP	Step of spectral response	Standard
Spectral_Information_List/Spectral_Informatio/Spectral_Response/VALUES	List of measures	Standard
Image_Display_Order/RED_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Display_Order/GREEN_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Display_Order/BLUE_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Brief
Image_Data_Info/Geometric_Info		
Field Name	**Description**	**Metatada Level**
RGM	Flag to identify if the Refined Geometric Model File is computed or obtained from a existing RGMF (reused)	Standard
Image_Refining	Refining results. Should exist only if REFINING_TYPE= REFINING or REFINING_REGISTRATION	Standard
VNIR_SWIR_Registration	Registration results. Should exist only if REFINING_TYPE= REGISTRATION or REFINING_REGISTRATION	Standard
Refined_Corrections_List	Description of the refined corrections. If the refining has been processed by Datastrip then, there are the refined corrections for each Datastrip. These data are created by Geo_S2.	Standard
Image_Data_Info/Product_Compression (OPTIONAL BRANCH)		
Field Name	**Description**	**Metatada Level**
COMPRESSION	Product Compression. The compression may be: - None.	Standard

	- LOSSLESS: Lossless compression, use reversible JPEG2000 compression. - LOSSY: Lossy compression, use compression that ensures that JPEG2000 compression has a negligible effect on image quality.	

Table 3-51: Level-1B Datastrip – Image_Data_Info Description

Satellite_Ancillary_Data_Info:
The Satellite_Ancillary_Data_Info are the same provided with a L0 Datastrip (cfr. Figure 22 and Table 3-34)

Quality_Indicators_Info:

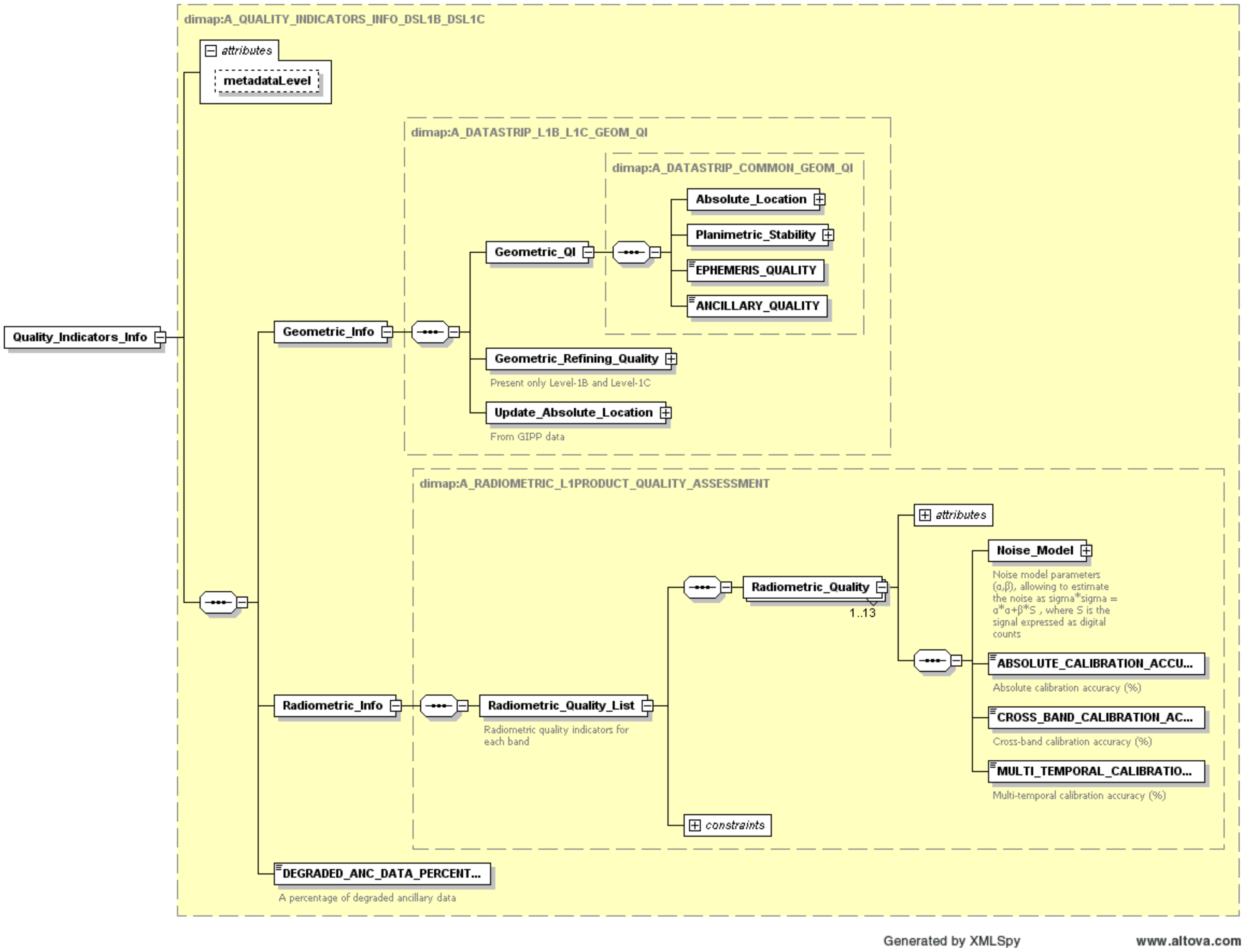


Figure 45: Level-1B Datastrip – Quality_Indicators_Info Diagram

Quality_Indicators_Info/Geometric_Info		
Field Name	**Description**	**Metadata Level**
Geometric_QI/Absolute_Location	Absolute location performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Geometric_QI/Planimetric_Stability	A planimetric stability performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Geometric_QI/EPHEMERIS_QUALITY	Ephemeris data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Geometric_QI/ANCILLARY_QUALITY	Ancillary data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Geometric_Refining_Quality	Available by Datastrip and only if geometric refining is applied. Include Multi_Spectral_Registration performance (3 values for 10, 20 and 60m bands (from GIPP data).	Brief
Update_Absolute_Location	From GIPP data	Brief
Quality_Indicators_Info/Radiometric_Info		
Field Name	**Description**	**Metadata Level**

Noise_Model	Alpha and Beta parameters providing the instrument noise as a function of the radiometric count X for Level-1B : Noise= square root(Alpha_X + Beta_X* X)	Brief
ABSOLUTE_CALIBRATION_ACCURACY	Absolute calibration accuracy provided as a percentage of accuracy	Brief
CROSS_BAND_CALIBRATION_ACCURACY	Cross-band calibration accuracy provided as a percentage of accuracy	Brief
MULTI_TEMPORAL_CALIBRATION_ACCURACY	Multi-temporal calibration accuracy provided as a percentage of accuracy	Brief
DEGRADED_ANC_DATA_PERCENTAGE	Percentage of degraded ancillary data	Brief

Table 3-52: Level-1B Datastrip – Quality_Indicators_Info Description

Auxiliary_Data_Info:

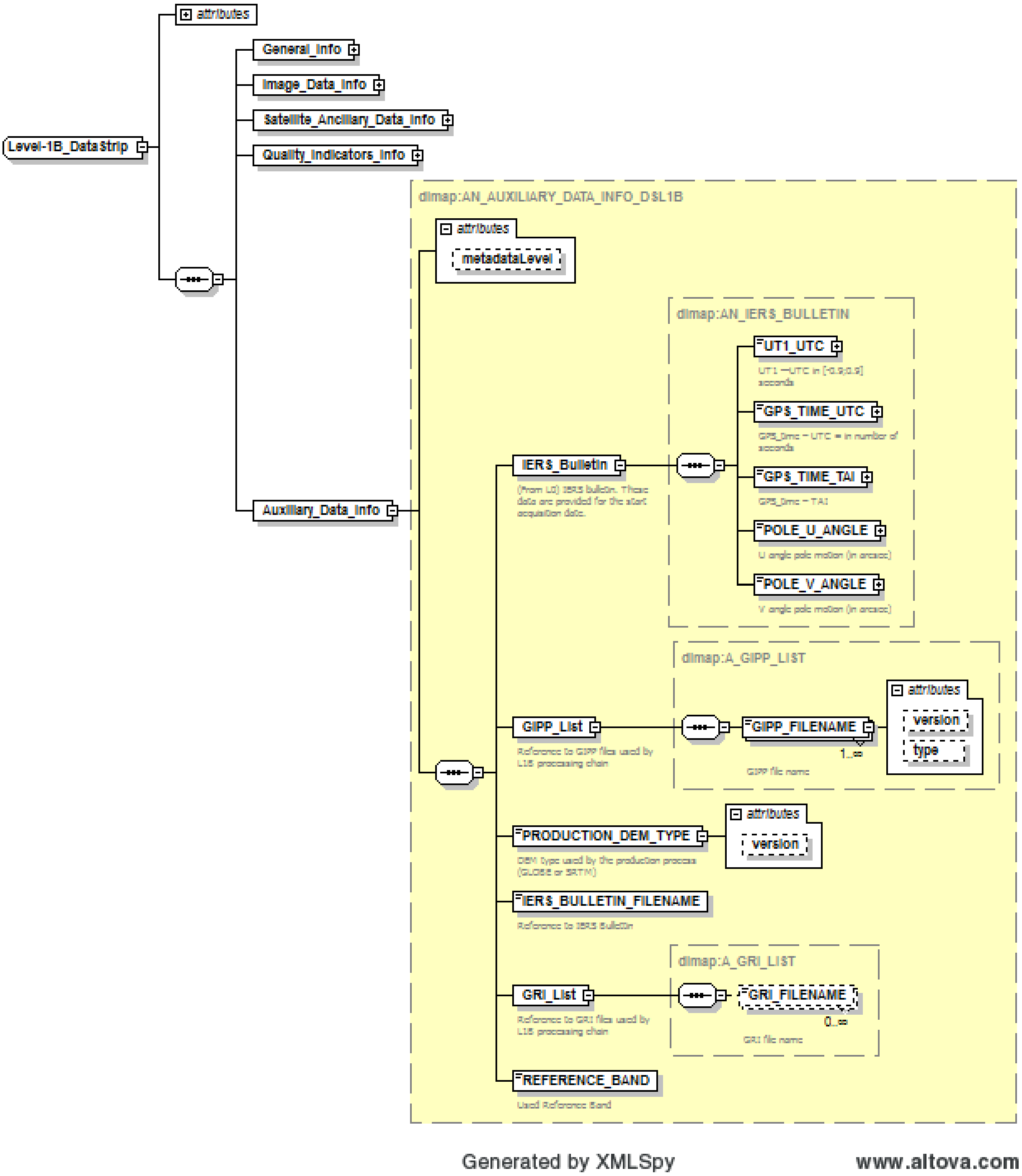
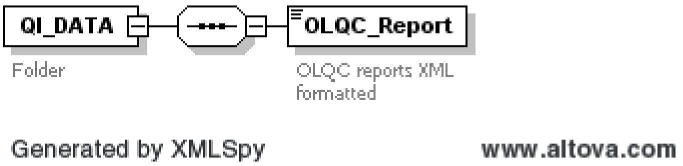


Figure 46 : Level-1B Datastrip – Auxiliary_Data_Info Diagram

Auxliary_Data_Info/IERS_Bulletin (aux info from Level-1A)		
Field Name	**Description**	**Metatada Level**
UT1_UTC	UT1 –-UTC in [-0.9;0.9] seconds	Standard
GPS_TIME_UTC	GPS_time – UTC = in number of seconds	Standard
GPS_TIME_TAI	GPS_time – TAI	Standard
POLE_U_ANGLE	U angle pole motion (in arcsec)	Standard
POLE_V_ANGLE	V angle pole motion (in arcsec)	Standard
Auxliary_Data_Info (aux data used by the processing)		
Field Name	**Description**	**Metatada Level**
GIPP_Filename	Reference to the GIPP files used by the L1B processing.	Standard
PRODUCTION_DEM_TYPE	DEM type used by the production process (GLOBE or SRTM)	Standard
IERS_BULLETIN_FILENAME	Reference to the used IERS Bulletin	Standard
GRI_FILENAME	Reference to the used GRI data	Standard
Auxliary_Data_Info (others aux info)		
Field Name	**Description**	**Metatada Level**
REFERENCE_BAND	Used reference band	Standard

Table 3-53: Level-1B Datastrip – Auxiliary_Data_Info Description

3.11.3.2 QI_DATA

diagram	
children	OLQC_Report
annotation	QI_DATA folder contains: - XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The Annex C contains the description of OLQC reports.

3.11.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1B PDI Datastrip level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;
- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:
  - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
  - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-1B_Datastrip_Metadata.xsd”);
  - a brief textual description of the field;
  - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
  - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
  - the allowed range of values of the field.

  In particular, the satellite ancillary data files (e.g. the SAD Raw Data file) and the auxiliary data files used for Level-1B processing (e.g. GIPP files, DEM, IERS Bulletin), are external to the product and are referenced in the Metadata of Manifest file Section (as “resources” in the “processing” section).

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-1B PDI Product (with the exception of the Manifest file itself); this includes:
  - the XML Metadata file;
  - the XML Inventory_Metadata file;
  - a set of Quality Indicator Data Files, including a OLQC Report file (XML format) and five Preliminary Quick Look files (in JPEG2000 format).

An example of Manifest file for the Level-1B Datastrip PDI containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->Datatake_Info->SPACECRAFT_NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	General_Info->Datatake_Info->SPACECRAFT_NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement Test_Mode
	instrument->mode->**identifier**	General_Info->Datatake_Info->DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1B Datastrip Product
	start	General_Info->Archiving_Info->ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info->Archiving_Info->ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_ UPA_ CDAM

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	PDI Level-1B Datastrip Product
	resource-> processing		Description of the L1A to L1B Processing		0..*	
	resource-> processing->**name**		Name of the L1A to L1B Processing	string	0..1	Processing of Level-1A Datastrip product
	resource-> processing->**start**	General_Info->Processing_Info->UTC_DATE_TIME	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing->facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing->facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing->facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing->facility-> **site**	General_Info->Processing_Info->PROCESSING_CENTER	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->software		Description of software component used for Processing		0..*	
	resource-> processing-> facility->resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc.) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are not provided with the product.		0..*	
	resource-> processing-> facility->resource->**name**	Satellite_Ancillary_Data_Info-> ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Auxiliary_Data_Info->IERS_Bulletin Auxiliary_Data_Info->GIPP_List->	Absolute path name of the auxiliary or ancillary file/folder	string	1	

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
		GIPP_FILENAME				
	resource-> processing-> facility->resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	
	acquisitionPeriod ->startTime	Datastrip->L1B_Datastrip_PDI_ID (substring <Sensing Time>, cf. section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Datastrip level, cf. section 3.6.1)	xs:dateTime	1	
measurementOrbitReference						
	orbitNumber	General_Info->Datatake_Info-> DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values "start" or "stop"). Set to "start" since the absolute orbit number refers to the first line of the Datastrip		0..1	start
	orbitNumber-> **groundTrackDirection**	General_Info->Datatake_Info-> SENSING_ORBIT_DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to orbitNumber->type (start or		0..1	ascending, descending

SAFE Manifest		From *S2_PDI_Level-0_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			stop)			
	relativeOrbitNumber	> General_Info->Datatake_Info-> SENSING_ORBIT_NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber->**type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..4	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-54 - Content of Metadata Section for PDI Level-1B Datastrip SAFE Manifest

3.12 Level-1C PDI Tile definition

Level-1C PDI Tile level is defined as a **tar** file with the following structure:

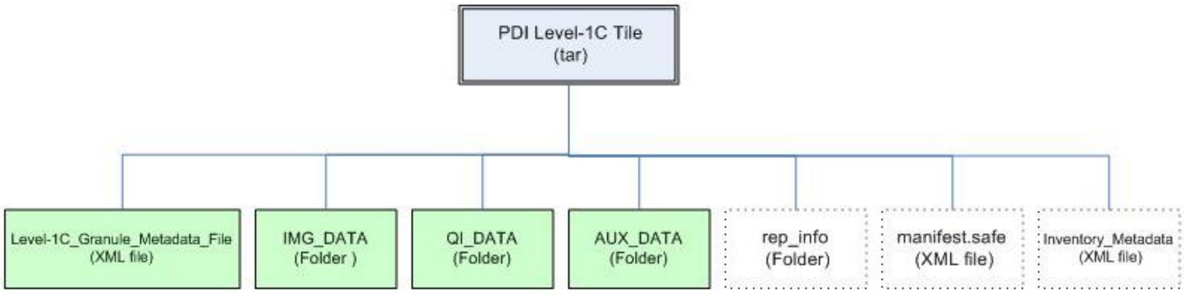


Figure 47: PDI Level-1C Tile Structure

The PDI Level-1C Tile consists of:

1. **Level-1C_Tile_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Tile;
2. **IMG_DATA**: folder containing image data files compressed using the JPEG2000 algorithm, one file per band;
3. **QI_DATA**: folder containing XML reports including quality checks, GML mask files and JP2 PVI file;
4. **AUX_DATA**: folder containing ECMWF data resampled in UTM projection;
5. **Inventory_Metadata.xml**: file containing the metadata needed to inventory the PDI;
6. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.12.4);
7. **rep_info**: folder containing the available XSD schema that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.4.4).

3.12.1 PDI_ID definition

The PDI_ID (Tile ID) used to identify a Level-1C Tile PDI, follows the description provided in the section 3.4.2. File_Type is defined in the section 3.2, Table 3-3.

Level-1C Tile template name (Tile ID):
S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_N11.11.tar

<u>Note that the PDI_ID.tar is the physical name of the Tile PDI after the tar compression.</u>

3.12.2 Level-1C Tile Physical Format

The PDI_ID defined above represents the "Tile directory" name. Inside the Tile directory, there are the Tile components as in the Figure 47:

Inside that directory, the naming convention used to identify each real files, follows the same convention used in the section 3.12.1 (and US-MGRS naming convention as in section 4.9.2) to define the Tile ID but without the Processing Baseline sub-string.

- **Level-1C_Tile_Metadata_File (XML file):**
  Tile Metadata File Template:
  S2A_OPER_MTD_L1C_TL_MTI__20141104T134012_A123456_T15SWC.xml

  The XSD schema which regulates the metadata file is the *S2_PDI_Level-1C_Tile_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **IMG_DATA (folder):**
  The naming convention used to identify the image files contained in the IMG_DATA folder is defined hereafter:

Image File naming convention = <PDI_ID*>_<Band_Index>.jp2

where:

Field Name	Value/Meaning	Note
PDI_ID	PDI_ID without Processing Baseline sub-string	
Band Index	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12	Field identifying the spectral bands

IMA_DATA/Level-1C image file template name:
S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_B03.jp2

- **QI_DATA (folder):**
  QI_DATA folder contains:
  - XML reports OLQC_Report.xml generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.
  - Quality_Masks (one for each type, GML/JPEG2000). The naming convention is defined below.
  - PVI Preview Image file provided in ground geometry. The preview image is a single file in JPEG2000 format with GML geo-location information; it contains 3 visible-bands (490nm, 560nm, 665nm) in ground geometry at 320m resolution and in display order (RGB).

Mask files naming convention = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.gml

L1C masks main file types (TTTTTTTTTT) are in the Table 3-16 and listed again hereafter

1. MSK_CLOUDS (Finer cloud mask files)
2. MSK_TECQUA (Technical quality mask files)
3. MSK_DETFOO (Detector footprint mask files)
4. MSK_DEFECT (Radiometric quality masks)
5. MSK_SATURA (Radiometric quality masks)
6. MSK_NODATA (Radiometric quality masks)

<Instance_Id> = <Site Centre>_<Creation Date>_<Abs Orbit>_<Tile>_<Band ID>_<Product_Type>

Where <Site Centre>, <Creation Date>, <Abs Orbit> and <Tile> are inherited from the L1C Tile ID, <Product Tipe> = “MSIL1C” and <Band ID>:

Band ID	Bxx where: xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12 xx = 00 for mask file band independent

Template masks filename are:
S2A_OPER_MSK_CLOUDS_MTI__20141104T134012_A123456_T15SWC_B00_MSIL1C.gml

The grouping strategy to have several masks in one physical GML file is described in theAnnex E.

Preview Image naming convention = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.jp2

PVI file type (TTTTTTTTTT) = PVI_L1C_TL

<Instance_Id> = <Site Centre>_<Creation Date>_<Abs Orbit>_<Tile>

MMM, CCCC and <Instance_ID> are directly inherited from L1C Tile ID.

Template PVI filename:
S2A_OPER_PVI_L1C_TL_MTI__20141104T134012_A123456_T15SWC.jp2

- **AUX_DATA (folder):**
This folder contains ECMWF data in UTM projection (single file in GRIB V1 format).
The naming convention is the same defined for ECMWF PDI with file type “AUX_ECMWFT”

Template name:
S2A_OPER_AUX_ECMWFT_PDMC_YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **manifest.safe (XML file):**
  XML file with fixed name *manifest.safe*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1C_Tile_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1C Tile Physical Format template:

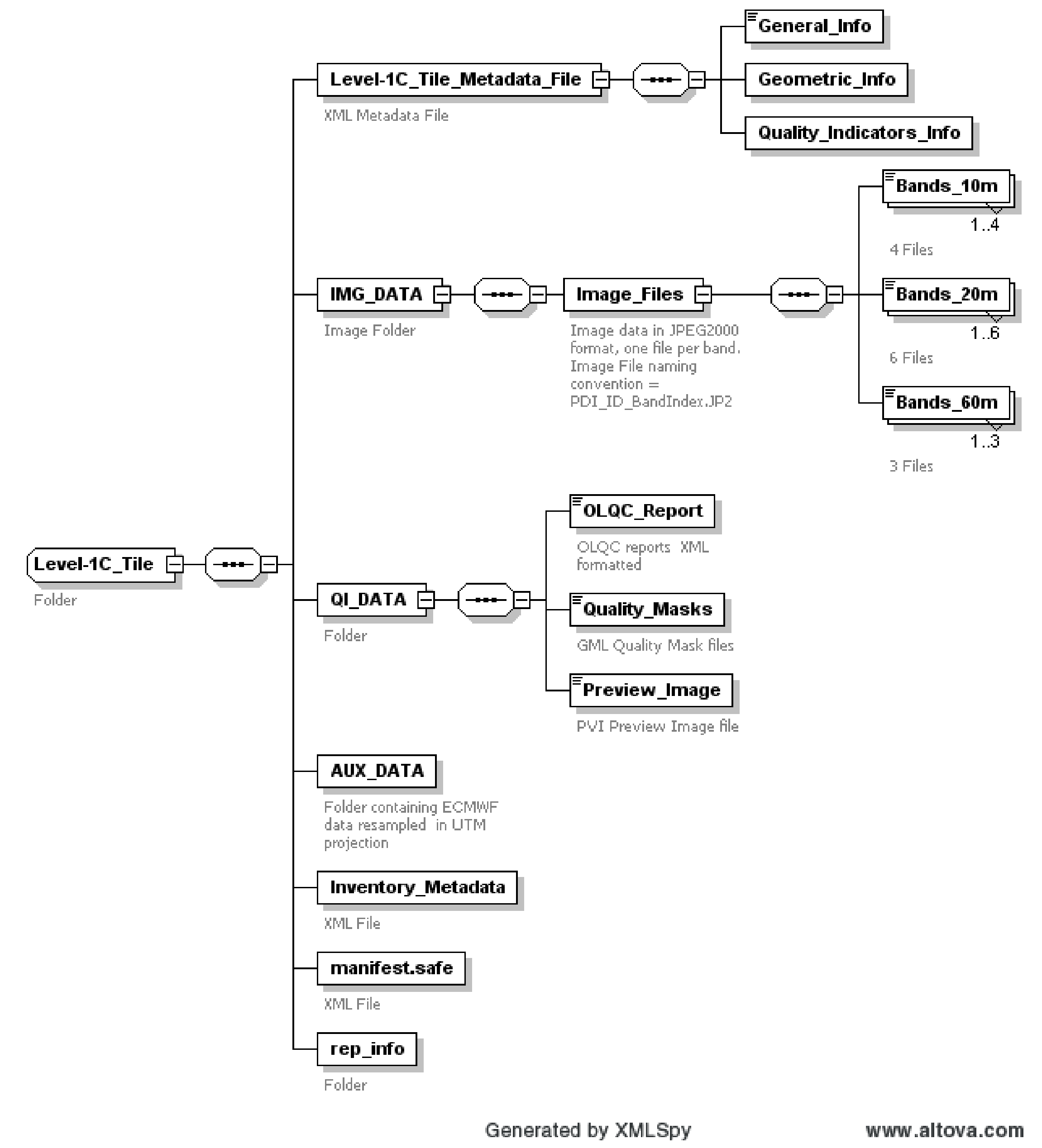
Level-1C Tile PDI_ID: ***S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_N11.11***
Inventory_Metadata.xml *S2A_OPER_MTD_L1C_TL_MTI__20141104T134012_A123456_T15SWC.xml* *manifest.safe* IMG_DATA *Appendix B : S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_B01.jp2* *S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_B02.jp2* . . . *S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_B12.jp2* QI_DATA *S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_GEOMETRIC_QUALITY_report.xml* *S2A_OPER_MSK_CLOUDS_MTI__20141104T134012_A123456_T15SWC_B00_MSIL1C.gml* . . *S2A_OPER_PVI_L1C_TL_MTI__20141104T134012_A123456_T15SWC.jp2* AUX_DATA *S2A_OPER_AUX_ECMWFT_PDMC_YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS* rep_info *S2_PDI_Level-1B_Tile_Metadata.xsd* *Inventory_Metadata.xsd*

OLQC_Report.xsd

Figure 48: PDI Level-1C Tile Physical Format

3.12.3 Level-1C PDI Tile Structure

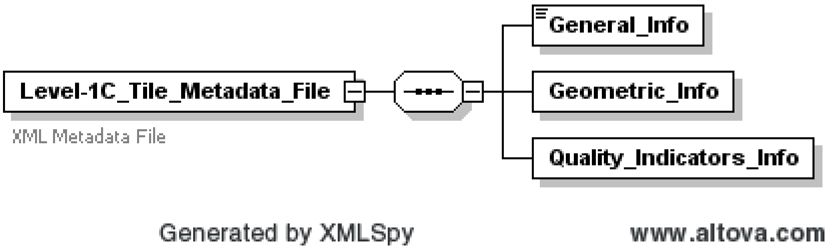
The *S2_PDI_Level-1C_Tile_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1C Tile PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 47.

diagram	
children	Level-1C_Tile_Metadata_File IMG_DATA QI_DATA AUX_DATA Inventory_Metadata manifest.safe

	rep_info
annotation	The Level-1C Tile is defined as a folder containing: 1. **Level-1C_Tile_Metadata_File**: XML main metadata file describing the Granule. 2. **IMG_DATA**: Folder containing Image data in GML JPEG2000 format, one file per band. 3. **QI_DATA**: Folder containing XML reports including Quality Indicators, GML Quality Mask files and JP2 Preview Image file 4. **AUX_DATA**: Folder containing ECMWF data resampled in UTM projection. 5. **Inventory_Metadata**: XML inventory metadata file 6. **manifest.safe**: XML SAFE Manifest file 7. **rep_info**: folder containing the XSD schemas provided inside a SAFE Level-1C Tile PDI Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.

3.12.3.1 *Level-1C_Tile_Metadata_File Schema*

Level-1C_Tile_Metadata_File is the XML metadata file provided inside each Level-1C Tile. The schema used to validate it is the *S2_PDI_Level-1C_Tile_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Quality_Indicators_Info
annotation	The Level-1C_Tile_Metadata_File is an XML file containing: 1. **General_Info**: to provide general Tile information. 2. **Geometric_Info**: to provide information regarding the Tile geolocation. 3. **Quality_Indicators_Info**: to provide information about image content quality indicators and quality control checks information.

The following figures and tables give a complete overview of the Level-1C_Tile_Metadata_File schema according the description provided in the section 3.4.1.

General_Info:

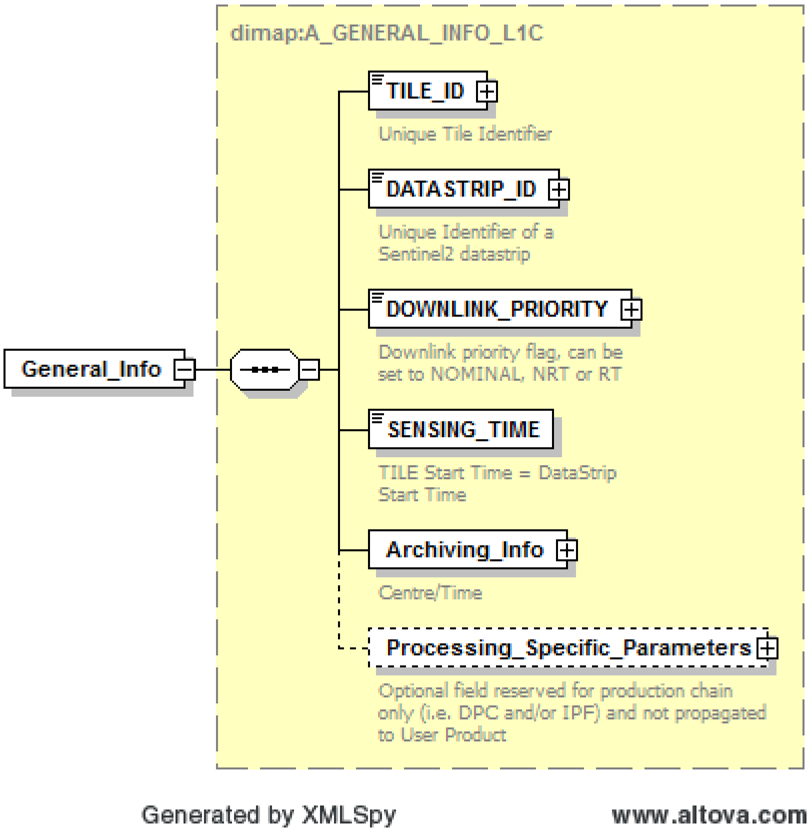


Figure 49: Level-1C_Tile_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Metatada Level**
TILE_ID	TILE identifier (PDI_ID) defined in section 3.12.1 .	Brief
DATASTRIP_ID	Unique identifier of the L1C PDI Datastrip linked to the L1C PDI Tile. This parameter coincides with the PDI_ID of the PDI Datastrp linked to the Tile. This link establishes the hierarchy TIle vs Datastrip.	Standard
DOWNLINK_PRIORITY	Downlink priority flag. It can be set Nominal/NRT/RT.	Standard
SENSING_TIME	TILE Start Time. This value is currently set to the Datastrip Start Time (cf. datastrip definition in section 2.3) Note: set as Type date_time:AN_UTC_DATE_TIME	Standard
Archiving_Info/ARCHIVING_CENTRE	The starting point of the circulation data. The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_ • UPA_ • CDAM • MPC_	Expertise
Archiving_Info/ARCHIVING_TIME	Processing/archiving date (UTC data time)	Expertise
Processing_Specific_Parameters/ PROCESSING_SPECIFIC_PARAMETERS	Optional field reserved for production chain only (i.e. DPC and/or IPF) and NOT propagated to User Product	Expertise

Table 3-55: Level-1C_Tile_Metadata_File - General_Info Description

Geometric_Info:

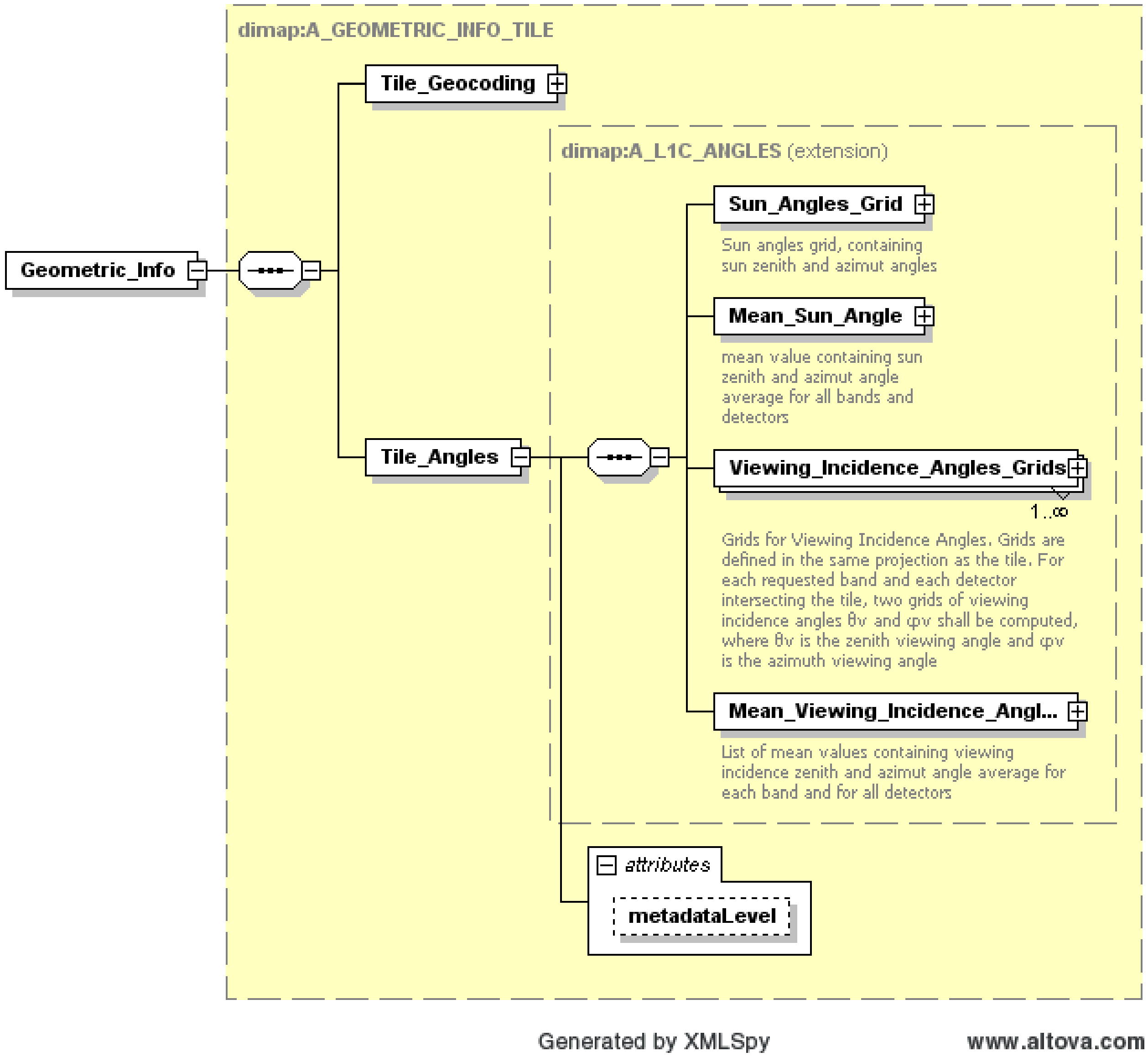


Figure 50: Level-1C_Tile_Metadata_File - Geometric_Info Diagram

Geometric_Info/Tile_Geocoding		
Field Name	**Description**	**Metatada Level**
HORIZONTAL_CS_NAME	Name of horizontal coordinate reference system. Example for Tile 33VWG: WGS84 / UTM zone 33N	Brief
HORIZONTAL_CS_CODE	EPSG Code of horizontal coordinate reference system. The EPSG code contains the info of reference system (WGS84) and projection (UTM zone). Example for Tile 33VWG: EPSG:32633	Brief
Size	Tile dimensions for each resolution band	Brief
Geoposition	XDIM and YDIM for each resolution band	Brief
Geometric_Info/Tile_Angles		
Field Name	**Description**	**Metatada Level**
Sun_Angles_Grid	Grid of sun angles (zenith and azimuth) and the correction which takes into account earth-sun distance variation and for each band sun equivalent irradiance	Standard
Mean_Sun_Angle	Mean value containing sun zenith and azimuth angle average for all bands and detectors	Standard
Mean_Incidence_Angle	List of mean values containing viewing incidence zenith and azimuth angle average for each band and for all detectors	Standard
Viewing_Incidence_Angles_Grids	Grid of incidence angles (zenith and azimuth) (per bands and detectors)	Standard

Table 3-56: Level-1C_Tile_Metadata_File - Geometric_Info Description

Quality_Indicators_Info:

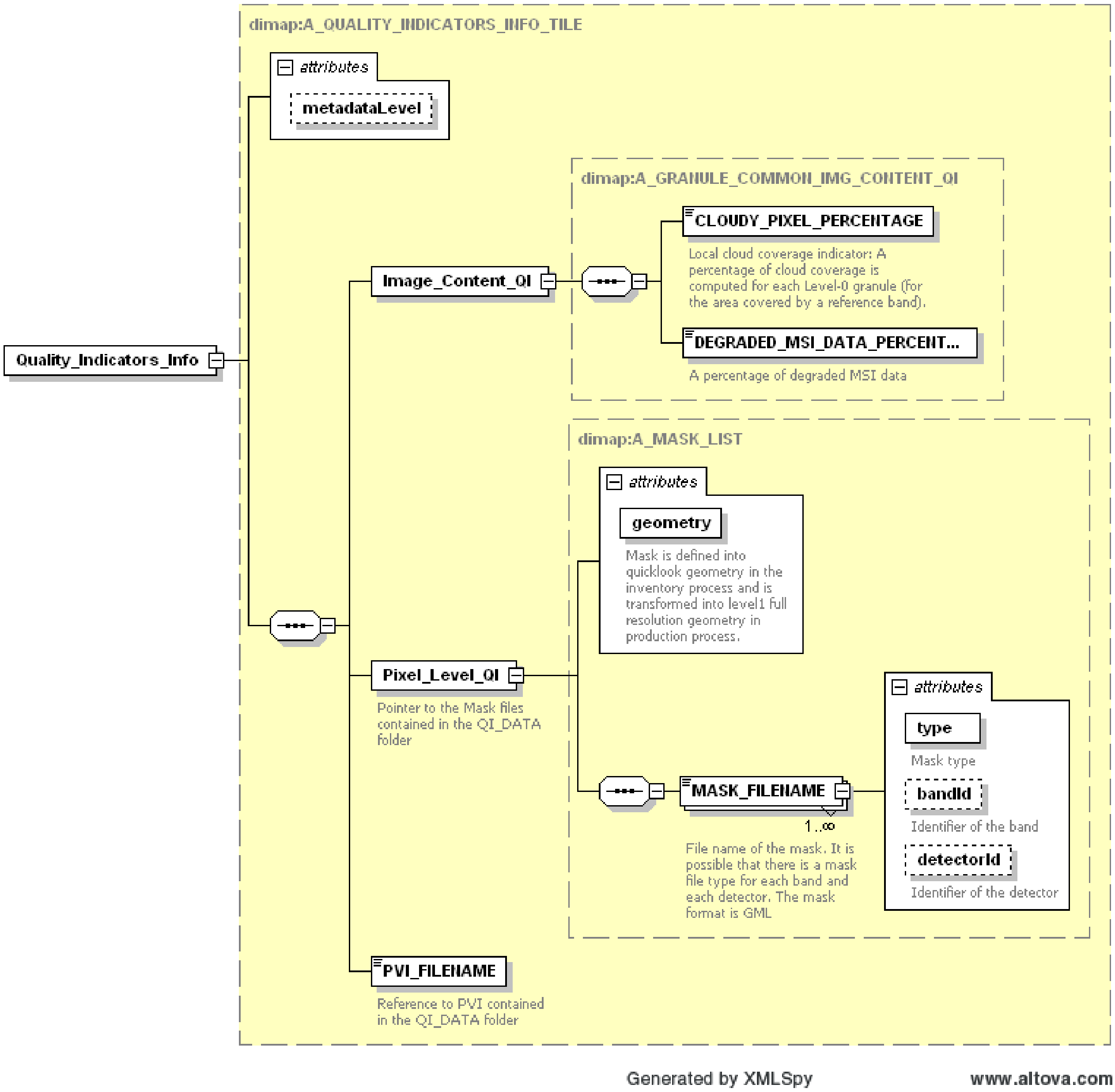


Figure 51: Level-1C_Tile_Metadata_File – Quality_Indicators_Info Diagram

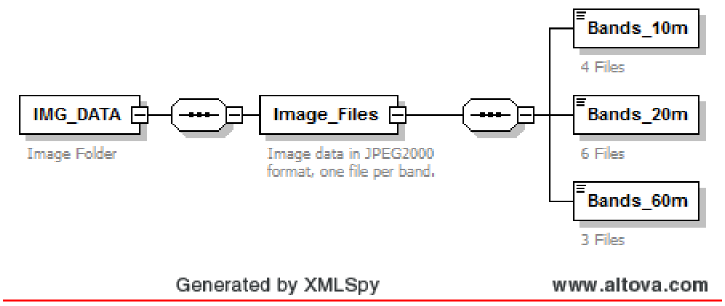
According to the content of the Table 3-14, the following table describes the Quality Indicators provided for a PDI Tile Level-1C.

Quality_Indicators_Info		
Field Name	**Description**	**Metatada Level**
CLOUDY_PIXEL_PERCENTAGE	Percentage of cloud coverage provided for each Tile. The cloud percentage is computed taking into account (removing) the NO_DATA pixels eventually present in the Tile image.	Standard
DEGRADED_MSI_DATA_PERCENTAGE	Percentage of degraded MSI data provided for each Tile.	Standard
Quality_Indicators_Info/Pixel_Level_QI		
Field Name	**Description**	**Metatada Level**
MASK_FILENAME	Pointer to the mask files contained in the QI_DATA folder: - Finer cloud mask files - Technical quality mask files - Detector footprint mask - Radiometric quality masks	Standard
PVI_FILENAME	Reference to PVI contained in the QI_DATA folder	

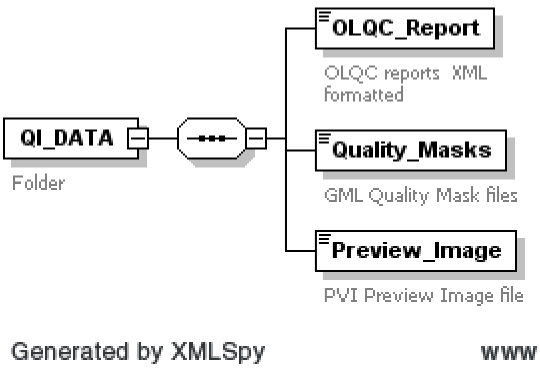
Table 3-57: Level-1C_Tile_Metadata_File – Quality_Indicators_Info Description

Note that, according to OLQC procedures consolidation, the results of all quality control checks performed by OLQC processor on Level-1C Tile, are included in the XML reports stored in the QI_DATA folder (cf. section3.4.1, Table 3-17).

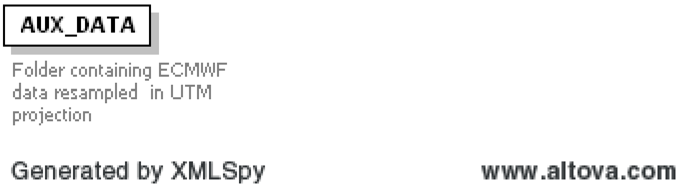
3.12.3.2 IMG_DATA

diagram	
children	[Image_Files]()
annotation	Folder containing image data (GML-JPEG2000), one file per spectral band (13 files).

3.12.3.3 QI_DATA

diagram	
children	[OLQC_Report]() [Quality_Masks]()
annotation	QI_DATA folder contains: • XML reports including the quality control checks performed by OLQC processor. The Annex C contains the description of OLQC reports • GML quality mask files; the masks files are listed in the Table 3-16 • JPEG2000 Preview_Image file, always provided with a Level-1C Tile

3.12.3.4 AUX_DATA

diagram	
children	-
annotation	The raw ECMWF global forecast dataset are resampled and provided as part of the Level-1C Tile PDI. These data are distributed in grid information tiles with the same dimensions as the Level-1C Tiles. Grid points are provided in latitude/longitude using WGS84 reference system. They are interpolated from original ECMWF data to match L1C Tiles both temporally (linear) and geometrically (bilinear with a Ground Sample Distance of 12.5km). Each Tile contains one single ECMWF data file in GRIB V1 format (cf. [GIRB])

3.12.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1C PDI Granule level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4 by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;

- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:

    - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
    - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-1C_Tile_Metadata.xsd”);

  - a brief textual description of the field;
  - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
  - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
  - the allowed range of values of the field.

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-1C PDI Granule Product (with the exception of the Manifest file itself); this includes:
  - the XML Granule Metadata file;
  - the XML Inventory_Metadata file;
  - a set of image files in JPEG2000 format (one file per spectral band, up to a total of 13 files);
  - a set of Quality Indicator Data Files, including a OLQC Report file and one or more pixel-level Quality Mask files.

