DEIMOS-2 Ground Segment

D2 GS

PRODUCT PROCESSORS
INTERFACE CONTROL DOCUMENT

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1. INTRODUCTION

This document is the Product Processors Interface Control Document of the Deimos 2 Ground Segment Project. The Product Processors is an element of the PDGS that is in charge of processing the payload raw data from the satellite to produce image products. The four, most important operations that the product processors perform on the input data are:

- A calibration, to convert the pixel elements from instrument digital counts into radiance units.
- A geometric correction, to eliminate distortions due to misalignments of the sensors in the focal plane geometry.
- A geolocation, to compute the geodetic coordinates of the input pixels.
- An ortho-rectification, to produce ortho-photos with vertical projection, free of distortions.

The previous steps also generate quality-related figures of merit that are made available in all the products. Moreover, the product processors generate metadata, in line with industry standards, to facilitate the cataloguing, filtering and browsing of the product image collection.

The output image products are classified into different levels, according to the degree of processing that they have been subjected to. In short:

- Level 0 products are unprocessed images, in digital count numbers.
- Level 1A products are calibrated products, in units of radiance.
- Level 1B products are calibrated and geometrically corrected products, blindly geolocated.
- Level 1C products are calibrated and geometrically corrected products, precisely geolocated using ground control points.

Within the L1B and L1C products, we make a distinction between resampled products in UTM projection (L1B-G and L1C-T), and products in the original raster format (L1B-R, L1C-R).

1.1. Purpose and Scope

The objective of this document is to present the external interfaces of the Deimos 2 Product Processors, an element of the Deimos 2 Payload and Data Segment.

Most importantly, this document defines the contents and format of the image products that will be generated by the Deimos 2 mission.

1.2. Acronyms, Definitions and Abbreviations

The acronyms, abbreviations and definitions used in this document can be found in the reference document [RD 1]. In addition, the following constants are used throughout this document:

Table 1: Constants

Name	Description	Value
S	Number of sensors	2
B_MS	Number of Multispectral Bands	4
B	Number of Bands, including PAN. By convention, Bands are numbered form 0 to 4, 4 being the PAN band.	5

Name	Description	Value
P_MS	Number of pixels in MS (one sensor)	1500
PA_MS	Number of active pixels in MS (one sensor)	1492
PD_MS	Number of dark ref pixels in MS (one sensor)	8
P_PAN	Number of pixels in PAN (one sensor)	6,000
PA_PAN	Number of active pixels in PAN (one sensor)	5,968
PD_PAN	Number of dark ref pixels in PAN (one sensor)	32

2. RELATED DOCUMENTS

2.1. Applicable Documents

The following table specifies the applicable documents that shall be complied with during project development.

Table 2: Applicable documents

Reference	Code	Title	Issue
[AD 1]	DQS	Deimos Quality System	
[AD 2]	DM2SE34300	Satellite to Ground Station ICD	1.0

2.2. Reference Documents

The following table specifies the reference documents that shall be taken into account during project development.

Table 3: Reference documents

Reference	Code	Title	Issue
[RD 1]	D2-DMS-TEC-STA01	Acronyms and Definition List	1.D
[RD 2]	D2-DMS-GS-MC-TEC-ICD07	M&C ICD	2.A
[RD 3]	D2-DMS-CAL-TEC-ICD01	CALVAL ICD	2.A
[RD 4]	EE-MA-DMS-GS-0002	Earth Explorer CFI	4.0
[RD 5]	D2-DMS-MPS-TEC-ICD04	MPS ICD	2.A

2.3. Standards

The following table specifies the standards that shall be complied with during project development.

Table 4: Standards

Reference	Code	Title	Issue
[STD 1]	PE-TN-ESA-GS-0001	ESA Earth Explorer – Ground Segment File Format Standard, PE-TN-ESA-GS-0001. Available: http://eop-cfi.esa.int/PE/	2.0
[STD 2]	PGSI-GSEG-EOPG-TN-06-0001	Products Naming Standard Convention	2.1
[STD 3]	GSC-T/OAR-OPT-ICD-2.0	GMES Space Component Coordinating Function Tasking / "Optical Acquisition" Report for Optical Products. ICD.	2.0

Reference	Code	Title	Issue
[STD 4]	GMES-GSEG-EOPG-TN-09-0016	GMES Generic PDGS-IPF Interface Specification	1.0

3. OVERVIEW

This document explains the format of the products generated by the Deimos-2 Product Processor Element. All the interfaces are file-based. The PP simply picks the input files from the directory and puts them in the output directory. The actual file transfer to and from the MAC is performed by the Orchestrator, which is described M&C sub-system. The external interfaces of the Product Processors are as follows:

Table 5: External interfaces

IF name	Description	Origin	Destination	Protocol
General				
JO	Job Order	M&C	PP	Shared Area
RAW	Payload Data.	M&C	PP	Shared Area
ORBIT	Orbit Data.	M&C	PP	Shared Area
ATTITUDE	Attitude Data.	M&C	PP	Shared Area
CONFIG	The processors' configuration files.	M&C	PP	Shared Area
SCENARIO	Scenario File.	Ingestion	PP	Shared Area
GCP	Ground Control Points for the Manual Ortho-rectification.	HMI	PP	Shared Area
ADFs				
REFIMG	Reference image for the Automatic Ortho-rectification.	M&C	PP	Shared Area
CCDB	The calibration and characterisation DB.	CALVAL	PP	Shared Area
DEM	The Digital Elevation model.	(external)	PP	Deployed during installation
Products				
L0	The L0 Product.	PP	Archive	Shared Area
L0R	The L0R Product.	PP	Archive	Shared Area
L1A	The L1A Product.	PP	Archive	Shared Area
L1BR	The L1B-R Product.	PP	Archive	Shared Area
L1BG	The L1B-G Product (resampled)	PP	Archive	Shared Area
L1CR	The L1C-R Product.	PP	Archive	Shared Area
L1CT	The L1C-T Product (resampled)	PP	Archive	Shared Area

IF name	Description	Origin	Destination	Protocol
LOG	Log files	PP	M&C	Shared Area
HMI	The PP HMI	Operator	PP	HMI

The Deimos-2 Processing Chain contains four Processing Levels and associated Products that are executed automatically upon ingestion of new satellite data. These are the following:

- Processing Level 0: Level 0 products contain un-processed raw data from the satellite. Two sub-levels are identified:
  - L0 product: the data is decoded, but not processed.
  - L0R product: the data is packed into square scenes and reformatted for the next levels of processing.
- Processing Level 1A: L1A data is radiometrically calibrated, and contains radiances in W.m-2.sr-1.um-1, but no other transformation is applied, not even band-registration. Some quality information is attached to the products, such as the number of invalid and saturated pixels, cloud coverage estimation, etc. L1A is an intermediate level that, in principle, is not intended for archiving.
- Processing Level 1B: These products contain calibrated radiances with some geometric corrections applied. Also, the images contain detailed quality annotations and crude geolocation grids. There are two types of L1B products:
  - L1B-R1: a calibrated, band-registered product, crudely geolocated (but not resampled). The PAN images (one for each sensor) are the reference bands and are unmodified from the L1A. The scenes from the two sensor (FPA1 and FPA2) are not merged. This product includes two crude geolocation grids (one for each PAN image) derived from the telemetry or from the Ground Segment orbit file. It is optional to use a Digital Elevation Model (DEM) to obtain an altitude grid.
  - L1B-G: this is the L1B-R1 product resampled to a UTM grid. During the resampling to UTM, the images from the two sensors are merged. Fill masks identify each of the pixels as "natural" or "filled". Also orphan pixels are collected in a separate file. Orphan pixels are the pixels (radiance, sensor and detector information) that were discarded during the resampling. Most of the orphan pixels will be from the overlapping area of the two sensors. With the orphan information, it is possible to re-generate the L1B-R1 product from the L1B-G.
- Processing Level 1C: These products include precise geolocation information obtained by comparing the image to a reference image, using Ground Control Points (GCP). The following sub products are identified:
  - L1C-R2: a calibrated, registered product. The contents are the same as L1B-R1, except that it includes a precise geolocation grid obtained using GCP and a reference image at medium resolution (e.g. DMS-1 or Landsat).
  - L1C-T1: This is the L1C-R2 product resampled to a UTM grid. It is the equivalent of L1B-G.
  - L1C-R3: a calibrated, registered product in Focal Plane geometry. It includes a precise geolocation grid obtained using GCP and a reference image at medium resolution (e.g. DMS-1 or Landsat). The difference with L1C-R2 is that the GCP are identified manually by the operator.
  - L1B-T2: This is the L1C-R3 product resampled to a UTM grid.

The execution of a Manual Processing Chain to obtain the L1C-R2 and L1B-T2 products requires the intervention of the operator.

The Manual Processing Chain can also be configured to reprocess one or more Processing Levels from the Automatic Processing Chain defined above. This is necessary, for example, if one wants to re-generate the automatic products using a different configuration.

The following table summarizes the Deimos-2 product hierarchy and compares it with that of other missions (Deimos-1, Landsat and SEOSAT). It also proposes which product levels should be stored in the archive for permanent storage, and which should be temporary products during the PP execution.

Table 6: Comparison of Product Levels for three missions

DMS2	DMS1	Land Sat	SEO SAT	R	B	G	D	CP	Resamp.	Description	Archive?
L0	L0	L0	L0						None	None.	Yes
L0R	-	L0R	L1A						None	Scenes	Yes
L1A	L0R	L1R	L1B1						None	Calibrated.	No
L1B-R1	L1R	-	-						FP	Registered + Crudely Geolocated	Yes
L1B-G	L1G	L1G(t)	-						UTM	L1B-R1 Resampled	No
L1C-R2	L2R	-	L1B2						FP	Precisely Geolocated	Yes
L1C-T1	L1G	L1T	L1C						UTM	L1C-R2 Resampled	No
L1C-R3	L3R	-	-						FP	Manually Geolocated	Yes
L1C-T2	L1T	-	-						UTM	L1C-R3 Resampled	No

R: Radiometric calibration.
B: Band and sensor registration.
G: Geolocated
D: Geolocated using Digital elevation model.
CP: Precise geolocation using ground-control points.
FP: Focal Plane.

4. INPUT INTERFACES

4.1. [ICD-JO] Job Orders

Job orders are described in the M&C ICD.

4.2. [ICD-RAW] RAW Data

The raw data are transfer frames in CCSDS format. The format is described in [AD 2].

4.3. [ICD-ORBIT] Orbit File

The orbit file is in Earth Explorer CFI XML format. It contains orbit state vectors covering the acquisition time of the input data.

For further details, please refer to section 6.16.

