Customer	**:**	**ESA**	**Document Ref**	**:**	**S2PAD-VEGA-PD-0001**
Contract No	**:**	**21450/08/I-EC**	**Issue Date**	**:**	**20 September 2012**
WP No	**:**	**1.1.2.1, 1.1.3.1**	**Issue**	**:**	**4.1**

Title : **Sentinel 2 MSI - Level 2A Product Definition**

Abstract : This document defines the content of the Sentinel-2 Level 2A product. The document has to be considered as add on to [S2-PDD] for the Level-2A product. Therefore the structure of the document is strongly in line with the chapter for Level-2A processing in [S2-PDD].

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Project Manager

Accepted : Christine Dingeldey
Quality Assurance Manager

Distribution :

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	DATE	DCI No	REASON
1 Draft A	06 Feb 2009	N/A	Initial Issue.
1 Draft B	26 Feb 2009	N/A	Incorporated refinements as per ESA requirements.
1 Draft C	20 Aug 2009	N/A	Reorganised to match section structure used for L2B and L3 products. Major rewrite of most sections. Updated table of possible applications for L2A according to latest version of DAP.
1	8 Oct 2009	N/A	Updates following Review by ESA, Document renamed from S2PAD.TN.001 to S2PAD-VEGA-PD-0001.
2	6 Nov 2009	N/A	Fixed RIDs from S2PAD_PDR_1: PDR-1, PDR-2, PDR-3, PDR-8, PDR-11, PDR-13, PDR-18, PDR-42, PDR-47, PDR-74, PDR-75, PDR-76, PDR-77, PDR-78, PDR-87, PDR-88, PDR-89, PDR-91, PDR-93, PDR-94, PDR-95, PDR-96, PDR-97, PDR-99, PDR-100
2.1	13 Nov 2009	N/A	Updated according to the comments received from ESA on 11th November 2009.
2.2	15 Apr 2010	N/A	Fixed RIDs from S2PAD_PDR_2: PADPDR-43, PADPDR-53, PADPDR-92, PADPDR-93, PADPDR-94, PADPDR-95, PADPDR-98, PADPDR-104, PADPDR-143, PADPDR-144
4.0	3 July 2012	N/A	Issue for S2PAD Phase 2 CDR. Updated according to the comments received from ESA on 23rd March 2011.
4.1	29 August 2012	N/A	Issue after S2PAD Phase 2 CDR. Updated according to ESA comments and discussion on CDR 02/08/2012

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DOCUMENT CHANGE RECORD

		DCR No	001
		Date	06 Nov 2009
		Originator	M. Mertens
		Approved by	M. Niézette
1. Document Title:		Sentinel-2 MSI – Level 2A Product Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		2	
4. Page	5. Paragraph	6. Reason for change	
25	5.1.1.3	RID PDR-1. Snow Cover map has been added into list of SMAC Ancillary files. Surface Type has been removed as obsolete (came from early ATBD version). Snow Cover map is static, therefore always available.	
deleted	2.2, 2.6	RID PDR-2. Sections 2.2 and 2.6 have been moved to S2PAD-VEGA-TN-0008.	
deleted	2.3	RID PDR-3. Section 2.3 has been removed.	
25	5.1.1.3	RID PDR-8. The surface type map is obsolete and has been removed. It came from an early version and is not any more mentioned in the SMAC ATBD.	
28	5.2.1.2	RID PDR-11. Removed mention of ENVI and TIFF. The L1C input files shall be accepted as per L1C product definition.	
55	6.7.1	RID PDR-13. Snow Cover map has been added into list of SMAC Ancillary files.	
26	5.1.2.1	RID PDR-18. Added the following clarification to the description of SMAC Atmospheric Correction: The Atmospheric Correction will derive Aerosol Optical Thickness (AOT) at 550nm and Water Vapour (WV) content from specific instrument channels. However, it needs external values for initialisation of the algorithm and as a fallback value in case of the retrieval of AOT and WV from sensor channels fails.	

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21	4.1	RID PDR-42. List appended as following: In addition, the Land and Terrestrial Environment services may be users of Sentinel-2 Level 2A products: • Land cover mapping • Change detection • Agriculture • Forest monitoring • Hydrology • Water demand • Irrigation
23, 26	5.1.1.1, 5.1.2.1	RID PDR-47. Only a short summary of the SMAC method is now shown, copied from the L2A ATBD (SMAC).
various	various	RID PDR-74. Output description updated to read: A pixel classification map is produced at 60m resolution and 1 byte. The values of the classification map are organised as follows: • 0: Dark features / Shadows • 1: Cloud shadows • 2: Vegetation • 3: Bare soils / deserts • 4: Water (dark and bright) • 5: Cloud low probability • 6: Cloud medium probability • 7: Cloud high probability • 8: Thin cirrus • 9: Snow Quality Indicators: In addition, the following QI will be provided at 60m resolution: • Cloud Confidence QI (0: high confidence clear sky, 1: high confidence cloudy) • Water Confidence QI (0: high confidence no water, 1: high confidence water) • Snow Confidence QI (0: high confidence no snow, 1: high confidence snow)
23	5.1.1.1	RID PDR-75. NDSI added into Project Glossary. SR removed as coming from an obsolete ATBD version.
31	6.2.1	RID PDR-76. Description changed to: The L2A product contains the following primary product components: • BOA reflectance (atmospheric correction) • Pixel classification In addition, the L2A product also contains the following secondary product components: • Atmosphere Optical Thickness • Water Vapour

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33	6.2.1	RID PDR-77. Updated to read 16bit
33	6.2.1	RID PDR-78. A QI has been added describing the Accuracy of the Atmosperic Correction at 1000m resolution. The discussion of the factors contributing to the accuracy (or errors) is found in the ATBDs for SMAC and L2A_SceneClass.
various	Various	RID PDR-87. Replaced "radiance" by "reflectance" for L1C product.
various	Various	RID PDR-88. Replaced "Quality Flag" by "Quality Indicator", since all affected QI are assumed to be quantities, not flags.
23	5	RID PDR-89. Word "to" inserted, sentence now reads: We first discuss the SMAC approach and then subsequently the S2AC approach to atmospheric correction.
23	5.1.1.1	RID PDR-91. Section now reads as follows. The first part of the SMAC approach aims at classification of each pixel as land, water, snow/ice, cloud cover or cloud shadow. The algorithm consists of the following main steps (see RD.8 for the detailed description). Sun angle pre-processing: The processing of sun angle is made as a pre-processing step before using SMAC. If a grid of sun angle is made, data can be interpolated to provide the true sun angle to the SMAC function, depending on the resolution of the grid.
25, 26, 54, 57	5.1.1.3, 5.1.1.4, 5.1.2.3, 5.1.2.4, 6.7, 6.8	RID PDR-93. Ancillary Data and Auxiliary data now listed in separate subsections and/or tables.
32	6.2.1	RID PDR-94. Removed the note. Sentence now reads: 1. Spatial resolution - Each of the proposed Atmospheric Correction algorithms (SMAC and L2A_SceneClass) provides atmospheric correction at the sensor resolution.
33	6.2.1	RID PDR-95. Table updated to read: Resolution n/a (binary parameter) Accuracy As shown in Pixel Classification Confidence QI
36	6.3.1	RID PDR-96. Updated B7 to 783nm and B9 to 945nm
25, 26, 54, 57	5.1.1.3, 5.1.1.4, 5.1.2.3, 5.1.2.4, 6.7, 6.8	RID PDR-97. Separated Ancillary Data and Auxiliary data.
59	6.12	RID PDR-99. Fixed number and added unit "Bytes".
deleted	7	RID PDR-100. Moved section 7 into S2PAD-VEGA-TN-0008