An example of Manifest file for the Level-1C Tile PDI, containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->TILE_ID (substring <Mission ID>, cf. section 3.12.1)	The mission name of the platform		0..1	Sentinel
	number	General_Info->TILE_ID (substring <Mission ID>, cf. section 3.12.1)	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Test_Mode
	Instrument->mode->**identifier**	N.A.	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1C Tile Product
	start	General_Info-> Archiving_Info ->ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info-> Archiving_Info ->ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occur rence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						MTI_ EPA_ UPA_ CDAM MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	PDI Level-1C Tile Product
	resource-> processing		Description of the L1B to L1C Processing		0..*	
	resource-> processing->**name**		Name of the L1B to L1C Processing	string	0..1	Processing of Level-1B Granule product
	resource-> processing->**start**	General_Info->TILE_ID (substring <Creation Date>, cf. section 3.12.1)	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing-> facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing-> facility-> **name**	N.A.	Extended name of Origin Centre	string	1	

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	resource-> processing-> facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing-> facility-> **site**	General_Info->TILE_ID (substring <Site Centre>, cf. section 3.12.1)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility-> **country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility-> software	N.A.	Description of software component used for Processing		0..*	
	resource-> processing-> facility-> software-> **name**	N.A.	Name of the software component	string	1	
	resource-> processing-> facility-> software-> **version**	N.A.	Version of the software component	string	0..1	
acquisitionPeriod					1	

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	startTime	General_Info->TILE_ID (substring <Sensing Time>, cf. section 3.12.1)	Reference time of acquisition of the Granule	xs:dateTime	1	
measurementOrbitReference						
	orbitNumber	General_Info-> TILE_ID (substring <Abs Orbit>, cf. section 3.12.1)	Absolute orbit number			
	orbitNumber->**type**		Absolute orbit number type (possible values “start” or “stop”). Set to fixed value “start” since the absolute orbit number refers to the first line of the Tile			
measurementFrameSet						
	cloudVoteNotationSystem				0..1	
	cloudVoteNotationSystem->**floor**	N.A.	Minimum value of cloud coverage index (Fixed value = 0.0)	double	0..1	0.0
	cloudVoteNotationSystem->**ceil**	N.A.	Maximum value of cloud coverage index (Fixed value = 100.0)	double	0..1	100.0
	frame	N.A.	The “frame” concept is used in SAFE to convey the cloud coverage information by sub-dividing the region of interest of the data into “frames” according to a World Reference System. In the case of Sentinel-2 L1C Products, a		0..1	

SAFE Manifest		From *S2_PDI_Level-1C_Tile_Metadata.xsd*	Description	Data Type	Occur rence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			a similar concept can be used, by associating one single "frame" " to the area covered by the Granule			
	frame->number	N.A.	Number of the band	integer	0..1	1
	frame→Tile	N.A.			1	One Tile for the single frame
	frame→Tile->**row**	N.A.	The column index of the frame Tile. This index is numbered starting from 1.	integer	1	1 (there is only one Tile for the single frame)
	frame→Tile->**column**	N.A.	The row index of the frame Tile. This index is numbered starting from 1.	integer	1	1 (there is only one Tile for the single frame)
	frame→Tile->cloudVote	Quality_Indicators_Info-> Image_Content_QI -> CLOUDY_PIXEL_PERCENTAGE	Numeric notation qualifying the cloud coverage of the frame Tile	double	0..1	0 to 100
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..11	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-58 Content of Metadata Section for PDI Level-1C Tile SAFE Manifest

3.13 Level-1C PDI Datastrip definition

Level-1C PDI Datastrip is defined as a **tar** file containing the following structure:

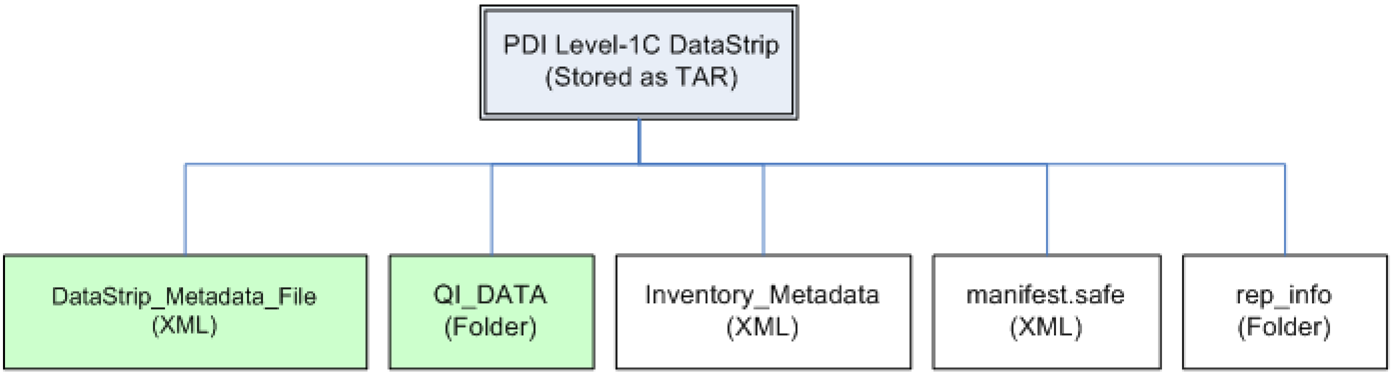


Figure 52: PDI Level-1C Datastrip Structure

The PDI Level-1C Datastrip consists of:

1. **Datastrip_Metadata_File**: XML metadata file containing the requested level of information and referring all the product elements composing the Datastrip,
2. **QI_DATA**: folder containing XML reports including Quality control checks information,
3. **Inventory_Metadata.xml:** file containing the metadata needed to inventory the PDI.
4. **manifest.safe**: XML SAFE Manifest file (mandatory, cf. section 3.5.4),
5. **rep_info**: folder containing the available XSD schemas that validate the PDI components (recommended by [SAFE-SPEC], cf. section 3.5.4).

3.13.1 PDI_ID definition

Datastrip PDI_ID (Datastrip ID) is defined in the section 3.5.2. The File_Type is specified in the section 3.2, Table 3-3.

Level-1C Datastrip Template Name (Datastrip ID):
S2A_OPER_MSI_L1C_DS_SGS__20141104T134012_S20141104T134012_N01.01.tar

<u>Note that the PDI_ID.tar is the physical name of the Datastrip PDI after the tar compression.</u>

3.13.2 Level-1C Datastrip Physical Format

The PDI ID defined above represents the “Datastrip directory” name. Inside the Datastrip directory, there are the Datastrip components as in the Figure 52:

Inside that directory, the naming convention used to identify each real files follows the same convention used to define the Datastrip ID but without the Processing Baseline sub-string.

- **Datastrip_Metadata_File (XML file):**
  Datastrip_Metadata_File template name:
  S2A_OPER_MTD_L1C_DS_SGS__20141104T134012_S20141104T134012.xml

  The XSD schema which regulates the metadata file is *S2_PDI_Level-1C_Datastrip_Metadata.xsd* included in the *S2-PDGS-TAS-DI-PSD-V14_Schemas.zip* file annexed to the document.

- **QI_DATA (folder):**
  QI_DATA folder contains XML reports *OLQC_Report.xml* generated by On-Line Quality Control processor, including Quality Control Checks results. The OLQC_Report.xsd schema and the reports naming convention are in the Annex C of the document.

- **Inventory_Metadata (XML file):**
  XML Inventory metadata file with fixed name *Inventory_Metadata.xml*

- **manifest.safe (XML file):**
  XML file with fixed name *manifest.safe*

- **rep_info (folder):**
  Folder containg the following XSD schemas:
  1. *S2_PDI_Level-1C_Datastrip_Metadata.xsd*
  2. *Inventory_Metadata.xsd*
  3. OLQC_Report.xsd

Level-1C Datastrip Physical Format template:

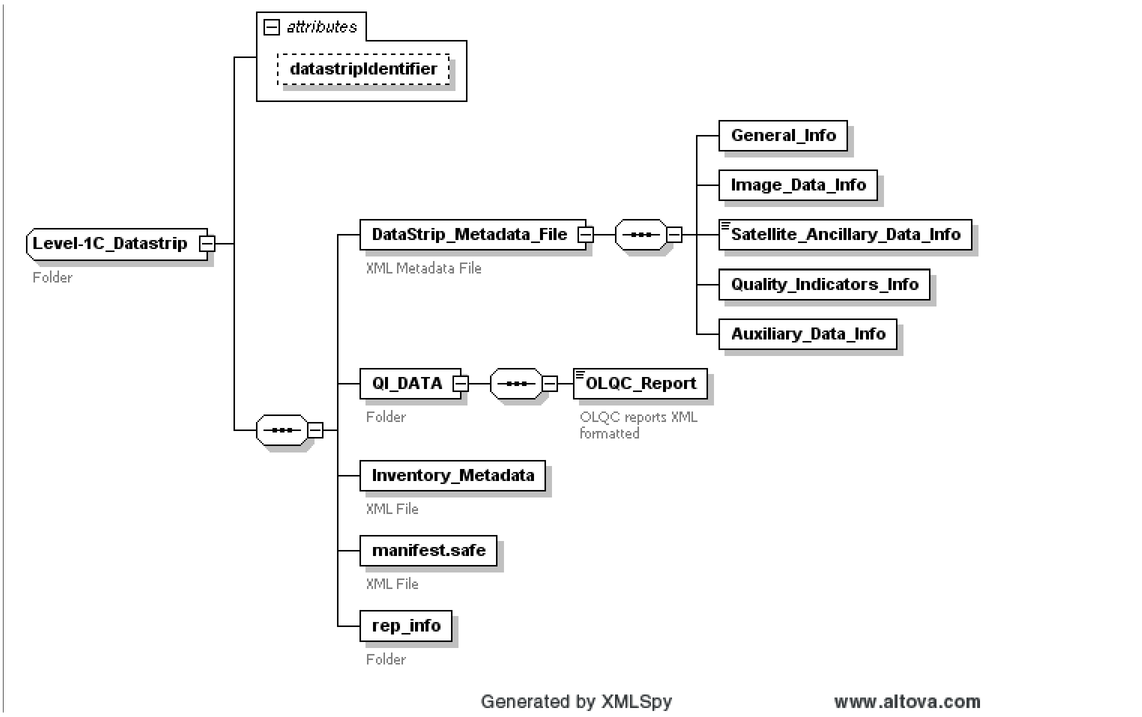
Level-1C Datastrip PDI_ID: ***S2A_OPER_MSI_L1C_DS_SGS__20141104T134012_S20141104T134012_N01.01***
Inventory_Metadata.xml *S2A_OPER_MTD_L1C_DS_SGS__20141104T134012_S20141104T134012.xml* *manifest.safe* QI_DATA *S2A_OPER_MSI_L1C_DS_SGS__20141104T134012_S20141104T134012_GEOMETRIC_QUALITY_report.xml*

- rep_info
  - *S2_PDI_Level-1C_Datastrip_Metadata.xsd*
  - *Inventory_Metadata.xsd*
  - *OLQC_Report.xsd*

Figure 53: PDI Level-1C Datastrip Physical Format

3.13.3 Level-1C PDI Datastrip Structure

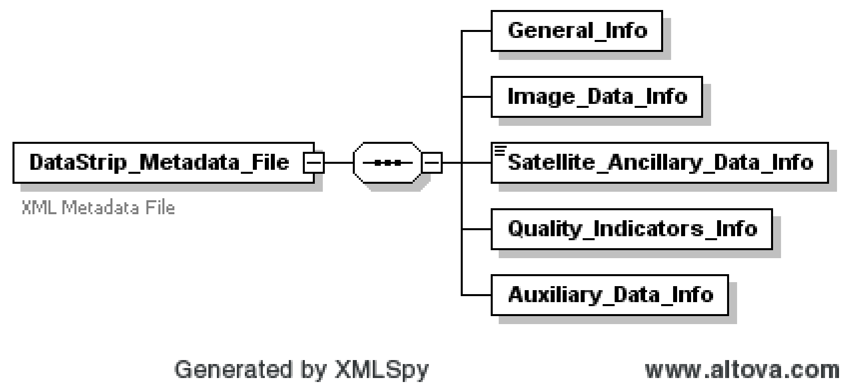
The *S2_PDI_Level-1C_Datastrip_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the organization of a Level-1C Datastrip PDI on disk. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the structure shown in the Figure 52.

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>children</td><td>Datastrip_Metadata_File QI_DATA Inventory_Metadata manifest.safe rep_info</td></tr>
<tr><td>annotation</td><td>The Level-1C Datastrip is defined as a folder containing:
1. Datastrip_Metadata_File: XML Main Metadata File containing the requested level of information and referring all the PDI elements.
2. QI_DATA: folder containing the XML reports including Quality Indicators
3. Inventory_Metadata: XML inventory metadata file</td></tr>
</table>

	4. **manifest.safe**: XML SAFE Manifest file 5. **rep_info**: folder containing the XSD schemas provided inside a SAFE Level-1C Datastrip PDI Note that the Inventory_Metadata.xml, manifest.safe and rep_info are removed when the PDI is included in the User Product.

3.13.3.1 Datastrip_Metadata_File Schema

Level-1C Datastrip_Metadata_File is the XML metadata file provided inside each Level-1C Datastrip. The schema used to validate it is the *S2_PDI_Level-1C_Datastrip_Metadata.xsd* annexed to this document. A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Image_Data_Info Satellite_Ancillary_Data_Info Quality_Indicators_Info Auxiliary_Data_Info
annotation	The structure of the Datastrip_Matadata_File is common to all processing level (cfr. § 3.5.1) The Datastrip_Metadata_File is an XML file containing all the metadata describing the whole product data item. 1. **General_Info**: This group of metadata provide general information characterizing the source Datastrip acquisition. 2. **Image_Data_Info**: Image data information from MSI telemetry. 3. **Satellite_Ancillary_Data_Info**: Ancillary data information from Satellite Ancillary Telemetry. 4. **Quality_Indicators_Info**: Results of all quality checks performed at Datastrip level. 5. **Auxiliary_Data_Info**: Auxiliary data information.

The following tables and figures give a complete overview of the Level-1C Datastrip_Metadata_File schema according the description provided in the section 3.5.1.

General_Info:

The General_Info provided through the Level-1C DataSrip_Metadata_File are the same described in the Figure 20 and Table 3-32.

Image_Data_Info:

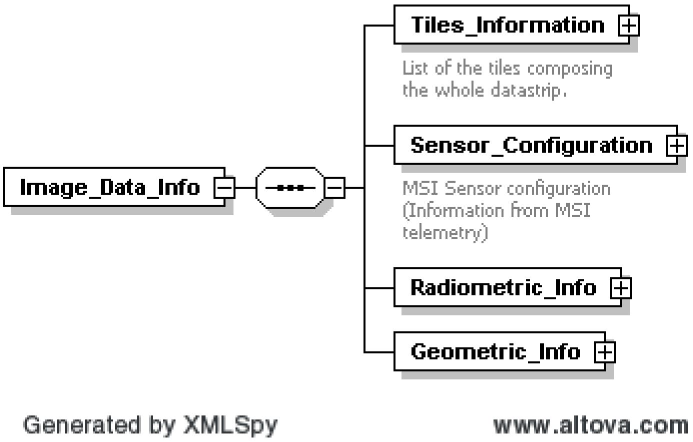


Figure 54 : Level-1C Datastrip – Image_Data_Info Diagram

Image_Data_Info/Tiles_Information		
Field Name	**Description**	**Metatada Level**
Tile_List	List of the tiles composing the whole Datastrip. Each Tile is univocally identified through a unique Tile identifier (PDI_ID, § 3.12.1).	Standard
Image_Data_Info/Sensor_Configuration (inherited from L1B)		
Field Name	**Description**	**Metatada Level**
See Table 3-51	MSI Sensor configuration (Information from MSI telemetry)	Expertise
Image_Data_Info/Radiometric_Info		
Field Name	**Description**	**Metatada Level**
SWIR_REARRANGEMENT_PROC	SWIR pixels re-arrangement (only for level 1A production but SWIR rearrangement information shall be preserved in L1B and L1C): A 'true' value indicates that data extraction and SWIR pixels re-arrangement have been processed.	Standard
SATURATED_PIXELS_PROC	Management of saturated pixels. A 'true' value indicates that saturated pixels has been processed.	Standard
Spectral_Information_List/Spectral_Informatio/RESOLUTION	(OPTIONAL FIELDS) Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION Spatial resolution	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/MIN	Minimum wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/MAX	Maximum wavelenght	Standard
Spectral_Information_List/Spectral_Informatio/Wavelength/CENTRAL	Central wavelenght	Standard

Spectral_Information_List/Spectral_Informatio/Spectral_Response/STEP	Step of spectral response	Standard
Spectral_Information_List/Spectral_Informatio/Spectral_Response/VALUES	List of measures	Standard
Image_Display_Order/RED_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Standard
Image_Display_Order/GREEN_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Standard
Image_Display_Order/BLUE_CHANNEL	Relation between product image channels and on board spectral bands (Band index).	Standard
QUANTIFICATION_VALUE	Reflectance quantification value (in order to convert digit count into reflectance)	Standard
Reflectance_Conversion/U	Correction to take into account the Sun-Earth distance variation (this correction is computed using the acquisition date)	Standard
Reflectance_Conversion/Solar_Irradiance_List/SOLAR_IRRADIANCE	Reflectance parameters defined for each band	Standard
Image_Data_Info/Geometric_Info		
Field Name	**Description**	**Metatada Level**
RGM	Flag to identify if the Refined Geometric Model file is computed or obtained from a existing RGM file (reused)	Standard
Image_Refining	Refining results. Should exist only if REFINING_TYPE= REFINING or REFINING_REGISTRATION	Standard
VNIR_SWIR_Registration	Registration results. Should exist only if REFINING_TYPE= REGISTRATION or REFINING_REGISTRATION	Standard
Refined_Corrections_List	Description of the refined corrections. If the refining has been processed by Datastrip then, there are the refined corrections for each Datastrip. These data are created by Geo_S2	Standard
Image_Data_Info/Product_Compression (OPTIONAL)		
Field Name	**Description**	**Metatada Level**

COMPRESSION	Product Compression. The compression may be: - None. - LOSSLESS: Lossless compression, use reversible JPEG2000 compression. - LOSSY: Lossy compression, use compression that ensures that JPEG2000 compression has a negligible effect on image quality.	Standard

Table 3-59: Level-1C Datastrip – Image_Data_Info Description

Satellite_Ancillary_Data_info:

The Satellite_Ancillary_Data_Info are the same provided for a L0 Datastrip (cfr. Figure 22 and Table 3-34).

Quality_Indicators_Info:

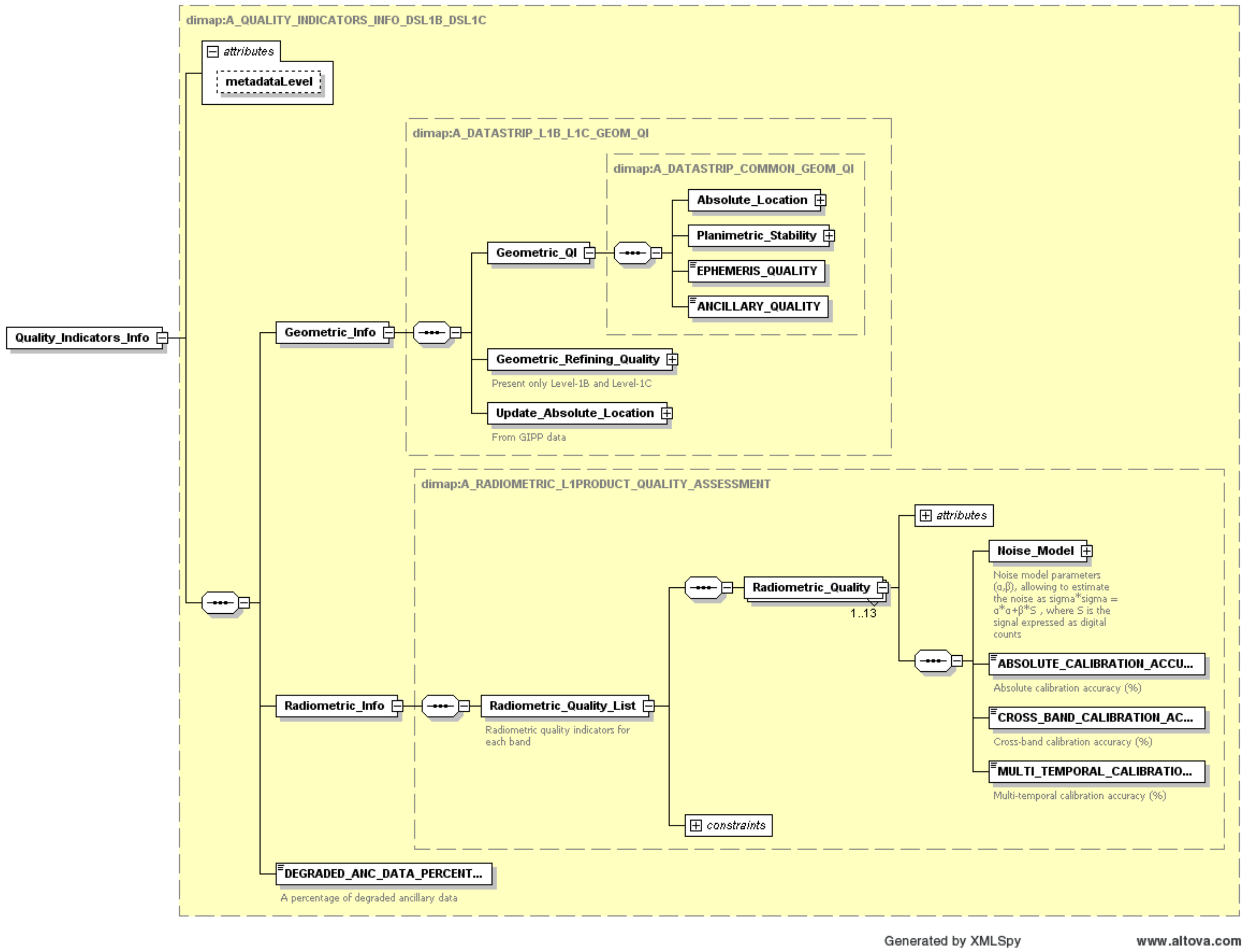


Figure 55: Level-1C Datastrip – Quality_Indicators_Info Diagram

Quality_Indicators_Info/Geometric_Info		
Field Name	**Description**	**Metadata Level**
Geometric_QI/Absolute_Location	Absolute location performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Geometric_QI/Planimetric_Stability	A planimetric stability performance for the Datastrip given from a GIPP table, depending on the health status of the GPS and AOCS sensors (gyros and startrackers) provided in the Satellite Ancillary Data.	Brief
Geometric_QI/EPHEMERIS_QUALITY	Ephemeris data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Geometric_QI/ANCILLARY_QUALITY	Ancillary data quality retrieved from GPS Dilution of precision (DOP) information.	Brief
Geometric_Refining_Quality	Available by Datastrip and only if geometric refining is applied. Include Multi_Spectral_Registration performance (3 values for 10, 20 and 60m bands (from GIPP data).	Brief
Update_Absolute_Location	From GIPP data	Brief
Quality_Indicators_Info/Radiometric_Info		
Field Name	**Description**	**Metadata Level**
Noise_Model	Alpha and Beta parameters providing the instrument noise as a function of the radiometric count X for Level-1B : Noise= square root(Alpha_X + Beta_X* X)	Brief
ABSOLUTE_CALIBRATION_ACCURACY	Absolute calibration accuracy provided as a percentage of accuracy	Brief
CROSS_BAND_CALIBRATION_ACCURACY	Cross-band calibration accuracy provided as a percentage of accuracy	Brief

MULTI_TEMPORAL_CALIBRATION_ACCURACY	Multi-temporal calibration accuracy provided as a percentage of accuracy	Brief
DEGRADED_ANC_DATA_PERCENTAGE	Percentage of degraded ancillary data	Brief

Table 3-60: Level-1C Datastrip – Quality_Indicators_Info Description

Auxiliary_Data_Info:

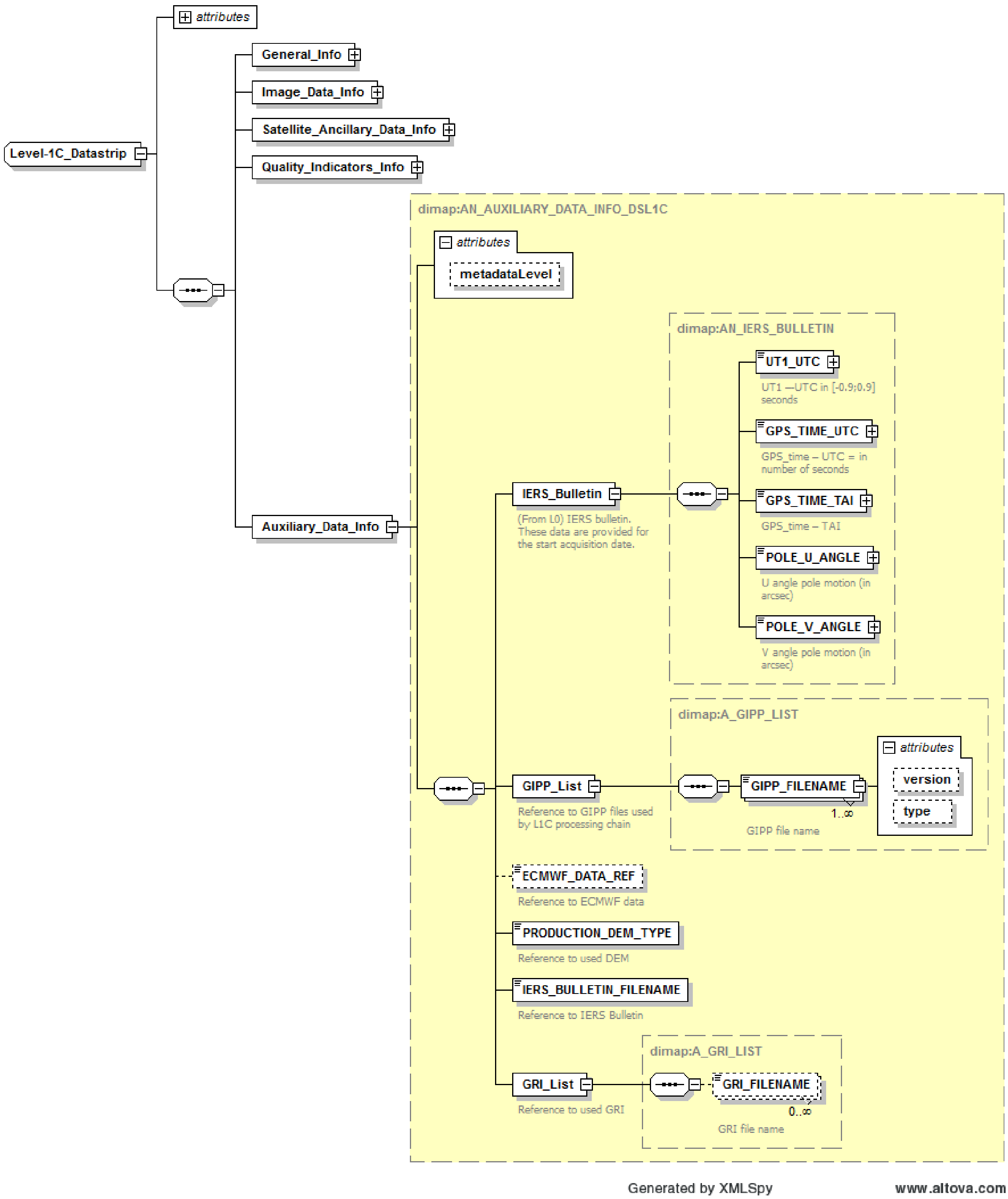
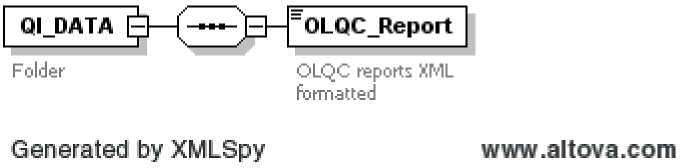


Figure 56 : Level-1C Datastrip – Auxiliary_Data_Info Diagram

Auxliary_Data_Info/IERS_Bulletin (from Level-1B)		
Field Name	**Description**	**Metatada Level**
UT1_UTC	UT1 –-UTC in [-0.9;0.9] seconds	Standard
GPS_TIME_UTC	GPS_time – UTC = in number of seconds	Standard
GPS_TIME_TAI	GPS_time – TAI	Standard
POLE_U_ANGLE	U angle pole motion (in arcsec)	Standard
POLE_V_ANGLE	V angle pole motion (in arcsec)	Standard
Auxliary_Data_Info (aux data used by the processing)		
Field Name	**Description**	**Metatada Level**
GIPP_List/GIPP_FILENAME	Reference to the GIPP files used by the L1C processing.	Standard
ECMWF_DATA_REF	Reference to raw ECMWF data (PDI)	Standard
PRODUCTION_DEM_TYPE	Inerited from L1B production	Standard
IERS_BULLETIN_FILENAME	Inerited from L1B production	Standard
GRI_List/GRI_FILENAME	Inerited from L1B production	Standard

Table 3-61: Level-1C Datastrip – Auxiliary_Data_Info Description

3.13.3.2 QI_DATA

diagram	
children	**OLQC_Report**
annotation	QI_DATA folder contains: - XML reports generated by On-Line Quality Control processor, including Quality Control Checks results. The Annex C contains the description of OLQC reports

3.13.4 SAFE Manifest synoptic table

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1C PDI Datastrip level.

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed (cf. section 3.4.4) by three main sections (Metadata, Information Package Map and Data Objects).

Part of the information contained in the Metadata section is extracted from the XML metadata file and is therefore duplicated in the SAFE Manifest and in the XML metadata file.

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;

- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:

  - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
  - the name of the corresponding tag (if available, else N.A.) of the XML Metadata File and of its XSD Schema (column “From S2_PDI_Level-1C_Datastrip_Metadata.xsd”);
  - a brief textual description of the field;

  - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
  - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
  - the allowed range of values of the field.

  In particular, the satellite ancillary data files (e.g. the SAD Raw Data file) and the auxiliary data files used for Level-1C processing (e.g. GIPP files, DEM, IERS Bulletin), are external to the product and are referenced in the Metadata of Manifest file Section (as “resources” in the “processing” section).

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-1C PDI Product (with the exception of the Manifest file itself); this includes:
  - the XML Metadata file;
  - the XML Inventory_Metadata file;
  - a set of Quality Indicator Data Files, including a OLQC Report file (XML format) and five Preliminary Quick Look files (in JPEG2000 format).

An example of Manifest file for the Level-1C Datastrip PDI containing realistic, though indicative values, is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	General_Info->Datatake_Info-> SPACECRAFT_NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	General_Info->Datatake_Info-> SPACECRAFT_NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument->**abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration Raw_Measurement Test_Mode
	instrument->mode-> **identifier**	General_Info->Datatake_Info-> DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name	N.A.	Name of the Archiving process	string	0..1	Archiving of PDI Level-1C Datastrip Product
	start	Level-1C_Datastrip_ID-> General_Info->Archiving_Info-> ARCHIVING_TIME	Archiving start date (UTC)	xs:dateTime	0..1	
	facility		Description of Origin Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	General_Info->Archiving_Info-> ARCHIVING_CENTRE	The starting point of the circulation data	string enum	0..1	SGS_ MPS_ MTI_ EPA_ UPA_ CDAM

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						MPC_
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource		Description of product being archived		0..*	
	resource->**name**	N.A.	Name of the product being archived	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	PDI Level-1C Datastrip Product
	resource-> processing		Description of the L1B to L1C Processing		0..*	
	resource-> processing->**name**		Name of the L1B to L1C Processing	string	0..1	Processing of Level-1B Datastrip product
	resource-> processing->**start**	General_Info->Processing_Info->PROCESSING_TIME	Processing start date (UTC)	xs:dateTime	0..1	
	resource-> processing-> facility	N.A.	Description of Processing Centre		0..*	
	resource-> processing-> facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	resource-> processing-> facility-> **organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	resource-> processing-> facility-> **site**	General_Info->Processing_Info->PROCESSING_CENTER	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
						MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	resource-> processing-> facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	resource-> processing-> facility->software	N.A.	Description of software component used for Processing		0..*	
	resource-> processing-> facility->resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc.) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are not provided with the product.		0..*	
	resource-> processing-> facility->resource->**name**	Satellite_Ancillary_Data_Info-> ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Auxiliary_Data_Info->IERS_BulletinN	Absolute path name of the auxiliary or ancillary file/folder	string	1	

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
		Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME				
	resource-> processing-> facility->resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	
	acquisitionPeriod ->startTime	Datastrip->L1C_Datastrip_PDI_ID (substring <Sensing Time>, cf. section 3.6.1)	Reference time of acquisition of the Granule (corresponding to sensing time of the first line of the PDI at Datastrip level, cf. section 3.6.1)	xs:dateTime	1	
measurementOrbitReference						
	orbitNumber	General_Info->Datatake_Info->DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
	orbitNumber->**groundTrackDirection**	General_Info->Datatake_Info->SENSING_ORBIT_DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time		0..1	ascending, descending

SAFE Manifest		From *S2_PDI_Level-1C_Datastrip_Metadata.xsd*	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
			corresponding to orbitNumber->type (start or stop)			
	relativeOrbitNumber	General_Info->Datatake_Info->SENSING_ORBIT_NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber->**type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		N.A	A reference to all Metadata files included in the product (e.g. the XML Metadata file, the XML Inventory Metadata file)		2..4	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..2	

Table 3-62 - Content of Metadata Section for PDI Level-1C Datastrip SAFE Manifest

3.14 PDI for GIPP files definition

GIPP files are a set of files used by the processors to achieve radiometric and geometric parameters. Each GIPP file is associated to a validity period since the parameters can be tuned during the PDGS lifetime. All GIPP file types are listed in the Table 3-4.

The GIPP PDIs are downloaded in TGZ format including one file DBL and one file HDR as specified in [EOFFS-PDGS].

3.14.1 PDI-ID definition

The applicable file naming convention used to identify a GIPP PDI is compliant to [GPP-IODD] and [EOFFS-PDGS]:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<instance_id>

The sub-strings MMM (Mission ID), CCCC (File Class), and TTTTTTTTTT (File Type) are detailed in the section 3.2 Table 3-4. The Instance ID for a PDI relative to a GIPP file is defined hereafter.

<Instance_Id> = <Site Centre>_<Creation Date>_<Start Validity Time >_<Stop Validity Time >_<Bxx>

<*Site Centre*> and <*Creation Date*> corresponding to the Instance_ID mandatory prefix (cf. section 3.2).
<Site Centre>:

- MPC_

The sub-fields composing the Instance_ID are described in the following table:

Field Name	Value/Meaning	Note
Start Validity Time	VyyyymmddThhmmss	"V" is the option Id for validity period
Stop Validity Time	YYYYMMDDThhmmss	
Bxx	Band index xx = 01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12 xx = "00" for GIPP files band independent	

Table 3-63: PDI-ID definition for GIPP files

File Template Name:
S2A_OPER_GIP_VIEDIR_MPC__20091210T235100_V20091210T235134_20091210T235224_B08

3.15 PDI for DEM file definition

The Image Quality Processor delivers the ***System DEM (Digital Elevation Model)*** that is composed of two layers (***Global Coarse DEM*** and ***SRTM DEM***) and a ***Basis Geoid Model***.

GLOBE DEM gives an average altitude information (in meters) in all points of a global grid. The altitude is provided in the WGS84 reference frame, with respect to the ellipsoid.
The GLOBE DEM is divided in elementary areas of 1^0 x 1^0, also called cells. Each cell, provided as a binary fie, is limited by meridians (integers of latitude), and parallel (integers of latitude).
The goal of this file is to define an altitude information with an average value for all the point on a global grid with a kilometric resolution. Global size of the Globe DEM is roughly 800 MByets.

SRTM DEM does not cover the entire globe. It covers 80% of land cover from the latitude 60^0 North to 56^0 South. The horizontal reference frame is WGS84. The altitude information is given in the geoid altimetric reference EGM96. Quality information are added to SRTM data through dedicated quality masks. The goal of this file (pseudostatic, supplied at beginning of mission and updatable 3 times during mission lifetime) is to provide a more accurate altimetry information (in meters). Global size of the SRTM DEM, respecting the DTED1 format, is roughly 50 GBytes.

Consistent with the GLOBE DEM, the **Geoid** is given in the WGS84 reference frame. The geoid is used to measure altitude and depth. The frequency is pseudostatic, supplied at beginning of mission via the CNES Euclidium CFI, single binary file of 131 MByets.

The DEM is never included in the User Product but simply referenced throught the metadata file.

The DEM format is defined in the [GPP-DEM] document.

3.15.1 PDI-ID definition

The PDI_ID (file naming convention) used to reference the DEM within the User Product is compliant to [EOFFS-PDGS] and follows the description provided in the section 3.1:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>.AAA

The sub-strings MMM (Mission ID), CCCC (File Class), and TTTTTTTTTT (File Type) are detailed in the section 3.2. The Instance ID for a DEM PDI it is defined hereafter.

<Instance_Id> = <*Site Centre*>_<*Creation Date*>_<*Start Validity Time*>

<*Site Centre*> and <*Creation Date*> corresponding to the Instance_ID mandatory prefix.
<*Site Centre*>*:*

- MPC_

The sub-fields composing the Instance_ID are described in the following table:

Field Name	Value/Meaning	Note

Field Name	Value/Meaning	Note
Start Validity Time	_**S**YYYYMMDDTHHMMSS	Taking into account that: 1. GLOBE DEM is classified "pseudostatic" i.e. files supplied at beginning of mission and updatable with (TBD by CNES) frequency; 2. SRTM DEM is classified "pseudostatic" i.e. files supplied at beginning of mission and updatable 3 times during mission lifetime as per CNES clarification; 3. Geoid Model is classified "pseudostatic" i.e. files supplied at beginning of mission via the CNES Euclidium CFI and potentially updatable with TBD by CNES frequency via redelivery of the Euclidium CFI We can consider the option envisaged for file types whose Stop Validity is not relevant or it is always set to EOM and every new file replaces the previous one (cf. [EOFFS-PDGS] section 2.1.4.1).

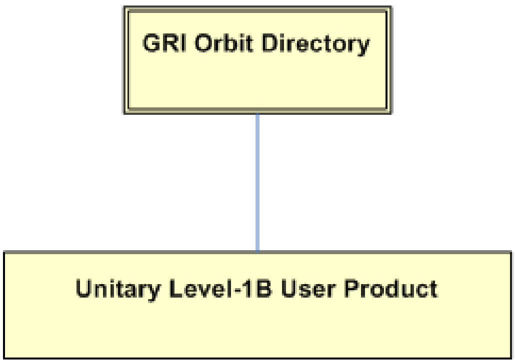
Table 3-64: PDI-ID definition for DEM

File Template Name:
S2__OPER_DEM_GLOBEF_MPC__ 20091210T235100 _**S**20091210T235100.tar

3.16 PDI for GRI definition

The Global Reference Images (GRI) is provided to the Sentinel-2 operational processor for the Level-1B product generation in order to refine the geometric accuracy. The GRI PDI is never included in the User Product but simply referenced through the metadata file. The GRI PDI definition (format and naming) is based on the [GRI-FFS].

The GRI PDI is defined as a TGZ file including the following structure. The naming for the “GRI Orbit Directory” and “Unitary Level-1B User Product” folders are defined in the next section.



3.16.1 PDI-ID definition

The PDI_ID (file naming convention) used to reference the GRI data within the User Product is defined according to [EOFFS-PDGS] and [GRI-FFS].

The PDI_ID is the physical name of the "GRI Orbit Directory" defined according to [EOFFS-PDGS] [GRI-FFS]. It is used to reference the GRI data within the User Product at Datastrip level.

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>

The sub-strings MMM (Mission ID), CCCC (File Class), and TTTTTTTTTT (File Type) are detailed in the section 3.2.

<Instance_Id> = <Site Centre>_<Creation Date>_<Validity_Time_Period>

Where:

<Site Centre> (equal to 'MPC_') and <Creation Date> correspond to the Instance_ID mandatory prefix (cf. section 3.1) and <Validity_Time_Period> is the applicability date.

<Validity_Time_Period> = _VyyyymmddThhmmss_YYYYMMDDTHHMMSS

Template:
S2__OPER_AUX_GRI123_MPC__yyyymmddThhmmss_VyyyymmddThhmmss_YYYYMMDDTHHMMSS

The PDI_ID with the TGZ extension identifies the physical name of the GRI PDI.

The naming convention for the "Unitary Level-1B User Product" is the same defined in the section 4.2 for a L1B User Product in SAFE format but with the filetype = GRI_MSIL1B and Site Centre = MPC_

Template:
S2A_OPER_GRI_MSIL1B_MPC__20150424T120700_R054_V20090101T000000_20181231T235959.SAFE

3.17 PDI for IERS Bulletin file definition

IERS Bulletin A contains Earth orientation parameters such as x/y pole, UTI-UTC and their errors at daily intervals and predictions for 1 year into the future. These values are needed for geometric transforms within the processing. When a IERS Bulletin A is published at day D0, its applicability date is retroactive to day D0-7. It remains valid until their next update. More precisely, their validity period is defined by the applicability date. The end of validity date is defined by the beginning of validity date of the posterior (i.e. next) bulletin.
The IERS Bulletin A is provided as an ASCII file on a weekly basis.

3.17.1 PDI-ID definition

The PDI_ID (file naming convention) used for a IERS Bulletin file, compliant to [EOFFS-PDGS] follows the description provided in the section 3.2:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>

<Instance_Id> = <Site Centre>_<Creation Date>_<Start Validity Time>_<Stop Validity Time>

<*Site Centre*> and <*Creation Date*> corresponding to the Instance_ID mandatory prefix (cf. section 3.2).
<Site Centre>:

- PDMC

The sub-fields composing the Instance_ID are described in the following table:

Field Name	Value/Meaning	Note
Start Validity Time	**V**YYYYMMDDThhmmss	**V** prefix to indicate the validity period
Stop Validity Time	YYYYMMDDThhmmss	

Table 3-65: PDI-ID definition for IERS Bulletin

File Template Name:
S2__OPER_AUX_UT1UTC_PDMC_YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS.txt

3.18 PDI for POD file definition (deleted)

3.19 PDI for ECMWF data definition

This PDI contains raw ECMWF dataset in GRIB V1 format.

These data, resampled in UTM projection are always provided as part of Level-1C Tile PDI.

Note: the raw ECMWF data are not included in the User Product (no download option).

For furter details regarding ECMWF data and GRIB V1 format see the reference documents [ECMWF-PDGS-ICD] and [GRIB].

3.19.1 PDI-ID definition

The PDI_ID defined for a ECMWF PDI follows the description provided in the section 3.2:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>

<Instance_Id> = <Site Centre>_<Creation Date>_<Start Validity Time>_<Stop Validity Time>

File Template Name:
S2__OPER_AUX_ECMWFD_PDMC_YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS

3.20 S2 HKTM PDI definition

House Keeping Telemetry (HKTM) PDI are routed to FOS after their generation at CGS. Spacecraft housekeeping telemetry is part of the ancillary data and is regularly downlinked to ground stations (every orbit). Raw VCDUs are provided with DFEP annotation as a separated file.

The HKTM PDI is formatted according to [SAFE-SPEC].

The PDI is defined as a **tar** file containing the following structure (representing the SAFE product structure):

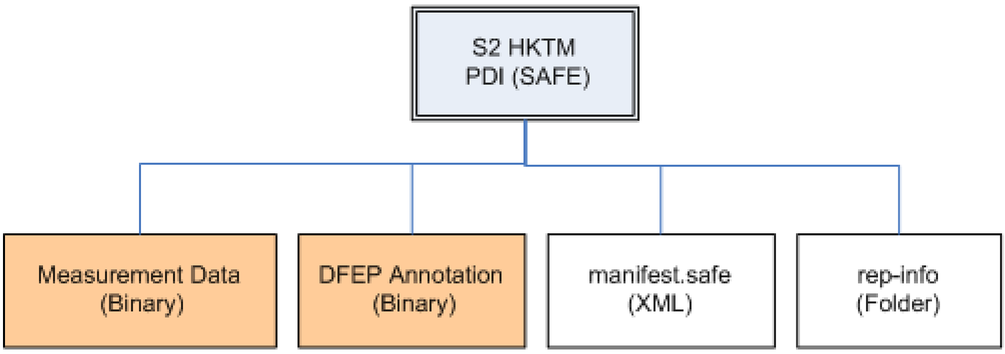


Figure 57: S2 HKTM PDI definition

As described in the figure, this Product Data Item consists of:

1. **Measurement Data file (Binary File)**: binary encoded file containing the stream of HKTM Transfer Frames TFs. The content of the housekeeping telemetry is detailed in [S2GICD]
2. **DFEP Annotation file (Binary File):** binary file composed by one record for each HKTM TF, containing the TF annotations computed by the DFEP (cfr. [DFEP-ICD]).
3. **manifest.safe (XML File)**: manifest file that includes metadata information describing the overall context where the HKTM data are generated (mission, product history, timing, orbit, etc.) and providing information regarding the content and structure of the product, through references to the other components present in the product. An example of the *manifest.safe* relative to an HKTM product is in the annexed S2-PDGS-TAS-DI-PSD-V14_SAFE.zip file .
4. **rep_info (Folder)**: folder containing the XSD schemas related to the Measurement Data and DFEP Annotation.

