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S2 MPC

Sen2like L2HF Product Definition Document

Ref. S2-PDGS-MPC-L2HF-PDD-V1.0

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1. Introduction

In the frame of the Copernicus programme jointly implemented by ESA and EC, ESA has developed the Sentinel-2 system, providing globally with systematic acquisition, high resolution (10-20 m) optical observations.

The Sentinel-2 mission offers an unprecedented combination of the following capabilities: (1) Systematic global coverage of land surfaces: from 56°South to 84°North, coastal waters and all Mediterranean sea; (2) High revisit: every 5 days at equator under the same viewing conditions with two satellites; (3) High spatial resolution: 10 m, 20 m and 60 m; (4) Multi-spectral information with 13 bands in the visible, near infra-red and short wave infra-red part of the spectrum, and (5) Wide field of view: 290 km.

With the scope to increase this high revisit (5 days), tailored towards the needs of operational land services, the idea emerged to harmonize Sentinel-2 and Landsat-8/9 data, considering Sentinel-2 as the reference mission respect to its higher revisit and spatial resolution.

In this context, a demonstration processor Sen2Like has been developed. Sen2like can ingest Sentinel-2 (Level 1C, Level 2A) and Landsat-8 (Level 1) products and generate harmonized ("Level-2H") and fused ("Level-2F") data products, with Level-2F including Landsat-8 Blue, Green, Red bands rescaled to 10.0 m pixel spacing.

Both formats Level-2H or Level-2F are quite similar. The difference is that the Level-2H embeds mission dependent harmonized data and the Level-2F embeds mission independent harmonized data: the spatial resolution of all images from equivalent band is the spatial resolution of the corresponding Sentinel-2 band.

A short definition of the "parent" products in Sentinel-2 mission is given hereafter. The Level-1C product [S2-PSD] provides ortho-rectified, i.e. a map projection of the acquired image using a Digital Elevation Model to correct ground geometric distortions, Top-Of-Atmosphere (TOA) reflectance with a sub-pixel multi-spectral and multi-date registration. This Level-1C product can be converted to surface reflectance and an associated scene classification, which constitutes the Level-2A product [S2-L2A-PDD].

1.1 Purpose of the document

This document defines the contents of the Sen2like Level-2H and Level-2F products.

1.2 Document structure

The document aligns to the structure of products definition given in [S2-L2A-PDD]. According to this scheme, the chapter 2 and chapter 3 of this document define respectively the structure of Level-2H and Level-2F products into six sections:

- Overview, in section 2.1 and 3.1;
- Image data, including preview in section 2.2 and 3.2;
- Metadata, in section 2.3 and 3.3;
- Quality Indicator Data, in section 2.4 and 3.4;
- Auxiliary Data, in section 2.5 and 3.5;
- Appendix A: Conversion Formulae
- Appendix B: L2H / L2F products composition table

1.3 References

The reference list of all project related documents with their version number and issue date is given in:

[S2-L2A-GLOS] S2PAD Project Glossary S2PAD-VEGA-GLO-0001, version 3.5, 22.05.2015

1.1 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 Informative Reference Documents

[ECMWF] ECMWF Deterministic Atmospheric Model Products, http://www.ecmwf.int/en/forecasts

[S2-PDD] GMES Space Component – Sentinel-2 Payload Data Ground Segment (PDGS), Product Definition Document

[S2-L2A-PDD] Sentinel-2 Level 2A Product Definition Document

[S2-PSD] Sentinel-2 Products Specification Document

[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

1.3 Relation to other Documents

The *Sen2like Algorithm Theoretical Basis Document* [S2-S2L-ATBD] define the algorithms used during Level 2HF processing.

The *Sen2like Products Specification Document* [S2-S2L-PSD] describes Level 2HF file naming convention and presents how the Level-2HF XSD schemas are organized.

1.4 Definitions of Terms and Conventions

Please refer to section 2.4 of [S2-PDD] for definition of Sentinel-2 mission and terms, e.g. Datatake, Datastrip, MSI Spectral bands, User-product, etc.

2. Sen2like Level-2H Product Definition

2.1 Overview

Level-2H processing includes Level-2A processing described in [S2-L2A-ATBD] and additional processing blocks i.e. Geometry check and correction, Spectral Band Adjustment, BRDF correction described in [S2-S2L-ATBD]. The input products are: a Level-1C or Level-2A product from Sentinel-2 mission or a Level-1 product from Landsat-8/9 missions.

