COPERNICUS SPACE COMPONENT SENTINEL OPTICAL IMAGING

MISSION PERFORMANCE CLUSTER SERVICE

Level 2HF Product Format Specification

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1.2	27 July 2023	Updated version for end of Sen2like Phase 3 (previous template)
1.3	11 Feb 2025	Updated version for PSD 15.0, support S2C & S2D New Optical MPC template

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1 Introduction

1.1 Purpose of the document

This document is produced in the context of the development and maintenance of the Sen2Like demonstrator processor [OMPC-FTO-056]. Its purpose is to define the organisation of the XSD schemas describing Sentinel-2 Level 2H & Level 2F Product Format Specifications. The XSD schemas' structure is based on Sentinel-2 Product Format Specifications [S2-PSD].

1.2 Document structure

The document is structured as follows:

- Chapter 1: This introductive chapter
- Chapter 2: Product format approach
- Chapter 3: Organisation of XML Schema Definitions Files
- Chapter 4: The L2H/F File Naming Convention
- Appendix A: XSDs Directory Structure
- Appendix B: Conversion Formulae

1.3 References

1.2.1 Normative Reference Documents

[GS-FFS]	Ground Segment File Format Standard
[GS-FFS-TSM]	Earth Observation GS File Format Standard - Tailoring for the Sentinel Missions PDGS

1.2.2 Informative Reference Documents

[S2-PSD]	Sentinel-2 Products Specification Document https://sentinel.esa.int/documents/d/sentinel/s2-pdgs-cs-di-psd-v15-0
[S2-MRD]	Sentinel-2 Mission Requirements Document
[S2-L2A-ATBD]	Sentinel-2 Level 2A Algorithm Theoretical Basis Document
[S2-S2L-UM]	Sen2like Processor Installation and User Manual
[S2-S2L-ATBD]	Sentinel-2 Sen2like Algorithm Theoretical Basis Document

1.4 Definitions of Terms and Conventions

Please refer to section 2 of [S2-PSD] for definition of Sentinel-2 mission and terms, e.g. Datatake, Datastrip, MSI Spectral bands, User-product, etc.

2 Product Format approach

Please refer to section 1.6 of [S2-PSD] for more information on the Sentinel-2 Product Format.

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3 Organisation of XML Schema Definition files (XSD)

A set of XML Schema Definition Files (XSD) is provided for the specification of Level-2HF products. These XSD files can be divided in two groups:

1) XSD schemas with "_Structure" suffix, created to define the "physical organization" of each product components (PDI) on disk, described in section 3.1 (no XML are generated and validated using these schemas)

2) XSD schemas with "_Metadata" suffix that will be used to validate the XML main metadata file inside each product component (PDI Tile) and User product. As well as the evolution of the item2HF.xsd and dimap2HF.xsd schemas.
The OLQC_Report.xsd schema used to validate the QI Report for L2H/F User Product.

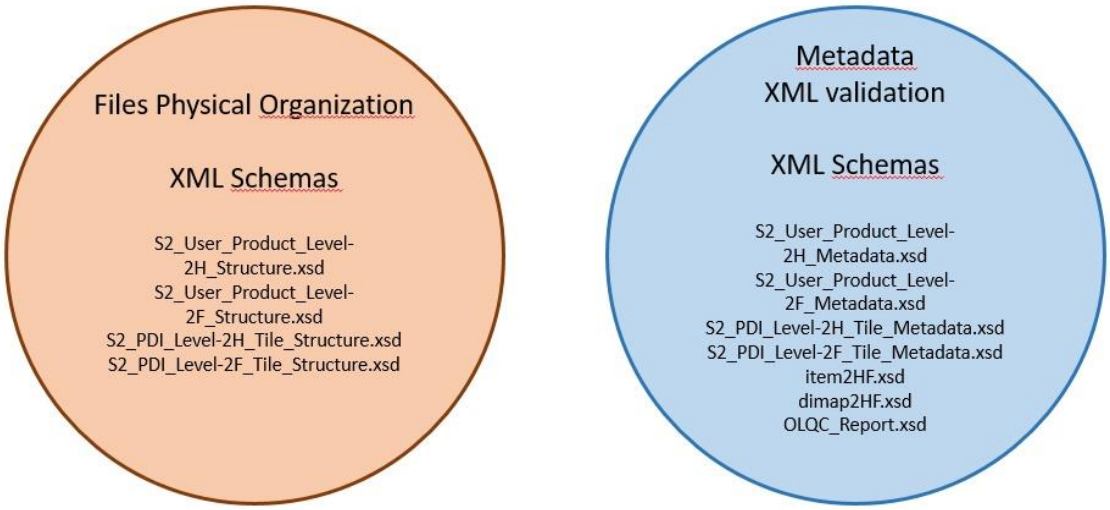

Figure 3-1 Different types of XSD files

3.1 Physical organisation XSD schemas:

1) S2_User_product_Level-2H_Structure.xsd
2) S2_User_product_Level-2F_Structure.xsd
3) S2_PDI_Level-2F_Tile_Structure.xsd
4) S2_PDI_Level-2F_Tile_Structure.xsd

3.1.1 S2_User_product_Level-2H_Structure.xsd

This XML schema describes the physical structure and contents of the Level-2H User Product directory. Figure 3-2 shows a partial view of the L2H user product structure.