3.20.1 PDI-ID definition

The applicable file naming convention used for PDI relative to HKTM data is compliant to [EOFFS]:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<instance_id*>

The sub-strings MMM (Mission ID), CCCC (File Class) are detailed in the section 3.2. The Instance ID for a PDI relative to a HKTM data is defined hereafter.

For HKTM PDIs, TTTTTTTTTT= 'PRD_HKTM__' (cf. Table 3-7)

<Instance_Id*> = <Valid UTC Start Time>_<Valid UTC Stop Time>_VVVV

Where:
<Valid UTC Start Time>: 8+6 digits, separated by "T"
<Valid UTC End Time>: 8+6 digits, separated by "T"
VVVV: four digit indicating the file version. Fixed to '0001' for HKTM PDIs

To identify the two binary files included in the tar structure the following naming convention is used:

Measurement Data (binary file) naming convention:
HKTM_PDI_ID_measurement

DFEP Annotation (binary file) naming convention:
HKTM_PDI_ID_annotation

Files Template Names:

HKTM PDI_ID (physical name of the *tar* file):
S2A_OPER_PRD_HKTM___YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_0001.tar

HKTM product name (physical name of the folder contained in the *tar* file):
S2A_OPER_PRD_HKTM___YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_0001.SAFE

Measurement Data file:
S2A_OPER_PRD_HKTM___YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_0001_measurement.dat

DFEP Annotation file:
S2A_OPER_PRD_HKTM___YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_0001_annotation.dat

manifest.safe: fixed filename,

Measurement and Annotation schemas (located in the final leaf of the "resources" directory in the annexed zip file):
s2-level-0.xsd
s2-level-0-annot.xsd

3.21 SAD PDI definition

RAW Satellite Ancillary Data (SAD) data are systematically downlinked to ground stations at the end of each downlink as source packets provided with their DFEP annotation.

Each SAD packets include their corresponding source packet binary annotations as a pre-pended header. A source packet header consists (according to this order) in:

- DPC annotation computed during the L0 processing DPC annotation (cf. section 4.6.2.1);
- DFEP annotation as received from the DFEP (cf. [DFEP-ICD]).

SAD data (used mainly by the POD) are stored as a PDI.

A SAD PDI consists in a single *tar* file containing a set of unitary Raw SAD files each matching a single packet type defined in the Table 3-9. Those files cover the temporal extent of the full orbit.

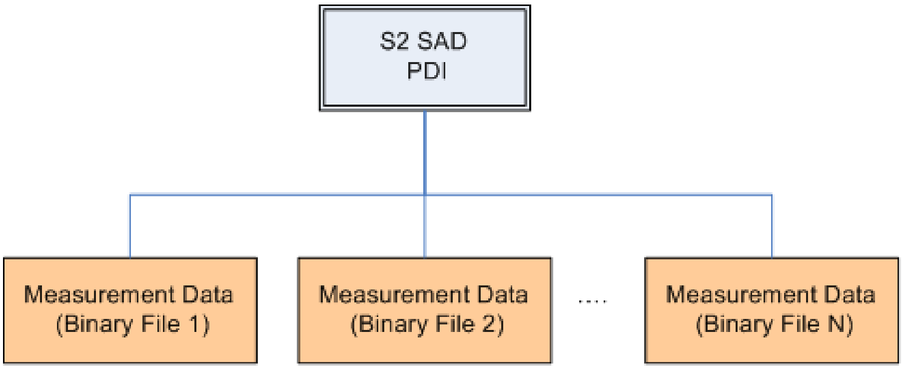


Figure 58: S2 SAD PDI definition

As described in the figure, the SAD PDI consists in a set of *Measurement Data* files (Binary Files), binary encoded files defined for each SAD type containing only a single source packets type. The content of the SAD telemetry is detailed in [S2GICD-SAD].

3.21.1 PDI-ID definition

SAD PDI is identified by a unique PDI_ID (filename) following the description provided in the section 3.2:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<instance_id>.tar

The sub-strings MMM (Mission ID), CCCC (File Class), and TTTTTTTTTT (File Type) are detailed in the section 3.2 and Table 3-9. The tar contains a set of unitary Raw SAD files, one for each SAD type (39 different types expected in nominal cases, up to 53 different types with normally disabled SAD enabled) defined in the Table 3-9.

The Instance ID is defined hereafter.

<Instance_Id> = <Site Centre>_<Creation Date>_<Sensing Start Time>_<Sensing Stop Time >_<Absolute Orbit Number>_<Completeness>_<Integrity>.tar

<*Site Centre*> and <*Creation Date*> corresponding to the Instance_ID mandatory prefix (cf. section 3.2).
<Site Centre>:

- MTI_ assigned to Matera CGS
- SGS_ assigned to Svalbard CGS
- MPS_ assigned to Mas Palomas CGS

The sub-fields composing the Instance_ID are described in the following table:

Field Name	Value/Meaning	Note
Sensing Start Time	VYYYYMMDDThhmmss	"V" = option Id for validity period
Sensing Stop Time	YYYYMMDDThhmmss	
Orbit Number	Axxxxxx xxxxxx = (000001-999999)	"A" = option Id for Absolute orbit number
Completeness	**Wx** where: x = **F** for Full orbit x = **P** for Partial orbit	"W" = option Id for Completeness Id
Degradation	**Ly** where: y = **N** for Nominal data (no degradation) y = **D** for Degraded data (some missing packets, due to synchro loss or corrupted telemetry)	"L" = option Id for Degradation Id

Table 3-66: PDI-ID definition for SAD

SAD PDI_ID template:
S2A_OPER_**AUX_SADATA**_SGS__YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_A123456_WF_LN.tar

Measurement Data file (binary file) template:
S2A_OPER_**AUX_S11125**_SGS__YYYYMMDDTHHMMSS_VYYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_A123456_WF_LN.bin

3.22 TCI PDI definition

The set of PDIs related to the True Colour Images (TCIs) are stored separately in their own PDIs. True Colour Image PDI is defined as a **tar** containing the following structure:

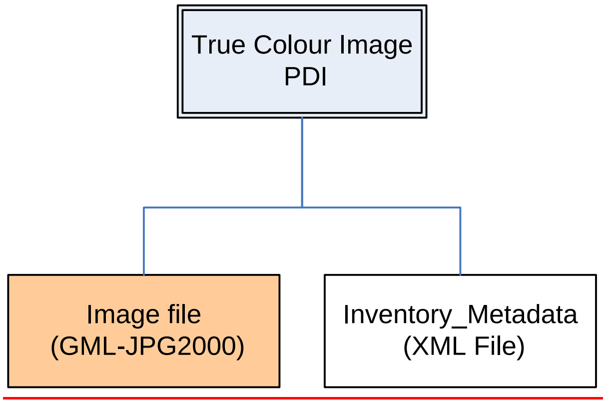


Figure 59: TCI PDI definition

As shown in the figure, the TCI PDI consists of:

- Image file: (GML-JPEG2000). The GML-JPEG2000 implementation is detailed in the reference document [GMLJP2]. It is a single file in JP2 format which gathers the 3 RGB bands.
- Inventory_Metadata file: XML inventory metadata file.

It is identified by a unique PDI-ID defined in the following section.

3.22.1 PDI-ID definition

The PDI_ID (file naming convention) used for a TCI PDI, compliant to [EOFFS-PDGS] follows the description provided in the section 3.12.1 relative to a Level-1C Tile PDI. The File Type MSI_L1C_TC is defined in the section 3.2.

4. USER PRODUCT PHYSICAL FORMAT DEFINITION

This section contains the definition of the physical structure and format for each Sentinel-2 User Products.

4.1 S2 User Product Physical Format

The following table summarizes for each S2 User Products the expected content and format.
Note that the User Product structure is common to all processing level (L0/L1A/L1B/L1C) except for the Satellite Ancillary Data provided only inside a Level-0 User Product.

Product Main Components	Physical Format	Mandatory	L0	L1A	L1B	L1C	Description
Product_Metadata_File	XML file	Y	Y	Y	Y	Y	This is the mandatory XML metadata file that describes the physical organization and the content of the User Product.
manifest.safe	XML file	N	Y	Y	Y	Y	The *manifest.safe* file will be included in the User Product only if the user requires the product SAFE formatted. Note that the User Product contains only one main *manifest.safe* file. The *manifest.safe* files relevant to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product, all lower manifest files at PDI level are removed.
GRANULE	Folder	Y	Y	Y	Y	Y	This is a folder of folders. In fact it contains the list of the Granule composing the product. For each Granule is provided a folder with a structure similar to the one defined in the chapter 3 and named as the Granule PDI_ID (Granule ID). This product main component is the core of the User Product containing the imaging data files.
DATASTRIP	Folder	Y	Y	Y	Y	Y	Folder containing the list of folders corresponding each one to the Datastrips composing the product named as the Datastrip PDI_ID (Datastrip ID).
AUX_DATA	Folder	Y	Y	Y	Y	Y	Folder containing the set of auxiliary files that can be embedded in the User Product if selected by the user. All the auxiliary files used for the processing are referenced at metadata level.
ANC_DATA	Folder	Y	Y	N	N	N	Folder containing the SAD raw data (ancillary data source packets) provided inside a single file. In order to have the maximum coverage

Product Main Components	Physical Format	Mandatory	L0	L1A	L1B	L1C	Description
							of the raw SAD in the L0 User Product, the latest SAD related to the downlink time will be embedded in the product.
Browse_Image	PNG file	N	Y	Y	Y	Y	The Browse Image is included in the User Product if required by the user (download option). The Browse Imageis based on the PVI extracted from the Level-1C Tiles PDI (JPEG2000, low resolution extraction, 3 visible-bands in ground geometry at 320m resolution, RGB).
rep_info	Folder	N	Y	Y	Y	Y	Folder containing the XSD schemas describing the User Product components. This folder is optional. It will be included in the User Product if the user selects the SAFE format as output format (cf. section 4.5).
INSPIRE	XML file	Y	Y	Y	Y	Y	Metadata file based on INSPIRE Metadata regulation ([EC-INSPIRE-CR] and [EC-INSPIRE-DIR]).
HTML	Folder	Y	Y	Y	Y	Y	Folder containing: 1. UserProduct_index.html 2. UserProduct_index.xsl 3. Additional files for HTML displaying The first file is a product presentation file allowing the End User to display easily the main content of the product. The second one represents the stylesheet used to generate the first one allowing the End User to display a selected sub-set of the product metadata. In addition some files are provided for correctly displaying the HTML page.

Table 4-1: Sentinel-2 Products Physical Format

Note that the User Product metadata provides different views of information and its content is organised at three levels:

- **Product level**: general information provided at product level. These metadata are grouped in the Product_Metadata_File described in the following sections for each processing level.
- **Granule/Tile level**: information referring to the Granules/tiles (or portion of Granule, i.e. the pixel-level information) composing the User Product. These metadata, (located in the User Product inside the GRANULE/Granule_Metadata_File), are embedded as they are from the Granule PDIs to the User Product.
- **Datastrip level information**: information referring to the Datastrip composing the User Product. These metadata (located in the User Product inside the DATASTRIP/Datastrip_Metadata_File), are embedded as they are from the Granule PDIs to the User Product.

For details regarding metadata management see section 2.10.

4.1.1 User Product XSD Schemas

This section contains the list of the XSD schemas (annexed to the document) used to describe the physical structure and the metadata content of each S2 User Product:

1. *S2_User_Product_ Level-0_Structure.xsd*
2. *S2_User_Product_Level-1A Structure.xsd*
3. *S2_User_Product_Level-1B Structure.xsd*
4. *S2_User_Product_Level-1C Structure.xsd*

5. *S2_User_Product_Level-0_Metadata.xsd*
6. *S2_User_Product_Level-1A Metadata.xsd*
7. *S2_User_Product_Level-1B Metadata.xsd*
8. *S2_User_Product_Level-1C Metadata.xsd*

The first set of the schemas (points 1 - 4) define the "physical organization" of a User Product on the disk.

These schemas are "improperly" used to specify elements not envisaged by the XML such as folders, therefore it is actually not expected to be used for the validation of the corresponding XML file.

Oppositely, the second set of the schemas (points 5 – 12) are used to validate the XML metadata file inside each S2 User Product (SAFE and DIMAP formatted).

4.2 S2 User Product Naming Convention

The naming of the **product name root directory** is compliant to [EOFFS-PDGS] and follows the naming convention defined hereafter:

MMM_CCCC_TTTTTTTTTT_<Instance_ID>.<FORMAT> where:

Part	Description	Comment
MMM	**Mission ID**	S2A S2B
CCCC	**File Class**	4 uppercase letters: OPER for Routine Operations (all phases) Note that the File Class will be set “OPER” for all products generated during the operation phase. During validation or for internal testing other values can be defined
TTTTTTTTTT	**File Type** (File Category + File	10 uppercase letters can contain digits and

	Semantic)	underscores: PRD_MSIL0P PRD_MSIL1A PRD_MSIL1B PRD_MSIL1C PRD_MSITCI
<Instance_ID>	**Instance Id**	Contains uppercase letters, digits and underscores.
<FORMAT>	**SAFE** **DIMAP**	According to the User Product output format selected by the final user.

Table 4-2: Main Product Directory - Naming Convention

*< instance ID> = ssss_yyyymmddThhmmss_**R**OOO_**V**YYYYMMTDDHHMMSS_YYYYMMTDDHHMMSS*

where:

ssss_yyyymmddThhmmss is the <Instance ID> mandatory prefix for Site Centre of the file originator and Creation Date.

Sub-String	Description	Comment
ssss	**Site Centre**	**Fixed string with value "PDMC"**
<Product Discriminator>	**String generated to ensure the uniqueness of the product name root directory in the use-base file-system**	**Default value for the *product discriminator* is the creation date of the product at the user base following this format** *yyyymmddThhmmss*
OOO	**Orbit Number**	Relative orbit number
YYYYMMDDHHMMSS	**Start Time**	Sensing Time of the first line of the first scene in the product
YYYYMMDDHHMMSS	**Stop Time**	Sensing sTime of the first line of the last scene in the product

The fixed characters "**_R"** and "**_V"** are defined in the section 3.2.

Examples of S2 product main directory are:

S2A_OPER_PRD_MSIL0P_PDMC_20130424T120700_R054_V20091210T235100_20091210T235134.SAFE
S2A_OPER_PRD_MSIL1A_PDMC_20130424T120700_R055_V20091210T235052_20091210T235143.SAFE
S2B_OPER_PRD_MSIL1B_PDMC_20130424T120700_R056_V20091210T235052_20091210T235143.DIMAP

Inside the product directory we have the product main components listed in the Table 4-1.

- **Product_Metadata_File (mandatory, XML Main Metadata file):**
  The product metadata file name follows the same convention defined for the main product directory where the File Type field is defined in the following table:

Product component	FileType	Note

Product_Metadata_File	MTD_SAFL0P MTD_SAFL1A MTD_SAFL1B MTD_SAFL1C	Valid if the User Product is SAFE formatted
	MTD_DMPL0P MTD_DMPL1A MTD_DMPL1B MTD_DMPL1C	Valid if the User Product is DIMAP formatted

Table 4-3: Product_Metadata_File - Naming Convention

File Template name:
S2A_OPER_MTD_DMPL1A_PDMC_20130424T120700_R054_V20091210235100_20091210235134.xml

- **manifest.safe (optional, XML file):**
  XML file with fixed name *manifest.safe.*

- **GRANULE (folder):**
  GRANULE folder contains the list of folders each one corresponding to the Granules composing the User Product. The name (PDI_ID) and the content (structure of *tar*) of each folder are defined in the chapter 3 for Level-0/Level-1A/Level-1B/Level-1C Granule/Tile.

  In case of Level-1C User Product, the GRANULE folder contains N folders each one corresponding to the Tiles composing the product.

  As defined in the section 3.12, for each tile there is a single folder named IMG_DATA where the image data files are available one for each band.

  During the Level-1C User Product generation, according to the *Spectral Bands* download options, the IMG_DATA folder can contain a set of bands and/or the TCI corresponding to the Tile. The TCI can be requested into the User Product even if no other spectral band data has been selected.

  The filename of the image data files present in the Tile folders is defined in the section 3.12.2.

  The filename of the TCI is based on the image data filename of the *Spectral Bands* with filetype equal to MSI_L1C_TC and the band qualifier “Bxx” defined by the string “TCI”.

  For instance, image data filename:

  S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVT_B01.jp2

  TCI filename:

S2A_OPER_MSI_L1C_TC_MTI__20160615T115939_A0051233_T36RVT_TCI.jp2

- **DATASTRIP (folder):**
DATASTRIP folder contains the list of folders each one corresponding to the Datastrips composing the User Product. The name (PDI_ID) and the content (structure of *tar*) of each folder are defined in the chapter 3 for Level-0/Level-1A/Level-1B/Level-1C Datastrip.

- **AUX_DATA (folder):**
AUX_DATA folder contains the set of auxiliary files that can be embedded in the User Product if selected by the user (download option). The folder can contain GIPP files and/or IERS bulletin (cf. section 2.13). All other kind of auxiliary data used for the processing are referenced at metadata level. The naming convention used to identify each auxiliary file is defined in the chapter 3 for each PDI-Type Auxiliary:
    - GIPP
    - DEM
    - GRI
    - ECMWF
    - IERS

- **ANC_DATA (folder):**
ANC_DATA folder contains the raw Satellite Ancillary Data (SAD) provided as a set of unitary raw data files each one matching a single packet type and named as defined in the section 3.21.1. The SAD coverage is the same of the one in the last Datastrip selected to be included in the product.

- **Browse_Image (optional, PNG file):**
The Browse Image file name follows the same convention defined for the main product directory where the File Type field is defined in the following table.
For each level of User Product has been defined a specific Browse Image File Type. The Browse Image when available within a User Product is always based on the PVI generated for the corresponding L1C Tiles.

Product component	FileType	Note
Browse_Image	BWI_MSIL0P BWI_MSIL1A BWI_MSIL1B BWI_MSIL1C BWI_MSITCI	Overview of the product (sub-sampled) mainly for image data browsing and selection purposes

Table 4-4: Product_Metadata_File - Naming Convention

File Template name:
S2A_TEST_BWI_MSIL1A_PDMC_20130424T120700_R054_V20091210235100_20091210235134.png

- **rep_info (folder):**
Folder with fixed name recommended by [SAFE-SPEC].

- **INSPIRE.xml (mandatory, XML file):**
  XML file with fixed name.

- **HTML (folder):**
  This folder contains two files:
  1. UserProduct_index.html
  2. UserProduct_index.xsl
  The first file is a product presentation file allowing the End User to display easily the main content of the product.
  The second one represents the stylesheet used to generate the first one allowing the End User to display a selected sub-set of the product metadata.

4.2.1 Compact Naming Convention

The *Compact Naming Convention* is a download option which generates to assign compact names to the Sentinel-2 User Products to overcome the limitation of some Operative System file-systems regarding the maximum length of the files full path.

The longest full path length used to refer to any User Product component for Level-1C products is 141 characters considering the overall product tree compacting addressing the different internal files and folders.

The longest full path length for Level-0, Level-1A and Level-1B products is 230 characters considering that compacting of the name applies only to the root directory.

The compact naming convention impacts only the names of files and folders composing the product but not its structure defined in previous sections of this document.

For Level-1C products, the Compact Naming Convention optimises the entire product tree structure whereas for Level-0, Level-1A and Level-1B such convention applies only to the root directory of the product name.

4.2.1.1 Product Name Root Directory

In case of *products generated with the Compact Naming convention*, the **Product Name Root Directory** is defined as follows:
MMM_MSIL1C_YYYYMMDDHHMMSS_Nxxyy_ROOO_<Product Discriminator>.SAFE
where:
- MMM: is the mission ID (S2A/S2B)
- MSIL1C: reference to the Level-1C product level
- YYYYMMDDHHMMSS: it is the datatake sensing start time
- Nxxyy: it is the production baseline number (e.g. N0201)
- ROOO: it is the relative orbit number

- <Product Discriminator>: it is a 15-characters string discriminator to distinguish different end user products associated to the same datatake
- SAFE file extension

Below some examples of different product root directory names following this naming convention:
S2A_MSIL1B_20150802T105414_N0102_R008_20150803T124046.SAFE
S2A_MSIL1C_20150802T105414_N0102_R008_20150803T124046.SAFE

4.3 User Product Quality Indicators

The Quality Indicators (QI) provided inside the User Product are:

1. QI at GRANULE level for each Granule composing the product;
2. QI at DATASTRIP level for each Datastrip composing the product;
3. QI at User Product level including:
   3a) QI consolidated from information available at Granules level:
   - cloud coverage % = AVG(Granule level cloud coverage indicator)
   - technical quality % = AVG(Granule level technical quality indicator)

   3b) reference to all OLQC reports (cf. Annex C) containing the FAILED checks performed on the Granules and Datastrips composing the product.
   3c) QI representing a synthesis of the OLQC inspections performed at Granule and Datastrip level.

More details regarding the needed processing to compute the QIs at product level, are in the Table 4-12.

4.4 Download Options

The download options proposed to the user at the time of the User Product selection are shown in the following table:

Download Options												
S2 User Product	**Area Of Interest**	**Full Swath**	**Full Datatake**	**PVI**	**Auxiliary Data**	**Metadata Level**	**Spectral Bands**	**Consolidated Tiles**	**Aggregation Along-Track**	**Output Format**	**Single Tile Product**	**Complete Single Tile**
Level-0	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES	NO	NO
Level-1A	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO
Level-1B	YES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NO	NO

Download Options												
S2 User Product	Area Of Interest	Full Swath	Full Datatake	PVI	Auxiliary Data	Metadata Level	Spectral Bands	Consolidated Tiles	Aggregation Along-Track	Output Format	Single Tile Product	Complete Single Tile
Level-1C	YES	NO	YES	YES	YES	YES	YES (*) TCI option	YES	NO	YES	YES	YES

- **Area Of Interest**: query option which describes exactly the area drawn by the User during the selection of the product.
- **Full Swath**: option to extend automatically the user selected area to the full MSI swath.
- **Full Datatake**: option to extend automatically the user selected area to the full Datatake.
- **PreView Image (PVI[2])**: option to include in the final Product the Browse Image corresponding to the selected User Product.
- **Auxiliary Data**: option to include in the User Product the auxiliary data used for processing. By default, a S2 product contains the list of used auxiliary data referenced at metadata level.
- **Metadata Level**: option to select the level of metadata (Brief/Standard/Expertise) to include in the User Product.
- **Spectral Bands**: this option allows to lower the volume of data to download, selecting a given subset of spectral bands. For Level-1C products, the TCI image can be selected as part of this download option as it were any other spectral band.
- **Consolidate Tiles**: using this option, the user may request to receive only complete L1C Tiles that have been consolidated (cf. Section 4.9.8).
- **Aggregation Along-Track**: this option allows to merge for each detector one image grouping all single Granules along track therefore producing at maximum 12 images per band. (cf. Section 4.7.8).
- **Output Format**: option to package the User Product in SAFE or DIMAP format for the traditional naming or SAFE_COMPACT when compact short naming is desired.
- **Single Tile Product Packaging:** this option allows to generate Single UTM Tile coverage Level-1C User Products from every product download request (i.e. original download request can be related to several tiles).
- **Complete Single Tile:** this option allows to include as part of the Single Tile Level-1C User Product all the full data associated to every single Tile in terms of any kind of imagery and metadata. This option tailors the single tile naming convention to ensure a deterministic and repeatable name of the product in case of download of the same tile. The Complete Single Tile does not include auxiliary data and BWI.

[2] The "Browse Image" is here referenced as "PreView Image" to be aligned with the ngEO terminology (cf. [NGEO-EICD-S2]).

4.5 User Product SAFE Format Approach

The User Product is formatted by default as a **SAFE** (Standard Archive Format for Europe) product.

Following the User Product presentation in the Table 4-1, a SAFE User Product includes a ***manifest.safe*** file and a ***rep_info*** folder according to [SAFE-SPEC].

The *manifest.safe* is an XML file formatted according to [SAFE-SPEC] providing metadata (concerning the overall context where the User Product is generated and the User Product itself) and a map of the User Product content (consisting in a reference to all data components inside the product including measurement data files, ancillary and auxiliary data files, XSD schema, etc).

The *manifest.safe* is composed by three main sections:

Manifest sections	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 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 4-5: High Level Structure of SAFE Manifest File

More in details the *manifest.safe* contains:

1. metadata information defined by [SAFE-SPEC] including not only the mandatory Metadata Sections (Platform and Processing sections) but, as added value, other relevant non mandatory Metadata Sections (e.g. acquisitionPeriod, measurementOrbitReference, measurementFrameSet),
2. a sub-set of metadata redundant respect to the mandatory XML Product_Metadata_File included in the User Product,
3. the map of the complete content of the User Product, namely all the references to all product component files (including the reference to the XML main metadata file) with the description of each file (e.g. file type, file size, coding, etc...).

Note that the Product_Metadata_File file groups all metadata regarding the product and the mission context, while the SAFE Manifest file contains, as added value, the exhaustive map of the User Product itself and a description of each file User Product components (e.g. file type, file size, coding, etc...).

In this respect, the present document provides, for each L0/L1A/L1B/L1C User Product defined in this Section 4, the following information:

- A set of 3 tables (one for each of the three main sections), containing the list of fields (tags or attribute) to be included in the Safe Manifest file, and for each field:
  - the field name in the SAFE Manifest file (attributes names are in bold character);
  - only for the Metadata section, the corresponding field name in the Product_Metadata_File schema; this column highlights the redundant sub-set of metadata included both in the XML Product_Metadata_File and in the XML SAFE Manifest file;
  - a brief textual description of the field;
  - the data type of the field;
  - the occurrence of the field (min/max occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory.

- A practical example of SAFE Manifest file containing the tags listed in the table mentioned above. Each tag is set to an indicative value, as realistic as possible; the compliance of the SAFE Manifest file to the SAFE specification has been verified by validating the Manifest file against the SAFE XSD schemas. All SAFE Manifest files and the schemas are provided in the zip file (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip) annexed to this document. The XSD schemas are provided as a set of *xfdu.xsd* schemas located in the final leaf of the *resources* directory.

In addition to the mandatory SAFE Manifest file, according to the applicable document [SAFE-SPEC], a SAFE User Product contains the *rep_info* folder (fixed folder name recommended by [SAFE-SPEC]) including all the available schemas describing the product component files. Those schemas are not mandatory but "may be provided" inside the product.

The XSD schemas provided inside the *rep_info* folder are referenced as internal product components by "metadataComponentSchemas" tag in the manifest file.

On the contrary, according to the SAFE specifications, the XSD schemas used to validate the SAFE manifest files are not included in the *rep_info* folder but they are external to the User Product.

Note that the User Product contains only one main SAFE Manifest file and one *rep_info* schemas repository. The Manifest files and *rep_info* repositories related to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product. All lower level manifest files and *rep_info* folders are removed before to build the User Product. SAFE does not authorise multiple SAFE manifest and SAFE schema repository in a product.

4.6 Level-0 User Product specification

4.6.1 Introduction

The Level-0 User Product is generated from the Sentinel-2 instrument and ancillary telemetries.
It contains raw data after restoration of the chronological data sequence at full space/time resolution with all auxiliary and ancillary information to be used in subsequent processing. In fact the Level-0 product contains all the information required to generate the Level-1 (and upper) product levels. The Level-0 consolidation processing stores the Quick Look image in the L0 Datastrip PDI. Reprocessing is from archived consolidated L0 which include QL image to get Level 1 products.

One Level-0 product refers always to one Datatake; it can cover the full Datatake or an its extract. It may refer to one or several Datastrips from the same Datatake.

The following figure gives an overview of the Level-0 User Product physical format. The yellow boxes correspond to folders and the white ones to files:

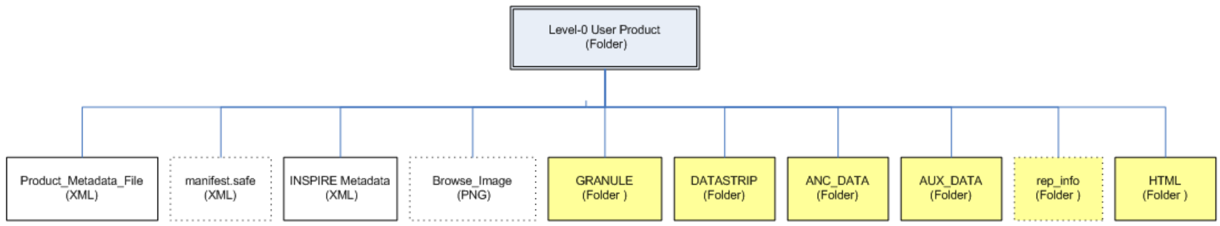


Figure 60: Level-0 User Product Structure

The Level-0 User Product consists of:

1. **Product_Metadata_File**: mandatory XML main metadata file.
2. **manifest.safe**: SAFE metadata file (optional). It is included in the product only if the user requests the SAFE as output format (download option).
3. **GRANULE**: folder containing all Granules composing the product (Image Data). The Image Data files inside each Granule are provided as a set of 13 binary files, one image file per band corresponding to a given detector.
4. **DATASTRIP**: folder containing the Datastrip composing the product linked to the selected Granules.
5. **AUX_DATA**: folder containing, if requested by the user (download option), the GIPP files and IERS Bulletins used for the Level-0 User Product production. All Level-0 auxiliary data are referenced in the product metadata file.
6. **ANC_DATA**: folder containing the Satellite Ancillary Data (SAD) needed for the processing (GPS data, attitude data, etc.). The SAD are always provided as a set of unitary Raw Data files each matching a single packet type. Those files are provided on the same temporal extent of the SAD embedded in the last Datastrip selected to be included in the product.

7. **rep_info**: folder containing the XSD schema provided inside the product. This folder is optional. It is included in the User Product if the user selects the SAFE format as output format (download option).
8. **Browse_Image**: PNG file consisting of an image limited to 3 visible-bands in ground geometry at 320m resolution. This file, provided if required by the user (download option), gives an overview of the product (sub-sampled) mainly for image data browsing and selection purposes.
9. **INSPIRE**: XML INSPIRE metadata file (cf. Annex B).
10. **HTML**: folder containing an HTML product presentation file (UserProduct_index.html) and the corresponding stylesheet (UserProduct_index.xsl).

Note: The number of the Granules available within a L0 product is variable and driven by the active detectors list specified at Datastrip level (ACTIVE_DETECTOR metadata).
The list of the active detectors depends on the MSI acquisition mode (compression by-passed or not).

Compression mode is reported in the MSI packet by the MODOP field (cf. [S2GICD-MSI]).

In the nominal products the compression is enabled and all detectors are available; in case of calibration products the compression is by-passed and only a subset of detectors are active and therefore available.

4.6.2 Image Data

4.6.2.1 Data Organization

The image data, inside the Level-0 User Product, are organized per Granules. Each Granule contains the mission data corresponding to one on-board scene for one detector and all spectral bands. Therefore, as described in the section 3.6, the image data inside each Level-0 Granule, are provided as a set of 13 binary files, one for each spectral band, including all corresponding annotated Image Source Packets (ISP) in the observation chronological sequence (cf. [S2GICD-MSI]).

For instance, a Datatake of 220 scenes (approx. 5000km) contains 220*12 = 2640 Granules corresponding to 2640*13 = 34320 binary files.

The L0 ISPs contain data part and annotations (note that the annotation must be removed before uncompressing during L1 processing).
The data part correspond to MSI compressed data or not inline with the indication in COMPRESS_MODE metadata. ISPs include their corresponding source packet annotations as a pre-pended header of each source packet. The annotations provided with the ISP (see following table) are the result of the following operations performed on each ISP:

- Reed-Solomon (RS) corrections on all Transfer Frames (TFs) containing the ISP;
- Checks if there are missing TFs by checking anomalies in the sequence of the Virtual Channel Frame Count in the Primary Header;
- CRC Error check on the ISP;
- DPC checks.

Note: even if L0 unconsolidated (L0u) are no User Products, ISP furnished in L0u are also annotated.

An annotation is made in two parts:

- first the DPC part;
- then the DFEP part.

The DPC part is 2 bytes long and contains:

- a "packet to be ignored" flag indicating if packet has to be ignored (value set to 1) or to be taken into account (value set to 0), on 1 bit: this indicator regroups all possible packets to be ignored;
- a "packet completeness" flag on 1 bit, set to:
  - 0 if packet complete;
  - 1 if packet is incomplete but long enough to be processed (therefore "packet to be ignored" flag is set to 0);
  - 1 if packet is incomplete and too short (not to be taken into account for further processing, therefore "packet to be ignored" flag is set to 1);
- a "packet validity" flag on 1 bit, set to:

  - 0 for valid packet (good CRC);
  - 1 if CRC is invalid but packet is declared trustworthy (main information of the header are all correct, "packet to be ignored" flag is set to 0);
  - 1 if CRC is invalid and packet is not trustworthy (not to be taken into account for further processing, therefore "packet to be ignored" flag is set to 1);
- the 13 bits remaining are reserved.

The DFEP part, 18 bytes long, is fully described in the [DFEP-ICD]:

Field ID	Description
mjd_time_stamp	Downlink/ground reception time. The time stamp is the downlink time of the first transfer frame containing parts of the packet
isp_lenght	Size in bytes of the ISP after reconstruction from transfer frames (it may be less than the initial size of the ISP in case of missing transfer frames)
num_VCDUs	Number of Transfer Frames containing the current ISP
num_missing_VCDUs	Number of missing Transfer Frames containing the current ISP
crc_error_flag	CRC Error flag, indicating the detection of CRC error in the ISP
VCID	First bit is set to 1 if VCID field contains VCID, 0 otherwise. 1 bit of spare. 6 bits containing the VCID
Channel	Channel information: C1/C2 01 (binary): C1 10 (binary): C2
Spare	

Table 4-6: DFEP Annotations for one Instrument Source Packet

The original downlinked data stream at ISP level is preserved but corrupted ISPs are flagged; i.e. corrupted ISPs are not discarded, but simply marked as such (field "packet to be ignored" of the DPC annotation set to 1).
DFEP also considers an ISP corrupted (and the corresponding DFEP annotation field crc_error set to TRUE) in one of the following cases:

- if one or more TFs containing the ISP are missing or found incorrigible during Reed-Solomon decoding (num_missing_VCDUs field in Table 1 > 0). In this case, the ISP is extracted, but the successive CRC error check on the packet detects an error, and the field CRCFlag is set to TRUE;
- if the CRC error check detects an error in the extracted ISP e.g. due to packet corruption after generation on-board by the source packet terminal.

4.6.2.2 Volume

Each .Granule has a constant volume of approximately **16 MB** and contains image data with the same time stamp but spatially deregistered due to the interband deregistration of 14km at maximum.

Level-0 data is kept on-board compressed. The following table describes the contents of a Granule in term of number of mission source packets in a Granule.

SSD	Number of bands	Number of packet per band in one Granule
10 m	4	144
20 m	6	72
60 m	3	24

Table 4-7: Number of mission source packets in a Granule

Each Level-0 Granule is identified in a unique way, using a unique identifier PDI_ID defined in the section 3.6.1.

4.6.3 Ancillary Data

Raw Satellite Ancillary Data (SAD) are provided inside the Level-0 User Product within the ANC_DATA folder. SAD data (DPC and DFEP annotated source packets, cf. §4.6.2.1) are splitted in binary files divided by PRID and SID (cf. Table 3-9). In order to have the maximum coverage of the raw SAD in the L0 User Product, the latest SAD related to the downlink time will be embedded in the product.

The decoded SAD, useful for further processing are provided at Datastrip level through the Datastrip metadata file. In particular, these data allow computing the associated geometric model and include:

- Time Correlation Data (sampled at 1Hz),
- Imaging orbit number,
- Ephemeris data,
- Attitudes data (sampled at 10Hz):
- Thermal data

4.6.4 Auxiliary Data

All Auxiliary Data used for the Level-0 processing are referenced in the product metadata file:

- IERS bulletin file,
- Ground Image Processing Parameters (GIPPs) files (cf. Annex D),
- Reference to used DEM.

The final user, according to a specific download option, will be able to include in the its Level-0 User Product, the IERS bulletin and/or the used GIPP files. DEM is never provided within the product but only referenced at metadata level.

4.6.5 Quality Indicators

The Quality Indicators (QI) are made available by the consolidation processing for the Level-0 product.

The *Product Level Quality Indicators* are provided at product level through the product metadata file.

The *Granule Level Quality Indicators* are provided at Granule level through the metadata file.

The *Datastrip Level Quality Indicators* are provided at Datastrip level through the metadata file.

The User Product QI are defined in the Table 4-12.

4.6.6 Metadata

The following table shows the groups of metadata provided inside a Level-0 User Product:

Level-0 User Product Metadata	
Product Level Metadata	All product level metadata, specific for the User level, are consolidated/computed because not present at Granule and Datastrip level.
Granule Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Granule level are copied from the input Granules to the User Product.
DATASTRIP Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Datastrip level are copied from the input Datastrips to the User Product;

Table 4-8: Level-0 Product Metadata

As mentioned in the section 2.10, the User Product metadata (all) are not provided with a *metadataLevel* attribute (Brief/Standard/Expertise) unlike what happens for all Granule and Datastrip metadata.

During the User Product assembling, this attribute is used to select by filtering, according to a download option, the set of metadata that must be included in the User Product.

For these filtered fields, the *metadataLevel* attribute is not written in the User Product's metadata.

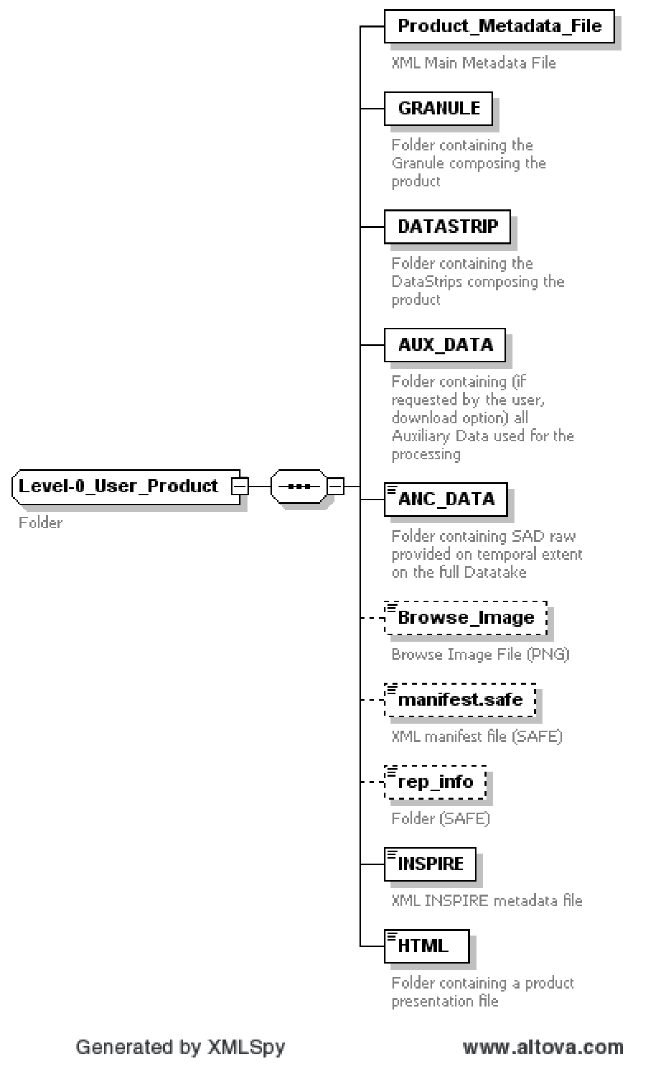
Note that a User Product for an expert user (Expertise download option) will contain all level of metadata (Brief/Standard/Expertise). A User Product for a user with “Standard” or “Brief” permission will contain only Brief/Standard or Brief metadata.

In addition to the metadata in the table above, the User Product contains the *manifest.safe* metadata (when the User Product is SAFE format) and the INSPIRE metadata.

The Level-0 Product Metadata are detailed in the section 4.6.7.

4.6.7 User Product Level-0 Structure

S2_User_Product_Level-0_Structure.xsd schema annexed to the document and shown in the following diagram represents the structure of a S2 Level-0 User Product. This schema is provided for information only as it is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the Figure 60.

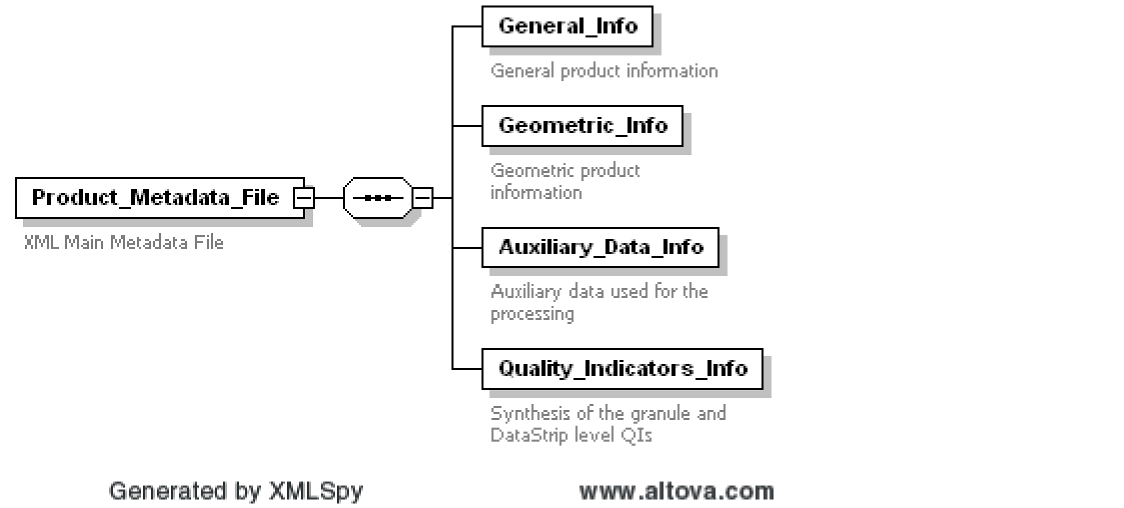
diagram	
children	**Product_Metadata_File GRANULE DATASTIP AUX_DATA ANC_DATA Browse_Image manifest.safe rep_info INSPIRE HTML**
annotation	The diagram above shows the Level-0 User Product structure cotaining: 1. **Product_Metadata_File**: XML Main Metadata file. 2. **GRANULE**: folder containing the list of the Granules belonging to the product. 3. **DATASTRIP**: folder containing the list of the Datastrip belonging the Datatake from

	wich the product has been selected. 4. **AUX_DATA**: folder containing all Auxiliary Data (GIPP and IERS Bulletin) used for Level-0 processing (optional, the aux data are included in the product if selected according to a specific download option). 5. **ANC_DATA**: folder containing Satellite Ancillary Data needed for processing (GPS data, attitude data, etc ….). 6. **Browse_Image**: PNG file for image data browsing and selection purposes. 7. **manifest.safe**: XML SAFE Manifest file 8. **rep_info**: optional folder containing the XSD schema 9. **INSPIRE.xml**: XML INSPIRE metadata file 10. **HTML**: folder contaioning an HTML product presentation file and the corresponding stylesheet.

4.6.7.1 *Product_Metadata_File Schema*

Product_Metadata_File is the XML metadata file provided inside the S2 Level-0 User Product. The XSD schema annexed to this document and used to validate it is *S2_User_Product_Level-0_Metadata.xsd*.

A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Auxiliary_Data_Info Quality_Indicators_Info
annotation	Product_Metadata_File is an XML file containing: 1. **General_Info**: this group of metadata provides general product information. 2. **Geometric_Info**: these metadata provide information describing the geolocation over WGS84 of the contour of the product. 3. **Auxiliary_Data_Info**: All the auxiliary data (GIPP and IERS Bulletin) used for the processing are here referenced. 4. **Quality_Indicators_Info**: Synthesis of the Granule and Datastrip level QIs.