4.4. [ICD-ATT] Attitude File

The attitude file is in Earth Explorer CFI XML format. It contains a set of quaternions, wrt J2000 ECI Frame, covering the acquisition time of the input data.

For further details, please refer to section 6.16.

4.5. [ICD-GCP] GCPs for the Manual Ortho-Rectification

This is a simple XML file with a list of GCPs. For each point, the image and geodetic coordinates are provided. This file can be generated with the HMI or other means.

4.6. [ICD-REFIMG] Reference Image for the Ortho-rectification

This is a file to be used as input for the ortho-rectification. The format is GEOTIFF. The resolution and geolocation information is given in the GEOTIFF tags, the projection type must be UTM.

4.7. [ICD-CONFIG] Configuration File

The configuration file is in XML format according to the following structure:

Table 7: Configuration File Structure

```
<?xml version="1.0"?>
<PP_configuration>
  <group1>
    <parameter name="paramX" value="value" description="blah blah blah">
    <parameter name="paramY" value="value" description="blah blah blah">
    <parameter name="paramZ" value="value" description="blah blah blah">
  </group1>
  <group2>
```

```
    <parameter name="paramU" value="value" description="blah blah blah">
    <parameter name="paramV" value="value" description="blah blah blah">
  </group2>
  <group3>Etc.</group3>
  Etc.
</Earth_Explorer_File>
```

Where the "groups" and "parameters" are listed in the following table:

Table 8: PP Configuration File Structure

Name	Description	Default Value	Unit
Group "switches"			
l0_intermediate	Switch to generate intermediate data in L0.	FALSE	BOOL
l1a_intermediate	Switch to generate intermediate data in L1A.	FALSE	BOOL
l1b_intermediate	Switch to generate intermediate data in L1B.	FALSE	BOOL
l1c_intermediate	Switch to generate intermediate data in L1C.	FALSE	BOOL
deconv_PAN	Apply the MTF deconvolution filter to the PAN band.	FALSE	BOOL
deconv_RED	Apply the MTF deconvolution filter to the RED band.	FALSE	BOOL
deconv_GREEN	Apply the MTF deconvolution filter to the GREEN band.	FALSE	BOOL
deconv_BLUE	Apply the MTF deconvolution filter to the BLUE band.	FALSE	BOOL
deconv_NIR	Apply the MTF deconvolution filter to the NIR band.	FALSE	BOOL
denoise_PAN	Apply the denoising filter to the PAN band.	FALSE	BOOL
denoise_RED	Apply the denoising filter to the RED band.	FALSE	BOOL
denoise_GREEN	Apply the denoising filter to the GREEN band.	FALSE	BOOL

Name	Description	Default Value	Unit
denoise_BLUE	Apply the denoising filter to the BLUE band.	FALSE	BOOL
denoise_NIR	Apply the denoising filter to the NIR band.	FALSE	BOOL
Group "scene_definition"			
scene_length	Length of the L0R scene, in PAN scan lines	12,000	scans
overlap_length	Overlap between consecutive L0R scenes, in PAN scan lines	3000	scans
min_isps_per_scene	Minimum percentage of valid Image Units required for a scene.	80	%
band_offset[N_SENSORS][N_BANDS]	Number of PAN lines separating each band sensor from the acquisition beginning.	TBD	scans
Group "pixel_classification"			
cloud_blue_threshold	If blue reflectance < threshold, pixel is not cloudy.	0.22	-
cloud_red_threshold	If red reflectance < threshold, pixel is not cloudy.	0.3	-
cloud_green_threshold	If green reflectance < threshold, pixel is not cloudy.	0.3	-
cloud_nir_threshold	If nir reflectance < threshold, pixel is not cloudy.	0.5	-
cloud_red_nir_threshold	If (red/nir) < threshold, pixel is not cloudy.	0.5	-
cloud_green_nir_threshold	If (green/nir) < threshold, pixel is not cloudy.	0.5	-
cloud_red_nir_2_threshold	If (nir+red)/(nir-red) > threshold, pixel is not cloudy.	20	-
NDVI_threshold[TBD]	Thresholds for terrain identification.	TBD	-
NDWI_threshold[TBD]	Thresholds for terrain identification.	TBD	-
Group "denoising"			

Name	Description	Default Value	Unit
den_filter	Type of filter to use for performing the wavelet transform: • 0: Haar • 1: Daubechies • 2: Symmlet • 3: Coiflet	0 (Haar)	ENUM
den_filter_size	Size of the denoising filter (not applicable to Haar).	3	pixels
den_decomp_level	Level of decomposition for wavelet transform (Number of times to apply the wavelet transform)	3	-
den_filter_threshold	Level of noise to remove	TBD	Rad
Group "deconvolution"			
deconv_filter	Type of filter to be used to perform the MTF deconvolution: • 0: Inverse • 1: Weiner	1 (Weiner)	ENUM
deconv_domain	Domain used to perform the MTF deconvolution. • 0: Spatial • 1: Fourier	1 (Fourier)	ENUM
Group "browse_product"			
browse_product_resolution	Resolution of the browse product, in metres	100	m
Group "registration"			
reg_tp_separation	Separation between consecutive tie points (in x and y directions).	50	pixels
reg_dist_to_borders	Minimum distance to borders for a tiePoint, in x and y directions.	50	pixels
reg_contrast	Minimum contrast between pixel values of a window to be valid.	TBD	Rad
reg_width_search_win	Width of search window.	40	pixels
reg_length_search_win	Length of search window.	40	pixels
reg_width_kernel_win	Width of kernel window.	10	pixels

Name	Description	Default Value	Unit
reg_length_kernel_win	Length of kernel window.	10	pixels
reg_max_corr_threshold	Threshold used to validate tie points once the cross-correlation is performed.	0.9	-
reg_geomet_model	Geometric model: • 0: affine, • 1: TPS • 2: polynomial.	0 (AFFINE)	ENUM
reg_interp_method	Interpolation method • 0: Nearest • 1: Bilinear • 2: Bicubic • 3: B-splines	0 (NEAREST)	ENUM
Group "geolocation"			
TAI_ref	TAI Time correlation reference. TAI Processing time in processing format	0.0003935185185	MJD2000
UTC_ref	UTC Time correlation reference. UTC Processing time in processing format	0	MJD2000
UT1_ref	UT1 Time correlation reference. UT1 Processing time in processing format	-3.47222222e-6	MJD2000
reference_ellipsoid	Reference ellipsoid	WGS84	-
use_thermal	Use the thermal model to correct the instrument-to-body orientation	FALSE	BOOL
use_atmosphere	Use the atmospheric refraction in the propagation of the line-of-sight	FALSE	BOOL
atmosphere_path	Path to the atmospheric refraction indices files	-	-
use_DEM	Flag to indicate whether DEM correction must be applied	TRUE	BOOL
DEM_path	Path to the GETASSE30 DEM configuration files	-	-

Name	Description	Default Value	Unit
l1b_grid_downsampling	Downsampling in the L1b geolocation grid (1=no downsampling, 2=50% downsampling, etc)	4	-
l1c_grid_downsampling	Downsampling in the L1c geolocation grid (1=no downsampling, 2=50% downsampling, etc)	4	-
Group "GCP_determination_#stage#"	Several determination stages are configurable by adding a stage number. Subsequent determination stages are applied using the optimised LOSM from the previous stage.		
search_size	Search window size for cross-correlation (in reference image resolution).	500	-
kernel_size	Kernel window size for cross-correlation (in reference image resolution).	50	-
n_col_GCPs	Number of GCP candidates across-track.	10	-
n_row_GCPss	Number of GCP candidates along-track.	10	-
weight_threshold	GCP weight filtering threshold. Weight goes from 0 to 1.	0.8	-
Group "LOSM_optimisation_#stage#"	Several optimization stages are configurable by changing stage number.		
max_iterations	Maximum number of optimization iterations in this stage.	10	-
optim_param_#param#	Optimizable parameter (focal_length, sensor_position, sensor_rotation, sampling_time, i_pitch, j_pitch, detector_position or detector_rotation) and the range. More than one parameter can be optimised by adding more than one optim_param entries to the file.	-	-
Group "resampling"			

Name	Description	Default Value	Unit
resolution	Resampled image resolution.	1	meters/ pixel
filled_window_size	Cosmetic Window Size: size of the window to be filled around each image pixel during resampling. (shall be odd)	5	pixels

4.8. [ICD-CCDB] Calibration and Characterisation DB

The DB is described in the CALVAL ICD. The following table contains the parameters of interest. The parameters of interest to the PP are listed in the following table. Two files are expected: one NetCDF file that contains the calibration parameters "Bi" and "Oi", and one XML file containing all the rest.

Table 9: Parameters of interest from SCCDB

Group	Parameter	Type	Dimensions	Description	Units
Defective_Pixels	PAN_Threshold	float	1	"Low SNR" threshold used to generate the mask below	%
	MS_Threshold	float	[N_MS_BANDS]	"Low SNR" thresholds used to generate the mask below	%
	PAN_Mask	bool	[N_SENSORS] [N_PAN_PIXELS]	Mask for "Low SNR" pixels (true=1=broken)	BOOL
	MS_Mask	bool	[N_SENSORS] [N_MS_PIXELS]	Mask for "Low SNR" pixels (true=1=broken)	BOOL
Bad_Pixels	PAN_Mask	bool	[N_SENSORS] [N_PAN_PIXELS]	Mask for broken pixels (true=1=broken)	BOOL
	MS_Mask	bool	[N_SENSORS] [N_MS_PIXELS]	Mask for broken pixels (true=1=broken)	BOOL
Geometric Characterization	FL	float	1	Focal length (position of the optical center)	mm
	INS2SAT_POS	float	[3]	Position of the INStrument wrt the SATellite body frames	mm
	n_thermo_days	int	1	Number of days of the year for which values are provided in the INS2SAT_ROT array	

Group	Parameter	Type	Dimensions	Description	Units
	n_thermo_angles	int	1	Number of orbital angles for which values are provided in the INS2SAT_ROT array	
	thermo_days	int	1	Days of the year values at which geometric models are provided	
	thermo_angles	int	1	Orbital angles values at which geometric models are provided	
	INS2SAT_ROT	int int double[3]	[n_thermo_days] [n_thermo_angles]	Roll/pitch/yaw between INStrument and SATellite body frames. Includes changes due to thermal deformation. Given as an array that has to be interpolated with the day of the year (fractional day since start of year) and the on-orbit-position (in degrees). Day: 0 to 365 angle: 0 to 360 roll/pitch/yaw: in degrees	degrees
Radiometric Calibration	Bi_PAN	float	[N_SENSORS] [N_PAN_PIXELS]	Calibration gain per pixel.	Rad/DN
	Bi_MS	float	[N_SENSORS] [N_MS_BANDS] [N_MS_PIXELS]	Calibration gain per pixel.	Rad/DN
	Oi_PAN	float	[N_SENSORS] [N_PAN_PIXELS]	Calibration offset per pixel.	Rad/DN
	Oi_MS	float	[N_SENSORS] [N_MS_BANDS] [N_MS_PIXELS]	Calibration offset per pixel.	Rad/DN
	TDIo	unsigned short	[N_SENSORS] [N_BANDS]	TDI step used during calibration.	-
	Lro	float	[N_SENSORS] [N_BANDS]	Line-rate used during calibration.	-
	Go	float	[N_SENSORS] [N_BANDS]	Gain of the sensor measured during calibration.	Rad/DN