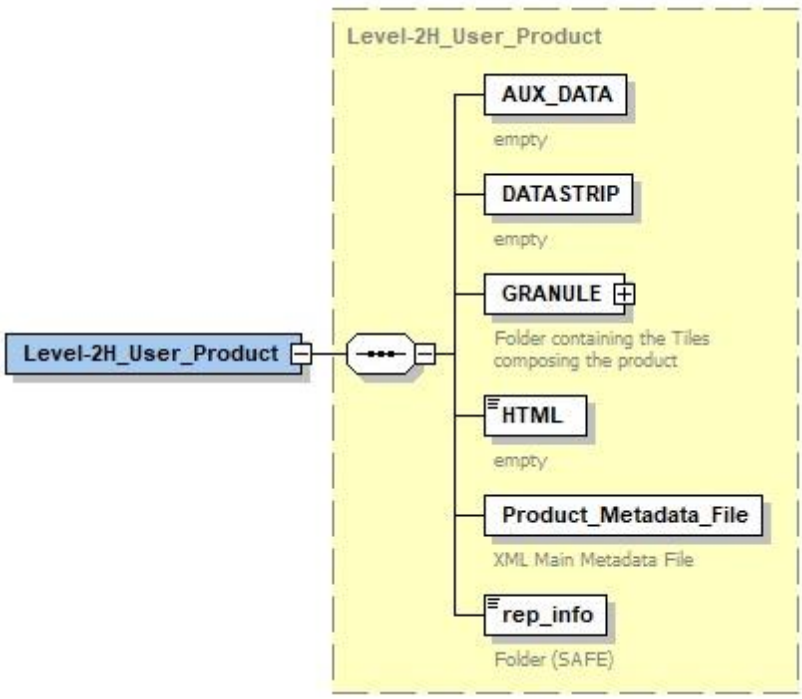

Figure 3-2 Level-2H user product – physical organisation

3.1.2 S2_User_product_Level-2F_Structure.xsd

This XML schema describes the physical structure and contents of the Level-2F User Product directory. It is identical in structure and contents to the Level-2H User Product directory. The only difference being that Landsat-8 bands are at Sentinel-2 native resolution.

3.1.3 S2_PDI_Level-2H_Tile_Structure.xsd

This XML schema describes the physical structure and contents of the Level-2H tile directory. Figure 3-3 shows a partial view of the overall structure, except the IMG_DATA folder, which is shown in Figure 3-4.