Level-2H main output is an orthoimage surface reflectance harmonised product together with Quality Indicators data.

Sentinel-2 Level-2H products are resampled as Level-1C products with a constant GSD (Ground Sampling Distance) of 10 m, 20 m and 60 m according to the native resolution of the different spectral bands.

Landsat-8 Level-2H products are resampled as Level-1 products with a constant GSD (Ground Sampling Distance) of 15 m and 30 m, according to the native resolution of the different spectral bands.

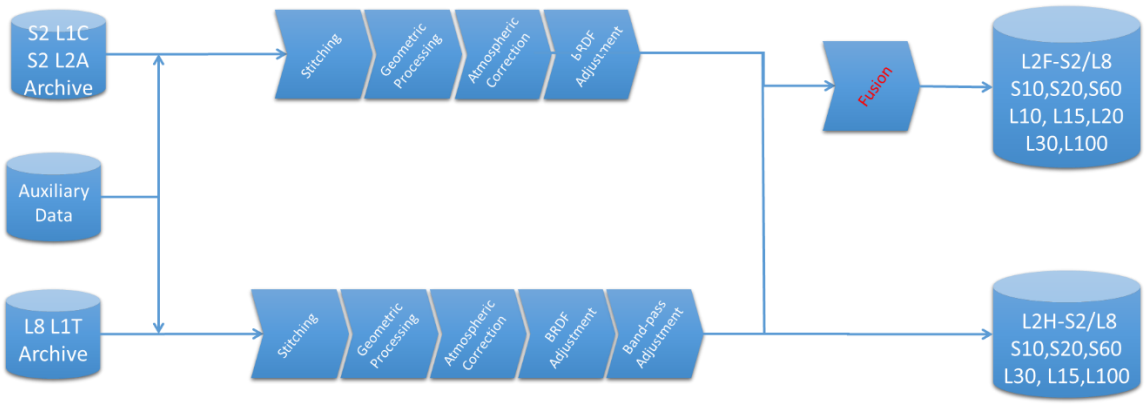

Figure 1 – Overview of Sen2Like processing workflow.

Product content is detailed in section 2.1.2.

2.1.1 Input data of L2H processing

The input data of L2H processing are described in Sen2like User manual S2-S2L-UM].

2.1.2 Product Summary

The geographic coverage of Level-2H products is the same as the Sentinel-2 Level-1C/Level-2A input products based on MGRS grid system. Landsat-8 images are "cropped" and geometrically registered to a Sentinel-2 reference image.

Figure 2-2 gives an overview of the L2H Product Physical Format. Please refer to [S2-PSD] and following sections of this document for more details.

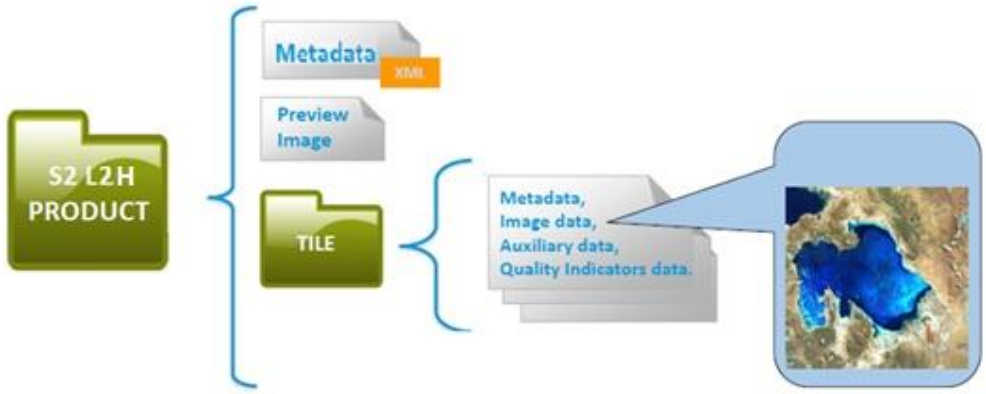

Figure 2-2 Level-2H Product Physical Format

The Level-2H product is characterised by the main following contents, outputs of the Level-2H algorithms:

- **Harmonised surface reflectance tiles**
  - S2: The harmonised surface reflectance tiles at Sentinel-2 native resolution with 7 channels (B01, B02, B03, B04, B8A, B11, B12) [Image Data];
  - L8: The harmonised surface reflectance tiles at Landsat-8 native resolution with 7 channels (B01, B02, B03, B04, B8A (L8 B5), B11 (L8 B6), B12 (L8 B07) [Image Data];
  - NATIVE S2: The surface reflectance tiles at Sentinel-2 native resolution with 4 channels (B05, B06, B07, B08) [Image Data / NATIVE];
  - NATIVE L8: The panchromatic surface reflectance tile (Landsat-8 B08) at 15 m and the two L1 Landsat-8 thermal bands at 30 m resolution (Landsat-8 B10 & B11) [Image Data / NATIVE];
  - The validity mask [QI Data].