Group	Parameter	Type	Dimensions	Description	Units
Geometric Calibration	overlap	int	[N_BANDS]	Approximate number of pixels that overlap between sensors 1 and 2.	Pixels
	det_size	int	[N_SENSORS] [N_BANDS]	Number of pixels of the detector array.	Pixels
	det_pitch_x	float	[N_SENSORS] [N_BANDS]	Pixel dimension along-track.	Micras
	det_pitch_y	float	[N_SENSORS] [N_BANDS]	Pixel dimension across-track.	Micras
	det_pos	float[2]	[N_SENSORS] [N_BANDS]	Detector position with regards to the projection of the optical center in the sensor reference frame. Position of pixel 0.	Micras
	det_rot	float[2]	[N_SENSORS] [N_BANDS]	Detector array rotation with regards to the sensor reference frame. Angle from x axis.	Degrees
	PAN_pos_error	float[2]	[N_SENSORS] [N_PAN_PIXELS]	Detector cell position error. The theoretical position depends on pixel number and detector array position and rotation. This position error is added to the theoretical position.	Micras
	MS_pos_error	float[2]	[N_SENSORS] [N_MS_BANDS] [N_MS_PIXELS]	Detector cell position error. The theoretical position depends on pixel number and detector array position and rotation. This position error is added to the theoretical position.	Micras
Deconvolution	PSF_size	int	1	Width of PSF (must be odd).	Pixels

Group	Parameter	Type	Dimensions	Description	Units
	PSF	float	[N_SENSORS] [N_BANDS] [MAX_PSF_SIZE]	Point Spread Function that characterises the distortion introduced by the optical system. PSF is different per sensor and band.	-

4.9. [ICD-DEM] Digital Elevation Model

This is a model of the earth surface elevation with respect to the reference geoid. It must be given in a format compatible with the Earth Explorer CFI, such as the Getasse 3.0 Digital Elevation Model.

5. OUTPUT INTERFACES

5.1. Product Naming Convention

The proposed product naming convention for Deimos 2 is a customization of the ESA Products Naming Standard Convention [STD 2].

Deimos-2 products are multi-files products. The following convention applies to the name of the containing directory or the packaging file. This convention specifies a name for the products, according to the following format:

MMNN_TTTTTTTTTT_YYYYMMDDTHHMMSS_YYYYMMDDTHHMMSS_FFF_OOOOOO_XXXX.EEEE

The elements of the name are separated by underscores, and are specified according to the following table:

Table 10: Product Naming Convention

Pattern	Description	Comment
MMNN	Mission Identifier	DE02 for Deimos-2 mission
TTTTTTTTTT	Product Type	See below.
YYYYMMDDTHHMMSS	Acquisition Start Time	15 characters separated by "T"
YYYYMMDDTHHMMSS	Acquisition End Time	15 characters separated by "T"
FFF		Originating Facility that generated the product package: • DE1: Boecillo • DE2: Puerto Llano • DE3: Madrid • XXX: Unknown
OOOOOO		Absolute orbit number at the Acquisition Start Time (no leading zeroes). This field is the only one that has variable length.
XXXX	Unique Product Identifier	Uniqueness file name identifier, i.e. an alphanumeric string that ensure the uniqueness of the file name in the case of repetitive generation of the same product. The specific implementation for Deimos-2 mission will follow the SAFE standard, with the following specifications: Checksum calculated with CRC-16 computed on the entire SAFE Manifest file, in hexadecimal format.
.EEE	Product Format Extension	Extension depends on packaging schema: • When unpacked, the extension is void. • Zipped: .zip • Tar-gzipped: .tgz

The Product Type field has the following format:

SSSLLLLBBB

Where:

- SSS is a 3-digit code that contains the sector number of the 1st ISP in the product.
- LLLL is a 4-digit code that defines the product level:
  - "L000": level L0
  - "L00R": level L0R
  - "L01A": level L1A
  - "L1BR": level L1B-R1
  - "L1BG": level L1B-G
  - "L1CR": level L1C-R2
  - "L1CT": level L1C-T
- BBB is a 3-digit code that is either:
  - "MAN": for products that have been manually processed.
  - "ddd": for automatic products, where ddd is the configuration baseline number (3 digits, using leading zeroes if necessary).

The CRC-16 of the Unique Product Identifier field is to be applied in its "direct" convention and with the following parameters:

- Generating polynomial: x16 + x12 + x5 + 1
- Initial value: 0xFFFF

The following convention applies to the name of the files contained in the product. The only exceptions are:

- the manifest file, which is always named "Manifest.xml".
- the EEH file, which is always named the same as the product with the ".EEH" extension.

This convention specifies a name for the files, according to the following format:

MMNN_TTTTTTTTTT_YYYYMMDDTHHMMSS.XXX

The elements of the name are separated by underscores, and are specified according to the following table:

Table 11: File Naming Convention

Pattern	Description	Comment
MMNN	Mission Identifier	DE02 for Deimos-2 mission
TTTTTTTTTT	File Type	See below
YYYYMMDDTHHMMSS	Creation date	The date/time in which the file was created
XXX	File extension	See below

For the File Type is a sequence of 10 characters, as follows:

Table 12: File Naming Convention (File Type)

File Type	TTTTTTTTTT	Where…
Sector File	ISP_*SSS*___	*SSS* is the sector number of the first ISP

Image File (PAN)	PAN_*LLLL*_*S*	*LLLL* is the product level *S* is the sensor number ("_" if both sensors are included).
Image File (MS)	MS*B*_*LLLL*_*S*	MS*B* is: • MS0: Blue • MS1: Green • MS2: Red • MS3: NIR • MS_: All bands
Browse Image	BRO_____	
Pixel Mask	MAS_____*S*	
Geolocation Grid	GRD_____*S*	
Tie Points File	GCP_____*S*	
Orphan Pixels	ORP_____	
Regridding files	RES_PAN___ RES_MS*B*___	
Geometry File	GEO_____*S*	
Registration File	RES_____S	
Telemetry report	TLM_____	
Quality metadata	QUA_____	
IPF Report file	REP_____	
Orbit file	ORB_____	
Attitude file	ATT_____	
DIMAP file	DIMAP_____	
Acquisition report file	GMESACQ___	

The file extension is as follows:

- .bin: Sector files
- .tif: TIFF Image files
- .jpg: JPEG files
- .xml: XML files
- .nc: NetCDF files

5.2. [ICD-L0] L0 Product

The L0 product contains the raw data, as it is received, with some annotations, extra headers and quality indicators. ISPs are grouped in sectors (see below).

Table 13: L0 Product Contents

File	Format	Contents
Manifest	XML	List of Files
Sector file	RAW	Each file contains 656 ISPs from a Sector in binary format as they come from the satellite. Each ISP is pre-pended with an annotation header (see further down). The ground footprint of a sector is approximately 2.7 km x 12 km, corresponding to 655 Image Units (Instrument Source Packets) and one Ancillary Data Unit. Each Image Unit (ISP) contains: • 4 PAN rows x 12k pixels • 4 MS Bands x 1 MS row x 3k pixels The number of sector files in each L0 product is variable and depends on the length of the acquisition.
EE Header	XML	Earth Explorer Header File
DIMAP Metadata	XML	DIMAP Metadata File
Acquisition Metadata	XML	Acquisition metadata file (e.g. see GMES optical acquisition report xml format): • Product name • Acquisition station. • Sensing period • Platform name (DMS2) • Instrument name • Sensor name • Etc.
Telemetry Report	XML	Metadata file containing the following statistics. Note that statistics are computed for all the ISPs in the sector: • Downlink time of the 1st and last TF • Average SNR for valid TFs. • Average SNR for invalid TFs. • Number of TFs received. • Number of TFs lost to errors. • Number of TFs missing. • Number of TFs with unrecoverable RS errors. • Number of TFs with no RS errors. • Number of errors fixed by RS. • Number of ISPs contained in the sector file. • Number of ISPs lost to errors. • TBD other information from the CORTEX
Report	XML	Processor execution report.

5.3. [ICD-L0R] L0R Product

The L0R product is the L0 product cut into scenes, reformatted, and free of communications metadata. It contains the following files:

Table 14: L0R Product Contents

File	Format	Size	Contents
Manifest	XML	-	List of files
PAN Images	TIFF (ushort) (2 files)	2 x 297 = 595 MB	Panchromatic images, one for each sensor. Image data is in 10 bits digital numbers (stored as 2-byte unsigned shorts). The total size has been computed assuming a 13kmx12km scene.
MS Images	TIFF (ushort) (8 files)	8 x 18 = 149 MB	Multi-spectral images, 2 sensors x 4 bands = 8 images. Image data is in 10 bits digital numbers, (stored as 2-byte unsigned shorts).
Browse Product	JPEG	-	Browse product, generated from the MS images.
EE Header File	XML		Earth Explorer Header File
Orbit File	XML		Orbit file, derived from the Ancillary Data.
Attitude File	XML		Attitude file, derived from the Ancillary Data.
DIMAP Metadata	XML		DIMAP Metadata File
Acq Metadata	XML	-	Acquisition metadata file (e.g. see GMES optical acquisition report xml format): • Product name • Acquisition station. • Sensing period • Platform name • Instrument name • Sensor name • Target footprint (crude geolocation) • Instrument configuration, • etc.
QA Metadata	XML	-	L0R Scene Metadata, as follows: • Percentage of invalid points. • Percentage of saturated pixels.
Report	XML	-	Processor execution report.
		744 MB	

5.4. [ICD-L1A] L1A Product

The L1A product contains calibrated radiances. The L1A product is an intermediate product not archived by default.