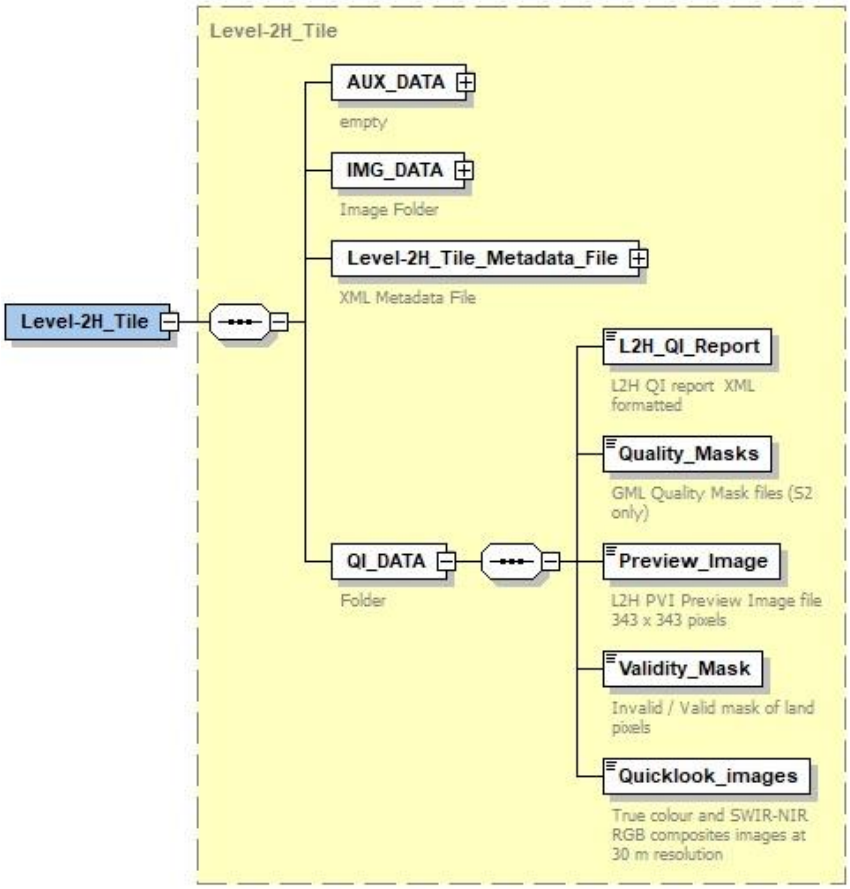

Figure 3-3 Level-2H tile – physical organisation except IMG_DATA folder

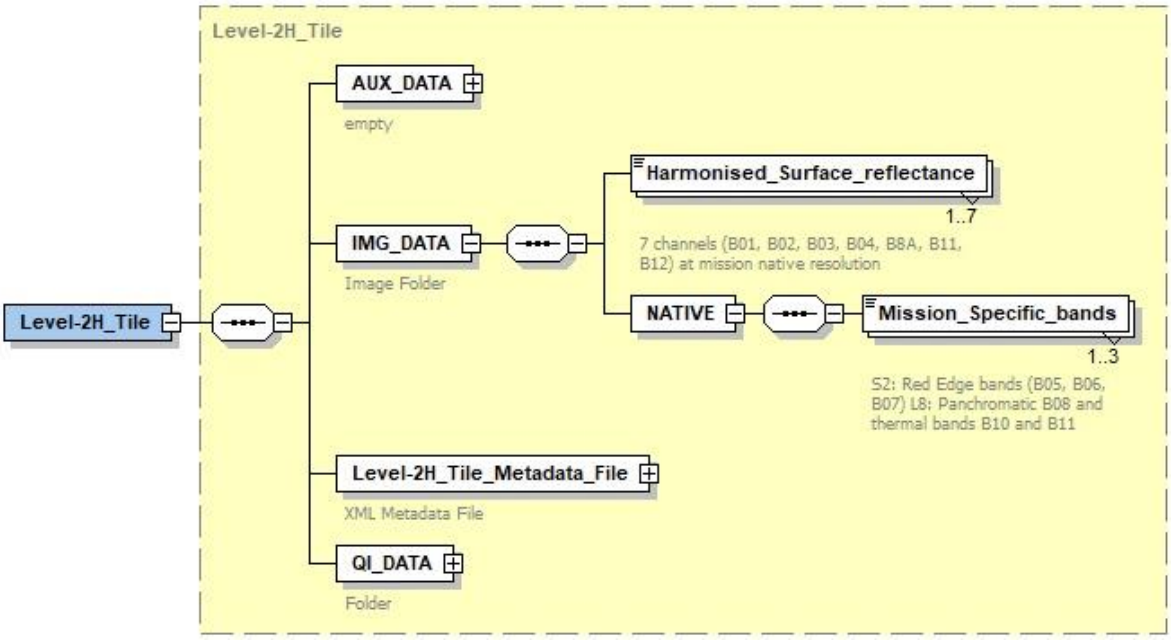

Figure 3-4 Level-2H tile IMG_DATA – physical organisation

3.1.4 S2_PDI_Level-2F_Tile_Structure.xsd

This XML schema describes the physical structure and contents of the Level-2F tile directory. It is identical in structure and contents to the Level-2H tile directory. The only differences being that Landsat-8 bands are at Sentinel-2 native resolution and that a Fusion Check Mask (FCM) is available in QI_DATA directory as shown in **Figure 3-5**