2.2 Image Data

The Level-2H image data is composed of harmonised surface reflectance images.

The Level-2H image data product uses the same tiling, encoding and filling structure as Level-1C as described in detail in section 8.2.1 and 8.2.2 of [S2-PDD].

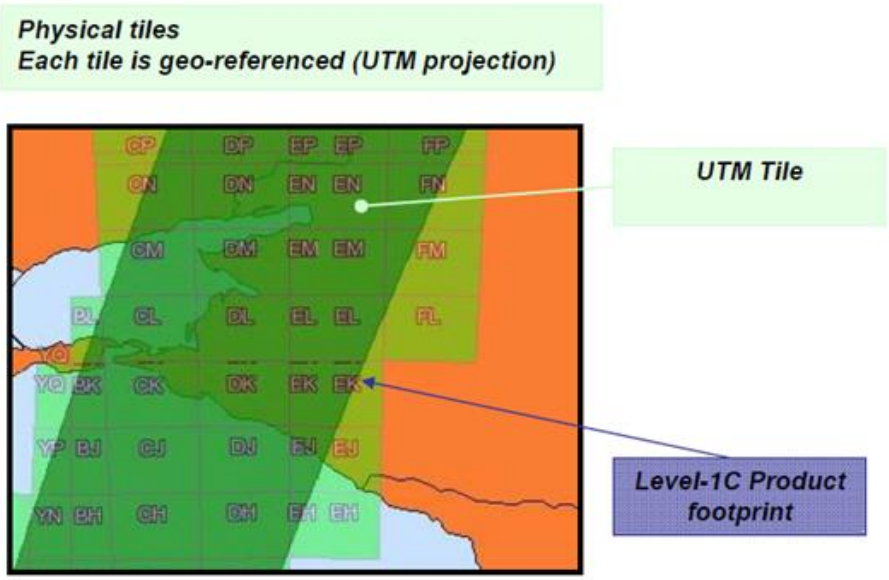

Figure 2-3: Example of Level-2A product tiled in several files

2.2.1 Harmonised surface reflectance image data

For harmonised surface reflectance images, pixel value is encoded on 16 useful bits and is directly proportional to surface reflectance values.

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 provide separately in a "NATIVE" directory.

Sentinel-2:

Table 2-I below lists the data type, the encoding, data size and resolution of the harmonised surface reflectance image data generated by the Level-2H processing.

Table 2-I: S2 Level-2H Image Data

Name	Data Type	Image Size (width, height)	Resolution	Description
Harmonised Surface Reflectance				
B01 channel	COG, 16bit	1830 x 1830	60 m	Image
B02 channel	COG, 16bit	10980 x 10980	10 m	Image

Name	Data Type	Image Size (width, height)	Resolution	Description
B03 channel	COG, 16bit	10980 x 10980	10 m	Image
B04 channel	COG, 16bit	10980 x 10980	10 m	Image
B8A channel	COG, 16bit	5490 x 5490	20 m	Image
B11 channel	COG, 16bit	5490 x 5490	20 m	Image
B12 channel	COG, 16bit	5490 x 5490	20 m	Image
Surface Reflectance / NATIVE				
B05 channel	COG, 16bit	5490 x 5490	20 m	Image
B06 channel	COG, 16bit	5490 x 5490	20 m	Image
B07 channel	COG, 16bit	5490 x 5490	20 m	Image
B08 channel	COG, 16bit	10980 x 10980	10 m	Image

Landsat-8:

Table 2-II below lists the data type, the encoding, data size and resolution of the harmonised surface reflectance image data generated by the Level-2H processing.