Table 15: L1A Product Contents

File	Format	Size	Contents
Manifest	XML	-	List of files
PAN Images	TIFF (float) (2 files)	2 x 297 = 595 MB	Panchromatic images, one for each sensor. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file.
MS Images	TIFF (float) (8 files)	8 x 18 = 149 MB	Multispectral images, 2 sensors x 4 bands = 8 images. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file.
EE Header	XML		Earth Explorer Header File
Orbit File	XML		Orbit file (from flight-dynamics if available, from ancillary data if not)
Attitude File	XML		Attitude file (from flight-dynamics if available, from ancillary data if not)
DIMAP Metadata	XML		DIMAP Metadata File
Acq Metadata	XML		Updated acquisition metadata file (e.g. see GMES optical acquisition report xml format).
QA Metadata	XML	-	L1A Metadata, as follows: • L0R Metadata (as above). • L1A Metadata: ○ Stripping assessment. ○ Percentage of clouds pixels and thresholds used for this estimate. ○ Denoising filter configuration. ○ Deconvolution filter configuration.
Report	XML	-	Processor execution report.
		744 MB	

5.5. [ICD-L1BR] L1B-R1 Product

This product contains calibrated radiances that are band-registered, with the pixel classification masks and the browse products. It also contains geolocation data but not applied to the image data.

Table 16: L1B-R1 Product Contents

File	Format	Size	Contents
Manifest	XML	-	List of files
PAN Images	TIFF (float) (2 files)	2 x 297 = 595 MB	Panchromatic images, one for each sensor. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Identical to L1A_PAN_1 and L1A_PAN_2.
MS Images	TIFF (float) (8 files)	8 x 18 = 149 MB	Multispectral images, 2 sensors x 4 bands = 8 images. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Identical to L1A_MS images.
Browse Product	JPEG (1 file)	-	Browse product, generated from the MS images, combining both sensors.
Pixel Mask	TIFF (char) (2 files)	18 MB	Pixel classification mask, where each point corresponds to a point in the MS images. For each point, the following information is given: • Clouds. • Water. • Vegetation (several sub-classes). • Non-vegetation land.
Geolocation Grid	NetCDF (2 files)	2 x 1.45GB = 2.9GB	Geolocation Grid. This is a grid of points. Each point corresponds to a point in the PAN image. For each point the following information is given. • Latitude (4 bytes) • Longitude (4 bytes) • Altitude (2 bytes) Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes.

Geometry	NetCDF (2 files)	2 x 2.3 GB = 4.65 GB	This is a grid of points, where each point corresponds to a point in the PAN image. For each point the following information is given. • Solar zenith angle • Solar azimuth angle • Satellite zenith angle • Satellite azimuth angle Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes. A scalar variable will be also included containing the Solar path at mid-product time.
Registration	XML (2 files)		These files contain the geometric transformation to be applied to the pixels of the multispectral bands to register them with those in the PAN image. There will be one geometric transformation for each band different than PAN. Each transformation will be modelled and defined in terms of a number of coefficients. The number of coefficients depends on the geometric model used for the transformation (affine, TPS, polynomial…). The geometric model is also specified in this file. This file also contains a flag indicating if the transformation coefficients apply at PAN resolution or multispectral resolution.
EE Header	XML		Earth Explorer Header File
Orbit File	XML		Orbit file
Attitude File	XML		Attitude file
DIMAP Metadata	XML		DIMAP Metadata File
Acquisition Metadata	XML	-	Updated acquisition metadata file (e.g. see GMES optical acquisition report xml format).

QA Metadata	XML	-	L1B Metadata, as follows:
			• L0 Metadata (as above).
			• L1A Metadata (as above).
			• L1B Metadata:
			  ○ Pixel classification statistics.
			  ○ Geolocation statistics.

Report	XML	-	Processor execution report.

		8.3 GB	Can be reduced if grid and/or angles are subsampled.

5.6. [ICD-L1BG] L1B-G Product

This is the L1B-R1 product resampled to a UTM grid. It is optional to use a Digital Elevation Model (DEM) to obtain an altitude grid. In that case the product is named "L1B-G". During the resampling to UTM, the images from the two sensors are merged. Orphan pixels are the pixels (radiance, sensor and detector information) that were discarded during the resampling. Most of the orphan pixels will be from the overlapping area of the two sensors. With the orphan information, it is possible to re-generate the L1B-R1 product from the L1B-G.

Table 17: L1B-G Product Contents

File Name	Format	Size	Contents
Manifest	XML	-	List of files
PAN Image	TIFF (float) (1 file)	TBD	Resampled panchromatic image. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. The image contains information from both sensors, projected in a UTM frame.
MS Images	TIFF (float) (4 files)	TBD	Resampled multispectral images, 2 sensors x 4 bands = 8 images. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Each image contains information from both sensors, projected in a UTM frame.
Browse Product	JPEG (1 file)	-	Browse product, generated from the MS images.
Pixel Mask	TIFF (char) (1 file)	TBD	Resampled pixel classification mask, in MS resolution, identifying: • Clouds. • Water. • Vegetation (several sub-classes). • Non-vegetation land.
Regrid files	NetCDF (5 files)	TBD	Regridding file. One file per band. For each pixel: • Scan number. • Detector + Pixel number. Filled pixels and no-data pixels are identified by special codes.

Orphan files	NetCDF (5 files)	TBD	List of orphan pixels. One file per band. For each pixel: • Scan number. • Detector + Pixel number. • Radiance values.
Geometry	NetCDF (1 file)	TBD	Resampled angles. This is a grid of points, where each point corresponds to a point in the PAN image. For each point the following information is given. • Solar zenith angle • Solar azimuth angle • Solar path length • Satellite zenith angle • Satellite azimuth angle • Satellite path length Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes.
EE Header	XML		Earth Explorer Header File
Orbit File	XML		Orbit file
Attitude File	XML		Attitude file
DIMAP Metadata	XML		DIMAP Metadata File
Acquisition Metadata	XML	-	Updated acquisition metadata file (e.g. see GMES optical acquisition report xml format).
QA Metadata	XML	-	L1B Metadata, as follows: • L0 Metadata (as above). • L1A Metadata (as above). • L1B-R1 Metadata (as above). • L1B-G Metadata: ○ Resampling statistics.
Report	XML	-	Processor execution report.
		TBD GB	Can be reduced if grid and/or angles are subsampled.

5.7. [ICD-L1CR] L1C-R2 and L1C-R3 Products

This product is similar to the L1B-R1 product. The only difference is that the geolocation data is extracted from the ortho-rectification module, which uses ground control points from a reference image instead of a blind algorithm.

The difference between L1C-R2 and L1C-R3 is that the former is generated by the automatic chain, and the latter is generated by the manual chain.

Table 18: L1C-R2 Product Contents

File Name	Format	Size	Contents
Manifest	XML	-	List of files
PAN Image	TIFF (float) (2 files)	2 x 297 = 595 MB	Panchromatic images, one for each sensor. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Identical to L1A_PAN_1 and L1A_PAN_2.
MS Image	TIFF (float) (8 files)	8 x 18 = 149 MB	Multispectral images, 2 sensors x 4 bands = 8 images. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Identical to L1A_MS images.
Browse Product	JPEG (1 files)	-	Browse product, generated from the MS images.
Pixel Mask	TIFF (char) (2 files)	18 MB	Pixel classification mask, where each point corresponds to a point in the MS image. For each point, the following information is given: • Clouds. • Water. • Vegetation (several sub-classes). • Non-vegetation land.
Geolocation Grid	NetCDF (2 files)	2 x 1.45GB = 2.9GM	Geolocation Grid. This is a grid of points. Each point corresponds to a point in the PAN image. For each point the following information is given. • Latitude (4 bytes) • Longitude (4 bytes), • Altitude (2 bytes). Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes.

Ground Control Points	NetCDF (2 files)	-	List of ground control points computed. For each tie point, the following information is given: • Row, in the PAN image. • Column, in the PAN image. • Latitude (4 bytes) • Longitude (4 bytes), In addition, the following general information is given: • File name of the reference file used to extract the real latitude and longitudes listed above.
Geometry	NetCDF (2 files)	2 x 2.3 GB = 4.65 GB	This is a grid of points, where each point corresponds to a point in the PAN image. For each point the following information is given. • Solar zenith angle • Solar azimuth angle • Satellite zenith angle • Satellite azimuth angle Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes. A scalar variable will be also included containing the Solar path at mid-product time.
Registration	XML		These files contain the geometric transformation to be applied to the pixels of the multispectral bands to register them with those in the PAN image. There will be one geometric transformation for each band different than PAN. Each transformation will be modelled and defined in terms of a number of coefficients. The number of coefficients depends on the geometric model used for the transformation (affine, TPS, polynomial…). The geometric model is also specified in this file. This file also contains a flag indicating if the transformation coefficients apply at PAN resolution or multispectral resolution.
EE Header	XML	-	Earth Explorer Header File
Orbit File	XML		Orbit file
Attitude File	XML		Attitude file
DIMAP Metadata	XML	-	DIMAP Metadata File

Acq Metadata	XML	-	Updated acquisition metadata file (e.g. see GMES optical acquisition report xml format).
QA Metadata	XML	-	L1B Metadata, as follows: • L0 Metadata (as above). • L1A Metadata (as above). • L1B Metadata (as above). • L1C Metadata: ○ Geolocation statistics.
Report	XML	-	Processor execution report.
		8.3 GB	Can be reduced if grid and/or angles are subsampled.

5.8. [ICD-L1CT] L1C-T1 and L1C-T2 Product

This is the L1C-R2 product resampled to a UTM grid. During the resampling to UTM, the images from the two sensors are merged. Orphan pixels are the pixels (radiance, sensor and detector information) that were discarded during the resampling. Most of the orphan pixels will be from the overlapping area of the two sensors. With the orphan information, it is possible to re-generate the L1C-R2 product from the L1C-T.

The difference between L1C-T1 and L1C-T2 is that the former is generated by the automatic chain, and the latter is generated by the manual chain.

Table 19: L1C-T Product Contents

File Name	Format	Size	Contents
Manifest	XML	-	List of files
PAN Image	TIFF (float) (1 file)	TBD	Resampled panchromatic image. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. The image contains information from both sensors, projected in a UTM frame.
MS Images	TIFF (float) (4 files)	TBD	Resampled multispectral images. Given in units of radiances. Radiance = ushort * scale + offset Where scale and offset are attributes of the file. Each image contains information from both sensors, projected in a UTM frame.
Browse Product	JPEG (1 file)	-	Browse product, generated from the MS images.