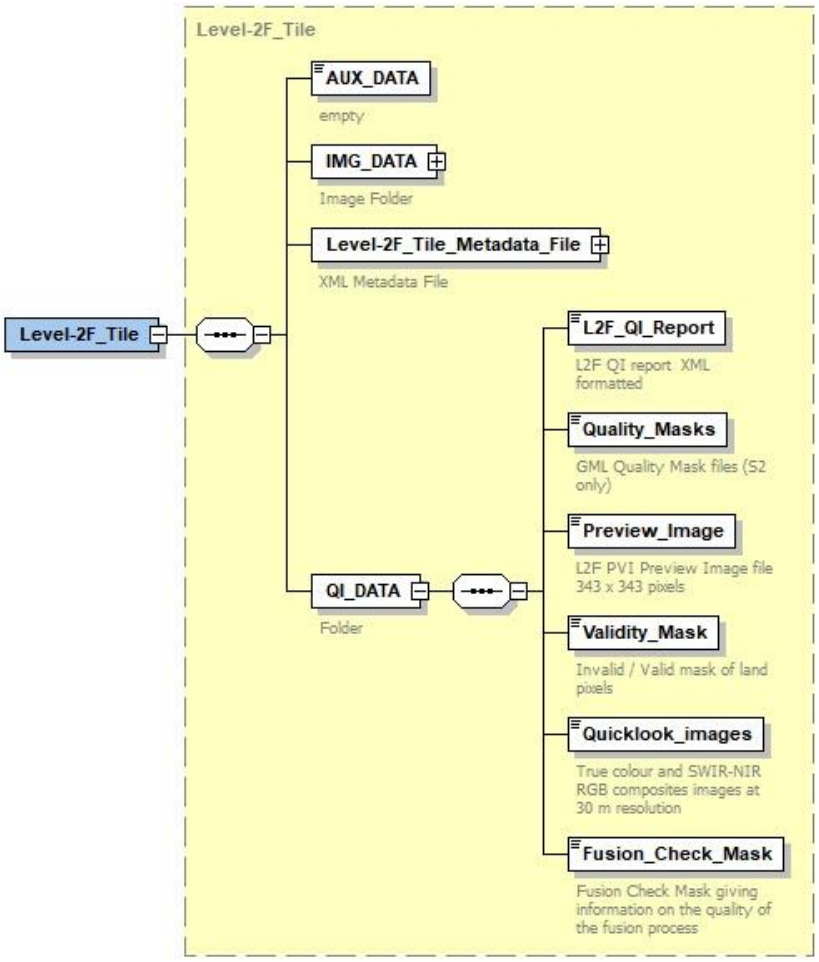

Figure 3-5 Level-2F tile – physical organisation except IMG_DATA folder

3.2 Metadata XML validation schemas

1) S2_User_Product_Level-2H_Metadata.xsd
2) S2_User_Product_Level-2F_Metadata.xsd
3) S2_PDI_Level-2H_Tile_Metadata.xsd
4) S2_PDI_Level-2F_Tile_Metadata.xsd
5) dimap2HF.xsd
6) item2HF.xsd