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		DCR No	002
		Date	13 Nov 2009
		Originator	H.-J. Lutz, M. Niézette
		Approved by	M. Niézette
1. Document Title:		Sentinel-2 MSI – Level 2A Product Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		2.1	
4. Page	5. Paragraph	6. Reason for change	
	Section 3.1	Comment from ESA in Ferran Gascon's email of 11th November 2009. Reference to the MSGE and ERSS services removed, only the second generic part of the section kept.	
	Section 5.5	Comment from ESA in Ferran Gascon's email of 11th November 2009. Delivery Time of MOS_001-EMSA service corrected to < 3 hours.	
	Section 5.6.1	Comment from ESA in Ferran Gascon's email of 11th November 2009. Assumption on image dimension (290km x276 km) and compression factor provided in a footnote.	
	Document	Comment from ESA in Ferran Gascon's email of 11th November 2009. Section 2 removed.	
	Section 1.4 and 1.5	Comment from ESA in Ferran Gascon's email of 11th November 2009. Removal of all reference to the contract work packages in section 1.5 to purely relate to documents and not work packages (as it is not a progress report). In particular removal for footnote 2 at the bottom of page 14.	
	Document	Comment from ESA in Ferran Gascon's email of 11th November 2009. Removal of all references to Level 2B and Level3 except in section 3. Section 2.4 "Product Tree" removed.	
	Document	Comment from ESA in Ferran Gascon's email of 11th November 2009. Removal of the "product group A" reference relevant only to the contract.	
	Document	Comment from ESA in Ferran Gascon's email of 11th November 2009. All reference to 'flag' replaced by 'indicator', except for 'data error flags'.	

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	Section 5.7 and 5.8	Comment from ESA in Ferran Gascon's email of 11th November 2009, RID PDR-93 and PDR-97. Auxiliary and Ancillary separated, Snow Climatology moved to auxiliary data set.
	Section 5.3.1	Comment from ESA in Ferran Gascon's email of 11th November 2009, RID PDR-96. Band centred at 1375nm has 30nm bandwidth (according to latest S2 configuration).
	Front sections	List of Figures and List of Tables fixed.

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		DCR No	003
		Date	15 Apr 2010
		Originator	Martin Mertens, M. Niézette
		Approved by	M. Niézette
1. Document Title:		Sentinel-2 MSI – Level 2A Products Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		2.2	
4. Page	5. Paragraph	6. Reason for change	
Title	Title	Replaced “ESRIN” by “ESA” (Customer)	
34	5.2.1	PADPDR-43. Use 12 bits for atmospheric correction output.	
47	5.4.1	PADPDR-43. Use 12 bits for atmospheric correction output.	
58	5.8	PADPDR-43. Use 12 bits for atmospheric correction output.	
47, 58	5.4.1, 5.8	PADPDR-53. Recalculate image sizes based on compression factor 2.3 for JPEG 2000 lossless compression.	
28	4.2.1.1	PADPDR-92. Removed wrong sentence which stated that L2A_SceneClass first computes reflectance values.	
41	5.4.1	Table 6: Added more details (e.g. data type and size). Removed row “Accuracy”, being too general.	
35	5.2.2	PADPDR-93. Section “Tile Identifier” inserted. Updated product naming rules.	
41	5.4.1	PADPDR-94. Recalculated size of images, based on 100km * 100km tiles, 12bit resolution. For quicklook images, assume 320m GSD. Adapted the size of Preview and Browse files.	
58	5.8	PADPDR-94. Recalculated size of images, based on 100km * 100km tiles, 12bit resolution.	
41	5.4.1	PADPDR-95. Recalculated size of images, based on 100km * 100km tiles, 12bit resolution. For quicklook images, assume 320m GSD.	
35	5.2.2	PADPDR-98. Section “Tile Identifier” inserted. Updated product naming rules.	
35	5.2.2	PADPDR-104. Section “Tile Identifier” inserted. Updated product naming rules.	

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		PADPDR-143
15	1	PADPDR-144. “FAPAR/fCover” instead of “FaPAR/Fcover”
15	1	PADPDR-144. Correct paragraph describing the scope of the document.
16	1.3	PADPDR-144. Added AD.8 to applicable documents.
17	1.4	PADPDR-144. Removed section “Context”.
18	2.2	PADPDR-144. Last sentence changed, limiting the scope to L2A.
19	2.3.2	PADPDR-144. Declared scene identification values list as preliminary, to be finalised after decision for SMAC or L2A_SceneClass approach.
28	4.2.1.1	Updated L2A_SceneClass flow chart drawing.
29	4.2.1.3	PADPDR-144. Removed reference to Radiometric Calibration file.
41	5.4	PADPDR-144. Removed section “”Scene Characteristics”.
55	5.5	PADPDR-144. Removed section “Product Mapping Frequency and Delivery Latency”.
41	5.4.1	PADPDR-144. Replace “Nearest neighbour” by “B-spline”.

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		DCR No	004
		Date	01 Dec 2010
		Originator	Uwe Müller-Wilm
		Approved by	M. Niézette
1. Document Title:		Sentinel-2 MSI – Level 2A Products Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		3.0	
4. Page	5. Paragraph	6. Reason for change as requested by reviewer.	
Page and table # refer to the previous document structure.			
All	All	New Document structure created according to comments FG: document shall be aligned with the document structure (i.e. table of contents) of the Level-1C Product Definition.	
All	All	replace MODTRAN with LIBRADTRAN.	
15	1	FG-2: Removed references to launch date.	
15	1.1	Removed algorithm description.	
15	1.2	Changed section to new document structure.	
16	1.3	References updated.	
18	2.3	Integrated reviewer comments on L2A content.	
All	All	Removed all references to SMAC and ATCOR.	
19	2.3.2	Section on scene identification rewritten.	
19	2.3.3	Section on quality indicators rewritten.	
22	3	Chapter on products application removed.	
24 - 28	4	Chapter on SMAC / ATCOR algorithms removed.	
27	4.1.2.4	Replaced info on ozone content.	
32	5.1	Introduction updated, now chapter 2.	
32	5.2.1	Added various reviewer comments of minor issue.	
32	5.2.1	Added sub-products: Water Vapour, Aerosol Optical Thickness, Cloud Probability and Snow Probability (as defined in L2A ATBD) in product summary table.	
38	5.3.1	Changed purpose to exclusive L2A processing.	
39	5.3.2	Updated section on sensor operating modes.	
41 - 55	5.4	Section and all tables completely rearranged according to new template, now chapter 2.	
55	5.4	Added section on auxilliary data from PDGS PDD.	