Pixel Mask	TIFF (char) (1 file)	TBD	Resampled pixel classification mask, where each point corresponds to a point in the MS image. For each point, the following information is given: • Clouds. • Water. • Vegetation (several sub-classes). • Non-vegetation land.
Regrid file	NetCDF (5 files)	TBD	Regridding files. One file per band. For each pixel: • Scan number. • Detector + Pixel number. Filled pixels and no-data pixels are identified by special codes.
Orphan files	NetCDF (5 files)	TBD	List of orphan pixels. One file per band. For each pixel: • Scan number. • Detector + Pixel number. • Radiance values.
Geometry	NetCDF (1 file)	TBD	Resampled angles. This is a grid of points. Each point corresponds to a point in the PAN image. For each point the following information is given. • Solar zenith angle • Solar azimuth angle • Solar path length • Satellite zenith angle • Satellite azimuth angle • Satellite path length Note: this file can be down-sampled. The file will carry the down-sampling information in the global attributes.
EE Header	XML	-	Earth Explorer Header File
Orbit File	XML		Orbit file
Attitude File	XML		Attitude file
DIMAP Metadata	XML	-	DIMAP Metadata File
Acq Metadata	XML	-	Updated acquisition metadata file (e.g. see GMES optical acquisition report xml format).

QA Metadata	XML	-	L1B Metadata, as follows: • L0 Metadata (as above). • L1A Metadata (as above). • L1B Metadata (as above). • L1C Metadata (as above). • L1C-T Metadata: ○ Resampling statistics.
Report	XML	-	Processor execution report.
		TBD GB	Can be reduced if grid and/or angles are subsampled.

5.9. [ICD-LOG] Logs

The format of the log files is described in the [M&C ICD].

6. FILE TYPES

6.1. Sector File

Level 0 Products are extracted from Transfer Frames in the form of Source Packets. There are two kinds of Source Packets: Image Units and Ancillary Data. Image Units and Ancillary Data are binary data with their own format as described in Satellite to Ground Station ICD. The Image Units and Ancillary Data are stored consecutively to form a Sector File. Each Sector File contains 655 Image Units, followed by an Ancillary Data Unit at the end. The Image Units contained in the Sector File are stored compressed as they come from the satellite. The Ancillary Data is also stored as it comes from the satellite. The size of the Image Units and Ancillary Data Units is not fixed, neither is known in advance. To be able to identify the contents of the Sector File, the Metadata File of the Level 0 contains a map of the Sector File with the details of the Image Units and Ancillary Data forming the Sector.

The Sector Files that are part from the same acquisition are stored together in the same L0 Product. There can be up to 512 Sectors in an L0 Product. The name of the Sector File contains an identifier of the Sector number.

The format of the L0_sector file is as follows:

Annotation Header	CCSDS ISP Header	ISP #1	…	Annotation Header	CCSDS ISP Header	ISP #655	Annotations Header	CCSDS ISP Header	Ancillary ISP

Figure 1: Sector File Format

The annotation header contains the following fields. Note that all statistics are for the ISP to which the header applies.

Table 20: L0 Annotations Header

Size (bytes)	Type	Units	Description	Source
16	long[2]	s and ms since ref epoch 1970	Downlink time of the first Transfer Frame (TF).	CORTEX
4	float	dB	Average SNR for valid TFs.	CORTEX
4	float	dB	Average SNR for invalid TFs.	CORTEX
2	ushort	#	Number of TFs received.	L0 decoder
2	ushort	#	Number of TFs missing.	L0 decoder
2	ushort	#	Number of TFs with unrecoverable RS errors.	CORTEX
2	ushort	#	Number of TFs with no RS errors.	CORTEX
2	ushort	#	Total errors fixed by RS.	CORTEX
2	ushort	#	Number of AES blocks lost to errors	L0 decoder

The Source packets follow the satellite to ground station ICD [AD2]:

Table 21: Instrument Source Packet

Size (bytes)	Type	Units	Description	Source
2	Byte[2]	-	CCSDS Packet Identification	Added by L0 decoder
2	Byte[2]	-	CCSDS Packer Sequence Count	Added by L0 decoder
2	Byte[2]	-	CCSDS Packet length	Added by L0 decoder
4	Byte[4]	-	Star of Sequence Marker: 0xFF02FF03	ISP
2	ushort	#	Sector Count: 0-511	ISP
2	ushort	#	ISP Count: 0 – 655 (655 = Ancillary ISP)	ISP
4	bitmap	bool	Bit[0]: compression flag (0: compressed)	ISP
var	bytes[var]	-	Image Data Field / Ancillary packet	ISP

6.2. Manifest File

This file contains the list of files contained in the product. The high level structure of the file is shown in the next table.

Table 22: Manifest File XML Structure

Field	Contents	Source	Filled in Product
<Manifest_File>			
<List_Of_Data_Objects>			
<Data_Object_Descriptor>	*See below*		
<Content>	*See below*	Internal	All
<Filename>	*See below*	Internal	All
<File_Format>	*See below*	Internal	All
<Type>	*See below*	Internal	All
<Size>	*See below*	Internal	All
<CRC>	*See below*	Internal	All
</Data_Object_Descriptor>			
</List_Of_Data_Objects>			
</Manifest_File>			

The list of data objects contains a list of all the files in the product, as follows:

- "Content" is a description of the file, such as:
  - "Sensor 1 Digital Numbers"
  - "Sensor 2 Calibrated Radiances"

- "Resampled Image in UTM"
- Etc.

- "Format" is one of:
  - XML
  - TIFF
  - JPEG
  - NETCDF
- "Type" is M for image data (Measurements) and A for annotations metadata.
- The size is in kilobytes (units of 1024 bytes).
- "CRC" is a checksum calculated on the file. It will be computed using the UNIX command "cksum".

6.3. Image Files

From Level 1A, and onwards, binary data is encoded in TIFF format. TIFF is a flexible, adaptable file format for handling images and data within a single file, by including the header tags (size, definition, image-data arrangement, applied image compression) defining the image's geometry.

Images are augmented with georeferencing information embedded within the TIFF file using GeoTIFF domain metadata standard. The additional information includes map projection, coordinate systems and everything obtained from the geolocation processors either in Level 1A, 1B or 1C.

6.4. Browse Products

Browse products are given in plain JPEG format.

6.5. Pixel Mask

Pixel Masks are given in TIFF format. The resolution is that of the MS images. Each pixel in the image is encoded as a single byte. The possible values are described in the next table. Note that if the pixel is cloudy, the mask value is 0xFF (255).

Table 23: Pixel Mask Enumeration

Bits	Description
0-1	Cloud cover. Possible Values: 0: No Clouds 1: Probably Clouds 2: <not used> 3: Clouds
2-3	Vegetation Index. Possible Values: 0: No Vegetation 1: Light Vegetation 2: <not used> 3: Heavy Vegetation OR Clouds

Bits	Description
4-5	Water Index. Possible Values: 0: No Water 1: Possible Water 2: <Not used> 3: Water OR Clouds
6-7	0: No clouds 1: <Not used> 2: <Not used> 3: Clouds

6.6. Geolocation Grid

The Geolocation is a 2D grid of points, where each point corresponds to a pixel of the original (unresampled) PAN image. For each point the following information is given.

- Latitude
- Longitude
- Altitude

Note: this file can be down-sampled (TBD). The file will carry the down-sampling information in the global attributes.

The format is NETCDF according to the following structure.

Table 24: Geolocation Grid Structure

Item	Label	Description
Dimension	N_ROWS	Number of rows
Dimension	N_COLS	Number of cols
Global Attribute	SUBSAMPLING	Subsampling factor, so that rows in the image is equal to N_ROWS/SUBSAMPLING.
Variable	int latitude (N_ROWS, NCOLS)	Latitude of point, in degrees
Variable Attribute	int _FillValue	-2^31
Variable Attribute	long_name	"latitude of detector FOV centre on the earth surface"
Variable Attribute	standard_name	"latitude"
Variable Attribute	units	"degrees_north"
Variable Attribute	float scale_factor	1E-6
Variable Attribute	float add_offset	0
Variable Attribute	int valid_min	-90,000,000

Item	Label	Description
Variable Attribute	int valid_max	90,000,000
Variable	int longitude (N_ROWS, NCOLS)	Longitude of point, in degrees
Variable Attribute	int _FillValue	-2^31
Variable Attribute	long_name	"longitude of detector FOV centre on the earth surface"
Variable Attribute	standard_name	"longitude"
Variable Attribute	units	"degrees_east"
Variable Attribute	float scale_factor	1E-6
Variable Attribute	float add_offset	0
Variable Attribute	int valid_min	-180,000,000
Variable Attribute	int valid_max	180,000,000
Variable	short elevation (N_ROWS, NCOLS)	Elevation of point, in meters
Variable Attribute	short _FillValue	NaN
Variable Attribute	long_name	"surface elevation of detector FOV above reference elipsoid"
Variable Attribute	standard_name	"surface_altitude"
Variable Attribute	units	"m"
Variable Attribute	float scale_factor	1E-1
Variable Attribute	float add_offset	0.0
Variable Attribute	short valid_min	-10,000
Variable Attribute	short valid_max	10,000

6.7. Tie Points File

XML file with the list of tie points computed during the ortho-rectification. The format is as follows:

Table 25: Tie Points file structure

Field	Contents
<TP_File>	*ProductFileName*.HDR

<Reference_File>	File Name of the reference file
<Num_TPs>	Number of Tie Points in this file
<TP_List>	
<TP>	
<row>	Row in the PAN image
<column>	Column in the PAN image
<latitude>	Latitude of the TP
<longitude>	Longitude of the TP
</TP>	
…	…
<TP_List>	
</TP_File>	

6.8. Geometry File

This file contains the observation and solar angles. Each point in the file corresponds to a point in the PAN image. If the PAN image is resampled, the observation grid is also resampled, so the correspondence is always 1-to-1. For each point the following information is given.

- Solar zenith angle.
- Solar azimuth angle.
- Satellite zenith angle.
- Satellite azimuth angle.

Note: this file can be down-sampled (TBD). The file will carry the down-sampling information in the global attributes.

A scalar variable will be also included containing the Solar path at mid-product time.

The format is NETCDF according to the following structure.

Table 26: Geometry File Structure

Item	Label	Description
Dimension	N_ROWS	Number of rows
Dimension	N_COLS	Number of cols
Global Attribute	N_PIXELS_PER_DETECTOR	Number of pixels in each detector array.
Global Attribute	SUBSAMPLING	Subsampling factor, so that rows in the image is equal to N_ROWS/SUBSAMPLING.
Global Attribute	SOLAR_PATH	Distance from sun to surface at mid-product time (m)
Variable	float solar_zenith (N_ROWS, N_COLS)	Solar zenith angle, in degrees.
Variable Attribute	float _FillValue	NaN
Variable Attribute	long_name	"Solar Zenith Angle"

Item	Label	Description
Variable Attribute	standard_name	"solar_zenith_angle"
Variable Attribute	units	"degree"
Variable	float solar_azimuth (N_ROWS, N_COLS)	Solar azimuth angle, in degrees.
Variable Attribute	float _FillValue	NaN
Variable Attribute	long_name	"Solar Azimuth Angle"
Variable Attribute	standard_name	"solar_azimuth_angle"
Variable Attribute	units	"degree"
Variable	float sat_zenith (N_ROWS, N_COLS)	Satellite zenith angle, in degrees.
Variable Attribute	float _FillValue	NaN
Variable Attribute	long_name	"Satellite Azimuth Angle"
Variable Attribute	standard_name	"azimuth_angle"
Variable Attribute	units	"degree"
Variable	float sza(N_ROWS, N_COLS)	Solar zenith angle, in degrees.
Variable Attribute	float _FillValue	NaN
Variable Attribute	long_name	"Satellite Zenith Angle"
Variable Attribute	standard_name	"zenith_angle"
Variable Attribute	units	"degree"

6.9. Regrid File

This file contains the result of the regridding. There are five files, one for each band. For each pixel in the resampled image, the following data fields are provided.