3.2.1 S2_User_Product_Level-2H_Metadata.xsd

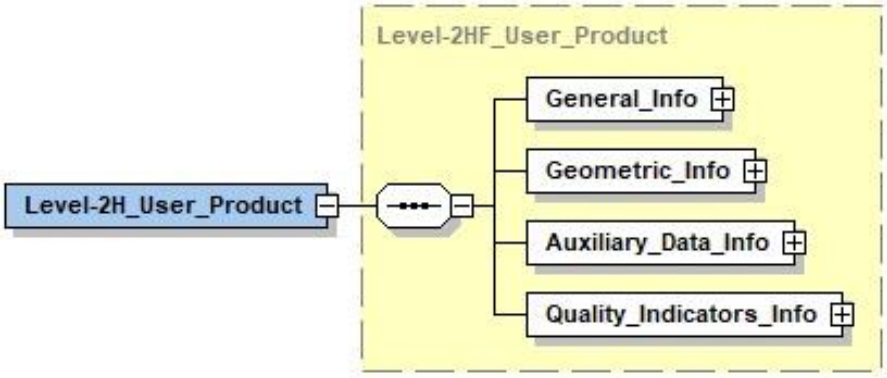

Figure 3-6 XML Schema metadata file L2H user product

3.2.2 S2_User_Product_Level-2F_Metadata.xsd

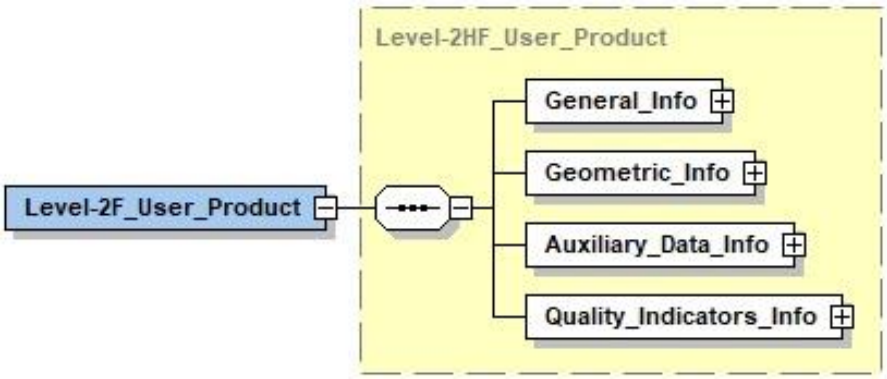

Figure 3-7 XML Schema metadata file L2F user product

3.2.3 S2_PDI_Level-2H_Tile_Metadata.xsd

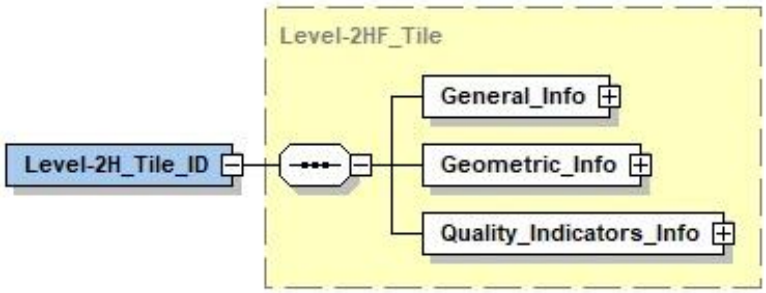

Figure 3-8 XML Schema metadata file L2H Tile

3.2.4 S2_PDI_Level-2F_Tile_Metadata.xsd

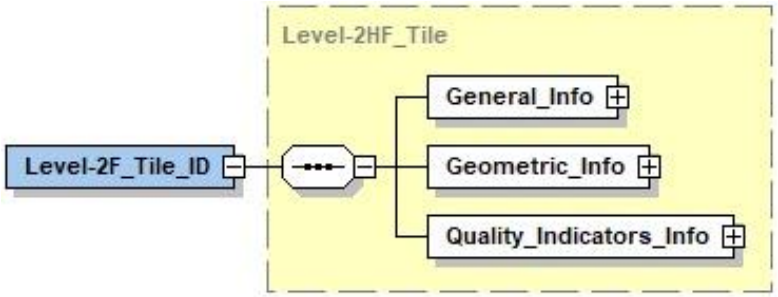

Figure 3-9 XML Schema metadata file L2F Tile

3.2.5 Item2HF.xsd

Item2HF.xsd schema contains simple Types that describe the L2HF Product Data Items.

Table 1: XSD types added to Item2HF.xsd

Type	Name	Description
SimpleType	DATASTRIP_ID_2A	Product Data Item identification
SimpleType	DATATAKE_ID_2HF	Datatake identification
SimpleType	DEM_ID_2HF	Product Data Item identification
SimpleType	ECMWF_ID_2HF	Product Data Item identification
SimpleType	GIPP_ID_2HF	Product Data Item identification
SimpleType	GLOBAL_SAD_ID_2HF	Product Data Item identification
SimpleType	GRANULE_ID_2HF	Product Data Item identification
SimpleType	GRANULE_TILE_ID_2HF	Product Data Item identification
SimpleType	GRI_ID_2HF	Product Data Item identification
SimpleType	HKTM_ID_2HF	Product Data Item identification
SimpleType	IERS_ID_2HF	Product Data Item identification
SimpleType	IMAGE_FILE_2HF	Product Data Item identification

Type	Name	Description
SimpleType	IMAGE_ID_2HF	Product Data Item identification
SimpleType	Item_ID_2HF	a PDI_ID_2HF or a Product ID
SimpleType	PDI_ID_2HF	Product Data Item identification list: Granule, Tile, Datastrip, GIPP, DEM, GRI, IERS, POD, ECMWF, HKTM, SAD)
SimpleType	QL_B432_ID_2HF	Quicklook Band 432 Image identification
SimpleType	QL_B12118A_ID_2HF	Quicklook Band 12118A Image identification
SimpleType	POD_ID_2HF	Product Data Item identification
SimpleType	Product_ID_2HF	Product Identifier in the archive (auxiliary, DEM, GIPP,...)
SimpleType	Product_ID_1C	New for PSD 14.2: references the Product Identifier of the L1C parent product
SimpleType	PVI_ID_2HF	Preview Image identification
SimpleType	SAD_ID_2HF	Product Data Item identification
SimpleType	TILE_ID_1	Product Data Item identification
SimpleType	TILE_ID_2A	Product Data Item identification
SimpleType	TILE_ID_2HF	Product Data Item identification

3.2.6 dimap2HF.xsd

This XML schema contains complex Types for the description of L2HF XML metadata. The list of new complex types is given in Table 2 hereafter with a short description:

Table 2: XSD types added to dimap2HF.xsd

Type	Name	Description
ComplexType	A_GIPP_LIST_2HF	
ComplexType	A_MASK_LIST_2HF	
ComplexType	A_PRODUCT_ORGANIZATION_2HF	General PDGS Product Information on Level 2HF
ComplexType	A_L2HF_Angles	
ComplexType	A_GEOMETRIC_INFO_TILE_2HF	
ComplexType	A_GEOMETRIC_INFO_TILE_2HF_Brief	
ComplexType	A_L2HF_Product_Info	Common general Product Information
ComplexType	A_PRODUCT_INFO_USERL2HF	General PDGS Product Information
ComplexType	A_L2A_SCENE_CLASSIFICATION_LIST	A list of L2A Scene Classification IDs