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56	5.5	Removed reference to TerraSAR.
Added from document S2PAD-VEGA-TN-0004, Quality Indicators:		
19 - 21	5	Added information on quality indicators to section 2.5

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		DCR No	005
		Date	3 July 2012
		Originator	Jérôme Louis
		Approved by	Uwe Müller-Wilm
1. Document Title:		Sentinel-2 MSI – Level 2A Products Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		4.0	
4. Page	5. Paragraph	6. Reason for change as requested by reviewer.	
Page and table # refer to the previous document structure.			
All	All	New Document structure created according to comments FG: document shall be aligned with the document structure (i.e. table of contents) of the Level-1C Product Definition.	
1	N/A	Updated author and approval	
1	Abstract	Removed sentence related to Level 2A input and data from abstract.	
18	Introduction	Updated following FG corrections.	
18	1.2	The structure of the document has been changed to be consistent with S2 PDD.	
19	1.3	The list of applicable and reference documents has been updated.	
20	1.5	A section 1.5 Definitions of Terms and Conventions has been added to indicate reference for the definition of Sentinel-2 mission and terms, e.g. Datatake, Datastrip, MSI Spectral bands, User-product, etc.	
21	2.1	Introduction section 2.1 changed to overview section 2.1	
21	2.1.1	Processing input section 2.1.1 changed to Input data of L2A processing section 2.1.1 with rewording of the section 2.1.1. Table Input of Level-2A processing renamed and updated	
22	2.1.2	Product summary section has been restructured to avoid replication of information and multiplication of subsections.	
28	2.1.3	File naming convention updated to follow applicable documents [AD.9] and [AD.10]. (now [GS-FFS], [GS-FFS-TSM])	
33	2.2	Section 2.2. Image data has been updated to be in line with DPM outputs.	
34	2.3	Section Metadata 2.3 fully restructured to be in line with Metadata section structure in S2 PDD [S2-PDD] .	

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36-40	2.4	Section QI Data 2.4 fully restructured to be in line with the current ATBD and DPM outputs.
40-41	2.5	Section Auxiliary Data 2.5 fully restructured to be in line with Auxiliary Data section structure in S2 PDD [S2-PDD] and with current ATBD and DPM auxiliary data inputs..
n/a	Ex-2.6	In order to be consistent with S2 PDD of L1C product the section 2.6 is removed and its information about Acquisition date, Sensor View Angles and Sun Angles is moved to section 2.3 Metadata
41	2.6	The File size estimation section has been updated to reflect the current ATBD and DPM outputs and is focused on the file size of a single tile (100x100 km^2)
n/a	Appendix	The Appendix listing the L2A GIPPs has been removed from this document. The reference given for the L2A GIPPs definition is the Appendix from [RD.15].

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		DCR No	006
		Date	29 August 2012
		Originator	Jérôme Louis
		Approved by	Uwe Müller-Wilm
1. Document Title:		Sentinel-2 MSI – Level 2A Products Definition	
2. Document Reference Number:		S2PAD-VEGA-PD-0001	
3. Document issue / revision number:		4.1	
4. Page	5. Paragraph	6. Reason for change as requested by reviewer.	
Page and table # refer to the previous document structure.			
24	Table 3-I	PDD_01: “Table 3-I: Input of Level-2A processing” has been modified to differentiate input data available from Level-1C product from input auxiliary data.	
30	3.1.3	PDD_03: Level-2A Product Naming Convention has been aligned with [S2-PFS] v4.0	
37	3.3	PDD_04: Metadata provided by Level-2A processing is now indicated in bold in sections 3.3.1 and 3.3.2, whereas metadata inherited from Level-1C and lower processing levels is not formatted.	
45	3.5	PDD_05: Section 3.5 has been updated to clarify which auxiliary data is provided or referenced within L2A product.	
44	3.4.3	PDD_06: “Table 3 XI: Level-2A Pixel Level Quality Indicators” has been updated to list the L1C quality masks at pixel level to be embedded in L2A product	
24	2.1.2	PDD_07: First sentence changed in “The geographic coverage of Level-2A products is the same as the Level-1C input products.	
24, 25	2.1 2.1.2	PDD_08: added sentences concerning the optional delivery of 10m, 20m and 60 m products.	
22	2	PDD_10: The new updated chapter 2 of this document refers to the updated [S2-L2A-GLOS] S2PAD Project Glossary document that contains the reference list of all project related documents.	
21	1.3	PDD_11: [AD.2] moved to Reference documents.	
21	1.3	PDD_12: [AD.3] deleted	
21	1.3	PDD_13: [AD.4] deleted	
21	1.3	PDD_14: [AD.5] moved to Reference documents.	
21	1.3	PDD_15: [AD.6] deleted	
21	1.3	PDD_16: [AD.7] deleted	

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21	1.3	PDD_17: [S2-PDD] moved to Reference documents.
21	1.3	PDD_18: [AD.11] moved to Reference documents.
21	1.3	PDD_19: [AD.11] version updated to 4.0.
21	1.3	PDD_20: [RD.1] deleted
21	1.3	PDD_21: [RD.2] deleted
21	1.3	PDD_22: [RD.3] deleted
21	1.3	PDD_23: [RD.4] deleted
21	1.3	PDD_24: [RD.5] deleted
21	1.3	PDD_25: [RD.6] deleted
21	1.3	PDD_26: [RD.7] deleted
21	1.3	PDD_27: [RD.8], [RD.9] deleted
21	1.3	PDD_28: [RD.10] updated
21	1.3	PDD_29: [RD.11] updated
21	1.3	PDD_30: [RD.12] deleted
21	1.3	PDD_31: [RD.13] deleted
21	1.4	PDD_32: Reference to Product Tree document removed.
21	1.4	PDD_33: Reference Link to ATBD added
21	1.4	PDD_34: Reference Link to PFS added
All	All	PDD_35: Document has been updated to clarify that 60m GSD product is only provided for 11 bands and 20m GSD product only for 9 bands. (Product description, File size estimation)
24,45	Table 3-I, 3.5	PDD_36: see modifications related to PDD_01, PDD_05
24,45	Table 3-I, 3.5	PDD_37: see modifications related to PDD_01, PDD_05
25	2.1.2	PDD_38: Reference to the PFS document added.
25	2.1.2	PDD_39: word “product” changed to “tile”
26	2.1.2	PDD_40: word “product” changed to “tile”
39	2.4.1	PDD_41: Literature references added for the declaration of model accuracy and WV Map accuracy
29	2.1.2	PDD_42: Scene classification accuracy set to TBD.
N/A	N/A	PDD_43: no change
	2	Chapter 2 Documentation and Definitions added to clarify document structure.

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1. INTRODUCTION

In the frame of the Global Monitoring for Environment and Security programme (GMES) jointly implemented by ESA and EC, ESA is developing the Sentinel-2 system, providing globally with systematic acquisition high resolution (10-20 m) optical observations with a high revisit tailored towards the needs of operational land services.

The Sentinel-2 mission will offer 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: 10m, 20m and 60m; (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.