- Scan number.
- Detector + Pixel number.

Filled pixels and no-data pixels are identified by special codes.

The file is in NETCDF format, according to the following structure:

Table 27: Regrid File Structure

Item	Label	Description
Dimension	N_ROWS	Number of rows in the image
Dimension	N_COLS	Number of cols in the image
Global Attribute	N_PIXELS_PER_DETECTOR	Number of pixels in the detectors
Variable	ushort scan(N_ROWS, NCOLS)	Scan number. For non-natural pixels, the fill value below is used.
Variable Attribute	ushort _FillValue	0xFFFF
Variable	ushort pixel(N_ROWS, NCOLS)	For pixels in detector 0: • Pixel number For pixels in detector 1: • N_PIXELS_PER_DETECTOR + Pixel number For non-natural pixels, the fill value below is used.
Variable Attribute	ushort _FillValue	0xFFFF

6.10. Orphan File

This file contains a list of the pixels discarded during the regridding process.

- Scan number.
- Detector + Pixel number.
- Radiance Value.

Radiance values, Filled pixels and no-data pixels are identified by special codes.

The file is in NETCDF format, according to the following structure:

Table 28: Regrid File Structure

Item	Label	Description
Dimension	N_ORPHANS	Number of orphan pixels
Global Attribute	N_PIXELS_PER_DETECTOR	Number of pixels in each detector.
Variable	ushort scan(N_ORPHANS)	Scan number. For non-natural pixels, the fill value below is used.
Variable Attribute	ushort _FillValue	0xFFFF

Item	Label	Description
Variable	ushort pixel(N_ORPHANS)	For pixels in detector 0: • Pixel number For pixels in detector 1: • N_PIXELS_PER_DETECTOR + Pixel number For non-natural pixels, the fill value below is used.
Variable Attribute	ushort _FillValue	0xFFFF
Variable	ushort R(N_ROWS, NCOLS)	Radiance = R x scale_factor + add_offset
Variable Attribute	ushort _FillValue	0xFFFF
Variable Attribute	scale_factor	Encoding scale factor.
Variable Attribute	add_offset	Encoding offset.

6.11. Telemetry Report

This XML metadata file contains telemetry statistics for each of the ISPs in the sector. The telemetry report must include an entry for each of the 656 ISPs. If an ISP is missing, the entry shall be present but with empty values.

The structure of the file is shown in the following table.

Table 29: Telemetry Report Structure

Field	Contents
<TM_Report>	
<Number_Of_ISPs>	656
<Number_Of_ISPs_Lost_to_Errors>	*Number of ISPs lost to errors.*
<List_Of_ISPs>	
<ISP>	
<Downlink_time_1st_TF>	*Downlink date/time of the 1st TF: UTC=yyyy-mm-ddThh:mm:ss*
<Downlink_time_last_TF>	*Downlink date/time of the last TF: UTC=yyyy-mm-ddThh:mm:ss*
<Average_SNR_for_valid_TFs>	*Average SNR for valid TFs.*
<Average_SNR_for_invalid_TFs>	*Average SNR for invalid TFs.*
<TFs_received>	*Number of TFs received.*
<TFs_lost>	*Number of TFs lost to errors.*
<TFs_missing>	*Number of TFs missing.*
<TFs_with_unrecoverable_RS_errors>	*Number of TFs with unrecoverable RS errors.*

Field	Contents
<TFs_with_no _RS_errors>	*Number of TFs with no RS errors.*
<TFs with_recovered_RS_errors>	*Number of errors fixed by RS.*
<TFs_with_unrecoverable_RS_errors>	*Number of ISPs contained in the sector file.*
	Number of ISPs lost to errors.
</ISP>	
…	
</List_Of_ISPs>	
</TM_Report>	

6.12. QA Metadata File

Table 30: QA Metadata File Structure

Field	Contents	Source	Filled in Product
<QA_Metadata>			
<L0>			
<invalid_pixels_BLUE1>	% of invalid points, BLUE band, sensor 1	Internal	L0R
<saturated_pixels_BLUE1>	% of saturated pixels, BLUE band, sensor 1	Internal	L0R
<invalid_pixels_GREEN1>	% of invalid points, GREEN band, sensor 1	Internal	L0R
<saturated_pixels_GREEN1>	% of saturated pixels, GREEN band, sensor 1	Internal	L0R
<invalid_pixels_RED1>	% of invalid points, RED band, sensor 1	Internal	L0R
<saturated_pixels_RED1>	% of saturated pixels, RED band, sensor 1	Internal	L0R
<invalid_pixels_NIR1>	% of invalid points, NIR band, sensor 1	Internal	L0R
<saturated_pixels_NIR1>	% of saturated pixels, NIR band, sensor 1	Internal	L0R
<invalid_pixels_PAN1>	% of invalid points, PAN band, sensor 1	Internal	L0R
<saturated_pixels_PAN1>	% of saturated pixels, PAN band, sensor 1	Internal	L0R
<invalid_pixels_BLUE2>	% of invalid points, BLUE band, sensor 2	Internal	L0R
<saturated_pixels_BLUE2>	% of saturated pixels, BLUE band, sensor 2	Internal	L0R
<invalid_pixels_GREEN2>	% of invalid points, GREEN band, sensor 2	Internal	L0R
<saturated_pixels_GREEN2>	% of saturated pixels, GREEN band, sensor 2	Internal	L0R
<invalid_pixels_RED2>	% of invalid points, RED band, sensor 2	Internal	L0R
<saturated_pixels_RED2>	% of saturated pixels, RED band, sensor 2	Internal	L0R
<invalid_pixels_NIR2>	% of invalid points, NIR band, sensor 2	Internal	L0R
<saturated_pixels_NIR2>	% of saturated pixels, NIR band, sensor 2	Internal	L0R
<invalid_pixels_PAN2>	% of invalid points, PAN band, sensor 2	Internal	L0R
<saturated_pixels_PAN2>	% of saturated pixels, PAN band, sensor 2	Internal	L0R

Field	Contents	Source	Filled in Product
</L0>			
<Radiomety>			
<stripping_BLUE1>	Stripping quality figure (TBD).	Internal	L1A
<stripping_GREEN1>	Stripping quality figure (TBD).	Internal	L1A
<stripping_RED1>	Stripping quality figure (TBD).	Internal	L1A
<stripping_PAN1>	Stripping quality figure (TBD).	Internal	L1A
<stripping_BLUE2>	Stripping quality figure (TBD).	Internal	L1A
<stripping_GREEN2>	Stripping quality figure (TBD).	Internal	L1A
<stripping_RED2>	Stripping quality figure (TBD).	Internal	L1A
<stripping_PAN2>	Stripping quality figure (TBD).	Internal	L1A
<cloud_blue_threshold>	If blue reflectance < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_red_threshold>	If red reflectance < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_green_threshold>	If green reflectance < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_nir_threshold>	If nir reflectance < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_red_nir_threshold>	If (red/nir) < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_green_nir_threshold>	If (green/nir) < threshold, pixel is not cloudy	Internal	L1A, L1B
<cloud_red_nir_2_threshold>	If (nir+red)/(nir-red) > threshold, pixel is not cloudy	Internal	L1A, L1B
<vegetation_threshold>	Threshold of the vegetation index to consider a pixels “with vegetation”.	Internal	L1B
<water_threshold>	Threshold of the water index to consider a pixels “with water”.	Internal	L1B
<denoising>	TRUE or FALSE		L1A
<MTF>	TRUE or FALSE		L1A
<cloud_pixels>	Percentage of clouds pixels and thresholds used for this estimate.	Internal	L1A, L1B
<vegetation_pixels>	Percentage of pixels with vegetation (low or dense).	Internal	L1B
<water_pixels>	Percentage of pixels with water.	Internal	L1B
</Radiometry>			
<Geolocation>			
	TBD	Internal	L1B, L1C
</Geolocation>			
<Resampling>			
<filled_pixels>	% of pixels cosmetically filled.	Internal	L1B, L1C

Field	Contents	Source	Filled in Product
<empty_pixels>	% of pixels empty	Internal	L1B, L1C
<natural_pixels>	% of natural pixels	Internal	L1B, L1C
</Resampling>			
</QA_Metadata>			

6.13. Earth Explorer Header File

This file is a customization of the Ground Segment File Format Standard [STD 1], in XML format. This standard is promoted by ESA to facilitate data exchanges between the Earth Explorer Missions of the Earth Observation Envelope Programme (EOEP).

The high level structure of the file is shown in the next table.

Table 31: Earth Explorer Header File High-Level Structure

```
<?xml version="1.0"?>
<Earth_Explorer_File>
  <Earth_Explorer_Header>
    <Fixed_Header>
    </Fixed_Header>
    <Variable_Header>
      <Main_Product_Header>
      </Main_Product_Header>
      <Specific_Product_Header>
      </Specific_Product_Header>
    </Variable_Header>
  </Earth_Explorer_Header>
</Earth_Explorer_File>
```

6.13.1. Fixed Header (FH)

Table 32: Earth Explorer Header File - Fixed Header

Field	Contents	Source	Filled in Product
<File_Name>	*ProductFileName*.HDR	Internal	All
<File_Description>	Deimos 2 Level *XX* Product	Internal	All
<Notes>	Elecnor Deimos Imaging. http://www.deimos-imaging.com	Fixed	L0R
<Mission>	Deimos 2	Fixed	L0R
<File_Class>	*XXXX (see below)*	Environment	All
<File_Type>	*III_XXX_LL (see below)*	Internal	All

<Validity_Period>			
<Validity_Start>	*UTC=yyyy-mm-ddThh:mm:ss (see below)*	ISPs	L0R
<Validity_Stop>	*UTC=yyyy-mm-ddThh:mm:ss (see below)*	ISPs	L0R
</Validity_Period>			
<File_Version>	0001	Fixed	L0R
<Source>			
<System>	PDGS	Fixed	L0R
<Creator>	PP	Fixed	L0R
<Creator_Version>	*PP version number (e.g. 1.0)*	Environment	L0R
<Creation_Date>	*UTC=yyyy-mm-ddThh:mm:ss*	Internal	All
</Source>			

The File Class is one of the following 4-digit words:

- AUTO: When the file is generated by the automatic chain, part of the routine operations.
- MANU: When the file is generated by the operator via the HMI.
- GSOV: When the file is generated by the automatic chain or the operator, as part of the Ground Segment Validation activities.
- CALI: When the file is part of the calibration operations (manual or automatic).
- TEST: When the file is a test, not intended for consumption/reselling.