Type	Name	Description
ComplexType	A_L2A_SCENE_CLASSIFICATION_ID	Pixel values assigned to L2A Scene Classification Image Data
ComplexType	A_QUALITY_INDICATORS_INFO_USER_PROD_L1C_L2A_L2HF	Quality Indicators information on product level (L2A + L1C Technical assessment info)
ComplexType	AN_IMAGE_DATA_INFO_DSL1C_DSL2A	List of L2A tiles + L1C Geometric and Radiometric info
ComplexType	A_QUALITY_INDICATORS_INFO_DSL1B_DSL1C_DSL2A	Quality Indicators information on Datastrip level (L2A + L1C Geometric and Radiometric QI info)
ComplexType	AN_AUXILIARY_DATA_INFO_USERL2A	Auxiliary Data information L2A on product level
ComplexType	AN_AUXILIARY_DATA_INFO_DSL1C_DSL2A	Auxiliary Data information on Datastrip level (L2A and L1C reference)
ComplexType	A_GENERAL_INFO_L2HF	General information on L2HF Tile
ComplexType	A_QUALITY_INDICATORS_INFO_TILE_L2HF	Quality Indicators information on L2HF Tile and Pixel level
ComplexType	A_L2HF_IMG_CONTENT_QI	Image content Quality Indicators (percentages of pixel type)
ComplexType	A_L2HF_GRANULE_IMG_CONTENT_QI	Image content Quality Indicators (percentages of pixel type)
ComplexType	A_L2HF_PIXEL_LEVEL_QI_LIST	Filenames of L2A QI Masks (Cloud confidence map, Snow/Ice confidence map)
ComplexType	A_LHF_QUANTIFICATION_VALUES_LIST	A list of L1C, L2A, L2H, L2F quantification values for digital counts on pixel level

4 File Naming Convention

This chapter describes the file naming convention of L2H/F PSD 1.3 supporting SAFE_COMPACT format.

4.1 Level-2H/F User Product Naming Convention

4.1.1 Product Main Directory (SAFE_COMPACT)

Level-2H/F main product directory is identified according to the syntax derived from section 4.9.11 of [S2_PSD] describing the single tile user product naming convention:

MMM_DDDDDD_<Instance_ID>
Where: <Instance_ID> =
[Datatake Sensing Time]_Nxxyy_ROOO_Txxxxx_[Product Discriminator]

Table 3: Level-2H/F Product name Nomenclature

Field	Signification	Length (max)	Example Value
MMM	Mission ID, e.g. S2A, S2B, S2C, S2D, LS8, LS9, S2P	3	S2A, LS8
n/a	Separator	1	_
DDDDDD	Semantic Descriptor, fixed string to identify imaging instrument and Level-2H or Level-2F products	6	MSIL2H, MSIL2F, OLIL2H, OLIL2F
n/a	Separator	1	_
Datatake Sensing Time	UTC Date/Time with second's resolution. Format: YYYYMMDDThhmmss	15	20201103T102201
n/a	Separator	1	_
Nxxyy	Production baseline	5	N9999 for prototype
n/a	Separator	1	_
ROOO	Orbit Number (Relative orbit number) R000-R143 for S2 Number of path from Worldwide Reference System-2 (WRS-2) for LS8	4	R065 (for S2) R196 (path 196 for LS8)
n/a	Separator	1	_
Txxxxx	Tile number	6	T32TNS
n/a	Separator	1	_
Product Discriminator	Fixed string to distinguish different end user products associated to the same datatake. Format: YYYYMMDDThhmmss	15	20171106T195236
	Total length for main product directory name without extension.	**60**	

Example of S2 L2F product main directory:
LS8_OLIL2F_20170911T102359_N9999_R196_T31TFJ_20170911T111427.SAFE

The product directory contains the product main components listed in the following sections.

4.1.2 Product Metadata File (XML file)

The product metadata file name is combined by the two fields MMM + DDDDDD separated with '_'.

Table 4: Level-2H/F Product Metadata File – Naming Convention

Field	Signification	Length (max)	Example Value
MMM	MTD, fixed string to identify a metadata file	3	MTD
n/a	Separator	1	_
DDDDDD	Semantic Descriptor, fixed string to identify Level-2H/F products	6	MSIL2H, MSIL2F, OLIL2H, OLIL2F

Fixed filename of L8 L2F product metadata in SAFE_COMPACT format is:

MTD_OLIL2F.xml

4.1.3 GRANULE (folder)

GRANULE folder contains a list of folders; each one corresponding to a tile composing the Level-2H/F user product. The file naming convention of its content is described in 4.2.