The Level-1C product provides ortho-rectified, i.e. a map projection of the acquired image using a system DEM to correct ground geometric distortions, Top-Of-Atmosphere (TOA) reflectance with a sub-pixel multi-spectral and multi-date registration. This Level-1C product is converted to Bottom-of-Atmosphere (BOA) reflectance and an associated scene classification, which constitutes the Level-2A product.

1.1 Purpose and Scope

This document defines the content of the Sentinel-2 Level-2A product. It delivers a collection of the Level-2A related input and output data, covering Scenes, AOT and Water Vapour maps and Quality Indicators. The document has to be considered as a specialisation of the definition provided in [S2-PDD] for the Level-2A product.

The general parts which are common to all products are thus part of the main document [S2-PDD] and will be referred at the corresponding sections.

1.2 Structure of the Document

The document aligns to the structure of products definition given in [S2-PDD]. According to this scheme, the Chapter 3 of this document defines the structure of Level-2A products into six sections:

- Overview, in section 3.1;
- Image data, including preview in section 3.2;
- Metadata, in section 3.3;
- Quality Indicator Data, in section 3.4;
- Auxiliary Data, in section 3.5;
- File Size Estimation, in section 3.6.

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2. DOCUMENTATION AND DEFINITIONS

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 3.0, 30.08.2012

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

2.2 Informative Reference Documents

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

[GSCDA-DAP] GMES Space Component - Data Access Portfolio Requirement Document (DAP/R)

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

[S2-PFS] Sentinel-2 Product Specification

[S2-MRD] Sentinel-2 Mission Requirements Document

[S2-L2A-PFS] Sentinel-2 MSI – Level 2A Product Format Specification Technical Note

[S2-L2A-ATBD] Sentinel-2 MSI - Level 2A Products, Algorithm Theoretical Basis Document

[S2-L2A-DPM] Sentinel-2 MSI – Level 2A Detailed Processing Model

[S2-L2A-SUM] Sentinel-2 MSI – Level 2A Prototype Processor Installation and User Manual

2.3 Relation to other Documents

The *Sentinel-2 MSI - Level 2A Products Algorithm Theoretical Basis Document* [S2-L2A-ATBD] define the algorithms used during Level 2A processing which are labelled as 2A-SC for Level 2A Scene Classification and 2A-AC for Level-2A Atmospheric Correction.

The *Sentinel-2 MSI - Level 2A Products Specification Technical Note* [S2-L2A-PFS] describes Sentinel-2 Level 2A file naming convention and presents how the Sentinel-2 Level 2A XSD schemas are organized.

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2.4 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.

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3. LEVEL-2A PRODUCT DEFINITION

3.1 Overview

Level-2A processing consists in scene classification and atmospheric correction applied to Level-1C orthoimage product.

Level-2A main output is an orthoimage Bottom-Of-Atmosphere (BOA) reflectance product. Additional outputs are Aerosol Optical Thickness (AOT) map, Water Vapour (WV) map, Scene Classification map together with Quality Indicators data.

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

The delivery of 10m, 20m or 60m product is optional. Product content is detailed in section 3.1.2.

3.1.1 Input data of L2A processing

Table 3-I lists the input data of Level-2A processing.

Level-1C TOA (Top-Of-Atmosphere) reflectance is the main input for the Level-2A product generation. Main part of Level-1C metadata will be included in the Level-2A product. The definition of Level-1C product is given in [S2-PDD] and therefore Level-1C metadata would not be further described in this document.

Table 3-I: Input of Level-2A processing

Input of Level-2A processing	**Description**
From Level-1C	Image Data: Level-1C Top-Of-Atmosphere reflectance values
	Metadata from Level-1C
	Ancillary data from the Level-1C (satellite and ground ancillary data, including solar and incidence angles)
	Quality Indicator files from Level-1C
	Ozone Total Column from ECMWF (TBC)
Auxiliary Data (see section 3.5)	GIPP: Level-2A processing parameters
	Digital Elevation Model (provided by user)
	LibRadtran LUTs (internal)
	Snow climatology (internal)

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3.1.2 Product Summary

The geographic coverage of Level-2A products is the same as the Level-1C input products.

One Level-2A product refers always to one Datatake. It may refer to one or several Datastrips from the same Datatake.

The Level-2A product may cover the full Datatake or an extract of the Datatake.

In the case of an extract, the image data are provided to cover the selected extract. In the case of an extract, the ancillary data are always provided through a metadata file on the full Datatake temporal extent.

Level-2A processing is performed on Level-1C products geometrically refined that are identified with a dedicated flag in the Level-1C metadata.

Figure 3-1 gives an overview of the L2A Product Physical Format. Please refer to [S2-L2A-PFS] and following sections of this document for more details.

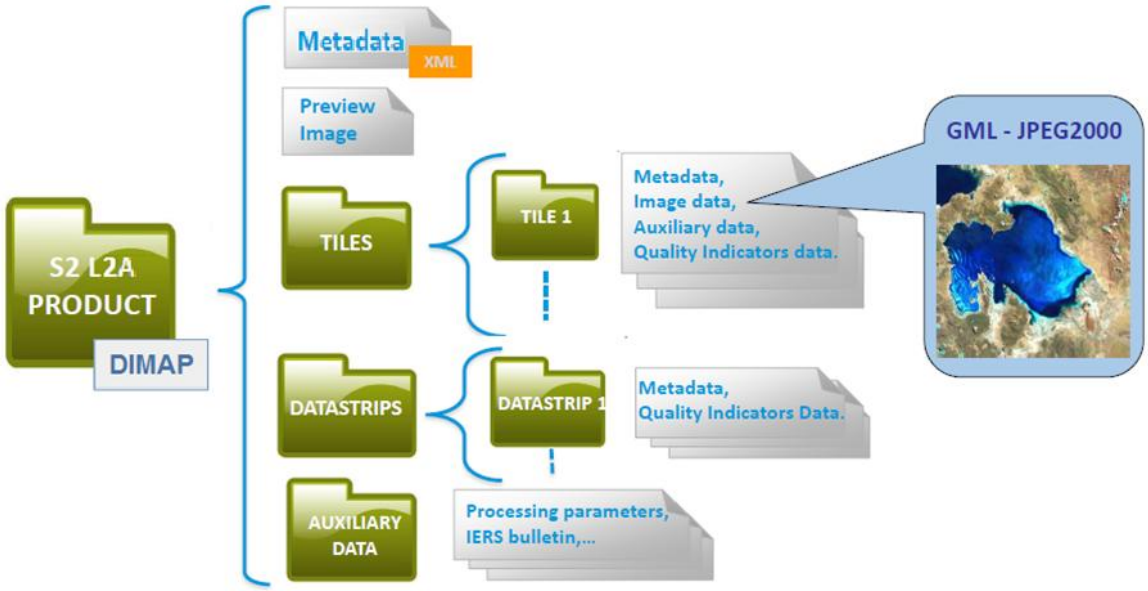

Figure 3-1 Level-2A Product Physical Format

The Level-2A product is characterised by the main following contents, outputs of the scene classification and atmospheric corrections algorithms:

- **Scene classification tiles**
    - The Scene Classification (attaching an attribute to each pixel to indicate its type) at 60m resolution [Image Data];
    - Statistics on percentage of pixels belonging to each class [QI Data];
    - The Quality Indicators for snow and cloud probability (60 m) [QI Data].
- **Atmospheric correction tiles**
    - The 60m resolution product [Image Data];

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- The surface (BOA) reflectance cube with 11 channels (B1, B2, B3, B4, B5, B6, B7, B8a, B9, B11, B12) excluding the 1375 nm cirrus band B10, as it does not contain surface information.
- The aerosol optical thickness map AOT (550nm) at 60m resolution;
- The water vapour map WV at 60 m resolution;

o The 20m resolution product [Image Data];

- The surface (BOA) reflectance cube with 9 channels (B2, B3, B4, B5, B6, B7, B8a, B11, B12), omitting the original 60 m channels (see [RD10] for further details).
- The aerosol optical thickness map AOT (550nm) at 20m resolution;
- The water vapour map WV at 20 m resolution;

o The 10m resolution product [Image Data];

- The surface (BOA) reflectance cube with 4 channels (B2, B3, B4, B8), omitting the original 20 and 60 m channels (see [S2-L2A-ATBD] for further details).
- The resampled AOT (aerosol optical thickness) map (550nm) at 10m resolution;
- The scene-averaged WV (Water Vapour) map at 10 m resolution;

Note: the user is able to select the output of the L2A processor: 10m resolution product only, 20m resolution product only or 60m resolution product only.

Table 3-II gives an overview of the components of Level-2A product.

Table 3-II: Level-2A Product – Summary Table

Name	**Level-2A**
Common Characteristics for L2A Products	
Identifier	S2_L2A
Product level	L2A
Description	The L2A product contains the following product components: • BOA reflectance images (10m, 20m, 60m); • Aerosol Optical Thickness (AOT) maps (10m, 20m, 60m); • Water Vapour (WV) maps (10m, 20m, 60m); • Scene classification map (on pixel basis) (60m); • Quality Indicators for Snow and Cloud probability (60m).

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Name	**Level-2A**
Parent Product	L1C
Coverage	Regional
Packaging	Tiles (same size and area coverage as Level 1C input data)
Geo-location accuracy	Identical to the level 1C geo-location performance.
Frequency	Variable upon Level 1C products availability.
Format	SAFE and DIMAP format, see section 1.2.8 of [S2-PFS].
Size	See section 3.6.
BOA Reflectance [Image Data]	
Algorithm	The surface reflectance is computed using the "Sentinel-2 Atmospheric Correction" (L2A_AtmCorr) algorithm and is based on reference radiative transfer code. Look Up Tables (LUTs) are based on LibRadtran. The aeorosol optical thickness retrieval is based on the dense dark vegetation (DDV) algorithm The water vapour retrieval over land is performed with the atmospheric precorrected differential absorption (APDA) algorithm
Unit	None
Range	0.0 to 1.0 (Reflectance could be above 1 with anisotropic targets and for certain viewing directions, e.g. specular configuration)
Sampling	12 bits/pixel
Channels and Resolution	B1 (443nm): 60m B2 (490nm): 60m, 20m, 10m B3 (560nm): 60m, 20m, 10m B4 (665nm): 60m, 20m, 10m B5 (705nm): 60m, 20m B6 (740nm): 60m, 20m B7 (783nm): 60m, 20m B8 (842nm): 10m

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Name	Level-2A
	B8a (865nm): 60m, 20m B9 (945nm): 60m, 20m B11 (1610nm): 60m, 20m B12 (2190nm): 60m, 20m Note: The MSI of the Sentinel-2 has 13 spectral channels. Channel B10 (Cirrus correction, 1375nm) which does not contain surface information will be barred. All the other channels will be processed.
Radiometric Accuracy	TBD
Water Vapour Map [Image Data]	
Algorithm	L2A_AtmCorr
Unit	Dimensionless
Range	0.4 – 5.5 cm
Sampling	16 bit
Resolution	60m, 20m, 10m
Accuracy	5 – 10 % (Schläpfer 1998, Chylek et al. 2003, Richter and Schläpfer 2008)
Aerosol Optical Thickness (AOT) Map [Image Data]	
Algorithm	L2A_AtmCorr
Unit	Dimensionless
Range	0 – 1
Sampling	16 bit
Resolution	60 m, 20m, 10m
Accuracy	TBD
Scene Classification [Image Data]	
Algorithm	L2A_SceneClass
Unit	None

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<table>
<tr><th>Name</th><th>Level-2A</th></tr>
<tr><td>Range</td><td>
<table>
<tr><td>0</td><td>No Data (Missing data on projected tiles) (black)</td></tr>
<tr><td>1</td><td>Saturated or defective pixel (red)</td></tr>
<tr><td>2</td><td>Dark features / Shadows (very dark grey)</td></tr>
<tr><td>3</td><td>Cloud shadows (dark brown)</td></tr>
<tr><td>4</td><td>Vegetation (green)</td></tr>
<tr><td>5</td><td>Bare soils / deserts (dark yellow)</td></tr>
<tr><td>6</td><td>Water (dark and bright) (blue)</td></tr>
<tr><td>7</td><td>Cloud low probability (dark grey)</td></tr>
<tr><td>8</td><td>Cloud medium probability (grey)</td></tr>
<tr><td>9</td><td>Cloud high probability (white)</td></tr>
<tr><td>10</td><td>Thin cirrus (very bright blue)</td></tr>
<tr><td>11</td><td>Snow or ice (very bright pink)</td></tr>
</table>
<u>Note:</u> Scene Classification pixels are set to 1 (Saturated or defective pixel) if at least one band involved in the L2A_SC is affected by Level-1C quality masks. See section 3.4.3 for details.
</td></tr>
<tr><td>Sampling</td><td>n/a (binary parameter)</td></tr>
<tr><td>Resolution</td><td>60m</td></tr>
<tr><td>Accuracy</td><td>TBD</td></tr>
<tr><td colspan="2">Cloud Probability [QI Data]</td></tr>
<tr><td>Algorithm</td><td>L2A_SceneClass</td></tr>
<tr><td>Unit</td><td>Dimensionless</td></tr>
<tr><td>Range</td><td>0 - 100</td></tr>
<tr><td>Sampling</td><td>8 bit/sample</td></tr>
<tr><td>Resolution</td><td>60m</td></tr>
<tr><td>Accuracy</td><td>See Cloud Confidence Table 3-XI</td></tr>
</table>

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Name	Level-2A
Snow Probability [QI Data]	
Algorithm	L2A_SceneClass
Unit	Dimensionless
Range	0 – 100
Sampling	8 bit/sample
Resolution	60m
Accuracy	See Snow Confidence **Table 3-XI**

3.1.3 Product Naming Schema

Level-2A main product directory is identified according to the following syntax derived from [GS-FFS] and [GS-FFS-TSM]:

MMM_CCCC_TTTTTTTTTT_<Instance_ID>

And <Instance_ID> = OOO_[Start Time]_[End Time]_[Processing Time]