The following figures and tables give a complete description of the User Product metadata.

General_Info:

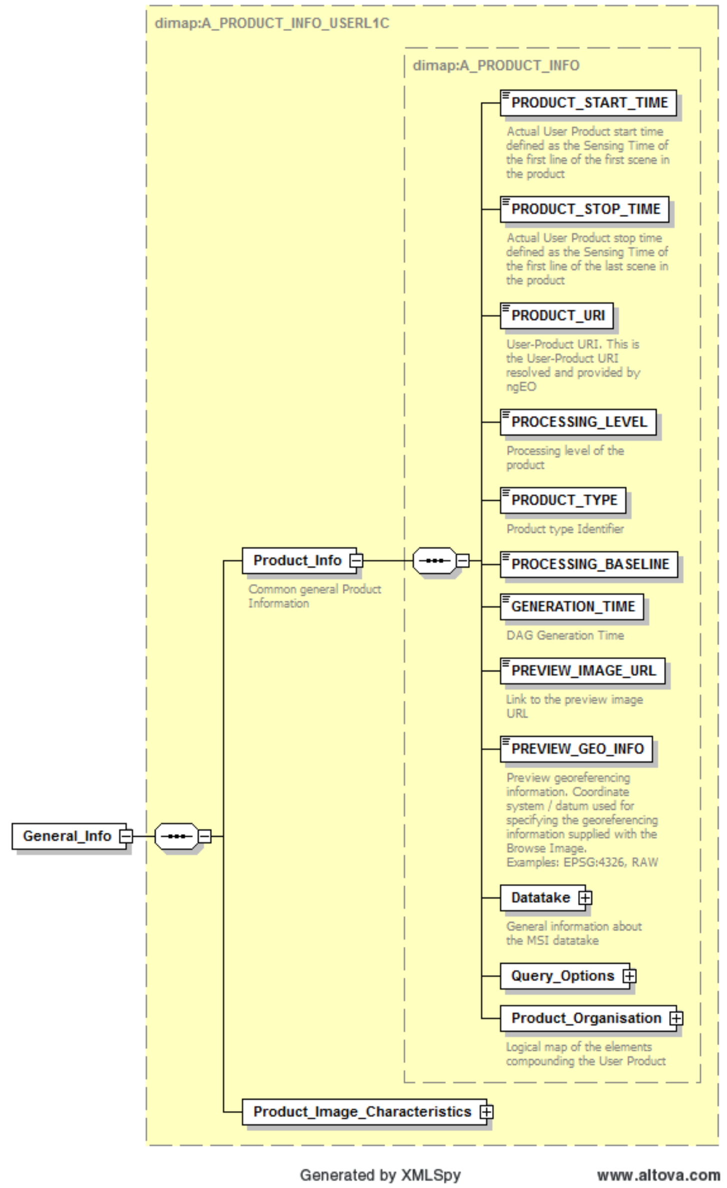


Figure 61 : Level-0 Product_Metadata_File - General_Info Diagram

Legend for the Table 4-9:

- ***Field Name***: provides the name used to identify the metadata;
- ***Description***: contains a short description of the related metadata;
- ***From Datastrip PDI***: indicates that the metadata at product level is filled using the corresponding information available at Datastrip level (from the Datastrip_Metadata_File of the PDI Datastrips composing the product);
- ***From Granule PDI***: indicates that the metadata at product level is filled using the corresponding information available at Granule level;
- ***From Additional Processing***: indicates that the metadata, specific to the product level, does not originate neither from the Granules nor from the Datastrips composing the product but it is computed during the User Product assembling because not present at PDI level.

Note: The first section of the table (General_Info (common section) is common to all processing level. The last section (Product image characteristics section) is specific for a Level-0 User Product.

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
PRODUCT_START_TIME	Actual User Product start time defined as the Sensing Time of the first line of the first scene in the product		X	X	Based on the Sensing Start Time of the first scene
PRODUCT_STOP_TIME	Actual User Product stop time defined as the Sensing Time of the first line of the last scene in the product		X	X	Based on the Sensing Start Time of the last scene
PRODUCT_URI	This is the User Product URI resolved and provided by the catalogue ngEO. If the URI from ngEO is not			X	User Product URI

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	available the field is set to the EUP name				resolved and provided by ngEO
PROCESSING_LEVEL	Processing level of the product (Level-0)			X	Extracted from PDI filetype
PRODUCT_TYPE	Product type Identifier: S2MSI0 S2MSI1A S2MSI1B S2MSI1C S2MSI2Ap			X	Extracted from PDI_ID
PROCESSING_BASELINE	Processing Baseline	X			cf. Table 3-32
GENERATION_TIME	Product generation time			X	End time of product generation
PREVIEW_IMAGE_URL	Link to the preview image URL If the URL from ngEO is not available the field is set to N/A			X	Provided by ngEO
PREVIEW_GEO_INFO	Preview georeferencing information. If the information from ngEO is not available the field is set to N/A Note: L1C User Product: browse image footprint covering the complete L1C User Product extent. L0/L1A/L1B : N/A			X	Provided by ngEO

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
Datatake/SPACECRAFT_NAME	Sentinel-2 Spacecraft name: Sentinel-2A Sentinel-2B	X			cf. Table 3-32
Datatake/DATATAKE_TYPE	MSI operation mode	X			cf. Table 3-32
Datatake/DATATAKE_SENSING_START	Imaging Start Time (Sensing start time of the Datatake)	X			cf. Table 3-32
Datatake/SENSING_ORBIT_NUMBER	Imaging Orbit Number	X			cf. Table 3-32
Datatake/SENSING_ORBIT_DIRECTION	Imaging Orbit Direction (Default = Ascending)	X			cf. Table 3-32
Query_Options/@*completeSingleTile*	attribute indicating if the complete single tile download option was activated or not. **In case of completeSingleTile="true" all the Query_options are omitted except for Query_Options/PRODUCT_FORMAT**			X	
Query_Options/Area_Of_Interest/Bbox	Bounding Box (rectangle) which describes exactly the area drawn by the User during the selection of the product. Defined by: LOWER_CORNER: Coordinates position (2D, Lat/Lon) of the minimal point (bottom right) within the envelope UPPER_CORNER: Coordinates position (2D, Lat/Lon) of the maximal point (upper left) within the envelope			X	Extracted from product URI provided by ngEO

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	(This Field is omitted in case of completeSingleTile = "true")				
Query_Options/Area_Of_Interest/Polygon	Polygon (simple and without holes) which describes exactly the area drawn by the User during the selection of the product. Defined by: EXT_POS_LIST: List of coordinates position (2D, LAT/LON) of the exterior points describing the surface boundary of the polygon. The polygon must be closed (the first and last vertices are the same). (This Field is omitted in case of completeSingleTile = "true")			X	Extracted from product URI provided by ngEO
Query_Options/Area_Of_Interest/Radius	Circular area which describes exactly the area drawn by the User during the selection of the product. Defined by: CENTER: Center coordinates position (2D, Lat, Lon) RADIUS_LENGHT: Radius expressed in meters (This Field is omitted in case of completeSingleTile = "true")			X	Extracted from product URI provided by ngEO
Query_Options/FULL_ SWATH _DATATAKE	Flag to extend the user selected area to the full MSI swath (L0/L1A/L1B) or the full Datatake (L0/L1A/L1B/L1C).			X	Option managed at ngEO

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	(This Field is omitted in case of completeSingleTile = "true")				server level
Query_Options/Band_List/BAND_NAME	Option to select a given sub-set of spectral band to be embedded in the product. In case of Level-1C User Product this option allow to embed in the product also the TCI corresponding to each TILE. (This Field is omitted in case of completeSingleTile = "true")		X	X	From product URI provided by ngEO containing Download Option flag
Query_Options/Metadata_Level_List/METADATA_LEVEL	List of metadata levels (Brief/Standard/Expertise). The End User, according to this download option, will be able to select the set of metadata at Granule and Datastrip level to be included in the User Product. NOTE: 1. option <u>Brief</u> means that metadata *Brief* will be included in the User Product; 2. option <u>Standard</u> means that metadata *Brief&Standard* will be included in the User Product; option <u>Expertise</u> means that metadata *Brief&Standard&Expertise* will be included in the User Product. (This Field is omitted in case of completeSingleTile = "true")	X	X	X	From product URI provided by ngEO containing Download Option flag (for instance: ngEO_DO={ ...,metadata Level:STANDARD,...}
Query_Options/Aux_List	The final user, according to this download option, will be able to select the auxiliary data to be embedded in the User Product:	X			The product URI provided by

General_Info (common section)						
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	• GIPP files (Link to GIPP files to embed in the product) • IERS (Link to IERS Bulletin files to embed in the product) Note: Raw ECMWF never downloaded (no embedding option); DEM never downloaded (no embedding option); GRI never downloaded (no embedding option); (This Field is omitted in case of completeSingleTile = "true")				ngEO indicates if the aux data have to be embedded in the User Product (ngEO_DO={ ...,auxData: YES,...} If YES, the list of aux files to be embedded in the User Product is copied from PDI Datastrip.
Query_Options/PREVIEW_IMAGE[3]	Option to include the Browse Image (if available) inside the User Product. The Browse Image as URL is always embedded in the product. Only the physical file is optional. (This Field is omitted in case of completeSingleTile			X	From product URI provided by ngEO containing Download

[3] The "Browse Image" is here referenced as "PreView Image" to be aligned with the ngEO terminology (cf. [NGEO-EICD-S2]).

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	= ”true”)				Option flags. The flag corresponding to this option is “pvi”. (for instance: ngEO_DO={ ...,,pvi:YES,, ...}
Query_Options/PRODUCT_FORMAT	The final user, according to this download option, will be able to select the User Product format (SAFE, DIMAP or SAFE_COMPACT).			X	From product URI provided by ngEO containing Download Option flag (for instance: ngEO_DO={ ...,outputFormat:SAFE_COMPACT}
Query_Options/AGGREGATION_FLAG	Flag to select Along-Track Aggregated Granules (L1A/L1B) and Consolidated Tiles (L1C). (This Field is omitted in case of completeSingleTile = ”true”)			X	For Level-0, aggregation is always FALSE
Query_Options/SINGLE_TILE	Option selected to generate L1C Single Tile User			X	

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	Products (This Field is omitted in case of completeSingleTile = "true")				
Product_Organisation/Granule_List/@DatastripIdentifier	Product_Organization represents the logical map of the elements (Granules vs Datastrip hierarchy) composing the User Product. DatastripIdentifier is the attribute identifing the Datastrip linked to the list of the Granules composing the User Product. In case of User Product including aggregation of Granules (L1A/L1B) or Tiles consolidated (L1C) this attribute contains two (or more) Datastrip identifiers.	X			
Product_Organisation/Granule_List/Granule/IMAGE_ID (*) applicable for PRODUCT_FORMAT SAFE and DIMAP	Pointers to Granule/Tile image data files (links to the physical image data) attibute: fileFormat (JPEG2000, BINARY)		X		
Product_Organisation/Granule_List/Granule/IMAGE_FILE (*) applicable for PRODUCT_FORMAT SAFE_COMPACT	This attribute is the relative path of the spectral bands and TCI image data files		X		
Product image characteristics section (specific for a L0 User Product)					
Product_Image_Characteristics/PHYSICAL_GAINS	Phisycal gains for each band	X			§ Table 3-33
Product_Image_Characteristics/REFERENCE_BAND	Reference band	X			§ Table 3-36
Product_Image_Characteristics/ON_BOARD_COMPRESSION_MODE	Flag to indicate the on board compression mode (by-passed or not). Note: if this flag is set TRUE, the corresponding	X			§ Table 3-33

General_Info (common section)					
Field Name	**Description**	**From Datastrip PDI**	**From Granule PDI**	**From Additional Processing**	**Note**
	metadata COMPRESS_MODE at L0 Datastrip PDI level is set TRUE. In case of complession by-passed, the list of active detectors is provided at Datastrip level (ACTIVE_DETECTOR metadata).				

Table 4-9: Level-0 Product_Metadata_File - General_Info Description

Geometric_Info:

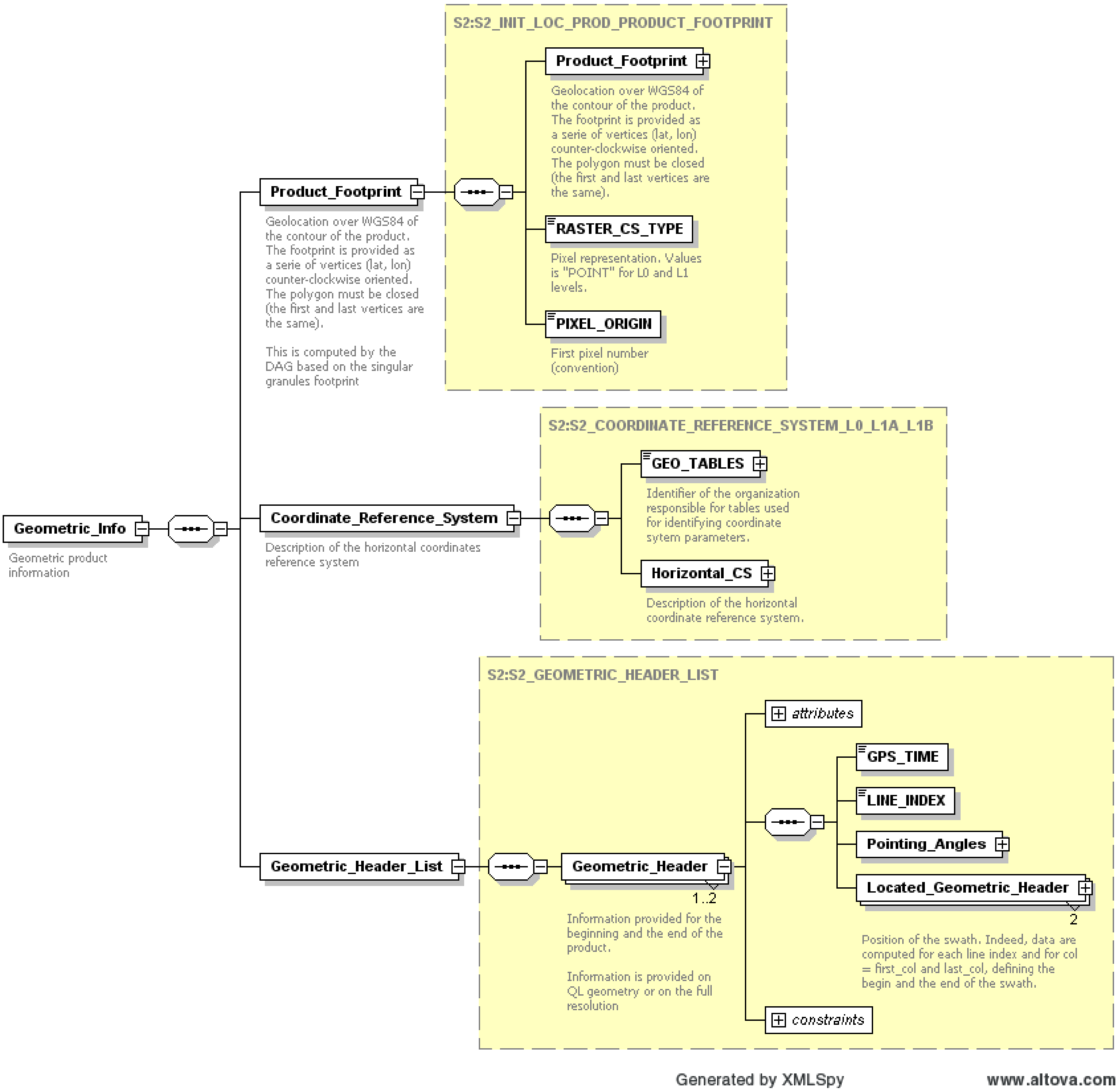


Figure 62: Level-0 Product_Metadata_File – Geometric_Info Diagram

Geometric_Info/Product_Footprint				
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Additional Processing**	**Note**
Product_Footprint/Global_Footprint/EXT_POS_LIST Product_Footprint/Global_Footprint/INT_POS_LIST	Geolocation over WGS84 of the contour of the product. The footprint is a closed polygon provided as a series of vertices (lat, lon) counter-clockwise oriented. Global precise footprint of the cut segment (Point list of LAT, LON or X,Y).		X	This is based on the singular Granules footprint
Product_Footprint/Unitary_Footprint_List/Unitary_Footprint/Footprint/EXT_POS_LIST Product_Footprint/Unitary_Footprint_List/Unitary_Footprint/Footprint/INt_POS_LIST	(OPTIONAL) Unitary footprint for each detector, each band of the product.		X	This is not required for the Level-0 product.
Product_Footprint/Product_Footprint/RASTER_CS_TYPE	Pixel representation. Values is "POINT" for L0 and L1 levels.		X	Availabe at Granulelevel
Product_Footprint/PIXEL_ORIGIN	First pixel number (convention)		X	Available at Granule level
Geometric_Info/Coordinate_Reference_System				
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Additional Processing**	**Note**
GEO_TABLES	Identifier of the organization responsible for tables used for identifying coordinate sytem parameters (EPSG).		X	Metadata filled as per description
HORIZONTAL_CS_TYPE	Description of the horizontal coordinates reference system type (PROJECTED | GEOGRAPHIC)		X	Metadata filled as per description
HORIZONTAL_CS_NAME	Description of the horizontal coordinates reference system		X	Metadata filled as per description

HORIZONTAL_CS_CODE	Code of horizontal coordinate reference system. It follows the 'EPSG:xxxx' pattern where xxxx is the unique identification code in the EPSG tables.		X	Metadata filled as per description
Geometric_Info/Product_Footprint/Geometric_Header_List (provided for the beginning and the end of the product)				
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Additional Processing**	**Note**
Geometric_Header/GPS_TIME	A GPS date-time value = TAI format	X		Geometric Header Information are provided for the beginning and the end of the product. § Table 3-33
Geometric_Header/LINE_INDEX	Integer	X		§ Table 3-33
Geometric_Header/Pointing_Angles/Satellite_Reference (ROLL, PITCH, YAW)	Pointing angles in satellite reference frame	X		§ Table 3-33
Geometric_Header/Pointing_Angles/Image_Reference (PSI_X, PSI_Y)	Pointing angles in focal plane referential	X		§ Table 3-33
Geometric_Header/Located_Geometric_Header/ORIENTATION	Track orientation. Also called "CAPE". The range of the angle is into [0,360°[	X		§ Table 3-33
Geometric_Header/Located_Geometric_Header/Incidence_Angles (ZENITH_ANGLE, AZIMUTH_ANGLE)	Inceidence angles	X		§ Table 3-33
Geometric_Header/Located_Geometric_Header/Solar_Angles (ZENITH_ANGLE, AZIMUTH_ANGLE)	Solar angles	X		§ Table 3-33
Geometric_Header/Located_Geometric_Header/Pixel_Size (ALONG_TRACK, ACROSS_TRACK)	Full resolution pixel sizes along and across track in meters	X		§ Table 3-33

Table 4-10: Level-0 Product_Metadata_File - Geometric_Info Description

Auxiliary_Data_Info:

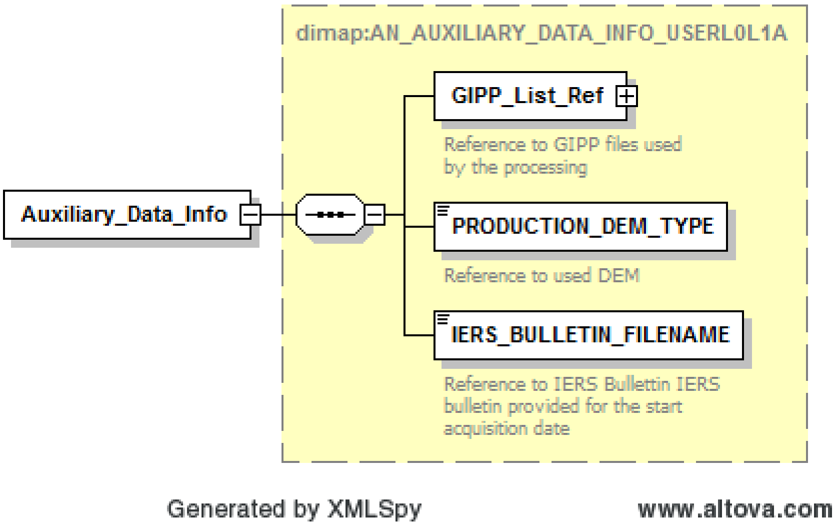


Figure 63 : Level-0 Product_Metadata_File – Auxiliary_Data_Info Diagram

Auxiliary_Data_Info				
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Additional Processing**	**Note**
GIPP_List_Ref/GIPP_FILENAME	Reference to the GIPP files used by the processing chain. These files could be in the product (AUX_DATA folder) according to a specific download option.	X		§ Table 3-36
PRODUCTION_DEM_TYPE	DEM type used by the production process (GLOBE or SRTM)	X		§ Table 3-36
IERS_BULLETIN_FILENAME	IERS bulletin filename. This files could be in the product (AUX_DATA folder) according to a specific download option.		X	§ Table 3-36

Table 4-11: Level-0 Product_Metadata_File – Auxiliary_Data_Info Description

Quality_Indicators_Info:

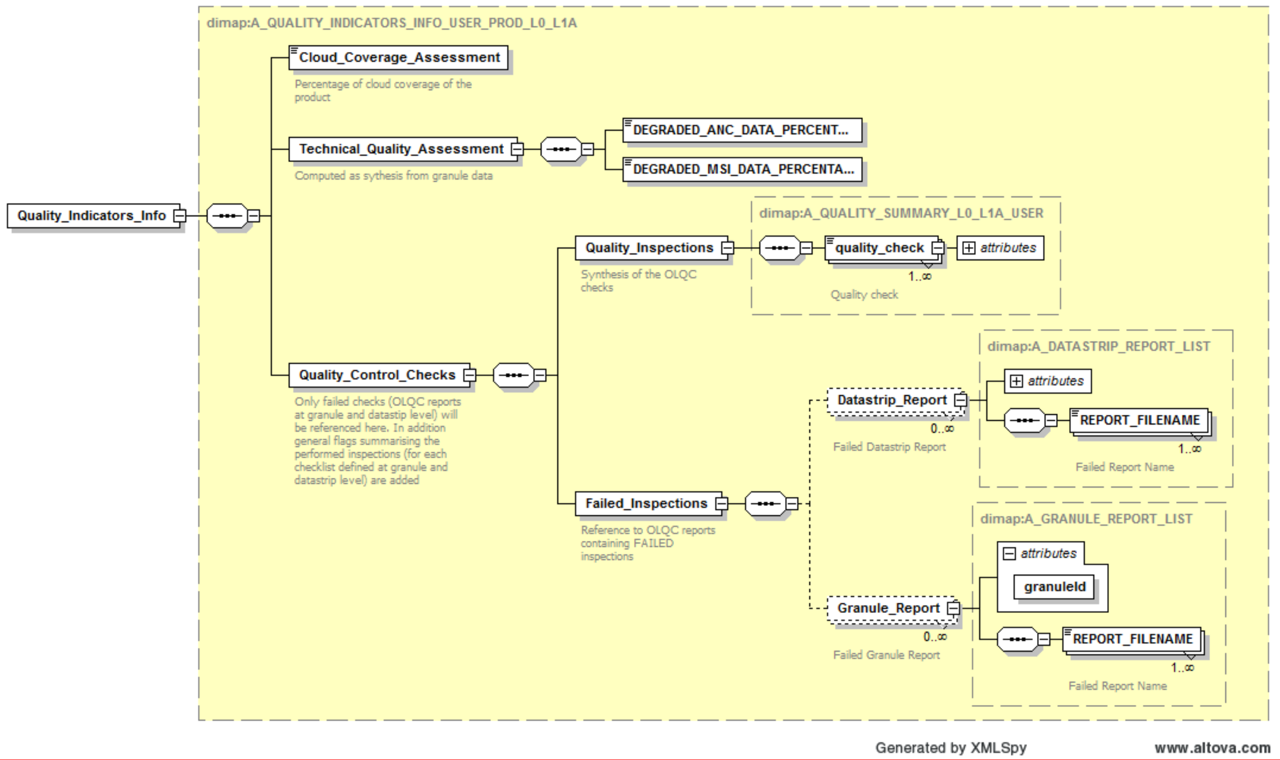


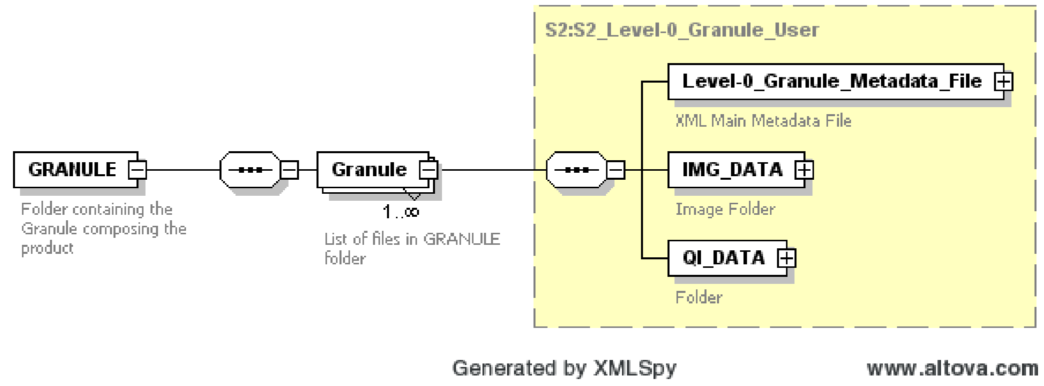
Figure 64 : Level-0_Product_Metadata_File – Quality_Indicators_Info Diagram

Quality_Indicators_Info					
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Level-0 Granule PDI**	**Additional Processing**	**Note**
CLOUD_COVERAGE_ASSESSMENT	Percentage of cloud coverage of the product for each area covered by a reference band		X	X	Based on CLOUDY_PIXEL_PERCENTAGE computed for each Granules composing the product: AVG(CLOUDY_PIXEL_PERCENTAGE)%
Quality_Indicators_Info/Technical_Quality_Assessment					
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Level-0 Granule PDI**	**From Additional Processing**	**Note**
DEGRADED_ANC_DATA_PERCENTAGE	Percentage of degraded ancillary data over the product.	X		X	Based on “degradationPercentage” values computed for each Datastrip: AVG(degradationPercentage)%
DEGRADED_MSI_DATA_PERCENTAGE	Percentage of degraded MSI data over the product.		X	X	Based on DEGRADED_MSI_DATA_PERCENTAGE computed for each Granule: AVG(DEGRADED_MSI_DATA_PERCENTAGE)%
Quality_Indicators_Info/Quality_Control_Checks/Quality_Inspections					
Field Name	**Description**	**From Level-0 Datastrip PDI**	**From Level-0 Granule PDI**	**From Additional Processing**	**Note**

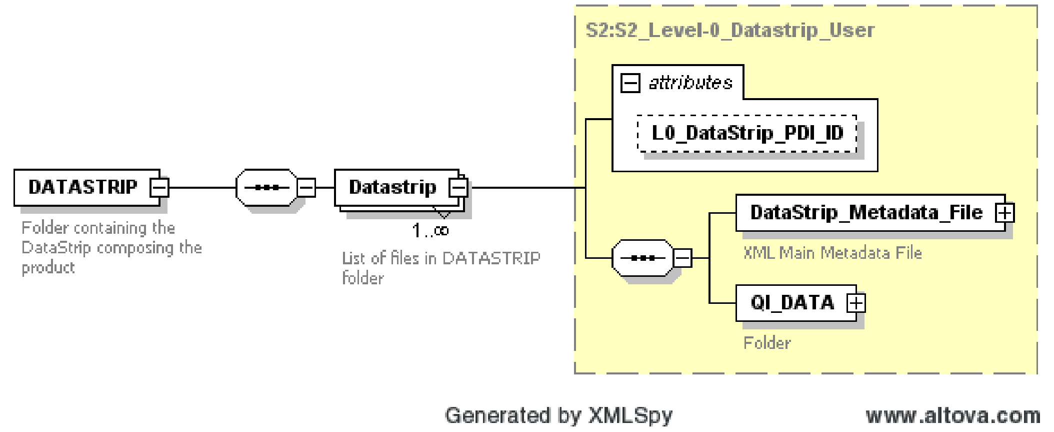
quality_check	Synthesis of the OLQC checks performed at: Granule level and or Datastrip level. Those checks are grouped in the OLQC reports and provided in the Granules/QI_DATA and Datastrip/QI_DATA folders.	X	X	X	The field is based on the OLQC reports contained in the Granules/QI_DATA and Datastrips/QI_DATA The OLQC reports are in *globalStatus* FAILED if at least one report at Datastrip level and/or at Granules level is with *globalStuatus FAILED.*
quality_check/@check_type	Type of the check				Cf. Table 3-17, Table 3-24
Quality_Indicators_Info/ Quality_Control_Checks/Failed_Inspections					
Field Name	**Description**	**From Level-0 Datastrip PDI**		**From Additional Processing**	**Note**
Datastrip_Report/REPORT_FILENAME	Reference (through the filename) to failed Datastrip reports (i.e. refers to OLQC reports with *globalStatus* FAILED).	X		X	REPORT_FILENAME list corresponds with the list of the FAILED Datastrip reports.
Granule_Report/REPORT_FILENAME	Reference (through the filename) to failed Granule reports(i.e. refers to OLQC reports with *globalStatus* FAILED).		X	X	REPORT_FILENAME list corresponds with the list of the FAILED Granule reports.

Table 4-12: Level-0 Product_Metadata_File – Quality_Indicators_Info Description

4.6.7.2 GRANULE

diagram	
annotation	GRANULE folder is a “folder of folders” each one corresponding to the Granules composing the product and identified by proper PDI_ID (Granule_ID). The structure of each Granule included in the product is the same of the Level-0 PDI Granule described in the section 3.6.3 taking into account that: 1. the Granules metadata are copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.6.6), 2. the XML Level-0_Granule_Metadata_File is validated using the *S2_PDI_Level-0_Granule_Metadata.xsd* schema annexed to the document, 3. the *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Granule PDI is included in the User Product (cf. section 3.6.3).

4.6.7.3 DATASTRIP

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>annotation</td><td>DATASTRIP folder is a “folder of folders” each one corresponding to the Datastrip composing the product and identified by proper PDI_ID (Datastrip_ID).
The structure of each Datastrip included in the product is the same of the Level-0 PDI Datastrip described in the section 3.7.3 taking into account that:

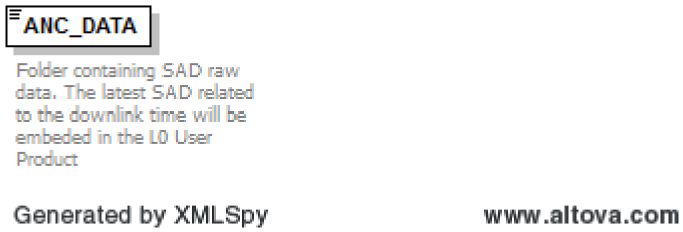
1. the Datastrips metadata are copied in the User Product as they are except for the metadataLevel attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.6.6),
2. the XML Datastrip_Metadata_File is validated using the S2_PDI_Level-0_Datastrip_Metadata.xsd schema annexed to the document,
3. Inventory_Metadata.xml, manifest.safe, ANC_DATA and rep_info are removed when the Datastrip PDI is included in the User Product (cf. section 3.7.3).

Note: Since the ANC_DATA folder inside the L0 Datastrip PDI is removed during the L0 User Product generation, the metadata ANC_DATA_REF inside the L0 User Product (defined at Datastrip level) refers to the mandatory folder ANC_DATA contained in the L0 User Product.</td></tr>
</table>

4.6.7.4 AUX_DATA

diagram	
annotation	All Auxiliary Data used for Level-0 processing are referenced through the Product_Metadata_File. GIPP files and IERS Bulletin file can be provided if requested by the user (download option). DEM is not provided itself inside the product but only as a reference to the data used.

4.6.7.5 ANC_DATA

diagram	
annotation	This folder contains different SAD files, one for each SAD packet type (SID, cf. Table 3-9). In order to have the maximum coverage of the raw SAD in the L0 User Product, the latest SAD related to the downlink time will be embedded in the product.

4.6.7.6 Browse_Image

diagram	
annotation	Browse Image file in PNG format. The Browse Image is included in the User Product if required by the user (download option). This Browse Image is based on the PVI extracted from the Level-1C Tile PDI (JPEG2000 low resolution extraction, 3 visible-bands in ground geometry at 320m resolution, RGB).The final geometric representation of the Browse Image is defined by the user according to its region of interest (either geographic or cartographic representation).

4.6.8 User Product Level-0 SAFE Manifest synoptic table

The User Product contains only one main *manifest.safe* file. The *manifest.safe* files related to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product, all lower level PDI are removed.

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-0 User product.

Since the User Product metadata refers to the contained Granules and Datastrips, the structure of the Manifest is based on the Level-0 Manifests provided for Granules and Datastrip (cf. sections 3.6.4 and 3.7.4).

The SAFE Manifest file is compliant to the SAFE specification (cf. [SAFE-SPEC]) and is composed by three main sections (Metadata, Information Package Map and Data Objects).

With reference to the three mentioned sections the chapter provides, as a guideline to the generation process of the SAFE Manifest file, the following elements:

- Table 3-29 describing the content and structure of the Information Package Map section; same consideration apply as in section 3.6.4;

- for the Metadata Section, a table that lists the fields (tags) composing the section, providing, for each field:

    - the field name in the SAFE Manifest file (column “SAFE Manifest”, divided into column “Metadata name”, containing the name of the Metadata section of the manifest to which the field belongs, and “Name of tag or attribute” containing the actual tag name or attribute name (for sake of clarity, attributes are written in bold characters))
    - the name of the corresponding tag (if available, else N.A.) of the S2_User_Product_Level-0_Metadata.xsd;
    - a brief textual description of the field;
    - the data type of the field (e.g. string, string enum, integer, double, xs:dateTime etc.);
    - the occurrence of the field (min/man occurrence e.g. 0..1); a minimum occurrence of 1 means that the field is mandatory;
    - the allowed range of values of the field.

- Table 3-31 describing the content and structure of the Data Objects section; consider that this section contains a reference to each file (Data files and Metadata files) composing the Level-0 User Product (with the exception of the Manifest file itself); this includes:
    - the XML Main Metadata file;
    - the INSPIRE Metadata.XML file;
    - the Auxiliary Data files (IERS Bulletin, GIPPs) required by the processing and included in the product, in the AUX_DATA folder;
    - the Ancillary Data files needed by processing and included in the product, in the ANC_DATA folder;

- the Preview Image, used for image data browsing and selection purposes;
- all files included in the "GRANULE" folder, representing the Granules composing the User Product;
- all files included in the "DATASTRIP" folder, representing the Datastrips linked to the Granules composing the User Product.

A practical example of Manifest file for the Level-0 User Product is provided as annexed to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	Level-0_User_Product->General_Info->Datatake->SPACECRAFT _NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	Level-0_User_Product->General_Info->Datatake->SPACECRAFT_ NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument-> **abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	N.A.	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Calibration Vicarious_Calibration Raw_Measurement Test_Mode
	instrument->mode-> **identifier**	Level-0_User_Product-> Product_Metadata_File->General_Info->Datatake-> DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name		Name of the L0 Processing	string	0..1	L0 Processing of Raw Data
	start	Level-0_User_Product->General_Info-> GENERATION_ TIME	Processing start date (UTC)	xs:dateTime	0..1	
	facility	N.A.	Description of Processing Centre		0..*	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	Level-0_User_Product->GRANULE->General_Info->GRANULE_ID (substring <Site Centre>)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	facility->software	N.A.	Description of software component used for Processing		0..*	
	facility->software-> **name**	N.A	Name of the software component	string	1	
	facility->software-> **version**	N.A	Version of the software component	string	0..1	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	facility->resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc.) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are provided with the product.		0..*	
	facility->resource-> **name**	Level-0_User_Product->DATASTRIP-> Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-0_User_Product->DATASTRIP-> Auxiliary_Data_Info->IERS_Bulletin Level-0_User_Product->DATASTRIP-> Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME Level-0_User_Product->DATASTRIP-> Auxiliary_Data_Info- DEM_FILENAME	Name of the auxiliary or ancillary files/folders needed for the Processing	string	1	
	facility->resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
acquisitionPeriod					1	
	acquisitionPeriod -> startTime	Level-0_User_Product->General_Info->Datatake->DATATAKE_SENSING_START	Reference time of acquisition of the product	xs:dateTime	1	
measurementFrameSet					1	
	footPrint	Derived from Level-0_User_Product->Geometric_Info->Product_Footprint	Product footprint (namely imaged landscape corresponding to the whole product)	string (gml:linearRingType namely blank separated list of comma-separated long/lat coordinates of footprint closed polygon with last vertex equal to first)[4]	0..1	
measurementOrbitReference						

[4] Note that the mentioned "gml" namespace represents the standard for geolocation in SAFE format and is not related to DIMAP type A_GML_POLYGON_3D; in order to convert lat/long coordinates between the DIMAP type A_GML_POLYGON_3D and the types gml:pointType and gml:linearRing in the tags <center> or <footprint>, the DIMAP lat/long coordinates should be simply moved into the corresponding tag of SAFE Manifest, properly formatted and the EPSG code in which these coordinates are expressed should be moved into the attribute srsName.

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	orbitNumber	Level-0_User_Product->General_Info->Datatake->DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the first Granule of the User Product		0..1	start
	orbitNumber->**groundTrackDirection**	Level-0_User_Product->General_Info->Datatake->SENSING_ORBIT_ DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to orbitNumber->type (start or stop)		0..1	ascending, descending
	relativeOrbitNumber	Level-0_User_Product->General_Info->Datatake->SENSING_ORBIT_ NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber->**type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-0_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
metadataComponents		Level-0_User_Product->DATASTRIP->Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-0_User_Product->DATASTRIP->Auxiliary_Data_Info->IERS_Bulletin Level-0_User_Product->DATASTRIP->Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME	A reference to all ancillary/auxiliary Metadata files/folders included in the product (e.g. the XML Metadata file, the INSPIRE Metadata file, the Ancillary Data files, the Auxiliary Data files)		1..*	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..1	

Table 4-13 - Content of Metadata section for Level-0 User Product SAFE Manifest

4.7 Level-1A User Product specification

4.7.1 Introduction

The Level-1A User Product is obtained by decompressing image data and developing a geometric model to locate any pixel in the image.

The following table introduces the input data of Level-1A processing:

Input of Level-1A processing	Description
Metadata	Metadata from Level-0 product
Image Data	Level-0 data (Granules)
Auxiliary Data	GIPP: Parameters from Level-0 complemented by radiometric and geometric processing parameters. DEM: only the reference to the data used is provided.
Quality Indicator Data	Quality indicators from Level-0

Table 4-14: Input for Level-1A processing

This level corresponds to the systematic processing steps that must be applied before any further processing. It includes:

- decompression of the image data,
- geometric model computation : geolocation information, coarse interband / interdetector registration,
- SWIR pixels re-arrangement.

As requiring only a fast processing, this 'Raw Level' product can be used to allow a quick display of the detectors (sub-swaths) in full resolution. The sub swath can be displayed using standard commercial image processing software.

Note that one Level-1A product:
- refers always to one Datatake;
- refer to one or several Datastrip from the same Datatake;
- may cover the full Datatake or an extract of the Datatake.

In the case of an extract, image data is provided only to cover the selected area.

The following figure gives an overview of the Level-1A User Product physical format. The yellow boxes correspond to folders and the white ones to files:

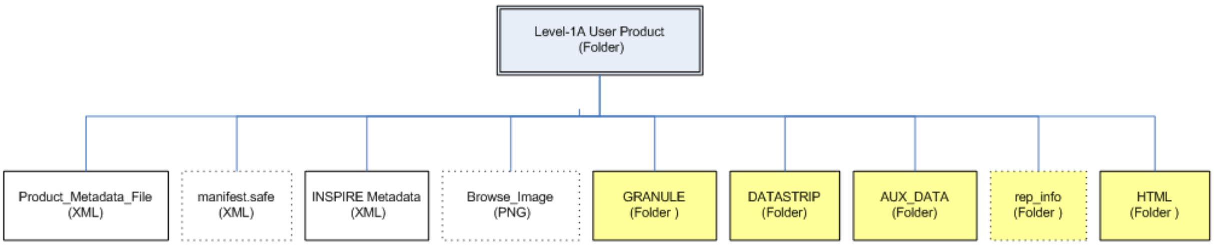


Figure 65: Level-1A User Product Structure

The Level-1A User Product consists of:

1. **Product_Metadata_File**: mandatory XML main metadata file.
2. **manifest.safe**: SAFE metadata file (optional). It is included in the product only if the user requests the SAFE as output format (download option).
3. **GRANULE**: folder containing all Granules composing the product (Image Data). The Image Data extent (raster files) correspond to a set of Granules and can covers up to *12 detectors * 13 bands* of the orbit in full resolution. A sub-set of the 13 bands can be provided (download option).
4. **DATASTRIP**: folder containing the Datastrip composing the product linked to the selected Granules.
5. **AUX_DATA**: folder containing, if requested by the user (download option), the GIPP files and IERS Bulletins used for the Level-1A User Product production. All Level-1A auxiliary data are referenced in the product metadata file.
6. **rep_info**: folder containing the XSD schema provided inside the product. This folder is optional. It is included in the User Product if the user selects the SAFE format as output format (download option).
7. **Browse_Image**: PNG file consisting of an image limited to 3 visible-bands in ground geometry at 320m resolution. This file, provided if requested by the user (download option), gives an overview of the product (sub-sampled) mainly for image data browsing and selection purposes.
8. **INSPIRE**: XML INSPIRE metadata file (cf. Annex B).
9. **HTML**: folder containing an HTML product presentation file (UserProduct_index.html) and the corresponding stylesheet (UserProduct_index.xsl).

4.7.2 Image Data

The Level-1A image data correspond to a collection of elementary Granules. Each Granule corresponds to one detector of one on board scene and therefore consists of N consecutive lines of one detector of a band, where N depends on the band Spatial Sampling Distance (SSD).

SSD	Number of bands	N : Number of full resolution lines per detector and per band in one Granule
10 m	4	2304
20 m	6	1152
60 m	3	384

Table 4-15: Number of lines in one Granule

The image data extent correspond to a set of "Granules" and can covers up to *12 detectors * 13 bands* of the orbit in full resolution. A sub-set of the 13 bands can be provided.

Each Level-1A Granule is identified in a unique way, using a unique identifier PDI_ID defined in the section 3.8.1.

4.7.2.1 Image Data Encoding and Files

Each image pixel value is encoded on 12 useful bits (as on-board).
The image data are provided as separated files for each spectral band (i.e. in total of 13 GML/JPEG2000 files per Granule).

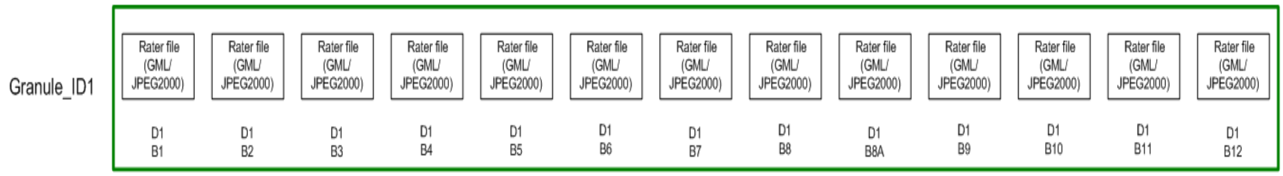


Figure 66 : Example of Level-1A Granule (image data) corresponding to Detector 1

In order to facilitate the product handling at the user base, it will be possible to provide the raster files according to two delivery options:

- Either one file per spectral band and per Granule. For instance, the user can request on a selection of six Granules, the six raster files corresponding to the spectral band B3 (six separated GML/JPEG2000).
- Either a file per spectral band corresponding to the concatenation of *Granules along-track* also called *aggregation of Granules*. For instance, the user can request on an aggregation of six Granules, the raster file corresponding to the spectral band B3 (one single GML/JPEG2000) (§ 4.7.8).

4.7.3 Ancillary Data

The raw Satellite Ancillary Data are not embedded in the Level-1A User Product.

4.7.4 Auxiliary Data

All Auxiliary Data used for Level-1A processing are referenced in the product metadata file:

- IERS bulletin file,
- Ground Image Processing Parameters (GIPPs) files (cf. Annex D),
- Reference to the used DEM.

For each auxiliary data a specific PDI is provided (cf. section 3.1) i.e. all Level-1A auxiliary data will be stored in archive and referenced by a unique identifier (PDI_ID equal to the PDI filename).