4.1.4 DATASTRIP (folder)

DATASTRIP folder is empty for L2H/F product.
Datastrip information is available from inputs products.

4.1.5 AUX DATA (folder)

AUX_DATA folder is empty for L2H/F product.
AUX_DATA information is available from inputs products.

4.2 Level-2H/F PDI Naming Convention

4.2.1 Datastrip_ID

Not applicable.

4.2.2 Datastrip Metadata File (XML file)

Not applicable.

4.2.3 Tile_ID

The PDI_ID (Tile ID) used to identify a Level-2H/F Tile PDI, follows the description:
Tile_ID = <Level>_<Tile>_<AbsoluteOrbit>_<TileDiscriminator>_MMM_ROOO
as described in the following table:

Table 5: Level-2H/F Tile ID – Naming Convention

Field	Signification	Length (max)	Example Value
Level	Processing level (L2H or L2F)		L2F
Tile	According to US-MGRS naming convention. (Inherited from Level-1C tile)	6	T32TNS
Absolute Orbit	Absolute Orbit Number AOOOOOO	7	A012360
Tile Discriminator	String discriminator to distinguish between partial tiles generated out of the same datatake	15	20171103T102724
MMM	Mission ID, e.g. S2A, S2B, S2C, S2D, LS8, LS9, S2P	3	S2A, LS8
ROOO	Orbit Number (Relative orbit number) R000-R143 for S2 Path identifier from Worldwide Reference System-2 (WRS-2) for LS8	4	R065 (for S2) R196 (path 196 for LS8)

Example of S2 L2F tile name (Tile ID) is:

L2F_T31TFJ_A012303_20171030T104754_S2A_R008

4.2.4 Tile Metadata File (XML file)

File naming = MTD_TL.xml. The name is fixed.

4.2.5 IMG_DATA (folder)

IMG_DATA folder contains the items listed in the following subsections.
For surface reflectance images, the digital number (DN) value "0" is reserved for nodata. DN value of "1" corresponds to a surface reflectance of 0.0001, or 0.01%. See Appendix B for details.

4.2.5.1 Harmonised or Fused Surface_Reflectance images

SAFE_COMPACT:
File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_<Band_Index>_<Resolution>
Where:

Table 6: Level-2H/F Image files – Naming Convention

Field	Signification	Length (max)	Example Value
Level	Processing level (L2H or L2F)		L2F
Tile	According to US-MGRS naming convention. (Inherited from Level-1C tile)	6	31TFJ
Datatake Sensing Time	This time refers to the sensing time of the first line of the PDI in UTC time. 15 digits, date and time, separated by the character T.	15	20171103T102201
MMM	Mission ID, e.g. S2A, S2B, S2C, S2D, LS8, LS9, S2P	3	S2A, LS8
ROOO	Orbit Number (Relative orbit number) R000-R143 for S2 Path identifier from Worldwide Reference System-2 (WRS-2) for LS8	4	R065 (for S2) R196 (path 196 for LS8)
Band_Index	Bxx where: xx = 01, 02, 03, 04, 8A, 11, 12	3	B04
Resolution	xxm where: xx = 10, 20, 30, 60	3	20m

Landsat-8 Level-2F fused surface reflectance image file example name:

L2F_T31TFJ_20170420T102253_LS8_R196_B04_10m.TIF

4.2.5.2 NATIVE images

Spectral bands specific to each mission, i.e. red edge bands B05, B06, B07 and B08 for Sentinel-2 and Panchromatic B08 and thermal bands B10, B11 for Landsat-8 are provided separately in a "NATIVE" directory.

SAFE_COMPACT:
File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_<Band_Index>_<Resolution>

Where:

Table 7: Level-2H/F NATIVE Image files – Naming Convention

Field	Signification	Length (max)	Example Value
Level	Processing level (L2H or L2F)		L2F
Tile	According to US-MGRS naming convention. (Inherited from Level-1C tile)	6	31TFJ
Datatake Sensing Time	This time refers to the sensing time of the first line of the PDI in UTC time. 15 digits, date and time, separated by the character T.	15	20171103T102201
MMM	Mission ID, e.g. S2A, S2B, S2C, S2D, S2P, LS8	3	S2A, LS8
ROOO	Orbit Number (Relative orbit number) R000-R143 for S2 Path identifier from Worldwide Reference System-2 (WRS-2) for LS8	4	R065 (for S2) R196 (path 196 for LS8)
Band_Index	Bxx where for: S2: xx = 05, 06, 07 L8: xx = 08, 10, 11	3	B10 (LS8 thermal band)
Resolution	xxm where: xx = 10, 20, 30, 60	3	20m

Landsat-8 native thermal image file example name:

NATIVE/L2F_T31TFJ_20170420T102253_LS8_R196_B10_30m.TIF

4.2.6 QI_DATA (folder)

QI_DATA folder contains the items listed in the following subsections.