Table 2-II: L8 Level-2H Image Data

Name	Data Type	Image Size (width, height)	Resolution	Description
Harmonised Surface Reflectance				
B01 channel	COG, 16bit	3660 x 3660	30 m	Image
B02 channel	COG, 16bit	3660 x 3660	30 m	Image
B03 channel	COG, 16bit	3660 x 3660	30 m	Image
B04 channel	COG, 16bit	3660 x 3660	30 m	Image
B8A channel (L8 B05)	COG, 16bit	3660 x 3660	30 m	Image
B11 channel	COG, 16bit	3660 x 3660	30 m	Image

Name	Data Type	Image Size (width, height)	Resolution	Description
(L8 B06)				
B12 channel (L8 B07)	COG, 16bit	3660 x 3660	30 m	Image
Panchromatic / Thermal bands / NATIVE				
B08 channel	COG, 16bit	7320 x 7320	15 m	Image
B10 channel	COG, 16bit	3660 x 3660	30 m	Image
B11 channel	COG, 16bit	3660 x 3660	30 m	Image

2.2.2 Preview Data

Table 2-III below lists the data type, the encoding, data size and resolution of the preview and quicklook image data as generated by the Level-2H processing.

Table 2-III Sentinel-2 Preview Data

Name	Data Type	Resolution	Description
Preview Image	GEOTiff 8bit	320 m	RGB (3 channels: RED = B4; GREEN = B3; BLUE = B2). Preview dynamic is stretched (min = 0.0, max = 0.250, scale =255.0)
Quicklook RGB image	Jpeg	30 m	RGB (3 channels: RED = B4; GREEN = B3; BLUE = B2). Preview dynamic is stretched (min = 0.0, max = 0.250, scale =255.0)
Quicklook SWIR-NIR image	Jpeg	30 m	SWIR-NIR (3 channels: RED = B12; GREEN = B11; BLUE = B8A). Preview dynamic is stretched (min = 0.0, max = 0.40, scale =255.0)

2.3 Metadata

This section describes the metadata provided with the Level-2H product.

Metadata provided by Level-2H processing is indicated **in bold** in following sections.

2.3.1 Product Level Metadata

The following information is provided in the Level-2H metadata at product level:

- Product level information:
  - Datatake information (inherited from Level-0 metadata, see [S2-PDD]):
    - Datatake unique identifier;
    - Spacecraft name (Sentinel-2A/B/…);
    - Datatake type (MSI Operation Mode: Nominal, Dark Signal, etc.);
    - Imaging start time;
    - Imaging orbit number;
    - Imaging orbit direction.
  - **Processing Level (Level-2H);**
  - List of Level-2H tiles composing the product and the dimensions of each tile;
  - Tiles aggregation flag (Boolean);
  - **Image format and pointer to the image data files;**
  - Spectral bands (relation between product image channels and on-board spectral bands);
  - Reflectance quantification value (in order to convert digit count into reflectance) and unit;
  - Special values encoding (e.g. NODATA, SATURATION).
- Product level quality indicators;

2.3.2 Tile Level Metadata

The following information is provided in the Level-2H metadata at tile level:

- Tile identifier, as referenced by Level-1C data;
- Tile geocoding:
    - Upper-left coordinates (ULX, ULY) of the tile (in meters);
    - Pixel dimensions (XDIM, YDIM) within the tile (in meters and depending on band GSD);
    - Tile size in number of lines/columns.
- Tile identification;
- 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
- Mean sun angle;
- Grid of incidence angles (zenith and azimuth) (per bands and detectors);
- Mean incidence angle;
- Quicklook data information:
    - **Pointer to quicklook image files (see section2.2.2);**
- **Tile level quality indicators as listed in section 2.4.1;**
- **Pixel level quality indicators (as a pointer to the QI files) as listed in section 2.4.2.**

2.4 Quality Indicator Data

The following quality indicators (QI) are provided with Level-2H products.

Some QIs provided in Level-2H products are inherited from Level-2A QIs.

2.4.1 Tile Level Quality Indicators

The following Level-2H Quality Indicators are provided on tile level in the L2H_QI_Report metadata file.

Table 2-IV: Level-2A Tile Level Quality Indicators

Name	Data Type	Description
Level-2A Quality Indicators (Tile level)		
L2A_SceneClass Quality indicators	Float formatted in String	L2A scene classification QI (Sen2Cor)
L2A_AtmCorr Quality indicators	Float formatted in String	L2A atmospheric correction QI (Sen2Cor).
Auxiliary_Data Quality indicators	Float formatted in String	Digital Elevation Model QI, Meteorological data QI, (to be consolidated)
L2H_Geometry Quality indicators	Float formatted in String	Reference of the method (string) QI derived from the geometric assessment processing
L2H_BRDF_NBAR Quality indicators	Float formatted in String	Reference of the method (string) QI derived from the BRDF processing
L2H_SBAF Quality Indicators	Float formatted in String	Reference of the method (string) SBAF coefficients and offsets (values)

2.4.2 Pixel Level Quality Indicators

Pixel level quality indicators are provided at tile level through dedicated quality masks that provide quality information at pixel level.