The final user, according to a specific download option, will be able to include in the Level-1A User Product, the IERS bulletin auxiliary file and/or the used GIPP files. DEM is never provided within the product but only as a reference to the data used.

4.7.5 Quality Indicators

The *Product Level Quality Indicators* are provided at product level and referenced through the product metadata file

The *Granule Level Quality Indicators* are provided at Granule level and referenced through the Granule metadata file.

The *Pixel Level Quality Indicators* are provided at Granule level through dedicated quality mask files pointed through the Granule level metadata file.

4.7.6 Metadata

The following table shows the groups of metadata provided inside a Level-1A User Product:

Level-1A User Product Metadata	
Product Level Metadata	All product level metadata, specific for the User level, are consolidated/computed because not present at Granule and Datastrip level.
Granule Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Granule level are copied from the input Granules to the User Product.
DATASTRIP Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Datastrip level are copied from the input Datastrips to the User Product;

Table 4-16: Level-1A Product Metadata

As mentioned in the section 2.10, the User Product metadata (all) are not provided with a *metadataLevel* attribute (Brief/Standard/Expertise) unlike what happens for all Granule and Datastrip metadata.

During the User Product assembling, this attribute is used to select by filtering, according to a download option, the set of metadata that must be included in the User Product.

For these filtered fields, the *metadataLevel* attribute is not written in the User Product's metadata.

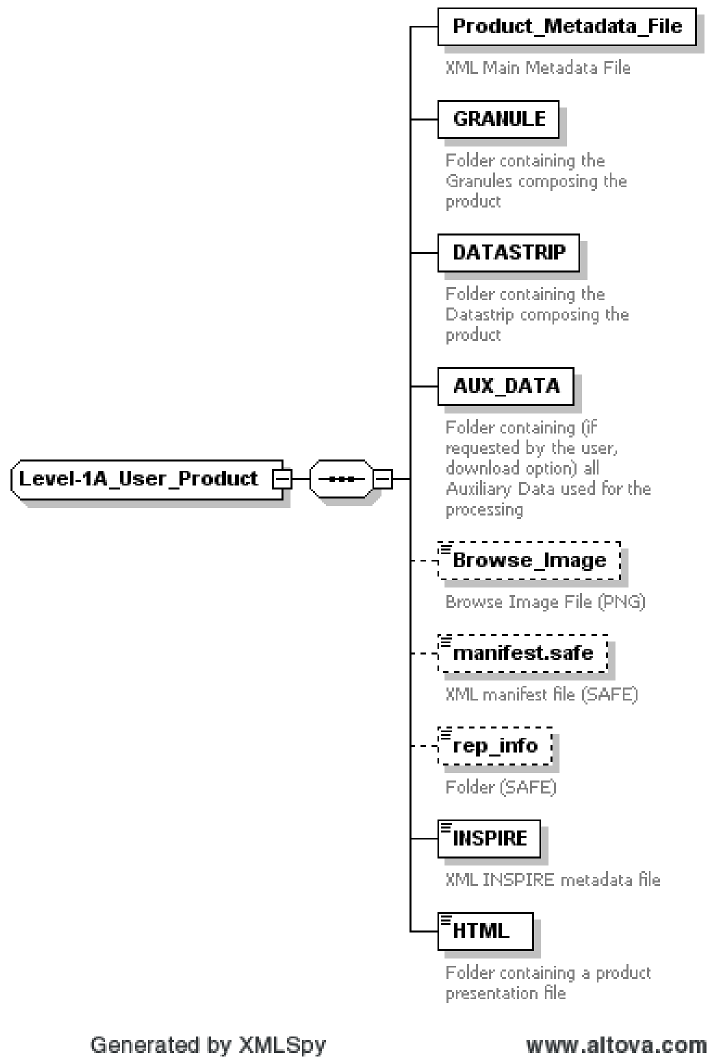
Note that an User Product for an expert user (Expertise download option) will contain all level of metadata (Brief/Standard/Expertise). An User Product for a user with “Standard” or “Brief” permission will contain only Brief/Standard or Brief metadata.

In addition to the metadata in the table above, the User Product contains the *manifest.safe* metadata (when the User Product is SAFE format) and the INSPIRE metadata.

The Level-1A Product Metadata are detailed in the section 4.7.7.1.

4.7.7 User Product Level-1A Structure

S2_User_Product_Level-1A_Structure.xsd schema annexed to the document and shown in the following diagram, represents the structure of a S2 Level-1A User Product. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the structure shown in the Figure 65.

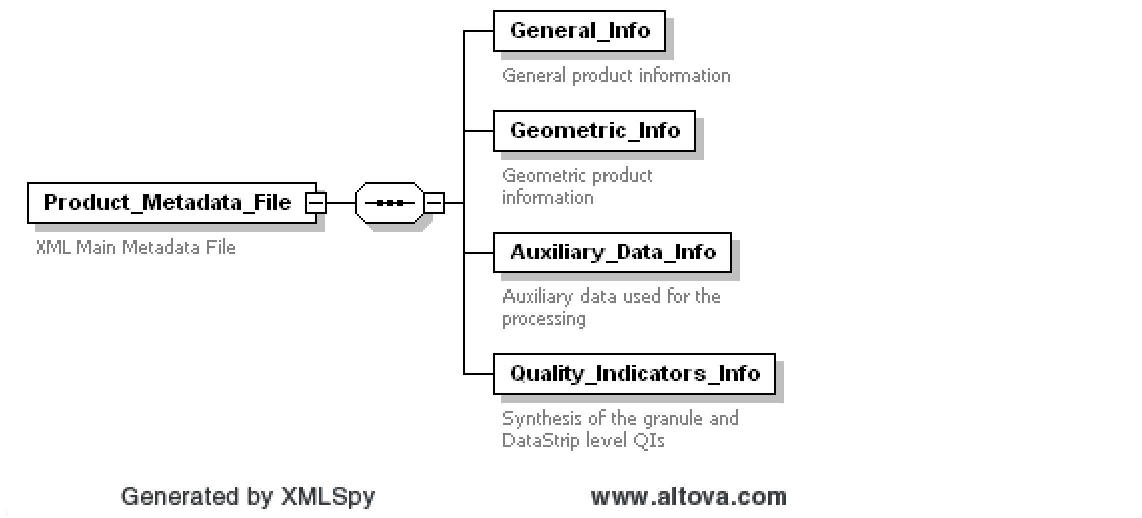
diagram	
children	Product_Metadata_File GRANULE DATASTRIP AUX_DATA Browse_Image manifest.safe rep_info INSPIRE HTML
Description	Level-1A User Product contains: 1. **Product_Metadata_File**: XML Main Metadata file. 2. **GRANULE**: folder containing the list of the Granules belonging to the User Product (the Granule structure is described in the section 3.8.3).

	3. **DATASTRIP:** folder containing the list of the Datastrip belonging the Datatake from which Level-1A User Product has been selected (the Datastrip structure is described in the section 3.9.3). . 4. **AUX_DATA**: folder containing all Auxiliary Data used for Level-1A processing (optional, the aux data are included in the product if selected according to a specific download option). 5. **Browse_Image:** PNG file for image data browsing and selection purposes. 6. **manifest.safe**: XML SAFE Manifest file 7. **rep_info**: optional folder containing the XSD schema 8. **INSPIRE.xml**: XML INSPIRE metadata file 9. **HTML**: folder containing an HTML product presentation file and the corresponding stylesheet.

4.7.7.1 Product_Metadata_File Schema

Product_Metadata_File is the XML metadata file provided inside the S2 Level-1A User Product. The XSD schema annexed to this document and used to validate it is *S2_User_Product_Level-1A_Metadata.xsd.*

A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Auxiliary_Data_Info Quality_Indicators_Info
Description	The Product_Metadata_File describes the product data items. It is presented to the user as a structured container of information. Product_Metadata_File is an XML file containing: 1. **General_Info**: provides general product information. 2. **Geometric_Info**: describing the geolocation over WGS84 of the contour of the product. 3. **Auxiliary_Data_Info**: Links to the AUX_DATA items. 4. **Quality_Indicators_Info**: Synthesis of the Granule and Datastrip level QIs.

The following figures and tables give a complete description of the User Product metadata.

General_Info:
In addition to the general information, common to all processing level (cf. Table 4-9) , the specific (general) metadata provided with a Level-1A User Product, are described hereafter.

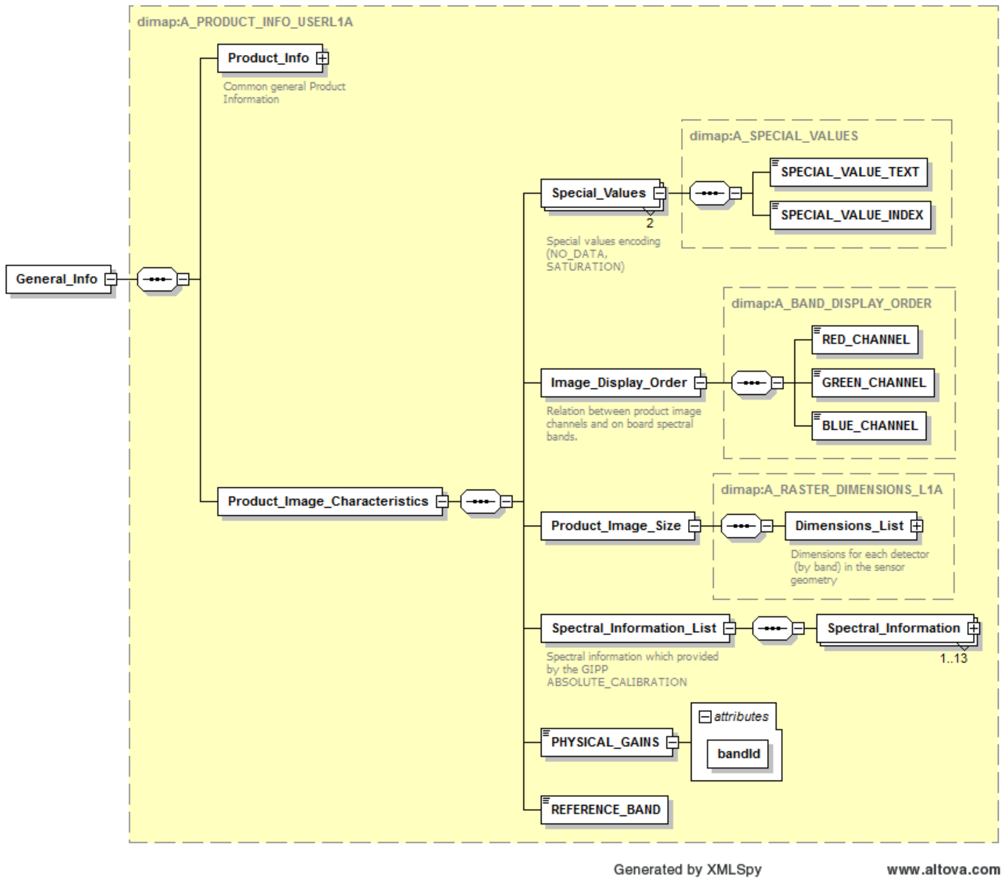


Figure 67 : Level-1A Product_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Note**
Product_Info	This group of metadata is described in the Table 4-9.	Table 4-9
Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_TEXT Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_INDEX	Special values encoding (e.g. NODATA, SATURATION)	Based on Radiometric_Info (PIXELS_NO_DATA_PROC and SATURATED_PIXELS_PROC) available at Datastrip level (cf. Table 3-43).
Product_Image_Characteristics/Image_Display_Order/RED_CHANNEL Product_Image_Characteristics/Image_Display_Order/GREEN_CHANNEL Product_Image_Characteristics/Image_Display_Order/BLUE_CHANNEL	Spectral bands (Relation between product image channels and on board spectral bands)	Information available at Datastrip level (cf. Table 3-43).
Product_Image_Characteristics/Product_Image_SizeDImension_List/Dimensions/ Detector_Dimensions/NROWS Product_Image_Characteristics/Product_Image_SizeDImension_List/Dimensions/ Detector_Dimensions/NCOLS	Product Image size (by band x detector)	Based on Granule dimensions
Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/RESOLUTION Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/Wavelenght/MIN Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/ Wavelenght/MAX Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/ Wavelenght/CENTRAL Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/Spectral_Response/STEP Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/Spectral_Response/VALUES	Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION	Information available at Datastrip level (cf. Table 3-43).
Product_Image_Characteristics/PHYSICAL_GAINS	Physical Gain for each band	

General_Info		
Field Name	**Description**	**Note**
Product_Image_Characteristics/REFERENCE_BAND	Reference Band used in the processing	

Table 4-17: Level-1A Product_Metadata_File - General_Info Description

Geometric_Info:
All geometric product information are described in the Table 4-10.

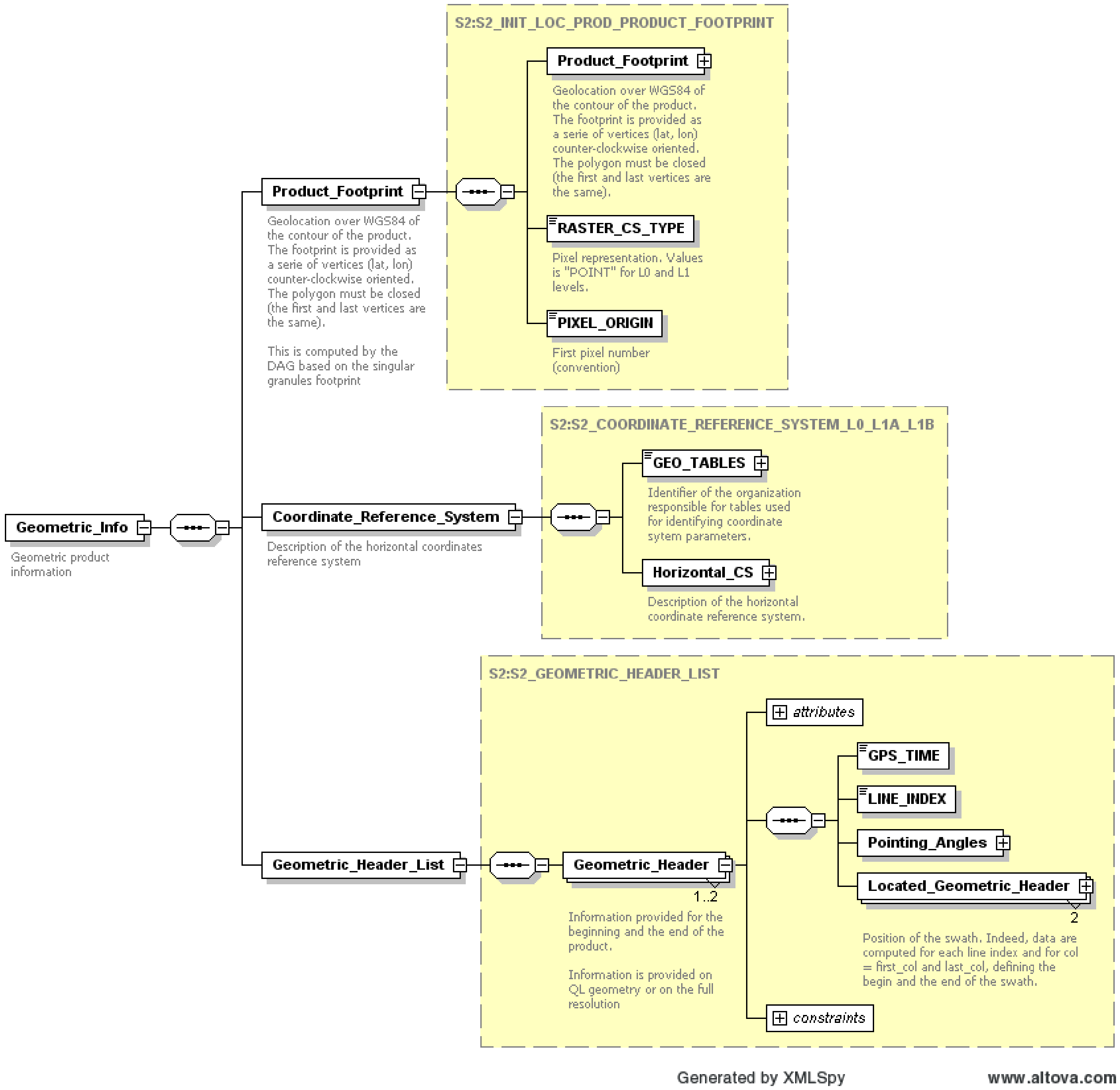


Figure 68: Level-1A Product_Metadata_File – Geometric_Info Diagram

Auxiliary_Data_Info:
All auxiliary data information are described in the Table 4-11.

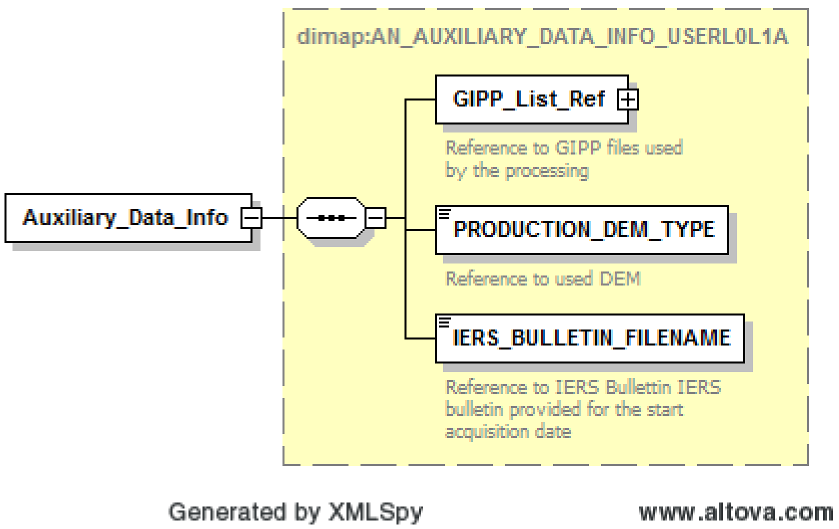


Figure 69 : Level-1A Product_Metadata_File – Auxiliary_Data_Info Diagram

Quality_Indicators_Info:

All Quality_Indicators_Info are the same described in the Table 4-12.

All OLQC checks performed on L1A Granules/Datastrips and related to a specific checklist name (cf. Annex C), are in the Table 3-17 and Table 3-24.

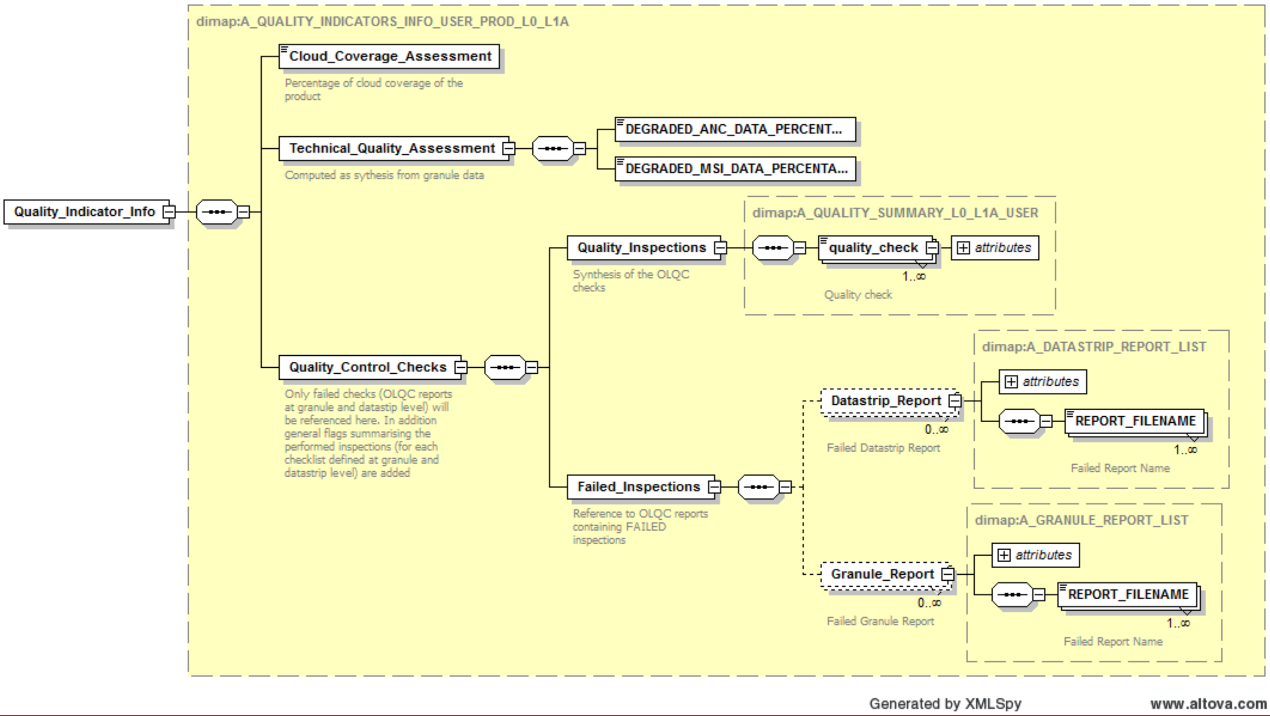
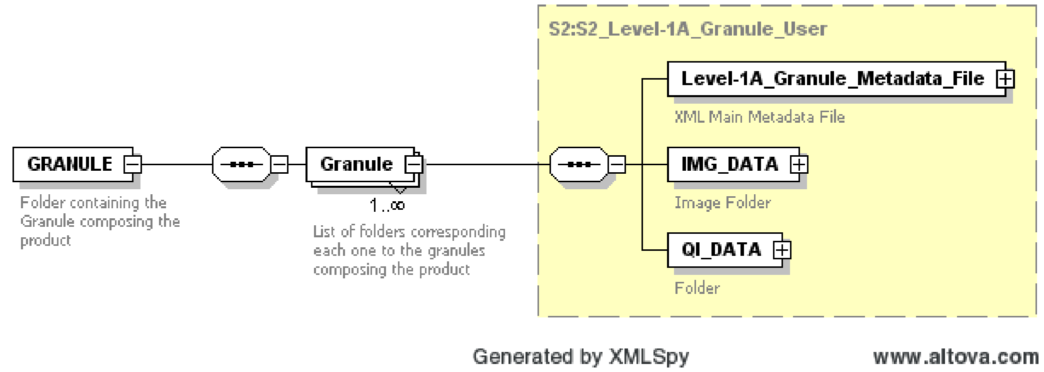
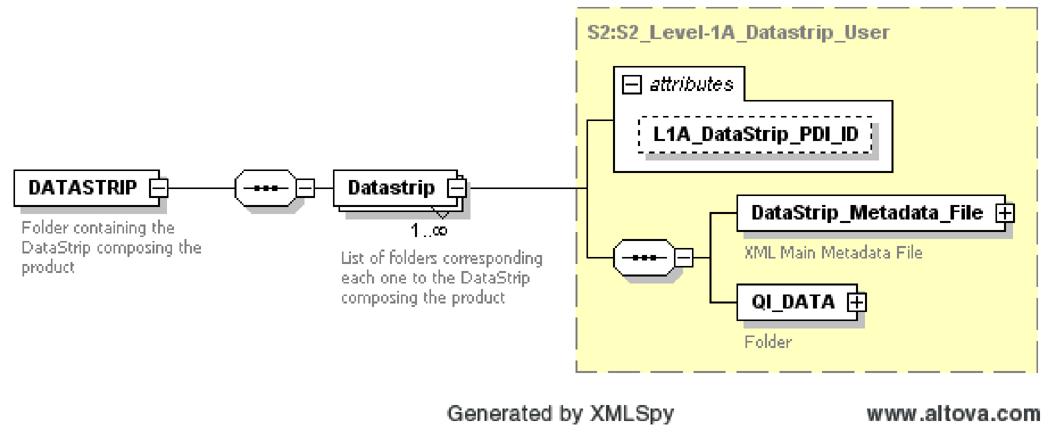


Figure 70 : Level-1A Product_Metadata_File – Quality_Indicators_Info Diagram

4.7.7.2 GRANULE

diagram	
annotation	GRANULE folder is a “folder of folders” each one corresponding to the Granules composing the product and identified by proper PDI_ID (Granule_ID). The structure of each Granule included in the product is the same of the Level-1A PDI Granule described in the section 3.8.3 taking into account that: 1. the Granule metadata copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.7.6), 2. the XML Level-1A_Granule_Metadata_File is validated using the *S2_PDI_Level-1A_Granule_Metadata.xsd* schema annexed to the document, 3. the *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Granule PDI is included in the User Product (cf. section 3.8.3).

4.7.7.3 DATASTRIP

diagram	
annotation	DATASTRIP folder is a “folder of folders” each one corresponding to the Datastrip composing the product and identified by proper PDI_ID (Datastrip_ID). The structure of each Datastrip included in the product is the same of the Level-1A PDI Datastrip described in the section 3.9.3 taking into account that:

	1. the Datastrips metadata are copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.7.6), 2. the XML Datastrip_Metadata_File is validated using the *S2_PDI_Level-1A_Datastrip_Metadata.xsd* schema annexed to the document, 3. *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Datastrip PDI is included in the User Product (cf. section 3.9.3).

4.7.7.4 AUX_DATA

diagram	
annotation	All Auxiliary Data used for Level-1A processing are referenced through the Product_Metadata_File. GIPP files and IERS Bulletin file can be provided if requested by the user (download option). DEM is not provided itself inside the product but only as a reference to the data used.

4.7.7.5 Browse_Image

diagram	
annotation	Browse Image file in PNG format. The Browse Image is included in the User Product if required by the user (download option). This Browse Image is based on the PVI extracted from the Level-1C Tile PDI (JPEG2000 low resolution extraction, 3 visible-bands in ground geometry at 320m resolution, RGB).The final geometric representation of the preview is defined by the user according to its region of interest (either geographic or cartographic representation).

4.7.8 Level-1A Granules Aggregation

As image viewer may not support well the high number of Granules constituting the L1A/L1B S2 User Products.

To handle more easily the Level-1A (and Level-1B) products, it is possible, when requested as a download-option, merge the Granule data and metadata of a Level-1A product (and Level-1B) along the satellite track direction.

This option (known as *concatenation of Granules along-track* or *aggregation of Granules*) allows to create one image per detector grouping all single Granules along track therefore producing at maximum 12 JPEG2000 images per band that can be displayed with a JPEG2000 viewer.

For all details regarding to the Tile consolidation algorithm refers to the reference document [CCTS-US].

The following figure shows an example of L1A Granules (on the right) and L1A/L1B granules aggregated along-track (on the left) included in an Area-Of-Interest selected by the user.

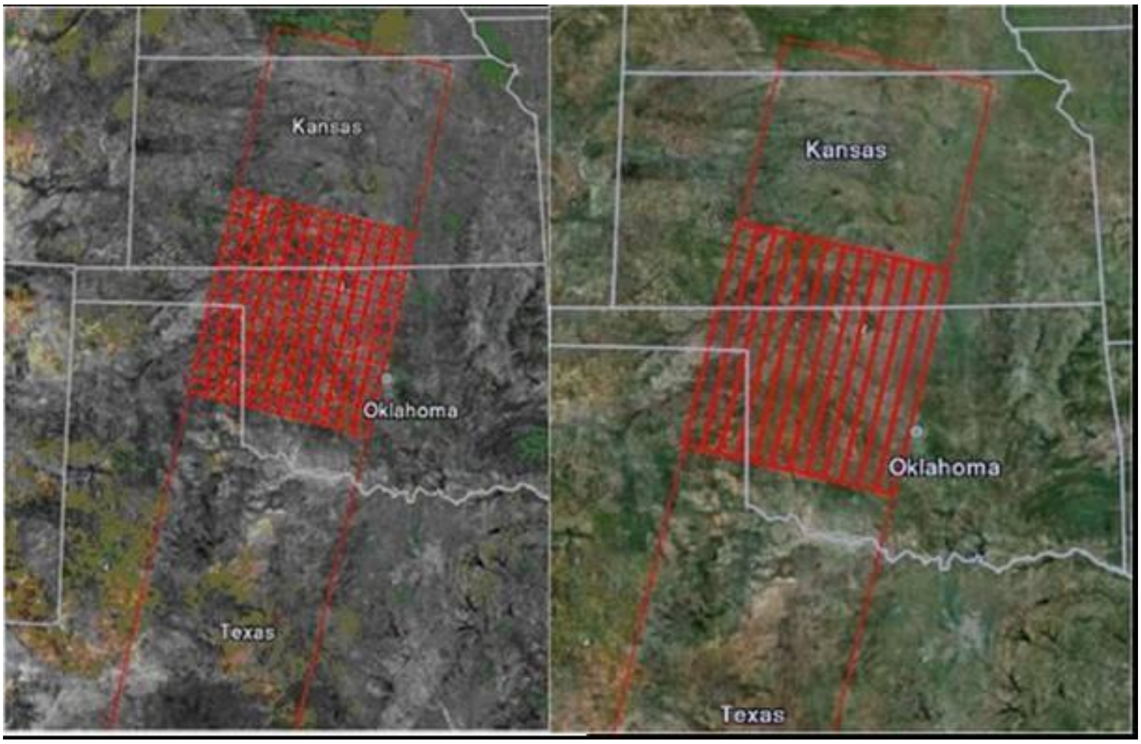


Figure 71 : Example of Level-1A Granules Aggregation

The Along-Track Aggregation Granules is a download option that can be selected by the user (cf. Section 4.4).

In this case the GRANULE folder of the User Product does not contain one folder for each elementary Granule composing the product but one folder for each Granule Aggregated and, as mentioned above, the User Product contains at maximum 12 folders each one corresponding to one detector.

Inside each folder, there are 13 image data files in JPEG2000 format (one for each spectral band) stored in the IMG_DATA sub-folder and ONE metadata file which envelops all the elementary Granules composing the aggregation.

4.7.8.1 Aggregated Granules ID

The Granule ID in case of L1A and L1B Granule aggregated follows the same naming convention defined in the sections 3.8.1 and 3.10.1 with file type **MSI_L1A_GA** and **MSI_L1B_GA**.

File name template:

- *S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_N01.01*
- *S2A_OPER_MSI_L1B_GA_SGS__20130419T100000_S20091211T165928_D05_N01.01*

4.7.8.2 Level-1A Aggregated Granules Physical Format

Based on Level-1A Granule PDI Physical format, the Granule aggregated is composed by:

- **Metadata_File (one XML file):**
  Template name:
  S2A_OPER_MTD_L1A_GA_SGS__20130419T100000_S20091211T165928_D07.xml

  Validated using the *S2_PDI_Level-1A_Granule_Metadata.xsd* schema annexed to the document.

- **IMG_DATA (fixed folder name):**
  Template names for the image files contained in the IMG_DATA folder of the Granule aggregated corresponding to the Detector 7:

  S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_B01.jp2
  S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_B02.jp2
  S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_B03.jp2
  …
  S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_B12.jp2

- **QI_DATA (fixed folder name):**
  QI_DATA folder contains:
  - All *OLQC_Report.xml* reports;

Template filename:
S2A_OPER_MSI_L1A_GA_SGS__20130419T100000_S20091211T165928_D07_SENSOR_GEOMETRY.xml

- Quality_Masks (one for each type, GML/JPEG2000).

Template masks filename:
S2A_OPER_MSK_CLOLOW_SGS__00000000T000000_S20091211T165928_D07_B00_MSIL1A.gml

S2A_OPER_MSK_DEFECT_SGS__00000000T000000_S20091211T165928_D07_B00_MSIL1A.gml

S2A_OPER_MSK_NODATA_SGS__00000000T000000_S20091211T165928_D07_B00_MSIL1A.gml

S2A_OPER_MSK_SATURA_SGS__00000000T000000_S20091211T165928_D07_B00_MSIL1A.gml

S2A_OPER_MSK_TECQUA_SGS__00000000T000000_S20091211T165928_D07_B00_MSIL1A.gml

Note that the quality masks are aggregated as well. This means that the quality masks are generated performing an APPEND of all mask files related to each Granule concatenated.

4.7.8.3 Metadata of Aggregated Granules

The metadata file envelops all the Granule metadata PDI composing the aggregation. The schema used to validate it is the same of the ones defined for L1A/L1B Granule PDI and annexed to the document.

The following table describes the meaning of each Granule metadata in case of Granule aggregated.

General_Info		
Field Name	**L1A Granule**	**L1A Granule Aggregated**
GRANULE_ID	Granule PDI Identifier.	Granule Aggregated Identifier as defined in the section 4.7.8.1.
DETECTOR_ID	Detector identifier.	Detector Identifier.
DATASTRIP_ID	Datastrip Identifier.	As the two uncompleted Tiles are on two Datastrip, this metadata contains two different Datastrip Identifiers.
DOWNLINK_PRIORITY	Downlink priority flag.	Downlink priority flag.
SENSING_TIME	Imaging Start Time in UTC data time.	Imaging Start Time in UTC data time.
Archiving_Info/ARCHIVING_CENTRE	Archiving Centre.	Archiving Centre.
Archiving_Info/ARCHIVING_TIME	Archiving date (UTC data time).	Archiving date (UTC data time).
Geometric_Info		
Field Name	**Description**	

Granule_Footprint/Granule_Footprint	Geolocation of the four corners of the elementary Granule (Lat, Lon, H coordinates with horizontal CRS as WGS84 and altitude given over EGM96).	Geolocation of the four corners of the Granule aggregated (Lat, Lon, H coordinates with horizontal CRS as WGS84 and altitude given over EGM96).
Granule_Footprint/RASTER_CS_TYPE	Pixel representation. Fixed values is "POINT".	Pixel representation. Fixed values is "POINT".
Granule_Footprint/PIXEL_ORIGIN	First pixel number (convention). Fixed value is “1”.	First pixel number (convention). Fixed value is “1”.
Granule_Position/POSITION	Position of the Granule in the Datatake. This position is identified through the position of the first line of the first scene in the Datatake and it is expressed as number of 10m resolution images lines.	Position of the Granule in the Datatake. This position is identified through the position of the first line of the first scene in the Datatake and it is expressed as number of 10m resolution images lines.
Granule_Position/Geometric_Header/GROUND_CENTER	Geolocation of the Granule centre (Lat, Lon, H).	Geolocation of the centre (Lat, Lon, H) of the Granule aggregated.
Granule_Position/Geometric_Header/QL_CENTER	The Granule centre in the QL display: 1 (r,c) point.	The Granule aggregated centre in the QL display: 1 (r,c) point.
Granule_Position/Geometric_Header/Incidence_Angles	Incidence angles corresponding to the centre of the Granule.	Incidence angles corresponding to the centre of the Granule aggregated.
Granule_Position/Geometric_Header/Solar_Angles	Solar angles corresponding to the centre of the Granule.	Solar angles corresponding to the centre of the Granule aggregated.
Granule_Dimension/Size/NROWS	Granule dimensions provided for each resolution band (10m, 20m and 60m) Number of Row	Granule aggregated dimensions provided for each resolution band (10m, 20m and 60m) Total Number of Row
Granule_Dimension/Size/NCOLS	Granule dimensions provided for each resolution band (10m, 20m and 60m) Number of Columns	Granule aggregated dimensions provided for each resolution band (10m, 20m and 60m) Number of Columns It is the same of an elementary Granule.
Quality_Indicators_Info		
Field Name	**Description**	
Image_Content_QI/CLOUDY_PIXEL_PERCENTAGE	Percentage of cloud coverage for each L1A Granule.	Average of the percentage of cloud coverage

		computed for each L1A Granule composing the Granule aggregated.
Image_Content_QI/DEGRADED_MSI_DATA_PERCENTAGE	Percentage of degraded MSI data for each L1A Granule.	Average of the percentage of degraded MSI data computed for each L1A Granule composing the Granule aggregated.
Pixel_Level_QI/MASK_FILENAME	Pointer to the mask files contained in the QI_DATA folder of the Granule.	Pointer to the mask files contained in the QI_DATA folder of the Granule aggregated.

An example of the Granules aggregated metadata file is provided in the Annex F.

Note that the Aggregation option is addressed at product level setting TRUE the AGGREGATION_FLAG metadata.

4.7.9 User Product Level-1A SAFE Manifest synoptic table

The final User Product contains only one main *manifest.safe* file. The *manifest.safe* files related to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product, all lower level PDI are removed.

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1A User Product, including a synoptic table with the list of the metadata information to be included in the SAFE Manifest.

Since the User Product metadata refers to the contained Granules and Datastrips, the structure of the Manifest is based on the Level-1A Manifests provided for Granules and Datastrip (cf. sections 3.8.4 and 3.9.4).

Same considerations as in section 4.6.8 applies for what concerns compliancy to SAFE specification [SAFE-SPEC] and content of the synoptic tables, with the exception that the Data Objects Section does not contain, differently from the Level-0 User Product, an ANC_DATA folder.

A practical example of Manifest file for the Level-1A User Product is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	Level-1A_User_Product->General_Info->Product_Info->Datatake->SPACECRAFT_NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	Level-1A_User_Product->General_Info->Product_Info->Datatake->SPACECRAFT_NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument-> **abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	Level-1A_User_Product->General_Info->Product_Info->Datatake->DATATAKE_TYPE	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Raw_Measurement Test_Mode
	instrument->mode-> **identifier**	Level-1A_User_Product->General_Info-> Product_Info->Datatake->DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name		Name of the L0 to L1A Processing	string	0..1	Generation of L1A User Product
	start	Level-1A_User_Product-> General_Info->Product_Info->GENERATION_ TIME	Processing start date (UTC)	xs:dateTime	0..1	
	facility	N.A.	Description of Processing Centre		0..*	
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	Level-1A_User_Product->GRANULE->General_Info->GRANULE_ID (substring <Site Centre>, cf. section 3.6.1)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	facility->software	N.A.	Description of software component used for Processing		0..*	
	facility->software->**name**	N.A	Name of the software component	string	1	
	facility->software->**version**	N.A	Version of the software component	string	0..1	
	resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS		0..*	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
			Bulletin etc.) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are provided with the product.			
	resource->**name**	Level-1A_User_Product->DATASTRIP->Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-1A_User_Product->DATASTRIP->Auxiliary_Data_Info->IERS_Bulletin Level-1A_User_Product->DATASTRIP->Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME	Name of the auxiliary or ancillary files/folders needed for the Processing	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	
	acquisitionPeriod ->startTime	Level-1A_User_Product->General_Info->Product_Info->Datatake->DATATAKE_SENSING_START	Reference time of acquisition of the product	xs:dateTime	1	
measurementFrameSet					1	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	footPrint	Derived from Level-1A_User_Product->Geometric_Info->Product_ Footprint	Product footprint (namely imaged landscape corresponding to the whole product)	string (gml:linearRingType namely blank separated list of comma-separated long/lat coordinates of footprint closed polygon with last vertex equal to first)	0..1	
measurementOrbitReference						
	orbitNumber	Level-1A_User_Product->General_Info->Product_Info->Datatake->DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the first Granule of the User Product		0..1	start
	orbitNumber->**groundTrackDirection**	Level-1A_User_Product->General_Info->Product_Info->Datatake->SENSING_ORBIT_DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to orbitNumber->type (start or stop)		0..1	ascending, descending

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1A_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	relativeOrbitNumber	Level-1A_User_Product->General_Info->Product_Info->Datatake->SENSING_ORBIT_ NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber-> **type**	N.A.	Relative orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		Level-1A_User_Product->DATASTRIP->Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-1A_User_Product->DATASTRIP->Auxiliary_Data_Info-> IERS_Bulletin Level-1A_User_Product->DATASTRIP->Auxiliary_Data_Info-> GIPP_List->GIPP_FILENAME	A reference to all ancillary/auxiliary Metadata files/folders included in the product (e.g. the XML Metadata file, the INSPIRE Metadata file, the Auxiliary Data files) or external to the product (the Ancillary Data files)		1..*	
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..1	

Table 4-18 - Content of Metadata section for Level-1A User Product SAFE Manifest

4.8 Level-1B User Product specification

4.8.1 Introduction

The Level-1B User Product is a *Radio-corrected and geo-refined* product obtained by performing radiometric corrections on the Level-1A data and refining its geometric model.
The Radiometric corrections are applied to obtain a Level-1B User Product but the geo-refinement model is only appended to the metadata and never applied to the product.
The following table introduces the input data of Level-1B processing:

Input of Level-1B processing	Description
Metadata	Metadata from Level-1A product
Image Data	Uncompressed image data (from Level-1A, in the data flow)
Auxiliary Data	GIPP : Parameters from Level-1A complemented by radiometric and geometric processing parameters. GRI (Global Reference Images): only the reference to the data used is provided. DEM: only the reference to the data used is provided.
Quality Indicator Data	Quality Indicator files from Level-1B

Table 4-19: Input for Level-1B processing

The Level-1B corrections include:

- Radiometric corrections:
  - dark signal
  - pixel response non uniformity
  - crosstalk correction
  - defective pixels
  - High spatial resolution bands restoration: deconvolution and denoising based on a wavelet processing (if necessary according to certain noise criteria).
  - Binning for 60m bands (spatial filtering)
- Physical geometric model refinement using GCPs provided by the GRI; this model is not applied to the image but appended to the metadata
- Pixel classification: singular pixels detections (defectives pixels, saturations, nodata).

No resampling is performed up to Level-1B.

The geometric model refinement of the Level-1B is optional. A dedicated flag in the metadata notifies whether the geometric model provided is the raw model or the refined model.

Note that one Level-1B product:

- refers always to one Datatake;
- refer to one or several Datastrip from the same Datatake;
- may cover the full Datatake or an extract of the Datatake.

In the case of an extract, the image data are provided to cover only the selected area.

The following figure gives an overview of the Level-1B User Product physical format. The yellow boxes correspond to folders and the white ones to files:

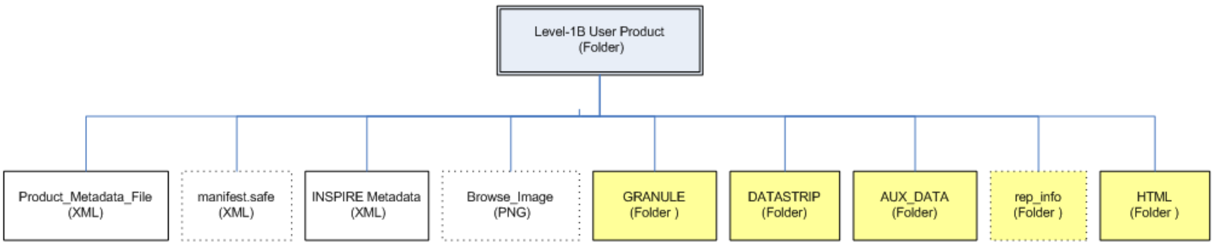


Figure 72: Level-1B User Product Structure

The Level-1B User Product consists of:

1. **Product_Metadata_File**: mandatory XML main metadata file.
2. **manifest.safe**: SAFE metadata file (optional). It is included in the product only if the user requests the SAFE as output format (download option).
3. **GRANULE**: folder containing all Granules composing the product (Image Data). The Image Data extent (raster files) correspond to a set of Granules and can covers up to *12 detectors * 13 bands* of the orbit in full resolution. A sub-set of the 13 bands can be provided (download option).
4. **DATASTRIP**: folder containing the Datastrip composing the product linked to the selected Granules.
5. **AUX_DATA**: folder containing, if requested by the user (download option), the GIPP files and IERS Bulletins used for the Level-1B User Product production. All Level-1B auxiliary data are referenced in the product metadata file.
6. **Browse_Image**: PNG file consisting of an image limited to 3 visible-bands in ground geometry at 320m resolution. This file, provided if requested by the user (download option), gives an overview of the product (sub-sampled) mainly for image data browsing and selection purposes.
7. **rep_info**: folder containing the XSD schema provided inside the product. This folder is optional. It is included in the User Product if the user selects the SAFE format as output format (download option).
8. **INSPIRE**: XML INSPIRE metadata file (cf. Annex B).
9. **HTML**: folder containing an HTML product presentation file (UserProduct_index.html) and the corresponding stylesheet (UserProduct_index.xsl).

4.8.2 Image Data

The Level-1B image data correspond to a collection of Granules. The image data extent correspond to a set of Granules and can cover *up to 12 detectors * 13 bands of the orbit in full resolution*. A sub-set of the 13 bands can be provided (same approach as Level-1A).

Each Level-1B Granule is identified in a unique way, using a unique identifier PDI_ID defined in the section 3.10.1.

4.8.2.1 *Image Data Encoding and Files*

Each image pixel value is encoded on 12 useful bits (as on-board).
The image data are provided as separated files for each spectral band (i.e. in total of 13 GML/JPEG2000 files per Granule).