4.2.6.1 Level 2H/F Quality Information Report File (XML file)

File naming for Level-2H = L2H_QI_Report.xml

File naming for Level-2F = L2F_QI_Report.xml

The name is fixed.

4.2.6.1.1 L1C Quality_Masks (S2 only)

Their file naming convention is described in [S2-PSD].

4.2.6.1.2 L2H/F Validity_Mask

SAFE_COMPACT:

File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_<mission>_MSK

Where <mission> is defined in Table 8 and all other parameters as for Table 6:

Table 8: Level-2H/F Validity Mask files – Naming Convention

Field	Signification	Length (max)	Example Value
mission	Mission ID, e.g. S2, L8	2	S2

Landsat-8 Level-2F validity mask file example name:

L2F_T31TFJ_20170114T102402_LS8_R196_L8_MSK.TIF

4.2.6.1.3 PVI Tile Preview Image

SAFE_COMPACT:
File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_<Band_Index>
Where: Band_Index = '**PVI'**, all other parameters as for Table 6.
Example of L8 L2F preview image file:

L2F_T31TFJ_20170114T102402_LS8_R196_PVI.TIF

4.2.6.1.4 Quicklook Images

SAFE_COMPACT:
File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_QL_<bands>
Where <bands> is defined in Table 9 and all other parameters as for Table 6:

Table 9: Level-2H/F Quicklook image files – Naming Convention

Field	Signification	Length (max)	Example Value
bands	Bands used for RGB composition: 432 for B04, B03, B02 12118A for B12, B11, B8A (Sentinel-2 band naming convention)	3 or 6	12118A

Examples of L8 L2F quicklook image file:

L2F_T31TFJ_20170114T102402_LS8_R196_QL_B432.jpg

L2F_T31TFJ_20170420T102253_LS8_R196_QL_B12118A.jpg

4.2.6.1.5 L2F Fusion Check Mask

SAFE_COMPACT:
File naming convention = <Level>_<Tile>_<Datatake_Sensing_Time>_MMM_ROOO_FCM
Where <mission> is defined in Table 8 and all other parameters as for Table 6.
Landsat-8 Level-2F Fusion Check Mask file example name:
L2F_T31UES_20200519T103928_LS8_R199_FCM.TIF

Appendix A XSDs Directory Structure

S2-PDGS-CS-DI-PSD-V15.0_S2L-V4.5_Schema directory structure:
Sen2like files appear in red italic.

```
|  S2-PDGS-MPC-L2HF-PFS-V1.3.docx
|  S2-PDGS-MPC-LHF-PFS-V1.3.pdf
\--- S2-PDGS-CS-DI-PSD-V15.0_S2L-V4.5_Schema
   |  S2_PDI_Level-2H_Tile_Metadata.xsd
   |  S2_PDI_Level-2F_Tile_Metadata.xsd
   |  S2_User_Product_Level-2H_Metadata.xsd
   |  S2_User_Product_Level-2F_Metadata.xsd
   |  S2_PDI_Level-2H_Tile_Structure.xsd
   |  S2_PDI_Level-2F_Tile_Structure.xsd
   |  S2_User_Product_Level-2H_Structure.xsd
   |  S2_User_Product_Level-2F_Structure.xsd
   |
   \---DICO
      \--- PDI-V14
      \--- EUP-V14
         +---DataAccess
         |  +---item
         |        item.xsd
         |        item2HF.xsd
         |
            +---DPC
         |
         +---FOS
         |
         +---GS
         |
         +---IPF
         |
         +---PDGS
         |  +---archive
         |  |
         |  +---base
         |  |
         |  +---center
         |  |
         |  +---component
         |  |
         |  +---configuration
```

```
|   |
|   +---dimap
|   |       dimap.xsd
|   |       dimap2HF.xsd
|   |
|   +---fileNaming
|   |
|   +---header
|   |
|   +---logical_definitions
|   |
|   +---spacecraft
|   |
|   \---station
|
\---SY
```

Appendix B Conversion Formulae

The table below lists the conversion formulae to apply to image digital numbers (DN) to obtain physical values.

Image Type	Conversion formula	Physical Units	Comments
Surface_reflectance	SR = (DN – 1000) / 10000	Unit less	Surface Reflectance values lies usually between 0.0 and 1.0. Specular effects on surface or clouds could lead to values higher than 1.0. The Level-2H and Level-2F Quantification Values and radiometric offset values are compliant with Sentinel-2 PSD version 14.9 (Collection-1) and version 15.0. The value 0 is reserved for nodata. Value DN=1 corresponds to SR of 0.0001, or 0.01%.

End of document