Where

Table 3-III: Level-2A Product Name Nomenclature

Field	Signification	Length (max)	Example Value
MMM	Mission, e.g. S2A, S2B	3	S2A
n/a	Separator	1	_
CCCC	File Class, i.e. the type of activity for which the file is used. Examples include: - SVTx for SVT tests (x = 0, 1, 2, 3) - TDxx for processing Test Data Sets (xx = 00..99) - OPER for routine operations - TEST for internal tests	4	OPER
n/a	Separator	1	_

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Field	Signification	Length (max)	Example Value
TTTTTTTTTT	File Type (File Category + File semantic) composed as follow: XXXXYYYLLL - XXXX: category : PRD_ - YYYY: semantic description : USER for user generated product - LL: processing level: 2A	10	PRD_USER2A
n/a	Separator	1	_
OOO	Orbit Number (Relative orbit number)	3	047
n/a	Separator	1	_
Start Time	UTC Date/Time of observation start with seconds resolution: YYYYMMDDHHMMSS	12	2010101223344
n/a	Separator	1	_
End Time	UTC Date/Time of observation end with seconds resolution : YYYYMMDDHHMMSS	12	2010101223344
n/a	Separator	1	_
Processing Time	UTC Date/Time of processing start with seconds resolution : YYYYMMDDHHMMSS	12	2010102010203
	Max. total length for main product directory name	**62**	

Examples of S2 L2A product main directory are:

S2A_OPER_PRD_USER2A_047_20140417094512_201404171094728_20140417102538

S2A_OPER_PRD_USER2A_048_20140417112512_201404171112728_20140417102538

The product directory contains the product main components shown in the Figure 3-1

- **Product_Metadata_File (mandatory, DIMAP XML file):** The product metadata file name follows the same convention defined for the L2A main product directory where the File Type field is defined in the following table:

Table 3-IV: Level-2A Product Metadata File – Naming Convention

Field	Signification	Length (max)	Example Value

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Field	Signification	Length (max)	Example Value
TTTTTTTTTT	File Type (File Category + File semantic) composed as follow: XXXXYYYLLL - XXXX: category : MTD_ for Metadata - YYYY: semantic description : DMP_ for Dimap format - LL: processing level: 2A	10	MTD_DMP_2A

Examples of S2 L2A product metadata file are:

S2A_OPER_MTD_DMP_2A_047_20140417094512_201404171094728_20140417102538.xml

S2A_OPER_ MTD_DMP_2A _048_20140417112512_201404171112728_20140417102538.xml

- **TILES (folder):**

TILES folder contains the list of folders each one corresponding to the tiles composing the Level-2A user product. The name of each folder follows the syntax defined in the chapter 3 of [S2-PFS] and its contents are described in [S2-L2A-PFS].

A product is composed by several Product Data Items, e.g.Tile 15SWC:

S2A_____PDI_G2A_____20141104T134012_000012_15SWC_BV03.TAR

- **DATASTRIP (folder):**

DATASTRIP folder contains the list of folders each one corresponding to the Datastrips composing the Level-2A user product. The name of each folder follows the syntax defined in the chapter 3 of [S2-PFS].

- **AUX DATA (folder):**

AUX_DATA folder contains the auxiliary data files used for the processing. The naming convention used to identify each auxiliary file is defined in the chapter 3 for each PDI-Type Auxiliary:

  - GIPP
  - ECMWF

- **Preview Image (optional, JPEG file):**
  The product preview image file name follows the same convention defined for the L2A main product directory where the File Type field is defined in the following table:

Table 3-V: Level-2A Preview image – Naming Convention

Field	Signification	Length (max)	Example Value

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Field	Signification	Length (max)	Example Value
TTTTTTTTTT	File Type (File Category + File semantic) composed as follow: XXXXYYYLLL - XXXX: category : PVI_ for Preview image - YYYY: semantic description : USER for user generated product - LL: processing level: 2A	10	PVI_USER2A

Examples of S2 L2A preview image file are:

S2A_OPER_PVI_USER2A_047_20140417094512_201404171094728_20140417102538.jpg

S2A_OPER_ PVI_USER2A_048_20140417112512_201404171112728_20140417102538.jpg

3.2 Image Data

The Level-2 A image data is composed of BOA reflectance images, Aerosol Optical Thickness (AOT) maps, Water Vapour (WV) maps and a Scene classification map.

The Level-2A 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].

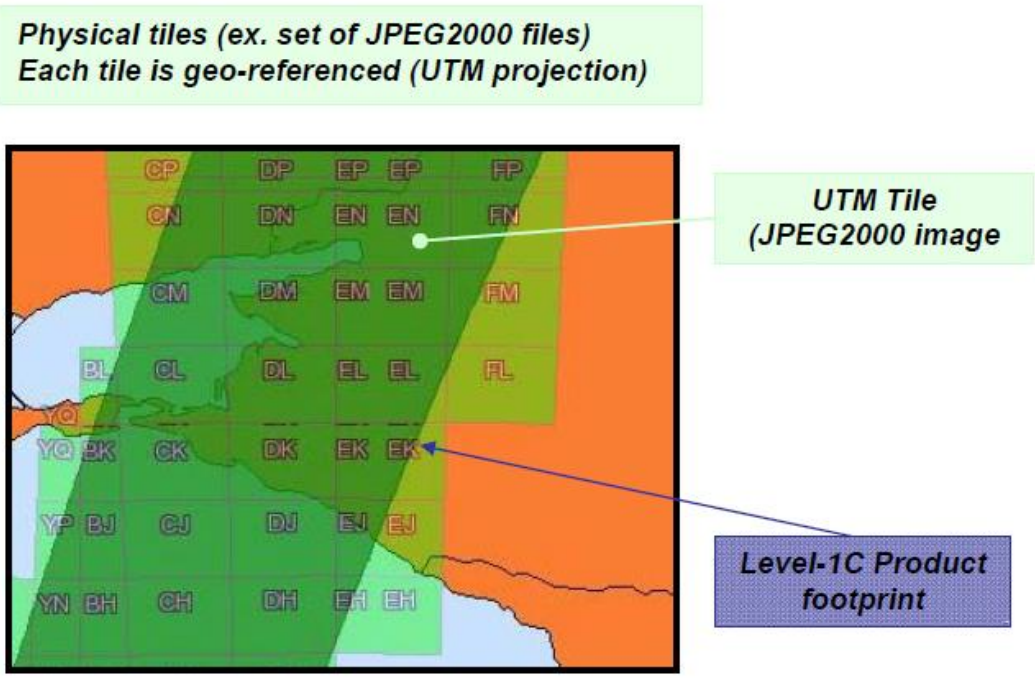

Figure 3-2: Example of Level-2A product tiled in several files

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3.2.1 Atmospheric correction images

For BOA Reflectance images, pixel value is encoded on 12 useful bits and is directly proportional to Bottom-Of-Atmosphere reflectance values.

Table 3-VI below lists the data type, the encoding, data size and resolution of the Atmospheric correction image data generated by the Level-2A processing.