As per a Level-1A product, the Level-1B product will be available to the final user according to two delivery options:

- Either one file per spectral band and per Granule;
- Either a file per spectral band corresponding to the concatenation of *Granules along-track* also called *aggregation of Granules* (§ 4.7.8).

4.8.3 Ancillary Data

The raw Satellite Ancillary Data are not embedded in the Level-1B User.

4.8.4 Auxiliary Data

All Auxiliary Data used for Level-1B processing are referenced in the product metadata file:

- IERS bulletin file,
- Ground Image Processing Parameters (GIPPs) files (cf. Annex D),
- Reference to the used DEM;
- Reference to the used GRI.

The final user, according to a specific download option, will be able to include in the Level-1B User Product, the IERS bulletin and/or the used GIPP files. DEM and GRI are never provided within the product but only referenced at metadata level.

4.8.5 Quality Indicators

Level-1B quality indicators are derived from Level-1A ones and are complemented by quality indicators relevant to the processing applied.

The *Product Level Quality Indicators* are provided at product level and referenced through the metadata file.

The *Granule Level Quality Indicators* are provided at Granule level and referenced through the metadata file.

The *Pixel Level Quality Indicators* are provided at Granule level through dedicated quality mask files pointed through the Granule level metadata file.

4.8.6 Metadata

The following table shows the groups of metadata provided inside a Level-1B User Product:

Level-1B User Product Metadata	
Product Level Metadata	All product level metadata, specific for the User level, are consolidated/computed because not present at Granule and Datastrip level.
Granule Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Granule level are copied from the input Granules to the User Product.
DATASTRIP Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Datastrip level are copied from the input Datastrips to the User Product;

Table 4-20: Level-1B Product Metadata

As mentioned in the section 2.10, the User Product metadata (all) are not provided with a *metadataLevel* attribute (Brief/Standard/Expertise) unlike what happens for all Granule and Datastrip metadata.

During the User Product assembling, this attribute is used to select by filtering, according to a download option, the set of metadata that must be included in the User Product.

For these filtered fields, the *metadataLevel* attribute is not written in the User Product's metadata.

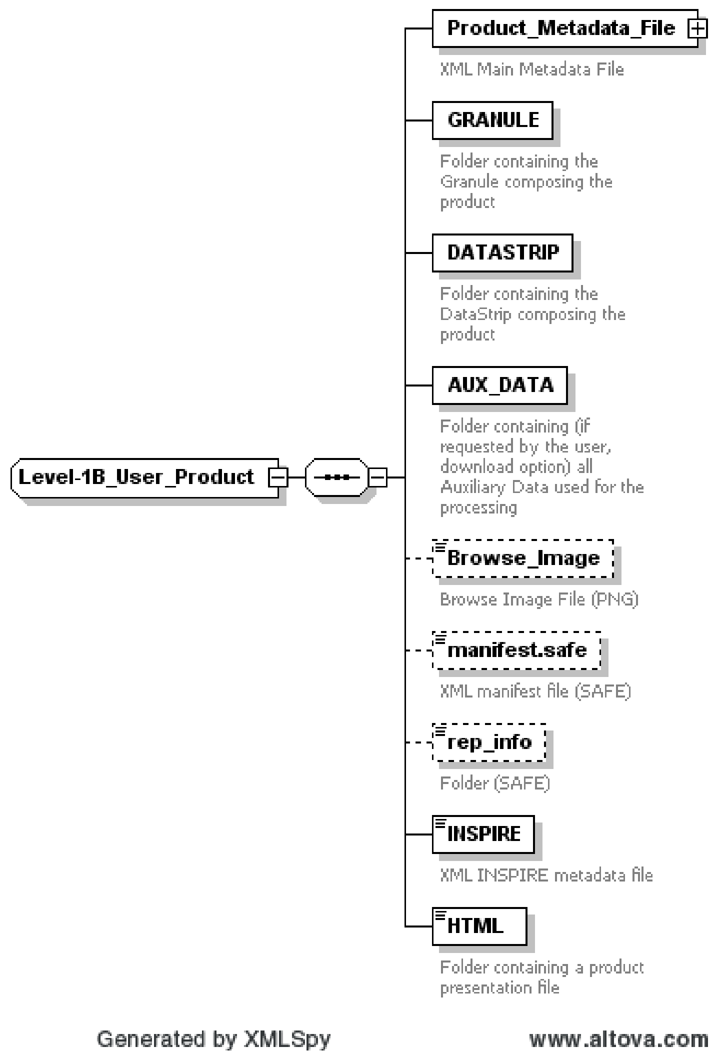
Note that a User Product for an expert user (Expertise download option) will contain all level of metadata (Brief/Standard/Expertise). A User Product for a user with “Standard” or “Brief” permission will contain only Brief/Standard or Brief metadata.

In addition to the metadata in the table above, the User Product contains the *manifest.safe* metadata (when the User Product is SAFE format) and the INSPIRE metadata.

The Level-1B Product Metadata are detailed in the section 4.8.7.

4.8.7 User Product Level-1B Structure

The *S2_User_Product_Level-1B_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the structure of a S2 Level-1B User Product. This schema is provided for information only as it is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the structure shown in the Figure 72.

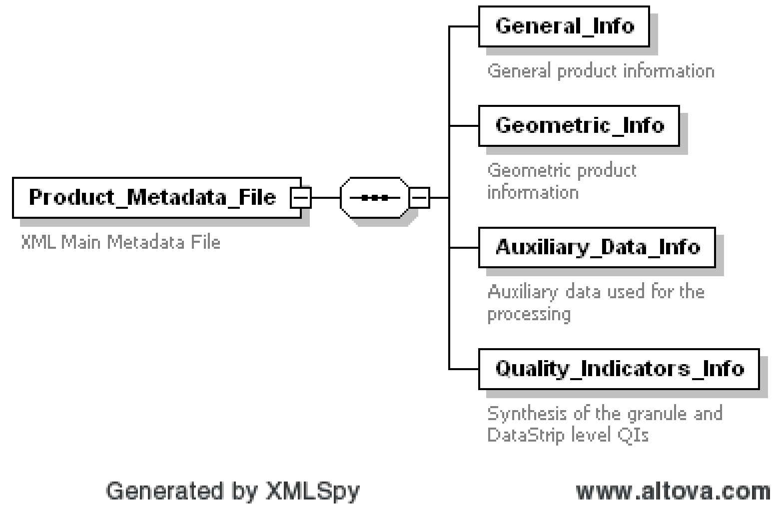
diagram	
children	**Product_Metadata_File GRANULE DATASTIP AUX_DATA Browse_Image manifest.safe rep_info INSPIRE HTML**
Description	Level-1B User Product contains: 1. **Product_Metadata_File**: XML Main Metadata file. 2. **GRANULE**: folder containing the list of the Granules belonging to the User Product

	(the Granule structure is described in the section 3.10.3). 3. **DATASTRIP**: folder containing the list of the Datastrip belonging the Datatake from which Level-1B User Product has been selected (the Datastrip structure is described in the section 3.11.3). . 4. **AUX_DATA:** folder containing all Auxiliary Data used for Level-1B processing (optional, the aux data will be included in the product if selected according to a specific download option). 5. **Browse_Image**: PNG file for image data browsing and selection purposes. 6. **manifest.safe**: XML SAFE Manifest file 7. **rep_info**: optional folder containing the XSD schema 8. **INSPIRE.xml**: XML INSPIRE metadata file 9. **HTML**: folder containing an HTML product presentation file and the corresponding stylesheet

4.8.7.1 *Product_Metadata_File Schema*

Product_Metadata_File is the XML metadata file provided inside the S2 Level-1B User Product. The XSD schema annexed to this document and used to validate it is *S2_User_Product_Level-1B_Metadata.xsd.*

A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Auxiliary_Data_Info Quality_Indicators_Info
Description	The Product_Metadata_File describes the product data items. It is presented to the user as a structured container of information. Product_Metadata_File is an XML file containing: 1. **General_Info**: provides general product information. 2. **Geometric_Info**: describing the geolocation over WGS84 of the contour of the product. 3. **Auxiliary_Data_Info**: Links to the AUX_DATA items. 4. **Quality_Indicators_Info**: Synthesis of the Granule and Datastrip level QIs.

The following figures and tables give a complete description of the User Product metadata.

General_Info:

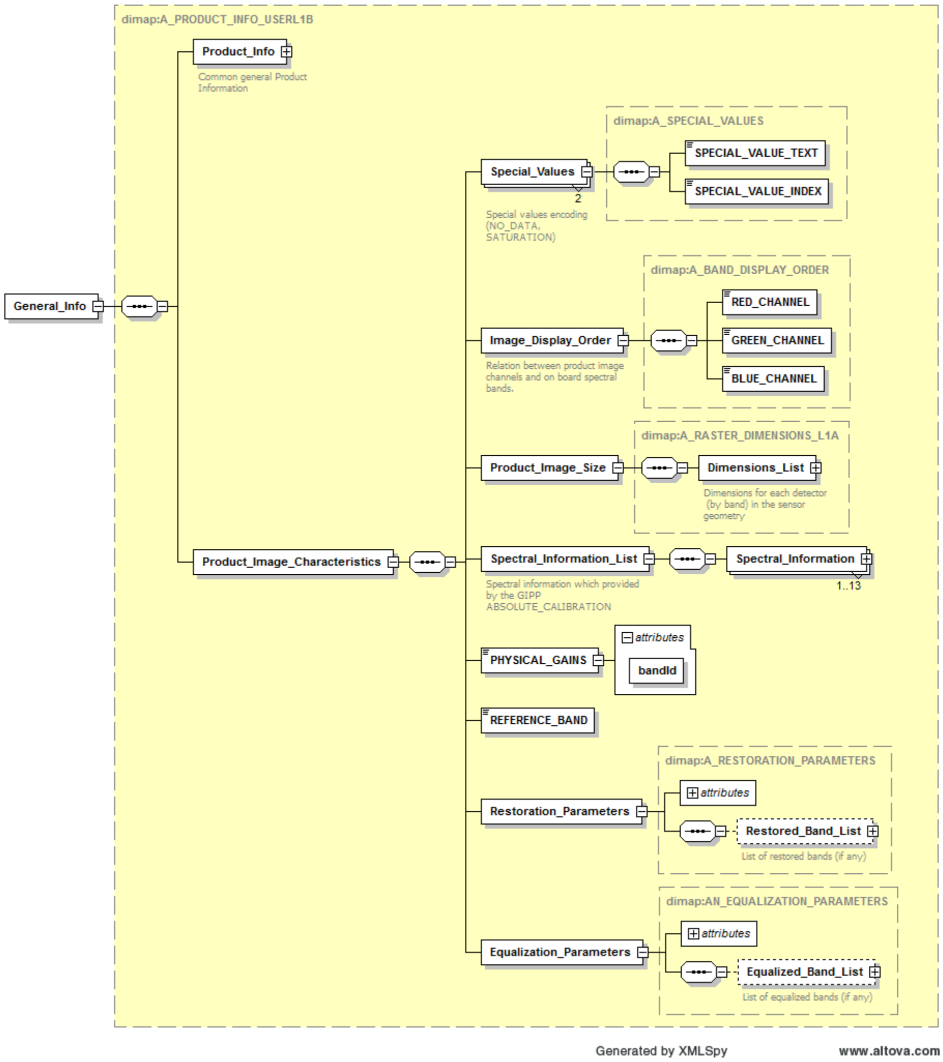


Figure 73 : Level-1B Product_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Note**
Product_Info	This group of metadata is described in the Table 4-9.	Table 4-9
Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_TEXT Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_INDEX	Special values encoding (e.g. NODATA, SATURATION)	Based on Radiometric_Info (PIXELS_NO_DATA_PROC and SATURATED_PIXELS_PROC) available at Datastrip level.
Product_Image_Characteristics/Image_Display_Order/RED_CHANNEL Product_Image_Characteristics/Image_Display_Order/GREEN_CHANNEL Product_Image_Characteristics/Image_Display_Order/BLUE_CHANNEL	Spectral bands (Relation between product image channels and on board spectral bands)	Information available at Datastrip level (cf. Table 3-51).
Product_Image_Characteristics/Product_Image_SizeDImension_List/Dimensions/ Detector_Dimensions/NROWS Product_Image_Characteristics/Product_Image_SizeDImension_List/Dimensions/ Detector_Dimensions/NCOLS	Product Image size (by band x detector)	Based on Granule dimensions
Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/RESOLUTION Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/Wavelenght/MIN Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/ Wavelenght/MAX Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/ Wavelenght/CENTRAL Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/Spectral_Response/STEP Product_Image_Characteristics/Spectral_Information_List/Spectral_ Information/Spectral_Response/VALUES	Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION	Information available at Datastrip level
Product_Image_Characteristics/PHYSICAL_GAINS	Physical Gain for each band	
Product_Image_Characteristics/REFERENCE_BAND	Reference Band used in the processing	

General_Info		
Field Name	**Description**	**Note**
Restoration_Parameters/Restored_Band_List/Restored_Band/RESTORATION_SCENARIO Restoration_Parameters/Restored_Band_List/Restored_Band/Levelling_Values/XMIN Restoration_Parameters/Restored_Band_List/Restored_Band/Levelling_Values/XMAX	Restoration parameters (list of restored bands, type of restoration and levelling values).	Available at Datastrip level, cf. Table 3-51
Equalization_Parameters/Equalized_Band_List/Equalized_Band/OFFSET_PROC Equalization_Parameters/Equalized_Band_List/Equalized_Band/DARK_SIGNAL_NON_UNIFORMITY_PROC	Equalization parameters	Available at Datastrip level, cf. Table 3-51

Table 4-21: Level-1B Product_Metadata_File - General_Info Description

Geometric_Info:
all geometric product information are described in the Table 4-10.

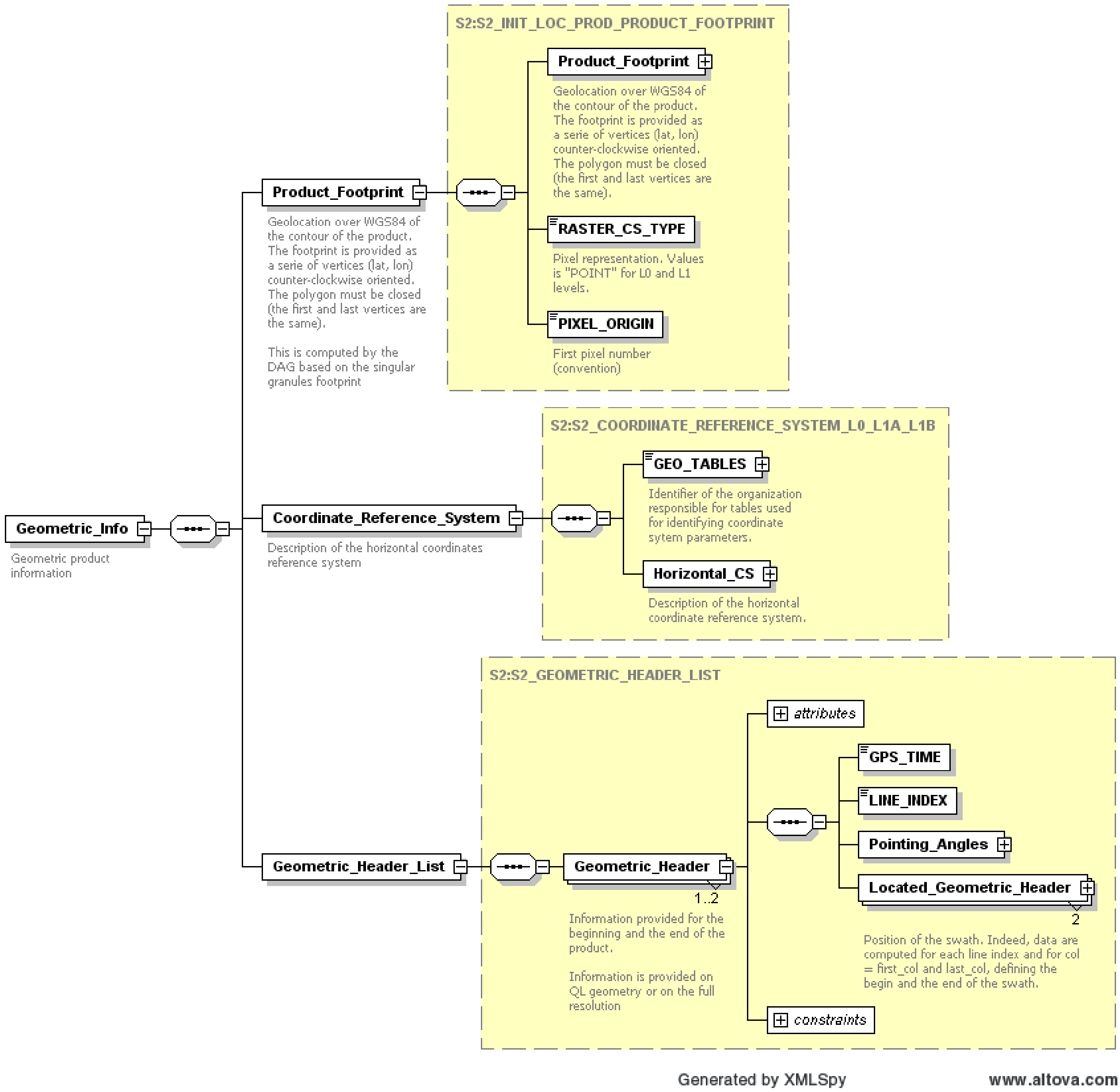


Figure 74: Level-1B Product_Metadata_File – Geometric_Info Diagram

Auxiliary_Data_Info:

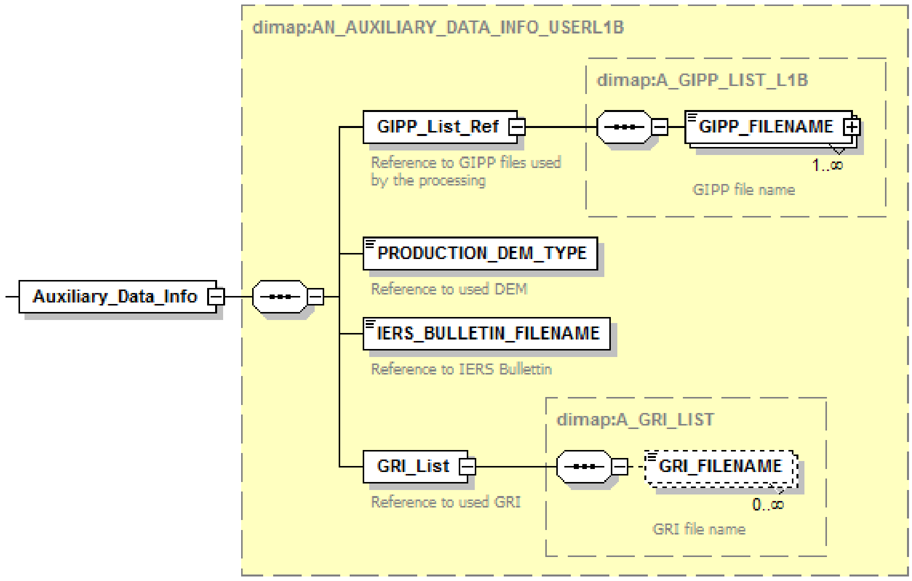


Figure 75 : Level-1B Product_Metadata_File – Auxiliary_Data_Info Diagram

Auxiliary_Data_Info		
Field Name	**Description**	**Note**
GIPP_FILENAME	Reference to the used GIPP files.	Available at Datastrip level, cf. Table 3-53
PRODUCTION_DEM_TYPE	Reference to the used DEM	Available at Datastrip level, cf. Table 3-53
IERS_BULLETIN_FILENAME	Reference to the used IERS Bulletin	Available at Datastrip level, cf. Table 3-53
GRI_FILENAME	Reference to the used GRI data	Available at Datastrip level, cf. Table 3-53

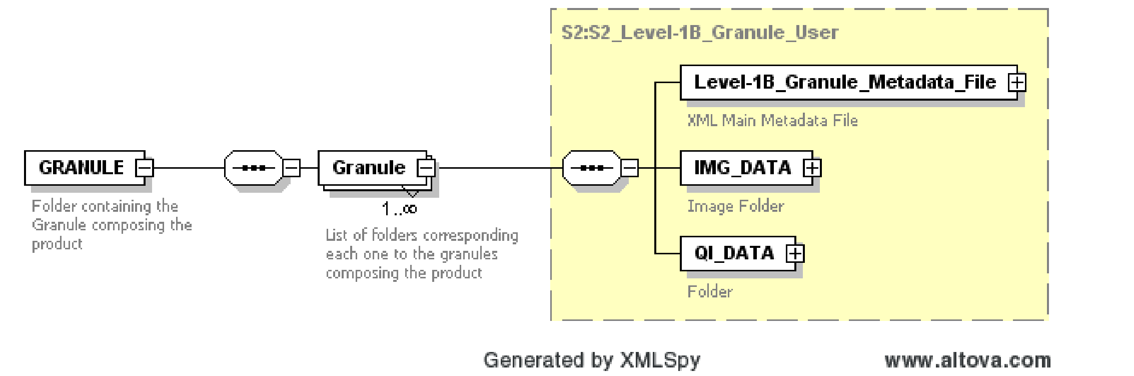
Table 4-22: Level-1B Product_Metadata_File - Auxiliary_Info Description

Quality_Indicators_Info:
The Quality_Indicators_Info are described in the Table 4-12.
In addition the Level-1B User Product contains the RADIOMETRIC_QUALITY check based on the OLQC reports contained in the Datastrips/QI_DATA with RADIOMETRIC_QUALITY checklist name.

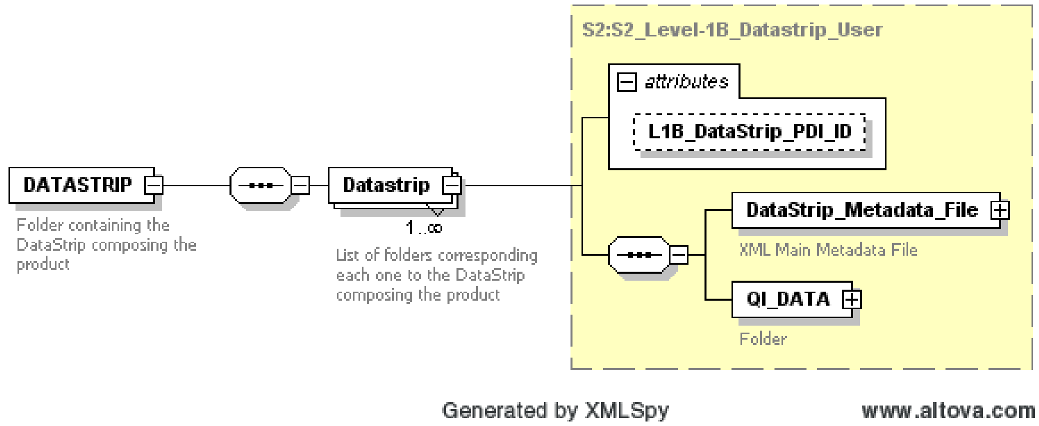
RADIOMETRIC_QUALITY check is FAILED if at least one report at Datastrip level is with *globalStuatus* FAILED.

All OLQC checks performed on L1B Granules/Datastrips and related to a specific checklist name (cf. Annex C), are in the Table 3-17 and Table 3-24.

4.8.7.2 GRANULE

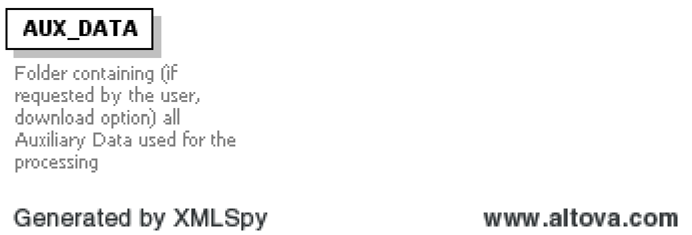
diagram	
annotation	GRANULE folder is a "folder of folders" each one corresponding to the Granules composing the product and identified by proper PDI_ID (Granule_ID). The structure of each Granule included in the product is the same of the Level-1B PDI Granule described in the section 3.10.3 taking into account that: 1. the Granule metadata are copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.8.6), 2. the XML Level-1B_Granule_Metadata_File is validated using the *S2_PDI_Level-1B_Granule_Metadata.xsd* schema annexed to the document, 3. the *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Granule PDI is included in the User Product (cf. section 3.10.3).

4.8.7.3 DATASTRIP

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>annotation</td><td>DATASTRIP folder is a “folder of folders” each one corresponding to the Datastrip composing the product and identified by proper PDI_ID (Datastrip_ID).
The structure of each Datastrip included in the product is the same of the Level-1B PDI Datastrip described in the section 3.11.3 taking into account that:

1. the Datastrips metadata are copied in the User Product as they are except for the metadataLevel attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.8.6),
2. the XML Datastrip_Metadata_File is validated using the S2_PDI_Level-1B_Datastrip_Metadata.xsd schema annexed to the document,
3. Inventory_Metadata.xml, manifest.safe and rep_info are removed when the Datastrip PDI is included in the User Product (cf. section 3.11.3).</td></tr>
</table>

4.8.7.4 AUX_DATA

<table>
<tr><td>diagram</td><td>
</td></tr>
<tr><td>annotation</td><td>All Auxiliary Data used for Level-1B processing are referenced through the Product_Metadata_File. GIPP files and IERS Bulletin file can be provided if requested by the user (download option). DEM and GRI are not provided itself inside the product but only as a reference to the data used.</td></tr>
</table>

4.8.7.5 Browse_Image

diagram	
annotation	Browse Image file in PNG format. The Browse Image is included in the User Product if required by the user (download option). This Browse Image is based on the PVI extracted from the Level-1C Tile PDI (JPEG2000 low resolution extraction, 3 visible-bands in ground geometry at 320m resolution, RGB).The final geometric representation of the preview is defined by the user according to its region of interest (either geographic or cartographic representation).

4.8.8 User Product Level-1B SAFE Manifest synoptic table

The final User Product contains only one main *manifest.safe* file. The *manifest.safe* files related to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product, all lower level PDI are removed.

The content of the SAFE Manifest for the Level-1B User Product level is the same as for the Level-1A User Product level and can be exhaustively described through Table 3-29, Table 4-13 and Table 4-13 , except for the following minor differences in Table 4-13:

- a few specific text string in the “processing” section (containing “L1B” instead of “L1A”)
- the Level-1B User Product Manifest includes a reference to the GRI Auxiliary file, contained in the AUX_DATA folder (differently from Level-1A User Product); see tag “metadataComponents” in Table 4-13.

Since the User Product metadata refers to the contained Granules and Datastrips, the structure of the Manifest is based on the Level-1B Manifests provided for Granules and Datastrip (cf. sections3.10.4 and 3.11.4).

A practical example of Manifest file for the Level-1B User Product is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

4.9 Level-1C User Product Specification

4.9.1 Introduction

The Level-1C User Product is an orthoimage product, i.e. a map projection of the acquired image using a system DEM to correct ground geometric distortions. Pixel radiometric measurements are provided in Top-Of-Atmosphere (TOA) reflectances with all parameters to transform them into radiances.

The conversion formulae to apply to image Digital Numbers (DN) to obtain physical values is:

Reflectance (float) = DC / (QUANTIFICATION_VALUE)

Note that the reflectance meaningful values go from “1” to “65535” as "0" is reserved for the NO_DATA.

Level-1C products are resampled with a constant GSD (Ground Sampling Distance) of 10m, 20m and 60m according to the native resolution of the different spectral bands.

Input of Level-1C processing	Description
Metadata	Metadata from Level-1B
Image Data	Radiometrically and geometrically corrected image data
Ancillary Data	Ancillary data from the Level-1B (satellite and ground ancillary data, including the refined geometric model)
Auxiliary Data	GIPP: Parameters from Level-1B complemented by radiometric and geometric processing parameters
Quality Indicator Data	Quality Indicator files from Level-1B

Table 4-23: Input of Level-1C Processing

Note that one Level-1C product:

- refers always to one Datatake;
- refer to one or several Datastrip from the same Datatake;
- may cover the full Datatake or an extract of the Datatake.

In the case of an extract, the image data are provided to cover only the selected area.

By default, Level-1C is geometrically refined. Some Level-1C may not be geometrically refined (e.g. for Cal/Val purposes). These products are identified with a dedicated flag in the metadata.

The following figure gives an overview of the Level-1C User Product physical format. The yellow boxes correspond to folders and the white ones to files:

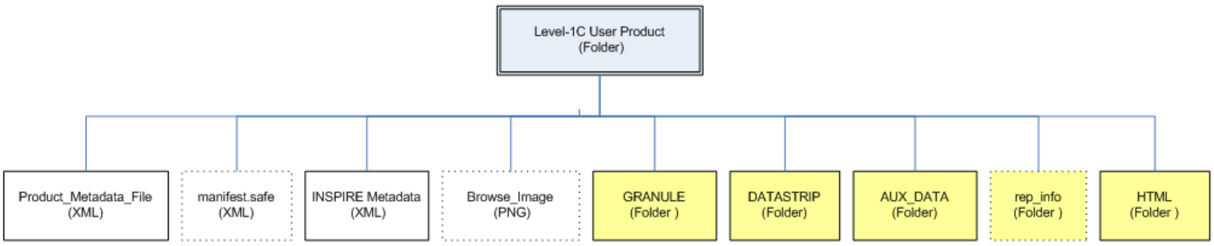


Figure 76: Level-1C User Product Structure

The Level-1C User product consists of:

1. **Product_Metadata_File**: mandatory XML main metadata file.
2. **manifest.safe**: SAFE metadata file (optional). It is included in the product only if the user requests the SAFE as output format (download option).
3. **GRANULE**: this folder (the name is chosen for homogeneity with respect to the other User Product but should be TILE) contains the tiles composing the product (Image Data). The Image Data corresponds to a set of Tiles containing one image file per band and the TCI corresponding to the coverage of the Tile itself. A sub-set of the 13 bands can be provided (download option).
4. **DATASTRIP**: folder containing the Datastrip composing the product linked to the selected tiles.
5. **AUX_DATA**: folder containing, if requested by the user (download option), the GIPP files and IERS Bulletins used for the Level-1C User Product production. All Level-1C auxiliary data are referenced in the product metadata file. In addition, the Level-1C User Product embeds always at GRANULE (TILE) level an elementary set of meteorological datasets resampled ECMWF in tile geometry.
6. **Browse_Image**: PNG file consisting of an image limited to 3 visible-bands in ground geometry at 320m resolution. This file, provided if requested by the user (download option), gives an overview of the product (sub-sampled) mainly for image data browsing and selection purposes,
7. **rep_info**: folder containing the XSD schema provided inside the product. This folder is optional. It will be included in the User Product if the user selects the SAFE format as output format (cf. section 1.6.4).
8. **INSPIRE**: XML INSPIRE metadata file (cf. Annex B).
9. **HTML**: folder containing an HTML product presentation file (UserProduct_index.html) and the corresponding stylesheet (UserProduct_index.xsl).

4.9.2 Image Data

The final projection of the product is ***UTM*** *(over* ***WGS84****)*. The appropriate UTM zone will be selected according to each Tile of the product.

The image data is tiled in several elementary units. Each Tile is defined (with an appropriate GIPP file passed to the Level-1C processing chain), by:

- Its projection code (UTM code),
- Its anchorage point (ground coordinates of the upper-left pixel of the Tile),
- Pixel size in line and column,
- Tile size in number of lines and columns (rectangle)

This definition insures for all resolutions:
- upper-left corner is at the same location
- the number of pixels in the Tile is an integer

However, depending on the information inside the GIPP defining the Tiles, coverage of a Tile could be slightly different depending on the resolutions. Consequently, the lower-right corner could be at different locations depending on the resolutions.

The tiling definition shall ensure an overlap between tiles at the UTM zone borders.
A UTM tiling following the US-MGRS (US Military Grid Reference System) approach is proposed (100x100km²).

The tiling concept is illustrated on Figure 78 showing the standard ***6º longitude x 8º latitude UTM zones divided into 100km x 100km tiles***.

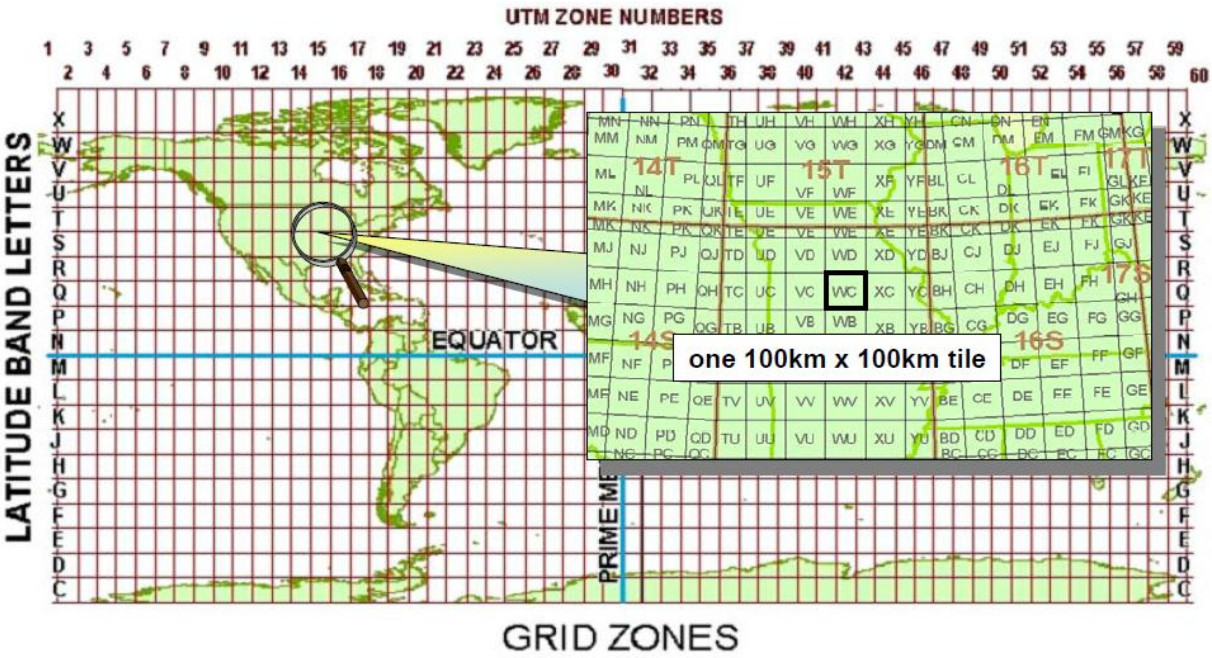


Figure 77: Level-1C Tiling Concept in UTM

Each Tile is then identified by 5 characters:

- The first two characters represent the 6° wide UTM zone.
  - Leading zeroes are included so that Zone 9 is ““09””.
- The third character is a letter designating a band of latitude.
  - Beginning at 80°S and proceeding northward, the 20 bands are lettered C through X, omitting I and O.
  - The bands are all 8° high except band X, which is 12° high.
- The fourth and fifth characters are a pair of letters designating one of the 100,000-meter side grid squares inside the grid zone.

For example, in the previous figure, the black-squared Tile is identified *15SWC*.

4.9.2.1 Image Data Encoding and Files

The image data are provided as separated raster files for each spectral band (i.e. in total of 13 GML/JPEG2000 files per Tile plus one additional file for the TCI).
Each image file is compressed using the JPEG2000 algorithm. The parameters of the JPEG2000 compression are specified in the Annex G. The upper-left pixel corner coordinates of all bands shall have the same coordinates and shall be a multiple of 60m. For each file, the JPEG2000 header contains GML-JP2 information for ortho-image georeferencing. Each Tile is therefore geo-referenced.

4.9.3 Ancillary Data

The raw Satellite Ancillary Data are not embedded in the Level-1C User.

4.9.4 Auxiliary Data

All Auxiliary Data used for Level-1C processing are referenced in the product metadata file.
The Level-1C auxiliary data (GIPPs and IERS bulletin) are provided with the product if requested by the user (download option).
In addition, the Level-1C User Product embeds always a GRANULE (TILE) level an elementary set of meteorological datasets extracted and resampled from ECMWF forecast output (cf. [ECMWF-FCAST]) and relevant to down-stream processing (e.g. atmospheric corrections).

The ECMWF auxiliary data embedded in the Level-1C at Tile level includes the following parameters:
- Total column ozone (TCO3) [Kg/m2];
- Total column water vapour (TCWV) [Kg/m2];
- Mean sea level pressure (MSL) [hPa].

Resulting from a temporal and spatial interpolation of the raw ECMWF global forecast dataset, this data will be provided as part of the Level-1C auxiliary data resampled and distributed in grid information tiles with the same dimensions as the Level-1C Tiles. Grid points are provided in latitude/longitude using WGS84 reference system.

They are interpolated from original ECMWF data to match L1C Tiles both temporally (linear) and geometrically (bilinear with a Ground Sample Distance of 12.5km) and provided in GRIB V1 format.

4.9.5 Quality Indicators

Level-1C quality indicators are derived from Level-1B ones and are complemented by quality indicators relevant to the processing applied.

The *Product Level Quality Indicators* are provided at product level and referenced through the metadata file.

The *Tile Level Quality Indicators* are provided at Tile level in the standard structure of the metadata file.

The *Pixel Level Quality Indicators* are provided at Tile level through dedicated quality masks that provide quality information at pixel level. The Tile level metadata file (Standard structure) contains a pointer to the mask file.

There is one vector file for each type of mask and each Tile (or aggregation of tiles). Each vector mask file consists of a set of polygons defined in ground geometry: (X, Y) in the projected reference frame.

4.9.6 Metadata

The following table shows the groups of metadata provided inside a Level-1C User Product:

Level-1C User Product Metadata	
Product Level Metadata	All product level metadata, specific for the User level, are consolidated/computed because not present at Granule and Datastrip level.
Granule Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Granule level are copied from the input Granules to the User Product.
DATASTRIP Level Metadata (Brief/Standard/Expertise)	All Brief/Standard/Expertise metadata (download option, cf. section 4.4) defined at Datastrip level are copied from the input Datastrips to the User Product;

Table 4-24: Level-1C Product Metadata

As mentioned in the section 2.10, the User Product metadata (all) are not provided with a *metadataLevel* attribute (Brief/Standard/Expertise) unlike what happens for all Granule and Datastrip metadata.

During the User Product assembling, this attribute is used to select by filtering, according to a download option, the set of metadata that must be included in the User Product.

For these filtered fields, the *metadataLevel* attribute is not written in the User Product's metadata.

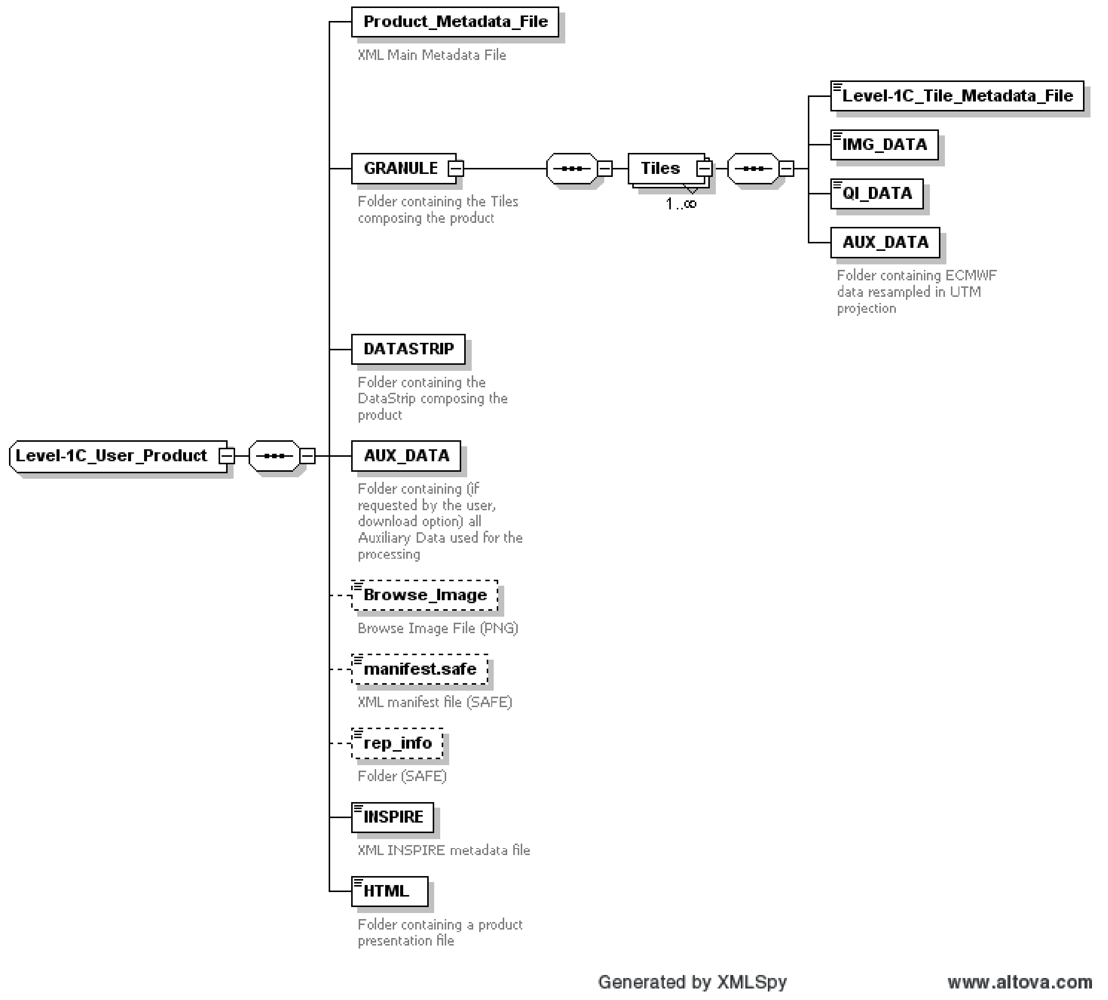
Note that an User Product for an expert user (Expertise download option) will contain all level of metadata (Brief/Standard/Expertise). An User Product for a user with “Standard” or “Brief” permission will contain only Brief/Standard or Brief metadata.

In addition to the metadata in the table above, the User Product contains the *manifest.safe* metadata (when the User Product is SAFE format) and the INSPIRE metadata.

The Level-1C Product Metadata are detailed in the section 4.9.7.

4.9.7 User Product Level-1C Structure

The *S2_User_Product_Level-1C_Structure.xsd* schema annexed to the document and shown in the following diagram, represents the structure of a S2 Level-1C User Product. This schema is provided for information only as It is actually not expected to be used for the validation of a XML file. The diagram reflects exactly the structure shown in the Figure 76.

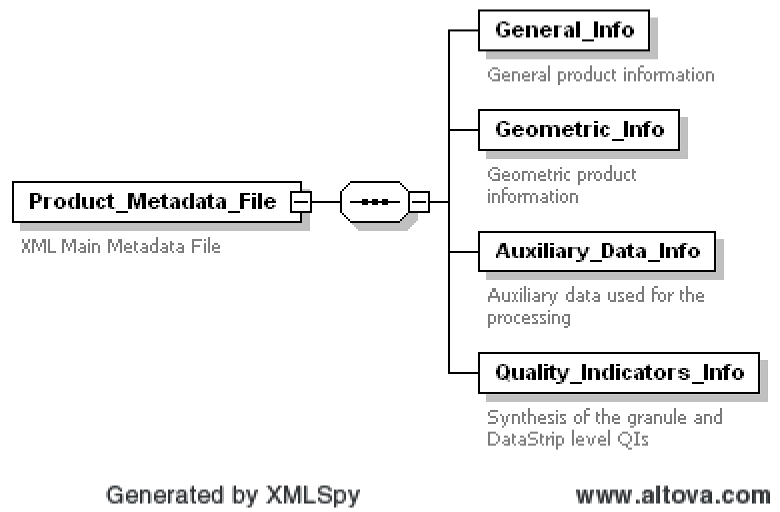
diagram	
children	Product_Metadata_File GRANULE DATASTIP AUX_DATA Browse_Image manifest.safe rep_info INSPIRE HTML
Description	Level-1C User Product contains: 1. **Product_Metadata_File**: XML Main Metadata file. 2. **GRANULE**: folder containing the list of the tiles belonging to the User Product. 3. **DATASTRIP**: folder containing the list of the Datastrip belonging the Datatake from which Level-1C User Product has been selected. 4. **AUX_DATA**: folder containing all Auxiliary Data used for Level-1C processing (GIPPs

	and IERS Bulletin are optional, they will be included in the product if selected according to a specific download option. Raw ECMWF are never included in the product (no download option), on the contrary, resampled ECMWF in tile geometry are mandatory, always embed in the product at GRANULE level. 5. **Browse_Image**: PNG file for image data browsing and selection purposes. 6. **manifest.safe**: XML SAFE Manifest file 7. **rep_info**: optional folder containing the XSD schema 8. **INSPIRE.xml**: XML INSPIRE metadata file 9. **HTML**: folder containing an HTML product presentation file and the corresponding stylesheet. Note that the folder containing the tiles is named “GRANULE” to maintain the same naming used for L0/L1A/L1B products.