QIs provided by Level-2H processing are provided at 20 m resolution as raster masks. Users may resample this mask to lower or higher resolution, if required, using "nearest" or "mode" resampling options.

The following Level-2H QIs are provided on pixel level.

Table 2-V: Level-2H Pixel Level Quality Indicators

Name	Data Type	Data Size (Byte)	Resolution	Description
Validity Mask	Unsigned Integer	1	20 m	1: Valid land pixel 2: Invalid land pixel

2.5 Auxiliary Data

No auxiliary data is provided in the Level-2H product structure. Only the reference of the auxiliary data used during Level-2A Sen2cor processing (when applicable) is provided.

2.5.1 Provided Auxiliary Data

Not applicable.

2.5.2 Referenced Auxiliary Data

The following auxiliary data is referenced in the Level-2H metadata:

- Level-2A auxiliary data (origin: L2A Sen2Cor):
    - The Digital Elevation Model (provided by user) used for the Level-2A processing is provided in the AUX data subfolder on the GRANULE level, labelled by resolution;
    - The reference to LibRadtran LUTs used for the Level-2A processing;
    - The reference to Snow climatology used for the Level-2A processing;
    - The reference to ESA CCI LC datasets used for the Level-2A processing (Land Cover map, water bodies v4 and snow products).

3. Sen2like Level-2F Product Definition

3.1 Overview

Level-2F processing includes Level-2A processing described in [S2-L2A-ATBD] and additional processing blocks i.e. Geometry check and correction, Spectral Band Adjustment, BRDF correction and Fusion described in [S2-S2L-ATBD]. The input products are: a Level-1C or Level-2A product from Sentinel-2 mission and a Level-1 product from Landsat-8/9 missions.

Level-2F main output is an orthoimage surface reflectance **fused** product together with Quality Indicators data.

Sentinel-2 Level-2F products are equivalent to Sentinel-2 Level-2H products with a constant GSD (Ground Sampling Distance) of 10 m, 20 m and 60 m according to the native resolution of the different spectral bands.

Landsat-8 Level-2F products are resampled as Sentinel-2 Level-2F products with a constant GSD (Ground Sampling Distance) of 10 m, 20 m and 60 m according to the Sentinel-2 native resolution of the different spectral bands in common with Landsat-8 mission.

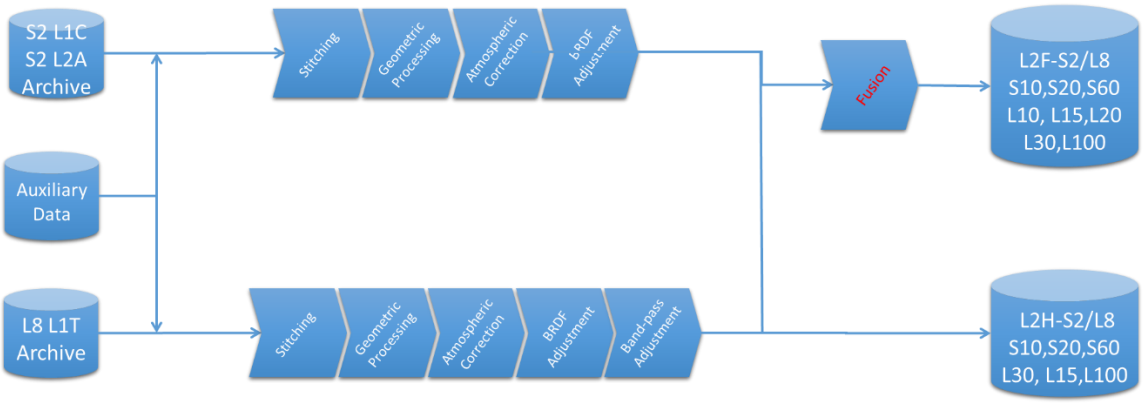

Figure 4 – Overview of Sen2Like processing workflow.

Product content is detailed in section 3.1.2.