Table 3-VI: Atmospheric correction Image Data

Name	Data Type	Data Size (Byte)	Resolution	Description
60m product				
BOA Reflectance				
B1 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B2 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B3 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B4 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B5 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B6 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B7 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B8a channel	JPEG 2000, 12bit	1,811,594	60m	Image
B9 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B11 channel	JPEG 2000, 12bit	1,811,594	60m	Image
B12 channel	JPEG 2000, 12bit	1,811,594	60m	Image
Water Vapour Map				

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Name	Data Type	Data Size (Byte)	Resolution	Description
WV map	JPEG 2000, 16 bit	2,415,458	60 m	Image
Aerosol Optical Thickness Map				
AOT map	JPEG 2000, 16 bit	2,415,458	60 m	Image
20m product				
BOA Reflectance				
B2 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B3 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B4 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B5 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B6 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B7 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B8a channel	JPEG 2000, 12bit	16,304,348	20m	Image
B11 channel	JPEG 2000, 12bit	16,304,348	20m	Image
B12 channel	JPEG 2000, 12bit	16,304,348	20m	Image
Water Vapor Map				
WV map	16 bit	21,739,131	20 m	Image
Aerosol Optical Thickness Map				
AOT map	16 bit	21,739,131	20 m	Image
10m product				

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Name	Data Type	Data Size (Byte)	Resolution	Description
BOA Reflectance				
B2 channel	JPEG 2000, 12bit	65,217,391	10m	Image
B3 channel	JPEG 2000, 12bit	65,217,391	10m	Image
B4 channel	JPEG 2000, 12bit	65,217,391	10m	Image
B8 channel	JPEG 2000, 12bit	65,217,391	10m	Image
Water Vapor Map				
WV map	JPEG2000, 16 bit	86,956,521	10 m	Image
Aerosol Optical Thickness Map				
AOT map	JPEG2000, 16 bit	86,956,521	10 m	Image

3.2.2 Scene Classification image

Table 3-VII below lists the data type, the encoding, data size and resolution of the scene classification Image data as generated by the Level-2A processing.

Table 3-VII: Scene Classification Image data

Name	Data Type	Data Size (Byte)	Resolution	Description
Scene Classification				
Pixel Type	JPEG 2000, 8bit	1,388,889	60m	Array covering all picture columns/rows at 60m spatial resolution.

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3.2.3 Preview Data

Table 3-VIII below lists the data type, the encoding, data size and resolution of the preview and browse image data as generated by the Level-2A processing.

Table 3-VIII Preview Data

Name	Data Type	Data Size (Byte)	Resolution	Description
Preview Image (Quick Look) for BOA Reflectance				
Preview Image	JPEG2000 with GML geo-location information, 8bit	29,297	320m	RGB (3 channels: RED = B4; GREEN = B3; BLUE = B2). Preview dynamic is stretched (by default 2% population threshold is applied).

3.3 Metadata

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

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

3.3.1 Product Level Metadata

The following information is applicable to the whole product.

3.3.1.1 Brief Metadata

The following information is provided in the Level-2A "brief" metadata:

- 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-2A);**

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  - List of Level-2A 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).**
- Datastrip level information (repeatable for each Datastrip composing the product):
  - Datastrip unique identifier;
- Preview data information:
  - **Pointer to preview image files (see section 3.2.3);**
- **Product level quality indicators (see section 3.4.1).**

3.3.1.2 Standard Metadata

The following information is provided in the standard metadata structure:

- Brief metadata, as in section 3.3.1.1.
- Following information repeatable for each Datastrip:
  - Auxiliary data information:
    - Auxiliary data from Level-1C;
    - **Identification of OGCD/GIPP used for Level-2A (identifier and version), including Meteorological data listed in section 3.5.**

3.3.1.3 Expertise Metadata

The following information is provided in the expertise metadata structure:

- Brief metadata, as in section 3.3.1.1;
- Standard metadata, as in section 3.3.1.2;
- Following information repeatable for each Datastrip:
  - **Datastrip generation information (Level-2A generation date, software version,…);**

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- Level-1C expertise metadata.

3.3.2 Tile Level Metadata

The following metadata are provided on tile level:

3.3.2.1 Brief Metadata

The following information is provided in the Level-2A "brief" metadata for each Level-2A tile:

- 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.

3.3.2.2 Standard Metadata

For each tile of the Level-2A product, the following information is provided in the standard metadata:

- Brief metadata
- Tile identification and reference to a given Datastrip;
- 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;
- **Tile level quality indicators as listed in section 3.4.2;**
- **Pixel level quality indicators (as a pointer to the QI files) as listed in section 3.4.3.**

3.3.2.3 Expertise Metadata

At tile level, the expertise metadata is composed by the same information as in the standard metadata structure (see section 3.3.2.2).

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3.4 Quality Indicator Data

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

Some QIs provided in Level-2A products are inherited from Level-1C QIs.

3.4.1 Product Level Quality Indicators

The following Level-2A QIs are provided on product level and refer to one Datatake. They are provided through the metadata file.

Table 3-IX: Product Level Quality Indicators

Name	Data Type	Data Size (Byte)	Resolution	Description
Level-2A Quality Indicators				
% of saturated or defective pixels	Unsigned Integer	1	n/a	This information is derived from the scene classification image based on Level-1C radiometric quality masks.
% of pixels classified as dark features /shadows	Unsigned Integer	1	n/a	For Level-2A products the recognition of cloud, land, water etc. pixel is made checking the pixel radiometry. Ranging from 0 for 0% to 100 for 100%.
% of pixels classified as cloud shadow	Unsigned Integer	1	n/a	"
% of pixels classified as vegetation	Unsigned Integer	1	n/a	"
% of pixels classified bare soils	Unsigned Integer	1	n/a	"
% of pixels classified as water	Unsigned Integer	1	n/a	"
% of pixels classified as low probability	Unsigned Integer	1	n/a	"

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Name	Data Type	Data Size (Byte)	Resolution	Description
cloud				
% of pixels classified as medium probability cloud	Unsigned Integer	1	n/a	"
% of pixels classified as high prb. Cloud	Unsigned Integer	1	n/a	"
% of pixels classified as snow or ice	Unsigned Integer	1	n/a	"
Declared accuracy of the radiative transfer model	String	10	n/a	Libradtran code achieves a relative accuracy of 5% - 10% http://www.bmayer.de/index.html?radtran.html&1
Water vapour retrieval accuracy	String	10	n/a	APDA (Atmospherically Precorrected Differential Absorption) method achieves a typical relative accuracy of 5 - 10% except over very dark surfaces. (Schläpfer 1998, Chylek et al. 2003, Richter and Schläpfer 2008)
Traceability and Accuracy of Auxiliary Data				
TBD	TBD		n/a	TBD
Embedded Level-1C Quality Indicators (Datastrip level)				
Geometric Quality indicators			n/a	Orbit level quality indicators from Level-0: Absolute location, Planimetric stability, and ephemeris and ancillary data quality. See section 5.5.1

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Name	Data Type	Data Size (Byte)	Resolution	Description
				of [S2-PDD] for details. Orbit level quality indicators from Level-1B: Geometric refining quality, average, mean quadratic residuals, histograms of spatio-triangulation residuals on ground for each axis (X, Y, Z) and in image reference frame for each axis (row, col). See section 7.4.1 of [S2-PDD] for details.
% of degraded MSI and ancillary data over the product	Unsigned Integer	1	n/a	Level-1C Quality Indicator