4.9.7.1 Product_Metadata_File Schema

Product_Metadata_File is the XML metadata file provided inside the S2 Level-1C User Product. The XSD schema annexed to this document and used to validate it is *S2_User_Product_Level-1C_Metadata.xsd.*

A detailed description of the schema is given here but for specific details regarding each metadata (e.g. type, default value, fixed value, enumerations, occurrences, etc...) refers to the XSD file.

diagram	
children	General_Info Geometric_Info Auxiliary_Data_Info Quality_Indicators_Info
Description	The Product_Metadata_File describes the product data items. It is presented to the user as a structured container of information. Product_Metadata_File is an XML file containing: 1. **General_Info**: provides general product information. 2. **Geometric_Info**: describing the geolocation over WGS84 of the contour of the product. 3. **Auxiliary_Data_Info**: Links to the AUX_DATA items. 4. **Quality_Indicators_Info**: Synthesis of the Granule and Datastrip level QIs.

The following figures and tables give a complete description of the User Product metadata.

General_Info:

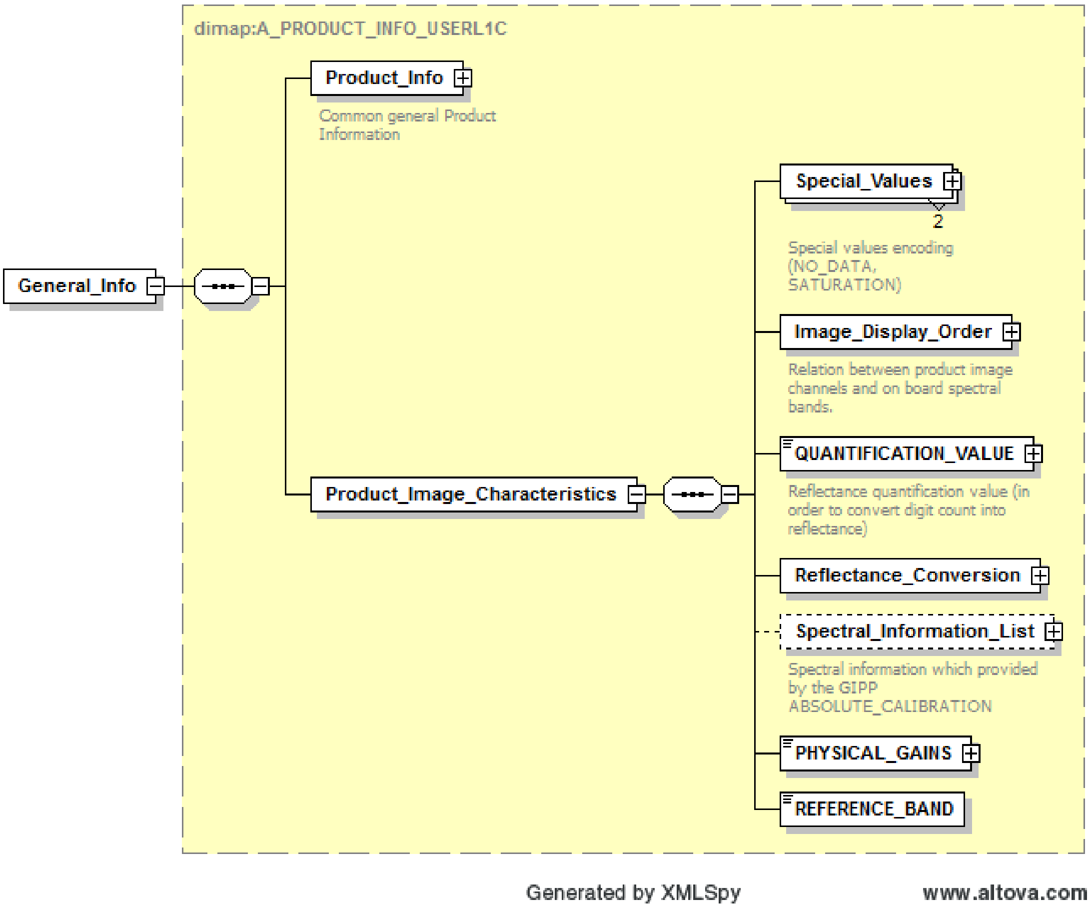


Figure 78 : Level-1C_Product_Metadata_File - General_Info Diagram

General_Info		
Field Name	**Description**	**Note**
Product_Info	This group of metadata is described in the Table 4-9.	Cf. Table 4-9
Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_TEXT Product_Image_Characteristics/Special_Values/SPECIAL_VALUE_INDEX	Cf. Table 4-17	Cf. Table 4-17
Product_Image_Characteristics/Image_Display_Order/RED_CHANNEL Product_Image_Characteristics/Image_Display_Order/GREEN_CHANNEL Product_Image_Characteristics/Image_Display_Order/BLUE_CHANNEL	Spectral bands (Relation between product image channels and on board spectral bands)	Information available at Datastrip level (cf. Table 3-59)
Product_Image_Characteristics/QUANTIFICATION_VALUE	Reflectance quantification value (in order to convert digit count into reflectance) and unit.	Information available at Datastrip level (cf. Table 3-59)
Product_Image_Characteristics/Reflectance_Conversion/U	Correction to take into account the Sun-Earth distance variation (this correction is computed using the acquisition date)	Information available at Datastrip level (cf. Table 3-59)
Product_Image_Characteristics/ Reflectance_Conversion/Solar_Irradiance_List/SOLAR_IRRADIANCE	Reflectance parameters defined for each band	Information available at Datastrip level (cf. Table 3-59)
Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/RESOLUTION Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/Wavelenght/MIN Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/ Wavelenght/MAX Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/ Wavelenght/CENTRAL Product_Image_Characteristics/Spectral_Information_List/Spectral_Information/Spectral_Response/STEP Product_Image_Characteristics/Spectral_Information_List/Spectral_	Spectral filter information provided by the GIPP ABSOLUTE_CALIBRATION	Information available at Datastrip level (cf. Table 3-56)
Product_Image_Characteristics/PHYSICAL_GAIN	Physical Gain for each band	Information available at Datastrip level
Product_Image_Characteristics/REFERENCE_BAND	Used Reference Band	Information available at Datastrip

General_Info		
Field Name	**Description**	**Note**
		level

Table 4-25: Level-1C_Product_Metadata_File - General_Info Description

Geometric_Info:
All geometric product information are described in the Table 4-10 except for *Geometric_Header_List* node not relevant for a Level-1c User Product.

Auxiliary_Data_Info:

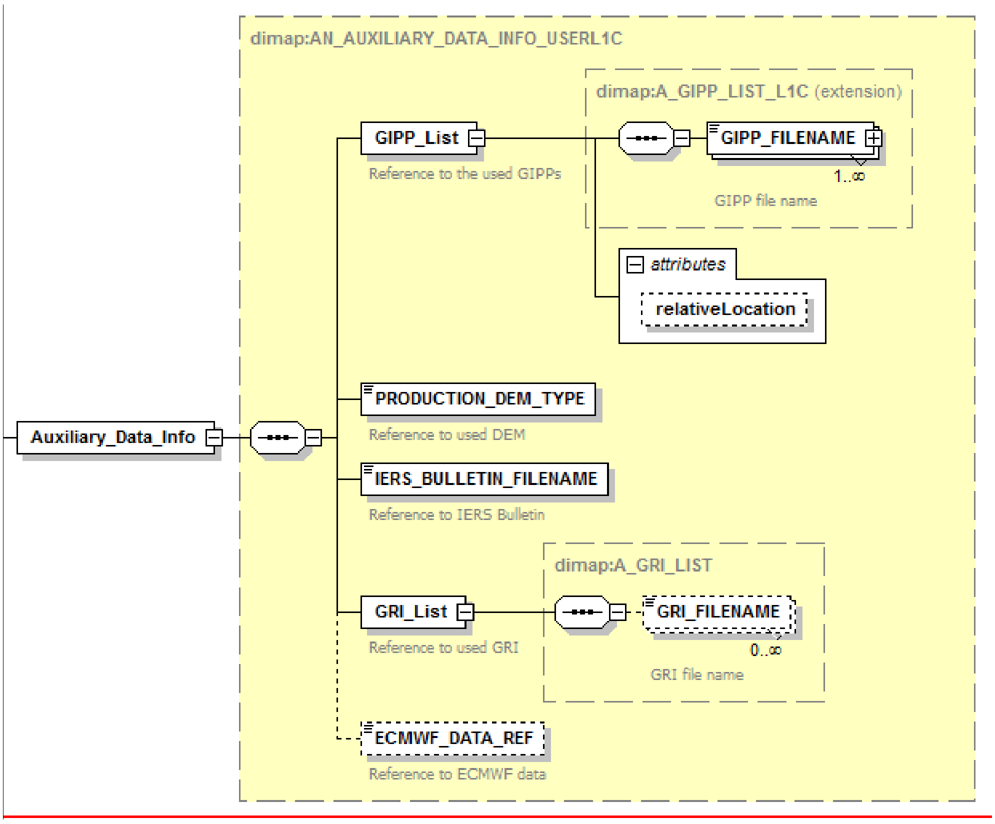


Figure 79 : Level-1C Product_Metadata_File – Auxiliary_Data_Info Diagram

Auxiliary_Data_Info		
Field Name	**Description**	**Note**
GIPP_FILENAME	Reference to the used GIPP files.	Available at Datastrip level
PRODUCTION_DEM_TYPE	Reference to the used DEM	Available at Datastrip level
IERS_BULLETIN_FILENAME	Reference to the used IERS Bulletin	Available at Datastrip level
GRI_FILENAME	Reference to the used GRI data	Available at Datastrip level
ECMWF_DATA_REF	Reference to the used ECMWF data	Available at Datastrip level

Table 4-26: Level-1C Product_Metadata_File - Auxiliary_Info Description

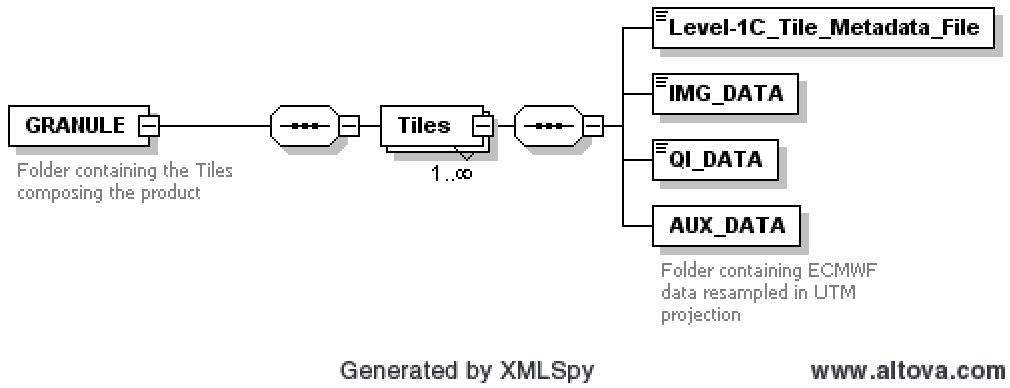
Quality_Indicators_Info:
The Quality_Indicators_Info are described in the Table 4-12.

In addition the Level-1C User Product contains the RADIOMETRIC_QUALITY check based on the OLQC reports contained in the Datastrips/QI_DATA with RADIOMETRIC_QUALITY checklist name.

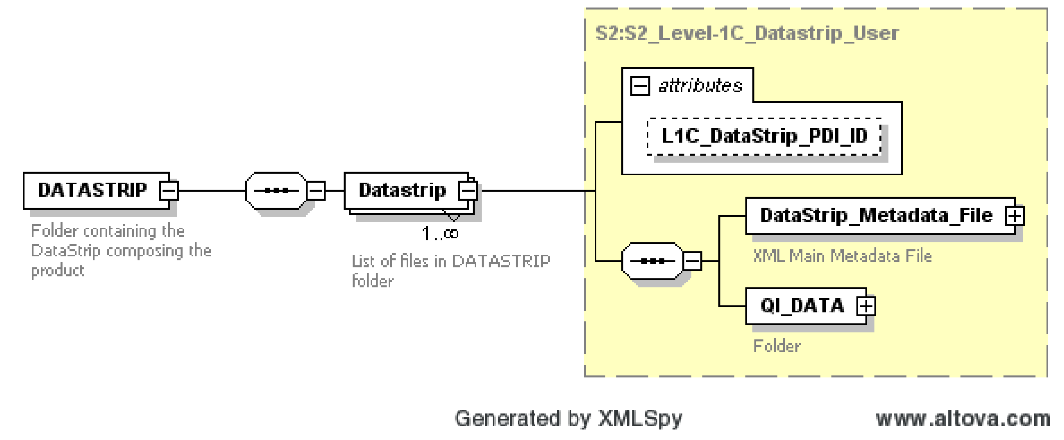
RADIOMETRIC_QUALITY check is FAILED if at least one report at Datastrip level is with *globalStatus* FAILED.

All OLQC checks performed on L1C Tiles/Datastrips and related to a specific checklist name (cf. Annex C), are in the Table 3-17 and Table 3-24.

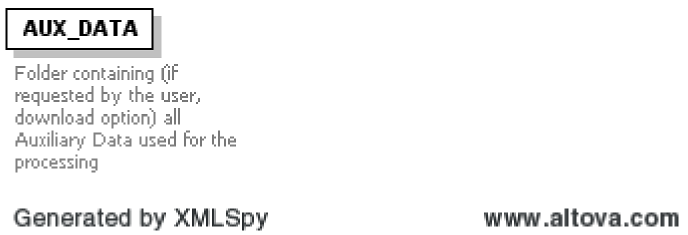
4.9.7.2 GRANULE

diagram	
annotation	Note: “GRANULE” name has been chosen for homogeneity with respect to the others User Product but should be TILE. GRANULE folder is a “folder of folders” each one corresponding to the Tiles composing the product and identified by proper PDI_ID (Tile ID). The structure of each Tile included in the product is the same of the Level-1C Tile PDI described in the section 3.12.3 taking into account that: 1. the Tile metadata are copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.9.6), 2. the XML Level-1C_Tile_Metadata_File is validated using the *S2_PDI_Level-1C_Tile_Metadata.xsd* schema annexed to the document, 3. the *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Tile PDI is included in the User Product (cf. section 3.12.3).

4.9.7.3 DATASTRIP

diagram	
annotation	DATASTRIP folder is a “folder of folders” each one corresponding to the Datastrip composing the product and identified by proper PDI_ID (Datastrip_ID). The structure of each Datastrip included in the product is the same of the Level-1A PDI Datastrip described in the section 3.13.3 taking into account that: 1. the Datastrips metadata are copied in the User Product as they are except for the *metadataLevel* attribute (Brief/Standard/Expertise) always set as empty string (cf. section 4.9.6), 2. the XML Datastrip_Metadata_File is validated using the *S2_PDI_Level-1C_Datastrip_Metadata.xsd* schema annexed to the document, 3. *Inventory_Metadata.xml*, *manifest.safe* and *rep_info* are removed when the Datastrip PDI is included in the User Product (cf. section 3.13.3).

4.9.7.4 AUX_DATA

diagram	
annotation	All Auxiliary Data used for Level-1C processing are referenced through the Product_Metadata_File. GIPP files and IERS Bulletin are included in the product if requested by the user (download option). In addition, ECMWF auxiliary data (resampled in UTM projection) are mandatory and always embedded in the Level-1C User Product at tile level (within the ANX_DATA folder defined at GRANULE level).

4.9.7.5 Browse_Image

diagram	
annotation	Browse Image in PNG format. The Browse Image is included in the User Product if required by the user (download option). This Browse Image is based on the PVI extracted from the Level-1C Tile PDI (JPEG2000 low resolution extraction, 3 visible-bands in ground geometry at 320m resolution, RGB).The final geometric representation of the preview is defined by the user according to its region of interest (either geographic or cartographic representation).

4.9.8 Tiles Consolidation

Two adjacent Tiles of the same Datatake but at the edge of two consecutive Datastrips have to be “consolidated” to create a complete one.

During the UTM Tile consolidation processing, the image part of 2 uncompleted and complementary Tiles are merged together.

For all details regarding to the Tile consolidation algorithm refers to the reference document [CCTS-US].

Consolidation shall be performed on metadata too, based on the metadata of the 2 source tiles.

Tile consolidation process is applied to TCI too.

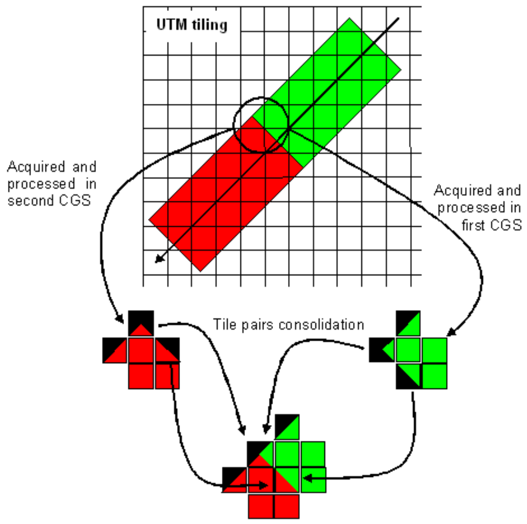


Figure 80: Tile pairs consolidation

If the Tile Consolidation option is activated in parallel with the *Single Tile Product Packaging* download option, the Tile consolidation process shall be performed prior to the Level-1C Single Tile User Products generation. In this way each Single Tile User Products shall contain each one a single consolidated Tile.

4.9.8.1 Tiles Consolidated ID

The Tile ID of a Tile consolidated resulting from a merging of the two uncompleted Tiles is the same described in the section 3.4.2 with file type **MSI_L1C_CO**:

PDI_ID = MMM_CCCC_TTTTTTTTTT_<Instance_ID>

Where:

<Instance_Id> = <Site Centre>_<Creation Date>_<Absolute Orbit>_<Tile>_<Processing Baseline>

Template name:
S2A_OPER_MSI_L1C_CO_EPA__20141104T134012_A012345_T15SWC_N01.01.tar

The physical organization (file system) of incomplete and complete Tiles is the same as described in the section 3.12.

Note that the merging of uncompleted Tiles is a download option that can be selected by the user (cf. Section 4.4). If this option is selected, then the User Product contains only completed tiles (which includes merged tiles, that is the user does not receive uncompleted tiles).

4.9.8.2 Metadata of a Consolidated Tile

All the metadata describing a consolidated Tile are the same of the ones described in the Section 3.12.3.1.

General_Info		
Field Name	**Tile**	**Tile Consolidated**
TILE_ID	TILE identifier (PDI_ID) defined in section 3.12.1	Tile ID defined above
DATASTRIP_ID	Identifier of the Datastrip containing the Tile	As the two uncompleted Tiles are on two Datastrip, this metadata contains two different Datastrip Identifiers
DOWNLINK_PRIORITY	Downlink priority flag. It can be set Nominal/NRT/RT	Downlink priority flag. It can be set Nominal/NRT/RT
SENSING_TIME	TILE Start Time. This value is currently set to the Datastrip Start Time (cf. datastrip definition in section 2.3) Note: set as Type date_time:AN_UTC_DATE_TIME	As the two uncompleted Tiles are on two Datastrip, this metadata contains two different Datastrip Start Time
Archiving_Info/ARCHIVING_CENTRE	The starting point of the circulation data. The allowed values are: • SGS_ • MPS_ • MTI_ • EPA_	“EPA_" assigned to Spanish PAC

	• UPA_ • CDAM • MPC_	
Archiving_Info/ARCHIVING_TIME	Processing/archiving date (UTC data time)	Processing/archiving date (UTC data time)
Geometric_Info		
Field Name	**Tile**	**Tile Consolidated**
Tile_Geocoding/HORIZONTAL_CS_NAME	Name of horizontal coordinate reference system	Name of horizontal coordinate reference system
Tile_Geocoding/HORIZONTAL_CS_CODE	Code of horizontal coordinate reference system	Code of horizontal coordinate reference system
Tile_Geocoding/Size	Tile dimensions for each resolution band	Tile dimensions for each resolution band
Tile_Geocoding/Geoposition	XDIM and YDIM for each resolution band	XDIM and YDIM for each resolution band
Tile_Angles/Sun_Angles_Grid	Grid of sun angles (zenith and azimuth) and the correction which takes into account earth-sun distance variation and for each band sun equivalent irradiance	Grid of sun angles (zenith and azimuth) and the correction which takes into account earth-sun distance variation and for each band sun equivalent irradiance
Tile_Angles/Mean_Sun_Angle	Mean value containing sun zenith and azimuth angle average for all bands and detectors	Mean value containing sun zenith and azimuth angle average for all bands and detectors
Tile_Angles/Mean_Incidence_Angle	List of mean values containing viewing incidence zenith and azimuth angle average for each band and for all detectors	List of mean values containing viewing incidence zenith and azimuth angle average for each band and for all detectors
Tile_Angles/Viewing_Incidence_Angles_Grids	Grid of incidence angles (zenith and azimuth) (per bands and detectors)	Grid of incidence angles (zenith and azimuth) (per bands and detectors)
Quality_Indicators_Info		
Field Name	**Tile**	**Tile Consolidated**
CLOUDY_PIXEL_PERCENTAGE	Percentage of the cloud coverage	Average of cloud coverage percentages computed for each

		uncompleted Tile
DEGRADED_MSI_DATA_PERCENTAGE	Percentage of degraded MSI data	Average of the percentages of degraded MSI data computed for each uncompleted Tile
Pixel_Level_QI/MASK_FILENAME	Pointer to the mask files contained in the QI_DATA folder: - Finer cloud mask files - Technical quality mask files - Detector footprint mask - Radiometric quality masks	Pointer to the consolidated mask files contained in the QI_DATA folder of the consolidated Tile
Pixel_Level_QI/PVI_FILENAME	Reference to PVI contained in the QI_DATA folder	Reference to PVI contained in QI_DATA folder of the consolidated Tile

4.9.9 User Product Level-1C SAFE Manifest synoptic table

The final User Product contains only one main *manifest.safe* file. The *manifest.safe* files related to each Granules/Datastrips composing the product are available at PDI level but they are not included in the User Product, all lower level PDI are removed.

This chapter provides a detailed description of the content of the SAFE Manifest for the Level-1C User Product, including a synoptic table with the list of the metadata information to be included in the SAFE Manifest.

The structure of the Manifest is based on the Level-1C Manifests provided for Tiles and Datastrip (cf. sections 3.12.4 and 3.13.4).

Same considerations as in section 4.6.8 applies for what concerns compliancy to SAFE specification [SAFE-SPEC] and content of synoptic tables (except for the Data Objects Section that does not contain an ANC_DATA folder).

A practical example of Manifest file for the Level-1C User Product is provided as annexed zip file to this document (S2-PDGS-TAS-DI-PSD-V14_SAFE.zip).

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
platform						
	nssdcIdentifier	N.A.	Unique identifier of the platform, defined by the World Data center for Satellite Information (WDC-SI)		1	WDC is discontinued; this tag is set to a default value 0000-0000
	familyName	Level-1C_User_Product->General_Info->Product_Info->Datatake->SPACECRAFT _NAME	The mission name of the platform	string enum	0..1	Sentinel
	number	Level-1C_User_Product->General_Info->Product_Info->Datatake->SPACECRAFT_ NAME	Sequence identifier of the platform among the mission	string enum	0..1	2A, 2B, 2C
	instrument->familyName	N.A.	The instrument name used for acquiring the product data	string enum	0..1	Multi-Spectral Instrument
	instrument-> **abbreviation**	N.A.	Abbreviation of the instrument name	string enum	0..1	MSI
	instrument->mode	Level-1C_User_Product->General_Info->Product_info->Datatake->DATATAKE_TYPE	The mode of the instrument	string enum	0..1	Nominal_Observation Dark_Signal_Calibration Extended_Observation Absolute_Radiometry_Calibration Vicarious_Calibration

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
						Raw_Measurement Test_Mode
	instrument->mode-> **identifier**	Level-1C_User_Product->General_Info-> Product_info->Datatake->DATATAKE_TYPE	The identifier of the instrument mode	string enum	1	INS-NOBS INS-EOBS INS-DASC INS-ABSR INS-VIC INS-RAW INS-TST
processing			Textual description of the history of processings that lead to the current product and of all the relevant resources involved in the processing (facilities, software, applicable documents etc)		1	
	name		Name of the L1B to L1C Processing	string	0..1	Generation of L1C User Product
	start	Level-1C_User_Product->General_Info-> Product_info->GENERATION_ TIME	Processing start date (UTC)	xs:dateTime	0..1	
	stop	N.A.	Processing stop date (UTC)	xs:dateTime	0..1	
	facility	N.A.	Description of Processing Centre		0..*	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	facility->**name**	N.A.	Extended name of Origin Centre	string	1	
	facility->**organization**	N.A.	Organization to which the Origin center belongs	string	0..1	
	facility->**site**	Level-1C_User_Product->GRANULE->General_Info->GRANULE_ID (substring <Site Centre>, cf. section 3.12.1)	Acronym of the Processing center	string enum	0..1	SGS_ MPS_ MTI_ EPA_ MPC_ UPA_ XXXX EDRS zzzL (zzz = first three characters of the LGS location)
	facility->**country**	N.A.	Country where Origin Centre is located	string	0..1	
	facility->software	N.A.	Description of software component used for Processing		0..*	
	facility->software-> **name**	N.A	Name of the software component	string	1	
	facility->software-> **version**	N.A	Version of the software component	string	0..1	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	Name of tag or attribute (in bold)	Tag name				
	resource		List of auxiliary data files used by the processors to support radiometric and geometric correction (GIPP, DEM, GRI, IERS Bulletin etc.) and of SAD Raw Data file containing the satellite ancillary telemetry; these files are provided with the product.		0..*	
	resource->**name**	Level-1C_User_Product->DATASTRIP->Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-1C_User_Product->DATASTRIP->Auxiliary_Data_Info->IERS_Bulletin Level-1C_User_Product->DATASTRIP->Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME	Name of the auxiliary or ancillary files/folders needed for the Processing	string	1	
	resource->**role**	N.A.	Role of the resource	string	1	Auxiliary data, Ancillary data
acquisitionPeriod					1	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	acquisitionPeriod -> startTime	Level-1C_User_Product->General_Info->Product_Info->Datatake->DATATAKE_SENSING_START	Reference time of acquisition of the product	xs:dateTime	1	
measurementFrameSet					1	
	footPrint	Derived from Level-1C_User_Product->Geometric_Info->Product_Footprint->Product_ Footprint	Product footprint (namely imaged landscape corresponding to the whole product)	string (gml:linearRingType namely blank separated list of comma-separated long/lat coordinates of footprint closed polygon with last vertex equal to first)	0..1	
measurementOrbitReference						
	orbitNumber	Level-1C_User_Product->General_Info->Product_Info->Datatake->DatatakeIdentifier (substring <AbsoluteOrbitNumber>)	Absolute orbit number		0..1	> 0
	orbitNumber->**type**	N.A.	Absolute orbit number type (possible values “start” or “stop”). Set to “start” since the absolute orbit number refers to the first line of the first Granule of the User Product		0..1	start

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
	orbitNumber-> **groundTrackDirection**	Level-1C_User_Product->General_Info-> Product_Info->Datatake->SENSING_ORBIT_ DIRECTION	Direction of the ground track of the Sentinel-2 platform at the time corresponding to orbitNumber->type (start or stop)		0..1	ascending, descending
	relativeOrbitNumber	Level-1C_User_Product->General_Info-> Product_Info->Datatake ->SENSING_ORBIT_ NUMBER	Relative orbit number (within the cycle)		0..1	1 to 143
	relativeOrbitNumber-> **type**	N.A.	Relative orbit number type (possible values "start" or "stop"). Set to "start" since the absolute orbit number refers to the first line of the Datastrip		0..1	start
metadataComponents		Level-1C_User_Product->DATASTRIP Satellite_Ancillary_Data_Info->ANC_DATA_REF (reference to the folder containing the SAD Raw Data files) Level-1C_User_Product->DATASTRIP-> Auxiliary_Data_Info->IERS_Bulletin Level-1C_User_Product->DATASTRIP-> Auxiliary_Data_Info->GIPP_List->GIPP_FILENAME	A reference to all ancillary/auxiliary Metadata files/folders included in the product (e.g. the XML Metadata file, the INSPIRE Metadata file, the Auxiliary Data files) or external to the product (the Ancillary Data files)		1..*	

SAFE Manifest		Corresponding metadata in the S2_User_Product_Level-1C_Metadata.xsd	Description	Data Type	Occurrence	Allowed range of values
Metadata name	**Name of tag or attribute (in bold)**	**Tag name**				
metadataComponentSchemas		N.A	A reference to the Schemas used to validate the Metadata files included in the product (e.g. the XML Metadata file Schema)		0..1	

Table 4-27- Content of Metadata section for Level-1C User Product SAFE Manifest

4.9.10 Compact Naming Convention

This section contains the rules applied to define the compact naming convention for a Level-1C User Product. Based on the standard User Product naming convention described in the section 4.2, the rules in the following table are described.

Notice that some metadata changes to keep the product coherency and navigation capabilities.

Level-1C User Product Components	Compact Naming Rules
Product Name Root Directory	The **Product Name Root** Directory follows this naming convention: MMM_MSIL1C_ *YYYYMMDDTHHMMSS*_Nxxyy_Rooo_<Product Discriminator>.SAFE where: • *MMM* is the mission identifiers S2A / S2B • *MSIL1C* is the fixed string to identify Level-1C products • *YYYYMMDDTHHMMSS*: is the *Datatake* sensing time • *Nxxyy* is the production baseline (e.g. N0201) • *Rooo* is the relative orbit number (e.g. R101) • *<Product Discriminator>*is a 15-characters string discriminator to distinguish different end user products associated to the same datatake Example below: S2A_MSIL1C_20150802T105414_N0102_R008_20150803T124046.SAFE

Level-1C User Product Components	Compact Naming Rules
Product_Metadata_File	MTD_MSIL1C.xml
manifest.safe	None
GRANULE	1. Each **Tile folder name** follows the naming convention: L1C_Txxxxx_Azzzzzz_<tile discriminator> where: • *<tile_discriminator>:* is a 15-characters string discriminator to distinguish between partial tiles generated out of the same datatake • *zzzzzz:* is the Absolute Orbit Number • *xxxxx:* is the Tile ID according to US-MGRS naming convention 2. The **Tile Metadata** filename is *MTD_TL.xml* 3. The **Image File name** of the tiles follows this naming convention: Txxxxx_YYYYMMDDTHHMMSS_Byy.jp2 where: • *YYYYMMDDTHHMMSS*: is the *Datatake* sensing time • *xxxxxx*: is the Tile ID according to US-MGRS naming convention • yy: is the band index (01, 02, 03, 04, 05, 06, 07, 08, 8A, 09, 10, 11, 12)

<table>
<tr><th>Level-1C User Product Components</th><th>Compact Naming Rules</th></tr>
<tr><td></td><td>
Accordingly, the TCI as a band filename is harmonised with the tile images above defined:

Txxxxx_YYYYMMDDTHHMMSS_TCI.jp2
where:

• YYYYMMDDTHHMMSS: is the Datatake start sensing time
• xxxxxx: is the Tile ID according to US-MGRS naming convention

4. The PVI filename is harmonised to the tile above defined:

Txxxxx_YYYYMMDDTHHMMSS_PVI.jp2

where:

• YYYYMMDDTHHMMSS: is the Datatake start sensing time
• xxxxxx: is the Tile ID according to US-MGRS naming convention

5. The Masks filename follows the naming convention:

TTTTTTTTTT_Byy.gml

where:
TTTTTTTTTT =
MSK_CLOUDS (Finer cloud mask files)
MSK_TECQUA (Technical quality mask files)
MSK_DETFOO (Detector footprint mask files)
MSK_DEFECT (Radiometric quality masks)
MSK_SATURA (Radiometric quality masks)
MSK_NODATA (Radiometric quality masks)
</td></tr>
</table>

Level-1C User Product Components	Compact Naming Rules
	6. The **OLQC report** filename follows the naming convention: <checklistname>.xml where <checklistname>= SENSOR_QUALITY GEOMETRIC_QUALITY GENERAL_QUALITY FORMAT_CORRECTNESS 7. The **ECMWF auxiliary** data filename is AUX_ECMWFT
DATASTRIP	1. The datastrip directory name follows the naming convention DS_ssss _yyyymmddThhmmss_S YYYYMMDDTHHMMSS Where: • ssss is the Site Centre of the file originator • yyyymmddThhmmss is the creation date • YYYYMMDDTHHMMSS is the datastrip sensing start time *DS_SGS__20150802T122135_S20150802T105331* 2. The Datastrip Metadata filename is *MTD_DS.xml* 3. The **OLQC report** filename is compacted to refer only to the checklistname:

Level-1C User Product Components	Compact Naming Rules
	<checklistname>.xml where <checklistname>= SENSOR_QUALITY GEOMETRIC_QUALITY GENERAL_QUALITY RADIOMETRIC_QUALITY FORMAT_CORRECTNESS
AUX_DATA	1. The **IERS auxiliary** data filename is *AUX_UT1UTC.txt* 2. The GIPP files are physically grouped altogether into tar file named *GIPP.tar*
Browse_Image	The **Browse Image** filename is <File-Type>.png : BWI_MSIL1C.png
rep_info	None
INSPIRE	None
HTML	None

In the following examples of Level-1C products tree with the standard naming convention and the corresponding compact naming convention are shown for better understanding of the differences.
Level-1C User Product tree defined using the Standard Naming Convention:

```
S2A_OPER_PRD_MSIL1C_PDMC_20160615T141550_R121_V20160615T082012_20160615T083135.SAFE

├──AUX_DATA

| ├──S2A_OPER_GIP_BLINDP_MPC__20150605T094736_V20150622T000000_21000101T000000_B00.TGZ

Appendix C : | ├──........

| ├──S2A_OPER_GIP_VIEDIR_MPC__20151117T131051_V20150703T000000_21000101T000000_B12.TGZ

| ├──S2__OPER_AUX_UT1UTC_PDMC_20160609T000000_V20160610T000000_20170609T000000.txt

├──DATASTRIP

| └──S2A_OPER_MSI_L1C_DS_MTI__20160615T115939_S20160615T083135_N02.04

| ├──QI_DATA

| └──S2A_OPER_MTD_L1C_DS_MTI__20160615T115939_S20160615T083135.xml

├──GRANULE

| ├──S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVT_N02.04

| | ├──AUX_DATA

| | | └──S2A_OPER_AUX_ECMWFT_MTI__20160615T115939_V20160615T060000_20160615T180000

| | ├──IMG_DATA

| | | ├──S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVT_B01.jp2
| | | ├──S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVT_TCI.jp2

| | | └──....

| | ├──QI_DATA

| | | ├──S2A_OPER_MSK_CLOUDS_MTI__20160615T115939_A005123_T36RVT_B00_MSIL1C.gml

| | | ├──....

| | | └──S2A_OPER_PVI_L1C_TL_MTI__20160615T115939_A005123_T36RVT.jp2

| | └──S2A_OPER_MTD_L1C_TL_MTI__20160615T115939_A005123_T36RVT.xml
```

```
| ├──S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVU_N02.04
| | ├──AUX_DATA
| | | └──S2A_OPER_AUX_ECMWFT_MTI__20160615T115939_V20160615T060000_20160615T180000
| | ├──IMG_DATA
| | | ├──S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVU_B01.jp2
| | | ├──….
| | ├──QI_DATA
| | | ├──S2A_OPER_MSK_CLOUDS_MTI__20160615T115939_A005123_T36RVU_B00_MSIL1C.gml
| | | ├──….
| | | └──S2A_OPER_PVI_L1C_TL_MTI__20160615T115939_A005123_T36RVU.jp2
| | └──S2A_OPER_MTD_L1C_TL_MTI__20160615T115939_A005123_T36RVU.xml
├──HTML
| ├──banner_1.png
| ├──banner_2.png
| ├──banner_3.png
| ├──star_bg.jpg
| ├──UserProduct_index.html
| └──UserProduct_index.xsl
├──INSPIRE.xml
├──manifest.safe
├──rep_info
| └──S2_User_Product_Level-1C_Metadata.xsd
└──S2A_OPER_MTD_SAFL1C_PDMC_20160615T141550_R121_V20160615T082012_20160615T083135.xml
└──S2A_OPER_BWI_MSIL1C_PDMC_20130424T120700_R054_V20091210235100_20091210235134.png
```

Level-1C User Product tree defined using the Compact Naming Convention:

```
S2A_MSIL1C_20150802T105414_N0102_R008_20150803T124046.SAFE

├──AUX_DATA

| ├──GIPP.tar

| ├──AUX_UT1UTC.txt

├──DATASTRIP

| ├──DS_SGS__20150802T122135_S20150802T105331

| | ├──QI_DATA

| | └──MTD_DS.xml

├──GRANULE

| ├──L1C_T36RVT_A005123_20160615T115939

| | ├──AUX_DATA

| | | └──AUX_ECMWFT

| | ├──IMG_DATA

| | | ├── T36RVT_20160615T115939_B01.jp2
| | | ├── T30RWQ_20150802T122135_TCI.jp2

| | | └──....

| | ├──QI_DATA

| | | ├──MSK_CLOUDS_B00.gml

| | | ├──....

| | | └── T36RVT_20160615T115939_PVI.jp2

| | └──MTD_TL.xml

| ├──L1C_T36RVU_A005123_20160615T115939

| | ├──AUX_DATA

| | | └──AUX_ECMWFT
```

```
| | ├──IMG_DATA
| | | ├── T36RVU_20160615T115939_B01.jp2
| | | ├── T30RWQ_20150802T122135_TCI.jp2
| | | ├──....
| | ├──QI_DATA
| | | ├──MSK_CLOUDS_B00.gml
| | | ├──....
| | | └── T36RVU_20160615T115939_PVI.jp2
| | └──MTD_TL.xml
├──HTML
| ├──banner_1.png
| ├──banner_2.png
| ├──banner_3.png
| ├──star_bg.jpg
| ├──UserProduct_index.html
| └──UserProduct_index.xsl
├──INSPIRE.xml
├──manifest.safe
├──rep_info
| └──S2_User_Product_Level-1C_Metadata.xsd
└── MTD_MSIL1C.xml
└──BWI_MSIL1C.png
```

4.9.11 Single Tile User Product

The Level-1C Single Tile User Product is a download option applicable to the Level-1C User Product (*Single Tile Product Packaging* download option).

The Level-1C Single Tile User Product format is based on the Level-1C Used Product format defined in the section 4.9. For each Tile composing the Level-1C User Product a separate set of self-standing and fully consistent Level-1C Single Tile User-Products are generated covering one single Tile.

Figure 81: Level-1C User Product decomposition

The Level-1C Single Tile User Product physical format is the same defined in the section 4.9 and reported hereafter. In this case (*Single Tile Product Packaging* download option set to TRUE) the **GRANULE** folder contains one single Tile (one image file per band).

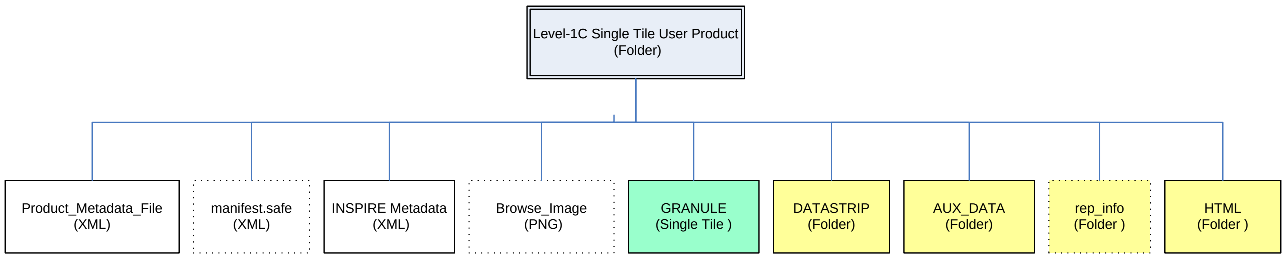


Figure 82: Level-1C Single Tile User Product Physical Format

The Level-1C Single Tile package output format shall be comply with the output format selected as download option for the Level-1C User Product (DIMAP,SAFE, SAFE_COMPACT); in other words, if the Level-1C User Product is requested via download option in SAFE format, the related Level-1C Single Tile products shall be generated in SAFE format as well.

4.9.11.1 Single Tile Naming Convention

The Level-1C Single Tile product name follows this naming convention:

MMM_MSIL1C_YYYYMMDDTHHMMSS_Nxxyy_ROOO_Txxxxx_<Product Discriminator>

where:

- MMM: is the mission ID (S2A/S2B)
- YYYYMMDDTHHMMSS: is the Datatake Sensing Time
- xxyy: identifies the current processing baseline
- OOO: is the relative orbit number
- Txxxxx: is the tile ID
- <Product Discriminator>: this field guarantees the uniqueness of the Single Tile product name; its value is the Level-1C Single Tile product CREATION DATE in the format yyyymmddThhmmss.

For instance:
S2A_MSIL1C_20150802T105414_N0102_R008_T30RWQ _20150803T124046.SAFE

4.9.11.2 Complete Single Tile Download Option

As anticipated in the section 4.4, the *Complete Single Tile* download option allows to include as part of the Level-1C Single Tile User Product all the full data associated to every single Tile in terms of any kind of imagery and metadata (i.e. expertise).

The *Complete Single Tile* product features all the characteristics of the *Single Tile Product in which all product items* (all Spectral Bands, the TCI band, Expertise level of metadata) are included. The Complete Single Tile does not include auxiliary data and BWI.

In addition, the <Product Discriminator> field of the product root directory name is specialised to ensure a deterministic repeatable name across time for the same product.

Example of the product root directory name for product in Complete Single Tile format:

S2A_MSIL1C_20160914T074612_N0204_R135_T36JTT_20160914T081456.SAFE

4.9.12 True Colour Image Naming Convention

This section defines the different naming conventions applicable to the TCI files when they are selected as any other spectral band (cf. band selection download option for Level-1C products defined in section 4.4). The name of the TCI files are harmonised with the name of the Level-1C tiles where the band suffix ‘Bxx’ is replaced with the literal string ‘TCI’.

Example of the name of TCI files when downloaded as band in SAFE format:
S2A_OPER_MSI_L1C_TL_MTI__20160615T115939_A005123_T36RVT_TCI.jp2

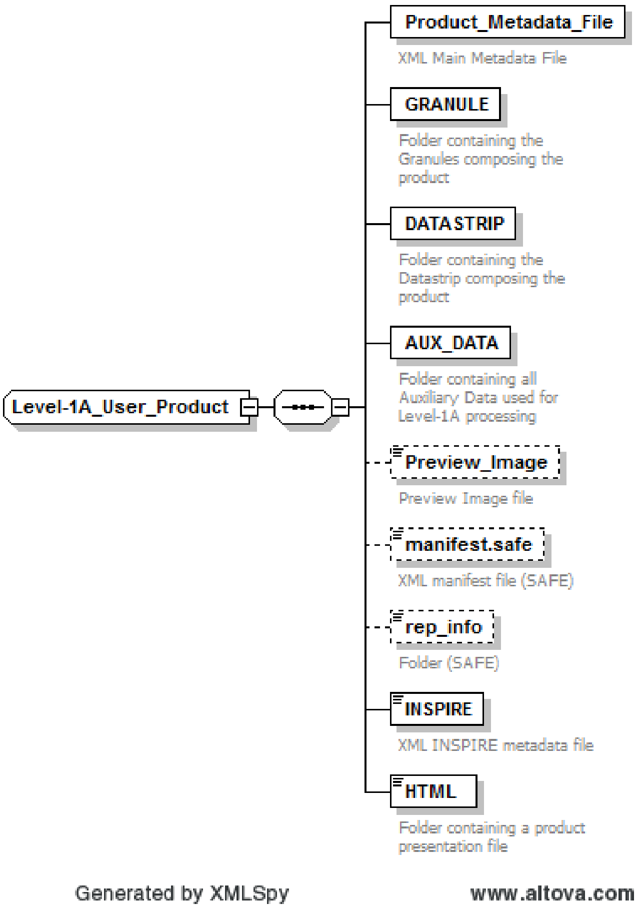
Example of the name of TCI files when downloaded as band in SAFE_COMPACT format:
T30RWQ_20150802T122135_TCI.jp2

ANNEX A: USER PRODUCT BASED ON DIMAP FORMAT

A User Product based on DIMAP format has the same structure of the SAFE format one except for the product components specific of a SAFE product that are:

- *manifest.safe*
- *rep_info*

For instance, the following diagram related to a L1A User Product, represents the structure of the product SAFE formatted when the manifest.safe and rep_info are provided, differently it represents the structure of a product DIMAP formatted when *manifest.safe* and *rep_info* are missing.