3.1.1 Input data of L2F processing

The input data of L2F processing are described in Sen2like User manual S2-S2L-UM].

3.1.2 Product Summary

The geographic coverage of Level-2F products is the same as the Sentinel-2 Level-1C/Level-2A input products based on MGRS grid system. Landsat-8 images are cropped and geometrically registered to a Sentinel-2 reference image.

Figure 2-2 gives an overview of the L2F Product Physical Format. Please refer to [S2-PSD] and following sections of this document for more details.

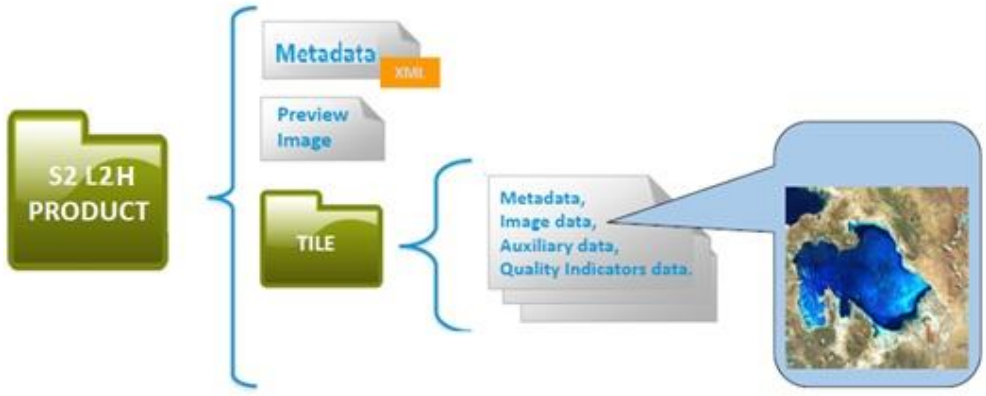

Figure 3-5 Level-2F Product Physical Format

The Level-2F product is characterised by the main following contents, outputs of the Level-2F algorithms:

- **Fused surface reflectance tiles**
    - S2: The fused surface reflectance tiles at native Sentinel-2 resolution with 7 channels (B01, B02, B03, B04, B8A, B11, B12) [Image Data];
    - L8: The fused surface reflectance tiles with 6 channels (B02, B03, B04, B8A (L8 B5), B11 (L8 B6), B12 (L8 B07)) at native Sentinel-2 resolution
      and B01 at native Landsat-8 resolution (30 m)
      [Image Data];
    - NATIVE S2: The surface reflectance tiles at native Sentinel-2 resolution with 4 channels (B05, B06, B07, B08)
      [Image Data / NATIVE];
    - NATIVE L8: The panchromatic surface reflectance tile (Landsat-8 B08) at 15 m and the two L1 Landsat-8 thermal bands at 30 m resolution (Landsat-8 B10 & B11)
      [Image Data / NATIVE];
    - The validity mask [QI Data].

3.2 Image Data

The Level-2F image data has the same tiling, encoding and filling structure as Level-2H product as described in section

3.2.1 Fused surface reflectance image data

For fused surface reflectance images, pixel value is encoded on 16 useful bits and is directly proportional to surface reflectance values.

Spectral bands specific to each mission, i.e. red edge bands B5, B6, B7 and B8 for Sentinel-2 and Panchromatic B8 and thermal bands B10, B11 for Landsat-8 are provide separately in a "NATIVE" directory.

Sentinel-2:

Table 3-I below lists the data type, the encoding, data size and resolution of the **fused** surface reflectance image data generated by the Level-2F processing.

Table 3-I: S2 Level-2F Image Data

Name	Data Type	Image Size (width, height)	Resolution	Description
Fused Surface Reflectance				
B01 channel	COG, 16bit	1830 x 1830	60 m	Image
B02 channel	COG, 16bit	10980 x 10980	10 m	Image
B03 channel	COG, 16bit	10980 x 10980	10 m	Image
B04 channel	COG, 16bit	10980 x 10980	10 m	Image
B8A channel	COG, 16bit	5490 x 5490	20 m	Image
B11 channel	COG, 16bit	5490 x 5490	20 m	Image
B12 channel	COG, 16bit	5490 x 5490	20 m	Image
Surface Reflectance / NATIVE				
B05 channel	COG, 16bit	5490 x 5490	20 m	Image
B06 channel	COG, 16bit	5490 x 5490	20 m	Image
B07 channel	COG, 16bit	5490 x 5490	20 m	Image
B08 channel	COG, 16bit	10980 x 10980	10 m	Image

Landsat-8:

Table 3-IITable 2-II below lists the data type, the encoding, data size and resolution of the **fused** surface reflectance image data generated by the Level-2F processing.