3.4.2 Tile Level Quality Indicators

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

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

Name	Data Type	Data Size (Byte)	Resolution	Description
Level-2A Quality Indicators (Tile level)				
% of no data pixels (missing data on projected tiles)	Unsigned Integer	1	n/a	This information is derived from the scene classification image based on Level-1C radiometric quality masks.
% of saturated or defective pixels	Unsigned Integer	1	n/a	"

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Name	Data Type	Data Size (Byte)	Resolution	Description
% of pixels classified as dark features /shadows	Unsigned Integer	1	n/a	This information is derived from the scene classification image based on Level-1C radiometry. Ranging from 0 for 0% to 100 for 100%.
% of pixels classified as cloud shadow	Unsigned Integer	1	"	"
% of pixels classified as vegetation	Unsigned Integer	1	"	"
% of pixels classified bare soils	Unsigned Integer	1	"	"
% of pixels classified as water	Unsigned Integer	1	"	"
% of pixels classified as low probability cloud	Unsigned Integer	1	"	"
% of pixels classified as medium probability cloud	Unsigned Integer	1	"	"
% of pixels classified as high prb. Cloud	Unsigned Integer	1	"	"
% of pixels classified as snow or ice	Unsigned Integer	1	"	"
Embedded Level-1C Quality Indicators (Tile level)				
% of degraded MSI and ancillary data over the tile	Unsigned Integer	1	n/a	Level-1C Quality Indicator

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3.4.3 Pixel Level Quality Indicators

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

Please note that high-level radiometric quality information is also available at pixel level through the scene classification image (2 classes: no data pixels and defective/saturated pixels).

QIs provided by Level-2A processing are provided at 60m resolution as raster masks, the same resolution as the Pixel Classification. Users may resample this to lower or higher resolution, if required.

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

Table 3-XI: Level-2A Pixel Level Quality Indicators

Name	Data Type	Data Size (Byte)	Resolution	Description
Cloud Confidence	Unsigned Integer	1	60m	Ranging from 0 for high confidence clear sky to 100 for high confidence cloudy.
Snow or Ice Confidence	Unsigned Integer	1	60m	Ranging from 0 for high confidence no snow/ice to 100 for high confidence snow/ice.
Embedded Level-1C Quality Indicators (Pixel level)				
Radiometric quality masks	TBD	TBD	Vector (TBD)	These masks are provided by Level-1B processing and are projected for each tile (defective pixels mask, saturated pixels mask and no-data pixels masks) and provided in the final reference frame (ground geometry).
Local Technical quality mask files	TBD	TBD	Vector (TBD)	The technical quality masks from Level-1B (lost mission data, degraded mission data, degraded ancillary data) are provided in the final reference frame (ground geometry).
DEM Quality mask	TBD	TBD	Vector (TBD)	DEM Quality mask used for Level-1C processing transformed in the final reference frame (DEM mask content

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Name	Data Type	Data Size (Byte)	Resolution	Description
				TBC)
Detector footprint mask	TBD	TBD	Vector (TBD)	A mask providing the ground footprint of each detector within a tile.

Note: QIs inherited from Level-1C products are provided as vector files; one for each type of mask and each tile. Each vector mask file consists of a set of polygons defined in ground geometry: (X, Y) in the projected frame.

3.5 Auxiliary Data

All Auxiliary Data used for Level-2A processing are referenced in the Level-2A Metadata whereas only GIPPs and Level-1C meteorological datasets are provided within Level-2A product.

Please refer to [S2-L2A-ATBD] for details on auxiliary data.

3.5.1 Provided Auxiliary Data

The following auxiliary data is provided in the Level-2A product structure:

- Ground Image Processing Parameter List (GIPP List) used.
  These GIPPs are provided as a separate XML file as listed in section 2.1.4 of [S2-L2A-SUM] and [S2-L2A-DPM].

- Level-1C inherited Auxiliary Data which consists in an elementary set of meteorological datasets extracted and resampled from ECMWF forecast output (cf. [ECMWF]).

3.5.2 Referenced Auxiliary Data

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

- The Digital Elevation Model (provided by user) used for the Level-2A processing is not provided itself within the product but only as a reference to the data used.

- The LibRadtran LUTs used for the Level-2A processing are not provided within the product but only as a reference to the data used.

- The Snow climatology used for the Level-2A processing is not provided itself within the product but only as a reference to the data used.

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3.6 File Size Estimation (single tile)

The total size of Image data and QI Data output can be calculated based on sections 3.2 and 3.4. The data size has been calculated for a single tile assuming an image size of 100km * 100km and lossless JPEG2000 compression, with a mean compression rate of 2.3.

The following data have been neglected in the file size estimation, due to their relatively small size:

- Product Metadata
- Quality Indicators provided in Metadata
- Preview Images
- Embedded Level-1C Quality indicators (TBC)

Table 3-XII: Total File Size (100x100km^2 tile)

Name	Data Format	Resolution	Bytes	Description
60m Image Data				
60m Product BOA Reflectance	JPEG2000, 12bit	60m	19,927,534	Primary Output, Image Data (BOA) for spectral channels B1, B2, B3, B4, B5, B6, B7, B8a, B9, B11, B12. One JP2 file per band.
60m WV map	JPEG2000, 16 bit	60m	2,415,458	Water Vapour map at 60m resolution
60m AOT map	JPEG2000, 16 bit	60m	2,415,458	Aerosol Optical Thickness map
60m Scene Classification	JPEG2000, 8 bit	60m	1,207,729	Category of the pixel, e.g. land, water, cloud, cloud shadow, snow or ice
Total (60m)			25,966,179	Bytes
20m Image Data				
20m Product	JPEG2000, 12bit	20m	146,739,132	Primary Output, Image Data (BOA) for spectral

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Name	Data Format	Resolution	Bytes	Description
BOA Reflectance				channels B2, B3, B4, B5, B6, B7, B8a, B11, B12. One JP2 file per band.
20m WV map	JPEG2000, 16 bit	20m	21,739,131	20m Water Vapour map
20m AOT map	JPEG2000, 16 bit	20m	21,739,131	20m Aerosol Optical Thickness map
Total (20m)			190,217,394	Bytes
10m Image Data				
10m Product BOA Reflectance	JPEG2000, 12bit	10m	260,869,564	Primary Output, Image Data (BOA) for spectral channels B2, B3, B4, B8. One JP2 file per band.
10m WV map	JPEG2000, 16 bit	10m	86,956,521	20m Water Vapour map
10m AOT map	JPEG2000, 16 bit	10m	86,956,521	20m Aerosol Optical Thickness map
Total (10m)			434,782,606	Bytes
Quality Indicators Data				
60m Cloud Confidence	JPEG2000, 8 bit	60m	1,207,729	Q.I. for cloud, ranging from 0 for high confidence clear sky to 100 for high confidence cloudy.
60m Snow or Ice Confidence	JPEG2000, 8 bit	60m	1,207,729	Q.I. for snow, ranging from 0 for high confidence no snow to 100 for high confidence snow.
Total			**653,381,637**	**Bytes**

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