ANNEX B: INSPIRE METADATA

Infrastructure for Spatial Information in the European Community (INSPIRE) is “an European Union initiative to establish an infrastructure for spatial information in Europe that helps to make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development".
In Europe a major recent development has been the entering in force of the INSPIRE Directive in March 2007 (cf. [EC-INSPIRE-DIR]) establishing an Infrastructure for Spatial Information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment.
The Directive addresses 34 spatial data themes needed for environmental applications

To ensure that the spatial data infrastructures of the Member States (27 Member States of the European Union) are compatible and usable in a Community and trans-boundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting).
Since, for the proper functioning of that infrastructure, it is necessary for a user to be able to find spatial data sets and services and to establish whether they may be used and for what purpose, Member States should provide descriptions in the form of metadata for those spatial data sets and services. Since such metadata should be compatible and usable in a Community and trans-boundary context, it is necessary to lay down rules concerning the metadata used to describe the spatial data sets and services corresponding to each theme.

In this context, the INSPIRE Metadata regulation [EC-INSPIRE-CR] dated 03/12/2008 defines a set of metadata necessary to allow identification of the information resource for which metadata is created, its classification and identification of its geographic location and temporal reference, quality and validity, conformity with implementing rules on the interoperability of spatial data sets and services, constraints related to access and use, and organization responsible for the resource. Metadata elements related to the metadata record itself are also necessary to monitor that the metadata created are kept up to date, and for identifying the organization responsible for the creation and maintenance of the metadata. This is the minimum set of metadata elements necessary to comply with Directive 2007/2/EC.

Moreover, instructions are necessary for the validation of metadata regarding to the conditions and expected multiplicity, the value domain of each metadata element is necessary to ensure interoperability of metadata in a multilingual context and that value domain should be able to take the form of free text, dates, codes derived from international standards, such as language codes, keywords derived from controlled lists or thesauri, or character strings.
INSPIRE Implementing Rules shall take account of relevant, existing international standards and user requirements. In the context of metadata for spatial data and spatial data services, the standards EN ISO 19115, EN ISO 19119 have been identified as important standards. XML representation of those metadata is ISO/TS 19139 encoded.
(cfr. http://inspire.jrc.ec.europa.eu/index.cfm/pageid/101)

For all details regarding INSPIRE DIRECTIVE Establishing an Infrastructure for Spatial Information and for INSPIRE REGULATION regarding Metadata generation, refers to the applicable documents [EC-INSPIRE-DIR] and [EC-INSPIRE-CR] (cfr. http://inspire.jrc.ec.europa.eu/index.cfm).

As part of the GMES program, S2 PDGS support and use INSPIRE Metadata regulation (cfr. [EC-INSPIRE-CR] and [EC-INSPIRE-DIR]).
The Sentinel-2 datasets in their inherent quality of describing spatial data are fully entitled to comply with the directive and hence the INSPIRE Metadata directive applies in entirety to the Sentinel-2 product set.

In this context, the proposed approach is to generate an XML INSPIRE file 19115/19139 encoded, including the set of metadata characterizing the User Product, to be included in the product itself.
A tailoring of the metadata filling the XML INSPIRE file has been done selecting the “Metadata elements” listed in the PART B of the applicable document [EC-INSPIRE-CR] and they are set out in the following tables. For each group of metadata, status (Dynamic (D), Static (S) or not applicable (-)), the multiplicity, the value domain and an example of the possible value are reported.

An example of XML INSPIRE metadata file has been generated and validated using the ***Metadata Editor*** tool provided in the INSPIRE Geoportal (http://inspire-geoportal.ec.europa.eu/editor/).

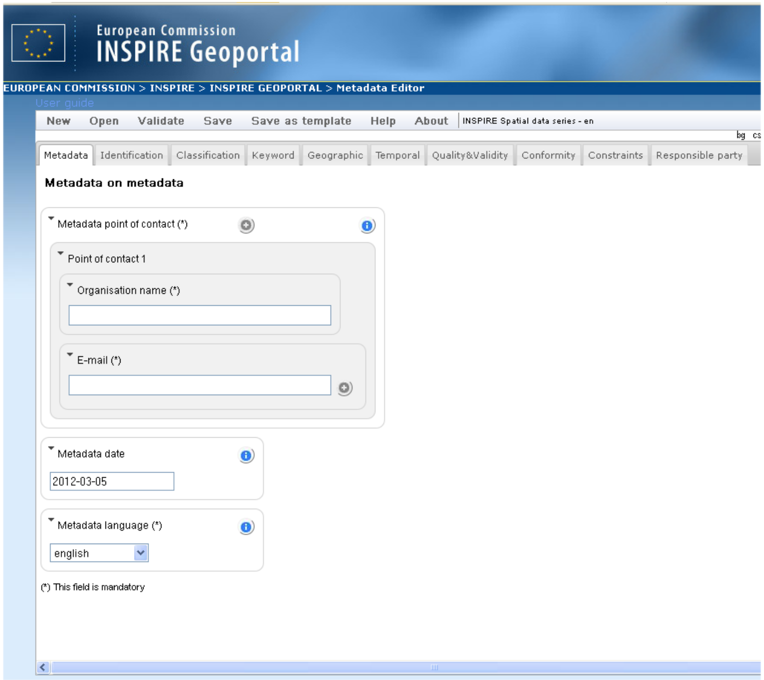


Figure 83: HMI of INSPIRE Metadata editor

IDENTIFICATION

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Resource title	This a characteristic, and often unique, name by which the resource is known.	D	1	free text	Product_Filename
Resource abstract	This is a brief narrative summary of the content of the resource.	D	1	free text	Product corresponding to a user-defined geographical selection
Resource type	This is the type of resource being described by the metadata.	S	1	From Part D.1 of [EC-INSPIRE-CR].	series
Resource locator	The resource locator defines the link(s) to the resource and/or the link to additional information about the resource.	D	01..*	character string (URL)	http://www.fao.org/geonetwork/srv/en/main.home
Unique resource identifier	A value uniquely identifying the resource.	D	1..*	mandatory character string code, generally	"http://www.isotc211.org/2005/resources/codeList.xml#CI_RoleCode" "publisher"

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
				assigned by the data owner, and a character string namespace uniquely identifying the context of the identifier code (for example, the data owner).	
Resource language	The language(s) used within the resource.	S	10..*	The value domain limited to the languages defined in ISO 639-2.	eng

CLASSIFICATION OF SPATIAL DATA AND SERVICES

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Topic category	The topic category is a high-level classification scheme to assist in the grouping and topic-based search of available spatial data resources.	S	1 ..*	The value domain of this metadata element is defined in Part D.2 of [EC-INSPIRE-CR]. 2.10. Imagery / Base Maps / Earth Cover (imageryBaseMapsEarthCover) Base maps. This category applies to the following Directive 2007/2/EC spatial data themes: Annex II(3) Orthoimagery, Annex II(2) Land cover.	imageryBaseMapsEarthCover

KEYWORD

If a resource is a spatial data set, at least one keyword shall be provided from the general environmental multilingual thesaurus (GEMET) describing the relevant spatial data theme as defined in Annex I, II or III to Directive 2007/2/EC.
For each keyword, the following metadata elements shall be provided:

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Keyword value	The keyword value is a commonly used word, formalised word or phrase used to describe the subject. While the topic category is too coarse for detailed queries, keywords help narrowing a full text search and they allow for structured keyword search.	S	1..*	free text	Processing
Originating controlled vocabulary	If the keyword value originates from a controlled vocabulary (thesaurus, ontology), for example GEMET, the citation of the originating controlled vocabulary shall be provided.	S	1..*	This citation shall include at least the title and a reference date (date of publication, date of last revision or of creation) of the originating controlled vocabulary.	Eionet GEMET Thesaurus Date of last revision 2011-09-12

GEOGRAFIC LOCATION

The requirement for geographic location referred to in Article 11(2)(e) of Directive 2007/2/EC shall be expressed with the metadata element geographic bounding box.

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Geographic bounding box	This is the extent of the resource in the geographic space, given as a bounding box.	D	1..*	The bounding box shall be expressed with westbound and eastbound longitudes, and southbound and northbound latitudes in decimal degrees, with a precision of at least two decimals.	118.4 86.73 14.55 32.71

TEMPORAL REFERENCE

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Temporal extent	The temporal extent defines the time period covered by the content of the resource. This time period may be expressed by: • an individual date, • an interval of dates expressed through the starting date and end date of the interval,	-S	01..*	The date shall refer to a temporal reference system and shall be expressed in a form compatible with that system. The default reference system shall be the Gregorian calendar, with dates expressed in	2014-01-01

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
	• a mix of individual dates and intervals of dates.			accordance with ISO 8601.	
Date of publication	This is the date of publication of the resource when available, or the date of entry into force. There may be more than one date of publication.	S-	01..*	The date shall refer to a temporal reference system and shall be expressed in a form compatible with that system. The default reference system shall be the Gregorian calendar, with dates expressed in accordance with ISO 8601.	2030-01-01
Date of last revision	This is the date of last revision of the resource, if the resource has been revised. There shall not be more than one date of last revision.	-	01..*	The date shall refer to a temporal reference system and shall be expressed in a form compatible with that system. The default reference system shall be the Gregorian calendar, with dates expressed in accordance with ISO 8601.	NA
Date of	This is the date of creation of the resource. There shall not be more than one date of	D	01..1	The date shall refer to a temporal reference system	2014-01-01

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
creation	creation.			and shall be expressed in a form compatible with that system. The default reference system shall be the Gregorian calendar, with dates expressed in accordance with ISO 8601.	

QUALITY AND VALIDITY

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Lineage	This is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist), and whether it has legal validity.	D	1	free text	missing

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Spatial resolution	Spatial resolution refers to the level of detail of the data set. It shall be expressed as a set of zero to many resolution distances (typically for gridded data and imagery-derived products) or equivalent scales (typically for maps or map-derived products).	D	01..*	A resolution distance shall be expressed as a numerical value associated with a unit of length.	20

CONFORMITY

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Specification	This is a citation of the implementing rules adopted under Article 7(1) of Directive 2007/2/EC or other specification to which a particular resource conforms. A resource may conform to more than one implementing rules adopted under Article 7(1) of Directive 2007/2/EC or other specification.	S	1..*	This citation shall include at least the title and a reference date (date of publication, date of last revision or of creation) of the implementing rules adopted under Article 7(1) of [EC-INSPIRE-DIR] or of the specification.	Article 5a(1) to (4) and Article 7 of Decision 1999/468/EC

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Degree	This is the degree of conformity of the resource to the implementing rules adopted under Article 7(1) of Directive 2007/2/EC or other specification.	S	1..*	From Part D.5 of [EC-INSPIRE-CR]. Degree of Conformity: **Conformant (conformant)**: The resource is fully conformant with the cited specification. **Not Conformant (notConformant) :** The resource does not conform to the cited specification. **Not evaluated (notEvaluated):** Conformance has not been evaluated.	conformant

CONSTRAINT RELATED TO ACCESS AND USE

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Conditions applying to access and use	This metadata element defines the conditions for access and use of spatial data sets and services, and where applicable, corresponding fees as required by Article 5(2)(b) and Article 11(2)(f) of Directive 2007/2/EC.	S	1..*	free text The element must have values. If no conditions apply to the access and use of the resource, "no conditions apply" shall be used. If conditions are unknown, "conditions unknown" shall be used. This element shall also provide information on any fees necessary to access and use the resource, if applicable, or refer to a uniform resource locator (URL) where information on fees is available.	no conditions apply
Limitations on public access	When Member States limit public access to spatial data sets and spatial data services under Article 13 of Directive 2007/2/EC, this metadata element shall provide information on the limitations and the reasons for them.	-	1..*	free text	NA

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
	If there are no limitations on public access, this metadata element shall indicate that fact.				

ORGANISATIONS RESPONSIBLE FOR THE ESTABLISHMENT, MANAGEMENT, MAINTENANCE AND DISTRIBUTION OF SPATIAL DATA SETS AND SERVICES

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Responsible party	This is the description of the organisation responsible for the establishment, management, maintenance and distribution of the resource.	S	1..*	This description shall include: - the name of the organisation as free text, - a contact e-mail address as a character string.	respons_party respons_party@org.ext
Responsible party role	This is the role of the responsible organisation.	S	1..*	From Part D.6 of [EC-INSPIRE-CR]. 6. RESPONSIBLE PARTY	user

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
				ROLE 6.1. Resource Provider (resourceProvider) Party that supplies the resource. 6.2. Custodian (custodian) Party that accepts accountability and responsibility for the data and ensures appropriate care and maintenance of the resource. 6.3. Owner (owner) Party that owns the resource. 6.4. User (user) Party who uses the resource. 6.5. Distributor (distributor)	

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
				Party who distributes the resource. 6.6. Originator (originator) Party who created the resource 6.7. Point of Contact (pointOfContact) Party who can be contacted for acquiring knowledge about or acquisition of the resource. 6.8. Principal Investigator (principalInvestigator) Key party responsible for gathering information and conducting research. 6.9. Processor (processor) Party who has processed the data in a manner such that the resource has been	

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
				modified. 6.10. Publisher (publisher) Party who published the resource. 6.11. Author (author) Party who authored the resource.	

METADATA ON METADATA

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Metadata point of contact	This is the description of the organisation responsible for the creation and maintenance of the metadata.	S	1..*	This description shall include: - the name of the organisation as free text,	org_name org_name@org.ext

Element name	INSPIRE Definition	(S)tatic (D)ynamic (-) N/A	Multiplicity	Value Domain	Value
Metadata date	The date which specifies when the metadata record was created or updated.	D	1	- a contact e-mail address as a character string. This date shall be expressed in conformity with ISO 8601.	2012-03-05
Metadata language	This is the language in which the metadata elements are expressed.	S	1	The value domain of this metadata element is limited to the official languages of the Community expressed in conformity with ISO 639-2.	eng

Setting the values listed above (in the column "Value") in the ***Metadata Editor*** tool provided in the INSPIRE Geoportal (http://inspire-geoportal.ec.europa.eu/editor/), the following XML INSPIRE ISO 19115/19139 encoded is provided.

```
<?xml version="1.0" encoding="UTF-8"?><gmd:MD_Metadata xsi:schemaLocation="http://www.isotc211.org/2005/gmd
http://schemas.opengis.net/iso/19139/20060504/gmd/gmd.xsd" xmlns:gmd="http://www.isotc211.org/2005/gmd"
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink">
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<gco:CharacterString>publisher</gco:CharacterString>
</gmd:fileIdentifier>
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</gmd:language>
<gmd:characterSet>
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codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode">MD_CharacterS
etCode_utf8</gmd:MD_CharacterSetCode>
</gmd:characterSet>
<gmd:hierarchyLevel>
<gmd:MD_ScopeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCod
elists.xml#MD_ScopeCode" codeListValue="dataset">dataset</gmd:MD_ScopeCode>
</gmd:hierarchyLevel>
<gmd:contact>
<gmd:CI_ResponsibleParty>
<gmd:organisationName>
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</gmd:organisationName>
<gmd:contactInfo>
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</gmd:electronicMailAddress>
</gmd:CI_Address>
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</gmd:contactInfo>
<gmd:role>
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elists.xml#CI_RoleCode" codeListValue="pointOfContact">pointOfContact</gmd:CI_RoleCode>
</gmd:role>
</gmd:CI_ResponsibleParty>
</gmd:contact>
<gmd:dateStamp>
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```

```
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</gmd:title>
<gmd:date>
<gmd:CI_Date>
<gmd:date>
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</gmd:date>
<gmd:dateType>
<gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCod
elists.xml#CI_DateTypeCode" codeListValue="creation">creation</gmd:CI_DateTypeCode>
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</gmd:code>
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</gmd:code>
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</gmd:identifier>
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</gmd:citation>
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<gco:CharacterString>respons_party@org.ext</gco:CharacterString>
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</gmd:address>
</gmd:CI_Contact>
</gmd:contactInfo>
<gmd:role>
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</gmd:role>
</gmd:CI_ResponsibleParty>
</gmd:pointOfContact>
<gmd:descriptiveKeywords>
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</gmd:keyword>
<gmd:keyword>
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</gmd:dateType>
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</gmd:thesaurusName>
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</gmd:keyword>
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<gmd:CI_DateTypeCode
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</gmd:dateType>
```

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</gmd:date>
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</gmd:title>
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</gmd:useLimitation>
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</gmd:resourceConstraints>
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codeListValue="eng">eng</gmd:LanguageCode>
</gmd:language>
<gmd:topicCategory>
<gmd:MD_TopicCategoryCode>imageryBaseMapsEarthCover</gmd:MD_TopicCategoryCode>
</gmd:topicCategory>
<gmd:extent>

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<gmd:EX_Extent>
<gmd:geographicElement>
<gmd:EX_GeographicBoundingBox>
<gmd:westBoundLongitude>
<gco:Decimal>-63.15</gco:Decimal>
</gmd:westBoundLongitude>
<gmd:eastBoundLongitude>
<gco:Decimal>-63.01</gco:Decimal>
</gmd:eastBoundLongitude>
<gmd:southBoundLatitude>
<gco:Decimal>18.05</gco:Decimal>
</gmd:southBoundLatitude>
<gmd:northBoundLatitude>
<gco:Decimal>18.12</gco:Decimal>
</gmd:northBoundLatitude>
</gmd:EX_GeographicBoundingBox>
</gmd:geographicElement>
<gmd:temporalElement>
<gmd:EX_TemporalExtent>
<gmd:extent>
<gml:TimePeriod gml:id="IDcd3b1c4f-b5f7-439a-afc4-3317a4cd89be" xsi:type="gml:TimePeriodType">
<gml:beginPosition>2014-01-01</gml:beginPosition>
<gml:endPosition>2030-01-01</gml:endPosition>
</gml:TimePeriod>
</gmd:extent>
</gmd:EX_TemporalExtent>
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<gmd:version>
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<gmd:MD_DigitalTransferOptions>
<gmd:onLine>
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```

<gmd:scope>
<gmd:DQ_Scope>
<gmd:level>
<gmd:MD_ScopeCode codeListValue="dataset" codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#MD_ScopeCode">dataset</gmd:MD_ScopeCode>
</gmd:level>
</gmd:DQ_Scope>
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<gmd:report>
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<gmd:result>
<gmd:DQ_ConformanceResult xsi:type="gmd:DQ_ConformanceResult_Type">
<gmd:specification>
<gmd:CI_Citation>
<gmd:title>
<gco:CharacterString>Article 5a(1) to (4) and Article 7 of Decision 1999/468/EC</gco:CharacterString>
</gmd:title>
<gmd:date>
<gmd:CI_Date>
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<gco:Date>1999-01-01</gco:Date>
</gmd:date>
<gmd:dateType>
<gmd:CI_DateTypeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#CI_DateTypeCode" codeListValue="creation">creation</gmd:CI_DateTypeCode>
</gmd:dateType>
</gmd:CI_Date>
</gmd:date>
</gmd:CI_Citation>
</gmd:specification>
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<gco:CharacterString>See the referenced specification</gco:CharacterString>
</gmd:explanation>
<gmd:pass>
<gco:Boolean>true</gco:Boolean>
</gmd:pass>
</gmd:DQ_ConformanceResult>
</gmd:result>
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</gmd:report>
<gmd:lineage>
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<gmd:statement>
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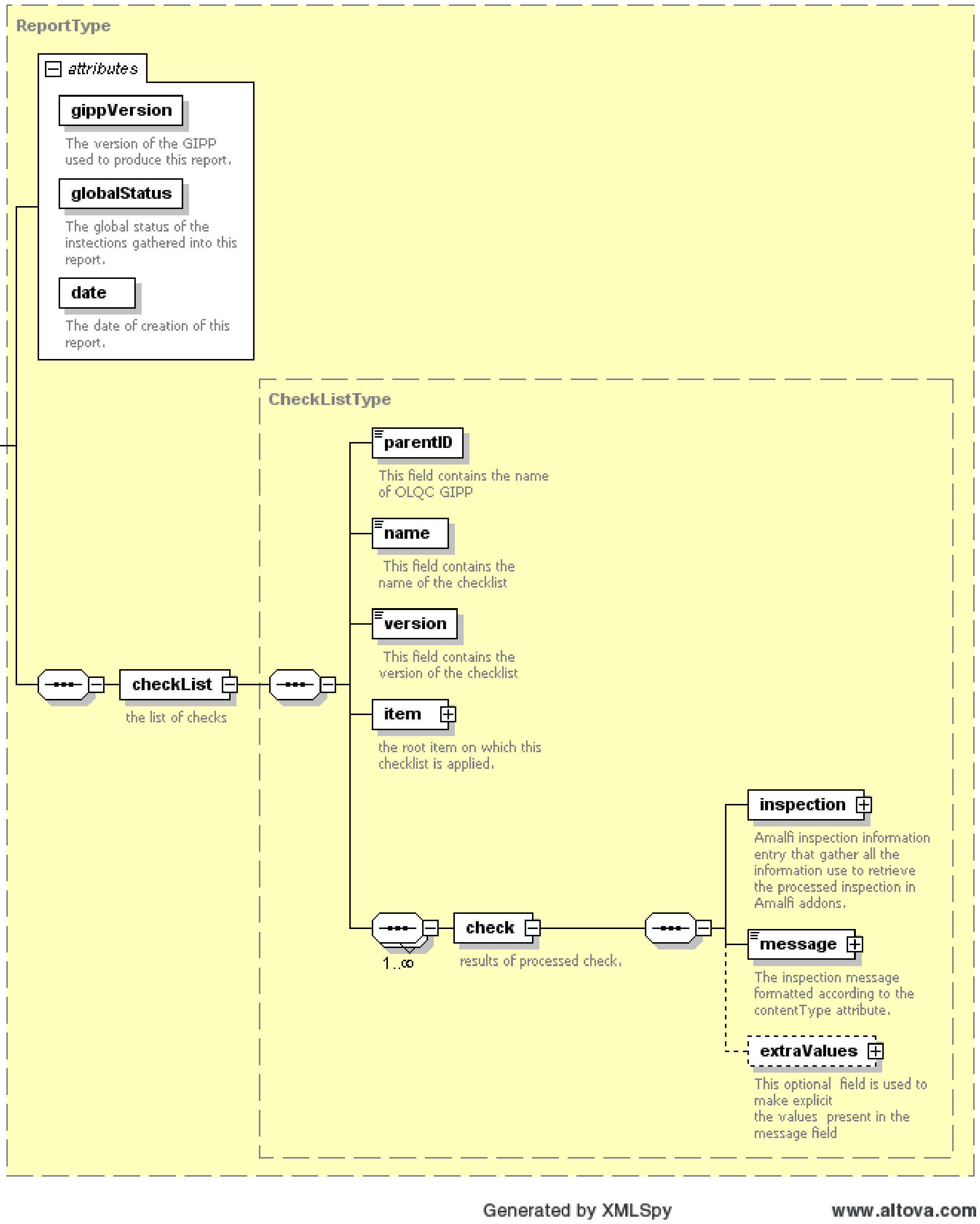
</gmd:statement>
</gmd:LI_Lineage>
</gmd:lineage>
</gmd:DQ_DataQuality>
</gmd:dataQualityInfo>
</gmd:MD_Metadata>

ANNEX C: OLQC REPORT XSD



The naming convention used for the OLQC reports is:

PDI_ID_<checklistname>_report.xml

PDI_ID is defined case by case in the chapter 3 for each Granule/Tile and Datastrip PDI and <checklistname> are defined in the following table.

For Granule/Tile PDI:

Checklist Name	L0c	L1A	L1B	L1C
SENSOR_QUALITY	Y	Y	Y	Y
GEOMETRIC_QUALITY	N	Y	Y	Y
GENERAL_QUALITY	N	Y	Y	Y
FORMAT_CORRECTNESS	Y	Y	Y	Y

For Datastrip PDI :

Checklist Name	L0c	L1A	L1B	L1C
SENSOR_QUALITY	Y	Y	Y	Y
GEOMETRIC_QUALITY	Y	Y	Y	Y
GENERAL_QUALITY	Y	Y	Y	Y
RADIOMETRIC_QUALITY	N	N	Y	Y
FORMAT_CORRECTNESS	Y	Y	Y	Y

Each report contains all checks related to the specific checklist name as defined in the Table 3-17 and Table 3-24.

The following example of OLQC XML report corresponds to:
inspected PDI = Level-0 Granule
S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12
Checklistname = *SENSOR_QUALITY*
Checks = *Corrupted_ISP, Missing_Lines, Sensing_Time*
GlobalStatus = *PASSED* (as all check status are PASSED)


```xml
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file generated by XMLSpy v2006 rel. 3 sp2 (http://www.altova.com)-->
<Earth_Explorer_File xmlns="http://gs2.esa.int/DATA_STRUCTURE/olqcReport"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://gs2.esa.int/DATA_STRUCTURE/olqcReport
\\bld16\auriemma\Desktop\olqcreport\OLQC_Report.xsd">
	<Earth_Explorer_Header>
		<Fixed_Header>
			<File_Name>String</File_Name>
			<File_Description>String</File_Description>
			<Notes>String</Notes>
			<Mission>S2_</Mission>
			<File_Class>String</File_Class>
			<File_Type>REP_OLQCPA</File_Type>
			<Validity_Period>
				<Validity_Start>UTC=0000-00-00T00:00:00</Validity_Start>
				<Validity_Stop>UTC=0000-00-00T00:00:00</Validity_Stop>
			</Validity_Period>
			<File_Version>2</File_Version>
```

```
<Source>
<System>String</System>
<Creator>String</Creator>
<Creator_Version>String</Creator_Version>
<Creation_Date>UTC=0000-00-00T00:00:00</Creation_Date>
</Source>
</Fixed_Header>
<Variable_Header/>
</Earth_Explorer_Header>
<Data_Block type="xml">
<report date="2001-12-17T09:30:47.0Z" gippVersion="01.00.01" globalStatus="PASSED">
<checkList>
<parentID>String</parentID>
<name>SENSOR_QUALITY </name>
<version>00.01</version>
<item
url="D:/S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar"
className="SENTINEL 2 Level 0 granule "
name="S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12"
class="ttp://pdgs.s2.esa.int/PSD"/>
<check>
<inspection
item="S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar" id="DimapPlan"
creation="2001-12-17T09:30:47.0Z" processingStatus="Done" status="PASSED" execution="2001-12-17T09:30:47.0Z"
duration="2.844" name="All Applicable Inspections Plan (Automatic)" priority="2"
itemURL="D:/S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar"/>
<message contentType="Text">"plain/text">All  inspection(s) passed
successfully</message>

</check>
<check>
<inspection
item="S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar" id="Corrupted_ISP"
creation="2001-12-17T09:30:47.0Z" processingStatus="Done" status="PASSED" execution="2001-12-17T09:30:47.0Z"
duration="2.844" name="Corrupted_ISP I" priority="5"
itemURL="D:/S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar"/>
<message contentType="Text">Check LOST ISP Percentage is less than
1,2%</message>
</check>
<check>
<inspection
item="S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar" id="Sensing_Time "
creation="2001-12-17T09:30:47.0Z" processingStatus="Done" status="PASSED" execution="2001-12-17T09:30:47.0Z"
duration="2.844" name="Sensing_Time " priority="5"
itemURL="D:/S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar"/>
<message contentType="Text">Check Sensing Time is  correct</message>
</check>
<check>
<inspection
item="S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar" id="Missing_Lines"
creation="2001-12-17T09:30:47.0Z" processingStatus="Done" status="PASSED" execution="2001-12-17T09:30:47.0Z"
duration="2.844" name="Missing_Lines " priority="5"
itemURL="D:/S2A_OPER_MSI_L0__GR_MTI__20141104T134012_S20141104T134012_D01_N01.12.tar"/>
<message contentType="Text"> Missing Lines threshold exceeded. threshold(5) LostLineNumber(254)
DegradedLineNumber(365)</message>
  <extraValues>
    <value name="threshold">5</value>
    <value name="LostLineNumber">254</value>
```

<value name="DegradedLineNumber">365</value>
</extraValues>
</check>
</checkList>
</report>
</Data_Block>
</Earth_Explorer_File>

ANNEX D: GROUND IMAGE PROCESSING PARAMETERS (GIPP)

The following table gives the list of GIPP files available for each kind of product level.
The column "Remarks" indicates if the GIPP file is Satellite dependent and spectral band dependent. There are 34 GIPP file types and a total of 154 GIPP files:

- 23 GIPP Satellite dependent
- 1 GIPP Satellite independent
- 10x13 GIPP Spectral Band dependent

For details see [GPP-IODD].

GIPP Description	Interface name / File Type	Volume	Remarks	L0	L1A	L1B	L1C
Pixel line of sight for each bands in the focal plane reference frame	[SATELLITE_ID]_[BAND_ID]_VIEWING_DIRECTIONS_FILE GIP_VIEDIR	1 MB for 10m band 500 KB for 20m bands 170 KB for 60m bands	Indexed by Satellite and by spectral bands	x	x	x	x
Platform model	[SATELLITE_ID]_SPACECRAFT_MODEL_FILE GIP_SPAMOD	50 KB	Indexed by Satellite	x	x	x	x
Earth model	EARTH_MODEL_FILE GIP_EARMOD	4 KB				x	x
Global geometrical parameters	[SATELLITE_ID]_GEOMETRICAL_PARAMETERS_FILE GIP_GEOPAR	8 KB	Indexed by Satellite			x	x
Description of the inter detectors overlapping area	[SATELLITE_ID]_INTER_DETECTOR_FILE GIP_INTDET	40 KB	Indexed by Satellite			x	x
Deconvolution filter for each deconvoluted band	[SATELLITE_ID]_[BAND_ID]_DECONVOLUTION_FILTER_FILE GIP_R2DEFI	100 KB for each band	Indexed by Satellite and by Spectral bands		x	x	x

GIPP Description	Interface name / File Type	Volume	Remarks	L0	L1A	L1B	L1C
Threshold file for deconvolution through wavelet packets	[SATELLITE_ID]_[BAND_ID]_DECONVOLUTION_THRESHOLD_FILE GIP_R2DECT	30 KB for each band	Indexed by Satellite and by Spectral bands		x	x	x
Wavelets filters	[SATELLITE_ID]_[BAND_ID]_WAVELET_FILTERS_FILE GIP_R2WAFI	10 KB for each band	Indexed by Satellite and by Spectral bands		x	x	x
L2 Norm coefficients (denoising)	[SATELLITE_ID]_[BAND_ID]_L2_NORM_COEFFICIENTS_FILE GIP_R2L2NC	30 KB for each band	Indexed by Satellite and by Spectral bands		x	x	x
Denoising thresholds (denoising)	[SATELLITE_ID]_[BAND_ID]_DENOISING_THRESHOLDS_FILE GIP_R2DENT	30 KB for each band	Indexed by Satellite and by Spectral bands		x	x	x
Noise model (denoising)	[SATELLITE_ID]_NOISE_MODEL_FILE GIP_R2NOMO	4 KB	Indexed by Satellite		x	x	x
SWIR detectors arrangement parameters	[SATELLITE_ID]_SWIR_REARRANGEMENT_PARAMETERS_FILE GIP_R2SWIR	20 KB	Indexed by Satellite		x	x	x
Radiometric equalization parameters on board (dark current, on-board inter pixel calibration)	[SATELLITE_ID]_[BAND_ID]_EQUALIZATION_ONBOARD_PARAMETERS_FILE GIP_R2EOB2	3 MB for 10m bands 1.5 MB for 20m bands 500 KB for 60m bands	Indexed by Satellite and by Spectral bands		x	x	x

GIPP Description	Interface name / File Type	Volume	Remarks	L0	L1A	L1B	L1C
Radiometric equalization parameters on ground (on-ground correction)	[SATELLITE_ID]_[BAND_ID]_EQUALIZATION_ONGROUND_PARAMETERS_FILE GIP_R2EQOG	3 MB for 10m bands 1.5 MB for 20m bands 500 KB for 60m bands	Indexed by Satellite and by Spectral bands		x	x	x
List of defective pixels	[SATELLITE_ID]_DEFECTIVE_PIXELS_FILE GIP_R2DEPI	5 KB	Indexed by Satellite		x	x	x
List of blind pixels	Appendix D : [SATELLITE_ID]_BLIND_PIXELS_FILE GIP_BLINDP	5 KB	Indexed by Satellite	x	x	x	x
Binning for 60m bands parameters (filters and undersampling)	[SATELLITE_ID]_BINNING_PARAMETERS_FILE GIP_R2BINN	5 KB	Indexed by Satellite		x	x	x
Absolute calibration parameters	[SATELLITE_ID]_ABSOLUTE_CALIBRATION_PARAMETERS_FILE GIP_R2ABCA	30 KB	Indexed by Satellite	x	x	x	x
Crosstalk correction	[SATELLITE_ID]_CROSSTALK_CORRECTIONS_FILE GIP_R2CRCO	1 MB	Indexed by Satellite		x	x	x
IAS AnaTm HK parameters file	[SATELLITE_ID]_ANA_TM_SAD_PARAMETERS_FILE GIP_ATMSAD	40 KB	Indexed by Satellite	x	x	x	x
IAS AnaTm image parameters file	[SATELLITE_ID]_ANA_TM_IMAGE_PARAMETERS_FILE GIP_ATMIMA	40 KB	Indexed by Satellite	x	x	x	x

GIPP Description	Interface name / File Type	Volume	Remarks	L0	L1A	L1B	L1C
IAS Datation parameters file	[SATELLITE_ID]_DATATION_PARAMETERS_FILE GIP_DATATI	40 KB	Indexed by Satellite	x	x	x	x
LR Extraction parameters file	[SATELLITE_ID]_LR_EXTRACTION_PARAMETERS_FILE GIP_LREXTR	40 KB	Indexed by Satellite	x	x	x	x
InitLoc Inv parameters file	[SATELLITE_ID]_INIT_LOC_INV_PARAMETERS_FILE GIP_INVLOC	40 KB	Indexed by Satellite	x	x	x	x
CloudInv parameter file	[SATELLITE_ID]_CLOUD_INV_PARAMETERS_FILE GIP_CLOINV	20 KB	Indexed by Satellite	x	x	x	x
InitLoc production parameters file	[SATELLITE_ID]_INIT_LOC_PROD_PARAMETERS_FILE GIP_PRDLOC	20 KB	Indexed by Satellite		x	x	x
RadioS2 parameters file	[SATELLITE_ID]_RADIO_S2_PARAMETERS_FILE GIP_R2PARA	40 KB	Indexed by Satellite		x	x	x
GeoS2 parameters file (preProc)	[SATELLITE_ID]_GEO_S2_PARAMETERS_FILE GIP_G2PARA	25 KB	Indexed by Satellite			x	x
Geometric parameter to refine	[SATELLITE_ID]_PARAMETERS_TO_BE_REFINED_FILE GIP_G2PARE	5 KB	Indexed by Satellite			x	x

GIPP Description	Interface name / File Type	Volume	Remarks	L0	L1A	L1B	L1C
TilingS2 parameters file	[SATELLITE_ID]_TILING_S2_PARAMETERS_FILE GIP_TILPAR	10 KB	Indexed by Satellite				x
ResampleS2 parameters file (preProc)	[SATELLITE_ID]_RESAMPLE_S2_PARAMETERS_FILE GIP_RESPAR	10 KB	Indexed by Satellite				x
MaskS2 parameters file	[SATELLITE_ID]_MASK_S2_PARAMETERS_FILE GIP_MASPAR	10 KB	Indexed by Satellite		x	x	x

ANNEX E: MASK TYPES AND GROUPING STRATEGY FOR L1 PRODUCTS

The following table shows the main and sub mask types. There are 8 main types of masks and for each main type, one GML file is defined.

Mask Type	Main Type	Sub Type	Comments	Processing Level
Technical quality masks	MSK_TECQUA	ANC_LOST	Ancillary lost data	L1A: one file per band and detector; L1B: one file per band and detector; L1C: one file per band and Tile;
		ANC_DEG	Ancillary degraded data	
		MSI_LOST	MSI lost data	
		MSI_DEG	MSI degraded data	
Radiometric quality masks	MSK_DEFECT	QT_DEFECTIVE_PIXELS	Defective pixels (matching defective columns)	L1A: one file per band and detector; L1B: one file per band and detector; L1C: one file per band and Tile;
Radiometric quality masks	MSK_SATURA	QT_SATURATED_PIXELS_L1A	Saturated pixels before on-ground radiometric processing	QT_SATURATED_PIXELS_L1A for L1A products : one file for each detector, each band; QT_SATURATED_PIXELS_L1A and/or QT_SATURATED_PIXELS_L1Bfor L1B products: one for each detector, each band; QT_SATURATED_PIXELS_L1A and/or QT_SATURATED_PIXELS_L1B for L1C products: one for each tile, each band.
		QT_SATURATED_PIXELS_L1B	Saturated pixels after on-ground radiometric processing	
Radiometric quality masks	MSK_NODATA	QT_NODATA_PIXELS	No–data pixels	L1A: one file per band and detector; L1B: one file per band and detector; L1C: one file per band and Tile;
		QT_PARTIALLY_CORRECTED_PIXELS	Pixels partially corrected during cross-talk processing.	
Detector footprint masks	MSK_DETFOO	DETECTOR_FOOTPRINT	For each band and detector intersecting the Tile, a feature describes the intersected ground footprint	L1C: one file per band and Tile;
Coarse cloud masks	MSK_CLOLOW	CLOUD_INV	One file per band and detector	L1A: one file per band and detector; L1B: one file per band and detector;

Finer cloud masks	MSK_CLOUDS	OPAQUE	Opaque clouds	L1C: one file per Tile;
		CIRRUS	Cirrus clouds	

The proposed solution is to group the masks per type and per band.
Each mask GML file contains the mask feature related to the corresponding mask sub types given a specific band.
The following example shows the adopted grouping strategy. It refers to the MSK_CLOUDS gml file and contains the mask features for the OPAQUE and CIRRUS sub types.

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<eop:Mask gml:id=" S2A_OPER_MSK_CLOUDS_MTI__20141104T134012_A123456_T15SWC_B03_MSIL1C"
xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:eop="http://www.opengis.net/eop/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation= "http://www.opengis.net/eop/2.0 ../eop.xsd">
<gml:name>Clouds mask from Tile S2A_OPER_MSI_L1C_TL_MTI__20141104T134012_A123456_T15SWC_N11.11</gml:name>
<gml:boundedBy>
<gml:Envelope srsName="urn:ogc:def:crs:EPSG:6.3:32614">
<gml:lowerCorner>399960.000000 4300060.000000</gml:lowerCorner>
<gml:upperCorner>509760.000000 4190260.000000</gml:upperCorner>
</gml:Envelope>
</gml:boundedBy>
<eop:maskMembers>
<eop:MaskFeature gml:id="opaque-0-B01-01-0000">
<eop:maskType codeSpace="urn:gs2:S2PDGS:maskType">OPAQUE</eop:maskType>
<eop:extentOf>
<gml:Polygon gml:id="opaque-0-B01-01-0000_Polygon" srsName="urn:ogc:def:crs:EPSG:6.3:32614">
<gml:exterior>
<gml:LinearRing>
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<gml:interior>
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.
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<eop:extentOf>
<gml:Polygon gml:id="opaque-0-B01-01-0001_Polygon" srsName="urn:ogc:def:crs:EPSG:6.3:32615">
<gml:exterior>
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Remark: this example is not fully realistic, technical masks will not include "holes".

ANNEX F: EXAMPLE OF METADATA FILE FOR A GRANULE AGGREGATED


```xml
<?xml version ="1.0" encoding="UTF-8"?>
	<n1:Level-1A_Granule_ID xsi:schemaLocation="http://pdgs.s2.esa.int/PSD/S2_PDI_Level-1A_Granule_Metadata.xsd S2_PDI_Level-1A_Granule_Metadata.xsd" xmlns:n1="http://pdgs.s2.esa.int/PSD/S2_PDI_Level-1A_Granule_Metadata.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
		<n1:General_Info>
			<GRANULE_ID metadataLevel="Brief">S2A_OPER_MSI_L1A_GR_MTI__20130621T120000_S20091211T165928_D07_N01.01</GRANULE_ID>
			<DETECTOR_ID metadataLevel="Brief">07</DETECTOR_ID>
			<DATASTRIP_ID metadataLevel="Brief">S2A_OPER_MSI_L1A_DS_MTI__20130621T120000_S20091211T165928_N01.01</DATASTRIP_ID>
			<DOWNLINK_PRIORITY metadataLevel="Standard">NRT</DOWNLINK_PRIORITY>
			<SENSING_TIME metadataLevel="Standard">2009-12-11T16:58:51.592742566Z</SENSING_TIME>
			<Archiving_Info metadataLevel="Expertise">
				<ARCHIVING_CENTRE>MTI_</ARCHIVING_CENTRE>
				<ARCHIVING_TIME>2013-02-19T10:15:44Z</ARCHIVING_TIME>
			</Archiving_Info>
		</n1:General_Info>
		<n1:Geometric_Info>
			<Granule_Footprint metadataLevel="Brief">
				<Granule_Footprint>
					<Footprint>
						<EXT_POS_LIST>37.781619442 -98.546300697 561.964 35.002917703 -99.387519694 512.921 34.949015084 -99.117608113 444.079 37.726697926 -98.266969317 513.995 37.781619442 -98.546300697 561.964</EXT_POS_LIST>
					</Footprint>
				</Granule_Footprint>
				<RASTER_CS_TYPE>POINT</RASTER_CS_TYPE>
				<PIXEL_ORIGIN>1</PIXEL_ORIGIN>
			</Granule_Footprint>
			<Granule_Position metadataLevel="Standard">
				<POSITION>1</POSITION>
				<Geometric_Header>
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					<QL_CENTER>4 5</QL_CENTER>
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						<ZENITH_ANGLE unit="deg">2.37884</ZENITH_ANGLE>
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					</Incidence_Angles>
					<Solar_Angles>
						<ZENITH_ANGLE unit="deg">62.9801</ZENITH_ANGLE>
						<AZIMUTH_ANGLE unit="deg">156.804</AZIMUTH_ANGLE>
					</Solar_Angles>
				</Geometric_Header>
			</Granule_Position>
			<Granule_Dimensions metadataLevel="Standard">
				<Size resolution="10">
					<NROWS>446026</NROWS>
					<NCOLS>2592</NCOLS>
				</Size>
				<Size resolution="20">
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					<NCOLS>1296</NCOLS>
				</Size>
				<Size resolution="60">
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					<NCOLS>1296</NCOLS>
				</Size>
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		</n1:Geometric_Info>
		<n1:Quality_Indicators_Info metadataLevel="Standard">
			<Image_Content_QI>
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</Image_Content_QI>
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ANNEX G: JPEG2000 COMPRESSION

The imagery files in the Level-1 User Product are compressed using JPEG2000 compression algorithms. JPEG2000 format is defined in [JP2STD].

JPEG2000 allows *lossless* or *lossy* compression and allows to optimize the products online delivery using the JPIP (JPEG2000 Interactive Protocol) streaming:

- LOSSLESS: Lossless compression, use reversible JPEG2000 compression.
- LOSSY: Lossy compression, use compression that ensures that JPEG2000 compression has a negligible effect on image quality.

Bands	Nb of Pixels (approx.)	Estimated size in GB with LOSSY Compression (eg. around 4,2 bits/pixels to be adjusted)	Estimated size in GB with LOSSLESS Compression (around 6bits/pixels in average)
4 Bands 10m	3364000000	1,645	2,350
6 Bands 20m	1261500000	0,617	0,881
3 Bands 60m	70083333	0,034	0,049
TOTAL		***2,296***	***3,280***

Figure 84 : Volume for image 290km x 290km, estimated with average JP2000 compression ratio)

The information is coded on 12 bits within the JPEG2000 format.

The JPEG2000 files are internally tiled (default tile size: 1024x1024).

The following configurable parameters are used to encode image in JPEG2000. Default values:
- Tile sizes : 1024x1024,
- Flush period : 1024 lines,
- Codeblock size : 64 (default value),
- Wavelet decomposition level : 5 (default value),
- Order : recommended order is RPCL (Resolution, Position, Colour component, Layer
- quality),
- Markers : ORGGen_plt option is used to allow optimized decompression,
- SPrecision and Qstep are 2 parameters depending on image coding (8 or 12 bits),
- SPrecision = coding dynamic (8 or 12) and Qstep = 1 / 2^(coding dynamic),
- Rate = 3.5 bits by colour plane.

Other parameters values are detailed in [JP2STD].

END OF DOCUMENT