Table 3-II: L8 Level-2F Image Data

Name	Data Type	Image Size (width, height)	Resolution	Description
Fused Surface Reflectance				
B01 channel	COG, 16bit	3660 x 3660	30 m	Image
B02 channel	COG, 16bit	10980 x 10980	10 m	Image
B03 channel	COG, 16bit	10980 x 10980	10 m	Image
B04 channel	COG, 16bit	10980 x 10980	10 m	Image
B8A channel (L8 B05)	COG, 16bit	5490 x 5490	20 m	Image
B11 channel (L8 B06)	COG, 16bit	5490 x 5490	20 m	Image
B12 channel (L8 B07)	COG, 16bit	5490 x 5490	20 m	Image
Panchromatic / Thermal bands / NATIVE				
B08 channel	COG, 16bit	7320 x 7320	15 m	Image
B10 channel	COG, 16bit	3660 x 3660	30 m	Image
B11 channel	COG, 16bit	3660 x 3660	30 m	Image

3.2.2 Preview Data

Table 2-III below lists the data type, the encoding, data size and resolution of the preview and quicklook image data as generated by the Level-2F processing.

Table 3-III Level-2F Preview Data

Name	Data Type	Resolution	Description
Preview Image	GEOTiff 8bit	320 m	RGB (3 channels: RED = B4; GREEN = B3; BLUE = B2). Preview dynamic is stretched (min = 0.0, max = 0.25, scale =255.0)
Quicklook RGB image	Jpeg	30 m	RGB (3 channels: RED = B4; GREEN = B3; BLUE = B2). Preview dynamic is stretched (min = 0.0, max = 0.25, scale =255.0)
Quicklook SWIR-NIR image	Jpeg	30 m	SWIR-NIR (3 channels: RED = B12; GREEN = B11; BLUE = B8A). Preview dynamic is stretched (min = 0.0, max = 0.40, scale =255.0)

3.3 Metadata

This section describes the metadata provided with the Level-2F product.

Metadata provided by Level-2F processing is indicated **in bold** in following sections.

3.3.1 Product Level Metadata

The following information is provided in the Level-2F metadata at product level:

- Product level information:
  - Datatake information (inherited from Level-0 metadata, see [S2-PDD]):
    - Datatake unique identifier;
    - Spacecraft name (Sentinel-2A/B/…);
    - Datatake type (MSI Operation Mode: Nominal, Dark Signal, etc.);
    - Imaging start time;
    - Imaging orbit number;
    - Imaging orbit direction.

- **Processing Level (Level-2F);**
- List of Level-2F tiles composing the product and the dimensions of each tile;
- Tiles aggregation flag (Boolean);
- **Image format and pointer to the image data files;**
- Spectral bands (relation between product image channels and on-board spectral bands);
- Reflectance quantification value (in order to convert digit count into reflectance) and unit;
- Special values encoding (e.g. NODATA, SATURATION).

- Product level quality indicators;

3.3.2 Tile Level Metadata

The following information is provided in the Level-2F metadata at tile level:

- Tile identifier, as referenced by Level-1C data;
- Tile geocoding:
  - Upper-left coordinates (ULX, ULY) of the tile (in meters);
  - Pixel dimensions (XDIM, YDIM) within the tile (in meters and depending on band GSD);
  - Tile size in number of lines/columns.
- Tile identification;
- 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
- Mean sun angle;
- Grid of incidence angles (zenith and azimuth) (per bands and detectors);
- Mean incidence angle;
- Quicklook data information:

- **Pointer to quicklook image files (see section 3.2.2);**

- **Tile level quality indicators as listed in section 3.4.1;**

- **Pixel level quality indicators (as a pointer to the QI files) as listed in section 3.4.2.**

3.4 Quality Indicator Data

The following quality indicators (QI) are provided with Level-2F products.

Some QIs provided in Level-2F products are inherited from Level-2A QIs.

3.4.1 Tile Level Quality Indicators

The following Level-2F Quality Indicators are provided on tile level in the L2F_QI_Report metadata file.

Table 3-IV: Level-2A Tile Level Quality Indicators

Name	Data Type	Description
Level-2A Quality Indicators (Tile level)		
L2A_SceneClass Quality indicators	Float formatted in String	L2A scene classification QI (Sen2Cor)
L2A_AtmCorr Quality indicators	Float formatted in String	L2A atmospheric correction QI (Sen2Cor).
Auxiliary_Data Quality indicators	Float formatted in String	Digital Elevation Model QI, Meteorological data QI, (to be consolidated)
L2H_Geometry Quality indicators	Float formatted in String	Reference of the method (string) QI derived from the geometric assessment processing
L2H_BRDF_NBAR Quality indicators	Float formatted in String	Reference of the method (string) QI derived from the BRDF processing
L2H_SBAF Quality Indicators	Float formatted in String	Reference of the method (string) SBAF coefficients and offsets (values)
L2F_FUS Quality Indicators	Float formatted in String	Reference of the method (string) (to be consolidated)

3.4.2 Pixel Level Quality Indicators

Pixel level quality indicators are provided at tile level through dedicated quality masks that provide quality information at pixel level.

QIs provided by Level-2F processing are provided at 20 m resolution as raster masks. Users may resample this mask to lower or higher resolution, if required, using "nearest" or "mode" resampling options.

The following Level-2F QIs are provided on pixel level.

Table 3-V: Level-2F Pixel Level Quality Indicators

Name	Data Type	Data Size (Byte)	Resolution	Description
Validity Mask	Unsigned Integer	1	20 m	1: Valid Land pixel 2: Invalid Land pixel

3.5 Auxiliary Data

No auxiliary data is provided in the Level-2F product structure. Only the reference of the auxiliary data used during Level-2A Sen2cor processing (when applicable) is provided.

3.5.1 Provided Auxiliary Data

Not applicable.

3.5.2 Referenced Auxiliary Data

The following auxiliary data is referenced in the Level-2F metadata:

- Level-2A auxiliary data (origin: L2A Sen2Cor):
  - The Digital Elevation Model (provided by user) used for the Level-2A processing is provided in the AUX data subfolder on the GRANULE level, labelled by resolution;
  - The reference to LibRadtran LUTs used for the Level-2A processing;
  - The reference to Snow climatology used for the Level-2A processing;
  - The reference to ESA CCI LC datasets used for the Level-2A processing (Land Cover map, water bodies v4 and snow products).

Appendix A 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 / 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 are aligned with the L1C and L2A Quantification Values

Appendix B L2H / L2F products composition table

Sentinel 2 MSI bands (Center Wavelength [µm])	Lansdat 8/ Landsat 9 bands (Center Wavelength)	Designation	Sen2like Convention	L2H-S2 resolution (m)	L2H-L8 resolution (m)	L2F-S2 resolution (m)	L2F-L8 resolution (m)
B01	B01 (442 nm)	Coastal Aersol	B01	60 m	30 m	60 m	30 m
B02 (490 nm)	B02 (482 nm)	Blue	B02	10 m	**30 m**	10 m	**10 m**
B03 (560nm)	B03 (561 nm)	Green	B03	10 m	**30 m**	10 m	**10 m**
B04 (665 nm)	B04 (654)	Red	B04	10 m	**30 m**	10 m	**10 m**
B08 (842 nm)		*NIR 1*	*B08*	*10 m*	-	*10 m*	-
B8A (865 nm)	B05 (864 nm)	NIR2	B8A	20 m	**30 m**	20 m	**20 m**
B11 (1610 nm)	B06 (1608 nm)	SWIR 1	B11	20 m	**30 m**	20 m	**20 m**
B12 (2190 nm)	B07 (2200 nm)	SWIR 2	B12	20 m	**30 m**	20 m	**20 m**
	B08 (589 nm)	*Panchromatic*	*NATIVE / B08*	-	*15 m*	-	*15 m*
	B10 (11 µm)	*TIRS 1*	*NATIVE / B10*	-	*30 m*	-	*30 m*
	B11 (12,2 µm)	*TIRS 2*	*NATIVE / B11*	-	*30 m*	-	*30 m*
B05 (705 nm)		*Red Edge 1*	*NATIVE / B05*	*20 m*	-	*20 m*	
B06 (740 nm)		*Red Edge 2*	*NATIVE / B06*	*20 m*	-	*20 m*	
B07 (783 nm)		*Red Edge 3*	*NATIVE / B07*	*20 m*	-	*20 m*	