The File Type is a 10-digit word with format III_XXX_LL, as follows:

- III indicates the instrument. In this case: DM2_.
- XXX indicates the product description:
  - OPT for the regular product.
  - STR for the stereo product (TBD).
- LL indicates the product level, which is one of:
  - 00
  - 0R
  - 1A
  - 1B
  - 1G
  - 1C
  - 1T

The Validity Start and Stop times refer to the acquisition start and stop times. The time reference is UTC, and the format is CCSDS, as follows:

- UTC= : to indicate UTC reference
- Yyyy-mm-dd : year, month and day.
- T: a capital "T"
- Hh:mm:ss: hours, minutes, seconds.

6.13.2. Variable Header – Main Product Header (MPH)

Table 33: Earth Explorer Header File – Variable Header MPH

Field	Contents	Source	Filled in Product
<Product_Name>	*XXX_LL (see File_Type in the FH)*	Internal	All
<Sensor_Name>	DEIMOS2	Fixed	L0R
<Platform>	DM2	Fixed	L0R
<Processing_Stage>	*LL (see File_Type in the FH)*	Internal	All
<References>			
<Prod_Def_Ref>	Deimos 2 Product Processors Interface Control Document, Issue 1.A	Fixed	L0R
<ATBD_Ref>	Deimos 2 Product Processors Design File, Issue 1.A	Fixed	L0R
</References>			
<Processing_Centre>	Madrid *or* Valladolid *or* Puertollano *or* Unknown	Environment	All
<Processing_Time>	*Same as Creation_Date in FH*	Internal	All
<PAN1_acquisition>		Ancill. ISP	
Start_Time	*Acquisition start time, with microseconds:* *UTC=yyyy-mm-ddThh:mm:ss.uuuuuu*	Ancill. ISP	L0R
Stop_Time	*Acquisition stop time, with microseconds:* *UTC=yyyy-mm-ddThh:mm:ss.uuuuuu* *Should be equal to start time + line rate * number of lines*	Ancill. ISP	L0R
Line Rate	TDI line rate	Ancill. ISP	L0R
TDI Step	TDI step	Ancill. ISP	L0R
First Sector	Sector number of the first ISP	Ancill. ISP	L0R
Gain	ADC Gain	Ancill. ISP	L0R
Offset	ADC Offset	Ancill. ISP	L0R
</PAN1_Acquisition>			
…	Repeat the acquisition structure for each band/sensor combination: PAN2, RED1, RED2, GREEN1, GREEN2, BLUE1, BLUE2, NIR1, NIR2.		
<Orbit_Description>			
<Phase>	A *for Commisioning* B *for Operations*	Environment	
<Cycle>	*Orbit Cycle Number*	Orbit File	L0R
<Relative_Orbit>	*Relative Orbit Number*	Orbit File	L0R
<Absolute_Orbit>	*Absolute Orbit Number*	Orbit File	L0R

Field	Contents	Source	Filled in Product
<Vector_Source>	*One of the following two digit codes:* OB: *on-board* FP: *FOS predicted* FR: *FOS restituted*	Orbit File	L0R
<State_Vector_Time>	*UTC Time at Orbit ANX* *UTC=yyyy-mm-ddThh:mm:ss.uuuuuu*	Orbit File	L0R
<Position_X>	X pos at ANX in ECEF	Orbit File	L0R
<Position_Y>	Y pos at ANX in ECEF	Orbit File	L0R
<Position_Z>	Z pos at ANX in ECEF	Orbit File	L0R
<Velocity_X>	X vel at ANX in ECEF	Orbit File	L0R
<Velocity_Y>	Y vel at ANX in ECEF	Orbit File	L0R
<Velocity_Z>	Z vel at ANX in ECEF	Orbit File	L0R
<Leap_Second>			
<Leap_Ocurrence>	Time of occurrence of the leap second. *UTC=yyyy-mm-ddThh:mm:ss.uuuuuu*	Orbit File	L0R
<Leap_Sign>	+1 *or* -1	Orbit File	L0R
<Leap_Error>	1 *if leap second occurs within segment* 0 *otherwise*	Internal	L0R
</Leap_Second>			
</Orbit_Description>			
<Data_Error_Flag>	1 *if there is at least one data error in the product* 0 *otherwise*		
<History>	*Processing log (See below).*	Internal	All
<Processor_Version_ID>	VV.VV 5 digits *version of the level processor. For example: 01.01*	Internal	All
<Format_Version_ID>	FFF *3 digits version of the ICD on which this product is based. For e.g. 1.A (same issue number as in field <Prod_Def_Ref>).*	Internal	All

The History field contains a list of processing steps (separated by newlines) through which the product has passed. Each processor must add one line to this field, with the following information: "TIME: Processor ID, Processor Version" (the TIME reference and format is unspecified, for e.g. it can be local time).

6.13.3. Variable Header – Specific Product Header (SPH)

Table 34: Earth Explorer Header File – Variable Header MPH

Field	Contents	Source	Filled in Product
<SPH_Descriptor>	*XXX_LL (see product name field in MPH) followed by* the words "Specific Header". *For example:* *OPT_1A Specific Header*	Internal	All
<Product_Title>	DEIMOS-2 Level *LL* Product	Internal	All
<Product_Time_Frame>	Single Scene	Fixed	L0R
<Parameter_Name>	*One of:* • TOA Digital Numbers • TOA Calibrated Radiances	Internal	L0R L1A
<Positioning_Information>			
<Top_Left>			
<Top_Left_Lat>	*Latitude of top-left pixel. In a resampled image, this refers to the top-left pixel of the original, unresampled image. This comment applies to all the fields in this structure.*	Geolocation	All
<Top_Left_Lon>	*Longitude of top-left pixel*	Geolocation	All
</Top_Left>			
<Top_Right>			
<Top_Right_Lat>	Latitude of top-right pixel.	Geolocation	All
<Top_Right_Lon>	Longitude of top-right pixel.	Geolocation	All
</Top_Right>			
<Center>			
<Center_Lat>	Latitude of center pixel.	Geolocation	All
<Center_Lon>	Longitude of center pixel.	Geolocation	All
</Center>			
<Bottom_Left>			
<Bottom_Left_Lat>	Latitude of bottom-left pixel.	Geolocation	All
<Bottom_Left_Lon>	Longitude of bottom-left pixel.	Geolocation	All
</Bottom_Left>			
<Bottom_Right>			
<Bottom_Right_Lat>	Latitude of bottom-right pixel.	Geolocation	All
<Bottom_Right_Lon>	Longitude of bottom-right pixel.	Geolocation	All
</Bottom_Right>			
<Positioning_Information>			
<List_Of_Data_Objects>			
<Data_Object_Descriptor>	*See below*		

Field	Contents	Source	Filled in Product
<Content>	*See below*	Internal	All
<Filename>	*See below*	Internal	All
<File_Format>	*See below*	Internal	All
<Type>	*See below*	Internal	All
<Size>	*See below*	Internal	All
</Data_Object_Descriptor>			
</List_Of_Data_Objects>			
<List_Of_Input_Files>			
<Filename>	*See below*	Internal	All
</List_Of_Input_Files>			
<Scans>	*Number of scan lines contained in the file (including empty lines)*	Internal	L0R
<Summary_Quality_Annotation>			
<Quality_Flags>			
TBD			
</Quality_Flags>			
<Quality_Stat>			
TBD			
</Quality_Stat>			
</Summary_Quality_Annotation>			

The list of data objects contains a list of all the files in the product, as follows:

- "Content" is a description of the file, such as:
  - "Sensor 1 Digital Numbers"
  - "Sendor 2 Calibrated Radiances"
  - "Resampled Image in UTM"
  - Etc.
- "Format" is one of:
  - XML
  - TIFF
  - JPEG
  - NETCDF
- "Type" is M for image data (Measurements) and A for annotations metadata.
- The size is in kilobytes.

6.14. DIMAP

This file is according to the standard interface DIMAP. Dimap, which is based on GIS-Geospot 4.0 and GISimage 1.1, is a standard to describe any geographic information data contents. It proposes a set of well-defined keywords to deliver the metadata.

The high level structure of the Deimos-2 DIMAP metadata file is shown in the next table.

Table 35: DIMAP Metadata File High-Level Structure

```
<Dimap_Document xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <Metadata_Id>
    </Metadata_Id>
    <Dataset_Id>
    </Dataset_Id>
    <Production>
    </Production>
    <Data_Processing>
    </Data_Processing>
    <Coordinate_Reference_System>
    </Coordinate_Reference_System>
    <Dataset_Frame>
    </Dataset_Frame>
    <Geoposition>
    </Geoposition>
    <Raster_CS>
    </Raster_CS>
    <Raster_Encoding>
    </Raster_Encoding>
    <Raster_Dimension>
    </Raster_Dimension>
    <Data_Access>
    </Data_Access>
    <Image_Interpretation>
    </Image_Interpretation>
    <Image_Display>
    </Image_Display>
    <Dataset_Sources>
    </Dataset_Sources>
</Dimap_Document>
```

The contents of each of the metadata fields are described in the next table:

Table 36: DIMAP Metadata File

Field	Contents	Source	Filled in Product
<Metadata_Id>			
<METADATA_FORMAT version="1.1">	DIMAP	Fixed	All
<METADATA_PROFILE>	DCMII	Fixed	All
</Metadata_Id>			
<Dataset_Id>			
<DATASET_NAME>	*ProductName*	Internal	All
<COPYRIGHT>	*Elecnor DMC copyright notice (TBD)*	Fixed	All
</Dataset_Id>			
<Production>			
<DATASET_PRODUCER_NAME>	*Elecnor DMC*	Fixed	All
<DATASET_PRODUCER_URL>	*Elecnor DMC website*	Fixed	All
<DATASET_PRODUCTION_DATE>	*yyyy-mm-ddThh:mm:ssZ*	Internal	All
<PRODUCT_INFO>	Deimos 2 Level *XX* Product	Internal	All
<PRODUCT_TYPE>	*III_XXX_LL (see below)*	Internal	All
<JOB_ID>	*TBD*	Environment	All
</Production>			
<Data_Processing>			
<GEOMETRIC_PROCESSING>	ORTHORECTIFIED	Fixed	L1C
</Data_Processing>			
<Quality_Assessment>			
</QUALITY_TABLES>	DEIMOS2	Fixed	All
<Quality_Parameter>	*List of quality parameters (See below)*		
<QUALITY_PARAMETER_CODE>	DEIMOS2:*QQQQ*	Fixed	All
<QUALITY_PARAMETER_DESC>	*Parameter Description*	Fixed	All
<QUALITY_PARAMETER_VALUE>	*Parameter Value*	Internal	All
</Quality_Parameter>			
</Quality_Assessment>			
<Coordinate_Reference_System>			
<GEO_TABLES>	EPSG	Fixed	All
<Horizontal_CS>			
<HORIZONTAL_CS_TYPE>	PROJECTED	Fixed	All
<HORIZONTAL_CS_CODE>	EPSG:EEEE	Internal	All
<HORIZONTAL_CS_NAME>	*Name of the Horizontal Coordinate System in use.*	Internal	All
<Coordinate_Axis>			

Field	Contents	Source	Filled in Product
<AXIS1_NAME>	*X axis name.*	See below	All
<AXIS1_ORIENTATION>	*X axis orientation.*	See below	All
<AXIS2_NAME>	*Y axis name.*	See below	All
<AXIS2_ORIENTATION>	*Y axis orientation.*	See below	All
</Coordinate_Axis>			
<Geographic_CS>			
<GEOGRAPHIC_CS_CODE>	EPSG:EEEE	See below	All
<GEOGRAPHIC_CS_NAME>	*Name of the Geographic Coordinate System in use.*	See below	All
</Geographic_CS>			
<Projection>			
<PROJECTION_CODE>	EPSG:EEEE	See below	L1C-T
<PROJECTION_NAME>	*Name of the Projection being used within the Coordinate System.*	See below	L1C-T
<Projection_CT_Method>			
<PROJECTION_CT_CODE>	EPSG:EEEE	See below	L1C-T
<PROJECTION_CT_NAME>	*Name of the Projection Coordinate Transform Method being used.*	See below	L1C-T
<Projection_Parameters>	*List of Projection Parameters associated with the Coordinate Transform Method*		
<Projection_Parameter>			
<PROJECTION_PARAMETER_CODE>	EPSG:EEEE	See below	L1C-T
<PROJECTION_PARAMETER_NAME>	*Name of the Parameter.*	See below	L1C-T
<PROJECTION_PARAMETER_VALUE>	*Value of the Parameter.*	See below	L1C-T
</Projection_Parameter>			
</Projection_Parameters>			
</Projection_CT_Method>			
</Projection>			
</Horizontal_CS>			
<Dataset_Frame>	*List of vertices with the latitude and longitude of top-left, top-right, bottom-left and bottom-right pixel of the unresampled image. In a resampled image, these refer to the equivalent pixels of the unresampled image.*		
<Vertex>			

Field	Contents	Source	Filled in Product
<FRAME_X unit="XX">	*Projected X coordinate of the vertex expressed in the Projected Coordinate System described by Coordinate_Reference_System.*	Geolocation	All
<FRAME_Y unit="XX">	*Projected Y coordinate of the vertex expressed in the Projected Coordinate System described by Coordinate_Reference_System.*	Geolocation	All
<FRAME_LAT unit="XX">	*Latitude of the vertex expressed in the Geographic Coordinate System described by Coordinate_Reference_System.*	Geolocation	All
<FRAME_LON unit="XX">	*Longitude of the vertex expressed in the Geographic Coordinate System described by Coordinate_Reference_System.*	Geolocation	All
<FRAME_COL>	*Pixel column coordinate of the vertex.*	Geolocation	All
<FRAME_ROW>	*Pixel row coordinate of the vertex.*	Geolocation	All
</Vertex>			
</Dataset_Frame>			
<Geoposition>			
<Geoposition_Points>	*List of geopositioning points for unresampled images.*		
<Tie_Point>			
<TIE_POINT_CRS_X unit="XX">	*X coordinate of the tie point, expressed in the Coordinate Reference System.*	Geolocation	Unresampled L1 levels
<TIE_POINT_CRS_Y unit="XX">	*Y coordinate of the tie point, expressed in the Coordinate Reference System.*	Geolocation	Unresampled L1 levels
<TIE_POINT_DATA_X>	*Pixel column coordinate of the tie point.*	Geolocation	Unresampled L1 levels
<TIE_POINT_DATA_Y>	*Pixel row coordinate of the tie point.*	Geolocation	Unresampled L1 levels
</Tie_Point>			
</Geoposition_Points>			

Field	Contents	Source	Filled in Product
<Geoposition_Insert>	*Relationship between raster and Coordinate Reference System for resampled images.*		
<ULXMAP unit="XX">	*See below*	Geolocation	Resampled L1 Levels
<ULYMAP unit="XX">	*See below*	Geolocation	Resampled L1 Levels
<DIMX unit="XX">	*See below*	Geolocation	Resampled L1 Levels
<DIMY unit="XX">	*See below*	Geolocation	Resampled L1 Levels
</Geoposition_Insert>			
</Geoposition>			
<Raster_CS>			
<RASTER_CS_TYPE>	POINT	Fixed	All
</Raster_CS>			
<Raster_Encoding>			
<NBITS>	10	Fixed	All
<BYTEORDER>	INTEL	Fixed	All
<DATA_TYPE>	*USHORT*	Fixed	All
</Raster_Encoding>			
<Raster_Dimensions>			
<NCOLS>	*Number of columns in the raster image.*	Internal	All
<NROWS>	*Number of rows in the raster image.*	Internal	All
<NBANDS>	*Number of bands in the raster image file.*	Internal	All
</Raster_Dimensions>			
<Data_Access>			
<DATA_FILE_FORMAT>	RAW or GEOTIFF	Environment	All
<DATA_FILE_ORGANISATION>	BAND_SEPARATE	Fixed	All
<Data_File>	*One entry per file*		
<BAND_INDEX>	*Band index number (1=RED, 2=GREEN, 3=BLUE, 4=NIR, 5=PAN)*	Internal	All
<DATA_FILE_PATH href="*FilePath*">	*Data file path*	Internal	All
</Data_File>			
</Data_Access>			
<Image_Interpretation>			
<Spectral_Band_Info>	*One entry per band*		

Field	Contents	Source	Filled in Product
<BAND_INDEX>	1, 2, 3, 4 or 5	Environment	L1 levels
<BAND_DESCRIPTION>	RED, GREEN, BLUE, NIR or PAN	Environment	L1 levels
<PHYSICAL_UNIT>	*Physical measure unit for the spectral band*	Internal	L1 levels
<PHYSICAL_GAIN>	*Physical gain for the pixels in the spectral band*	Internal	L1 levels
<PHYSICAL_BIAS>	*Phisical bias for the pixels in the spectral band*	Internal	L1 levels
</Spectral_Band_Info>			
</Image_Interpretation>			
<Image_Display>			
<Band_Statistics>	*One entry per band*		
<BAND_INDEX>	1, 2, 3, 4 or 5	Internal	All
<STX_MIN>	*Minimum data value for the spectral band.*	Internal	All
<STX_MAX>	*Maximum data value for the spectral band.*	Internal	All
<STX_MEAN>	*Mean of data values for the spectral band.*	Internal	All
<STX_STDV>	*Standard deviation of data values for the spectral band.*	Internal	All
<STX_LIN_MIN>	*Recommended linear minimum stretching value for displaying the image for the spectral band.*	Internal	All
<STX_LIN_MIN>	*Recommended linear maximum stretching value for displaying the image for the spectral band.*	Internal	All
</Band_Statistics>			
</Spectral_Band_Info>			
</Image_Interpretation>			
<Dataset_Sources>			
<Source_Information>			
<SOURCE_ID>	*Input file name*	Environment	All
<SOURCE_DESC>	*Input file description*	Environment	All
<SOURCE_TYPE>	*Input file type (See below)*	Environment	All
<Quality_Assessment>	*For input files with an associated DIMAP metafile, quality assessment records shall be copied here.*	Environment	All
</Source_Information>			

Field	Contents	Source	Filled in Product
</Dataset_Sources>			

The time reference is UTC, and the format is xsd:dateTime, as follows:

- yyyy-mm-dd : year, month and day.
- T: a capital "T"
- Hh:mm:ss: hours, minutes, seconds.
- Z: a capital "Z" to indicate UTC reference.

The Product Type is a 10-digit word with format III_XXX_LL, as follows:

- III indicates the instrument. In this case: DM2_.
- XXX indicates the product description:
  - OPT for the regular product.
  - STR for the stereo product (TBD).
- LL indicates the product level, which is one of:
  - 00
  - 0R
  - 1A
  - 1B
  - 1G
  - 1C
  - 1T

The Quality Assessment record shall include Deimos 2 specific quality parameters as defined in Table 30.

The Coordinate Reference System is always identified using EPGS tables. Hence, all Coordinate Reference System codes use a namespace prefix "EPGS:" in front of the code itself. The Geographic Coordinate System and Projected Coordinate System are determined by the <HORIZONTAL_CS_CODE> field. The rest of the fields in <Horizontal_CS> are the parameters associated to the Horizontal Coordinate System in use. Refer to the EPGS documentation for the value of these parameters.

The possible values for latitude and longitude coordinates units are:

- DEG
- DMS
- MNT
- SEC
- GON
- RAD

The possible values for X and Y projected coordinates units are:

- M
- FT
- FTUS

- FTCLA
- LKCLA
- LKBEN
- CHBEN
- CHSEAR
- YDSEAR
- YDIND
- FTSEAR
- FM
- NM
- CM
- KM
- FTIND
- SFT
- DEG
- DMS
- MNT
- SEC
- GON
- RAD

For non resampled images, geopositioning is defined using a list of tie-points.

For resampled images, geopositioning is defined by insertion point using a unique point (upper-left) and dimensions of pixel cells. The relationship between raster and CRS coordinates is then the following:

```
X = <ULXMAP> + <XDIM> * i
Y = <ULYMAP> - <YDIM> * j
```

where (i,j) are floating point pixel coordinates starting from (0.0, 0.0); in the case when PIXEL_ORIGIN is set to 1, then i and j should be substracted 1.0 before the previous equations are applied. These equations are valid for standard axis orientations, they should be adapted (sign changed in front of XDIM or YDIM), should the Axis orientation are not eastwards and northwards.

The `<Spectral_Band_Info>` record provides the parameters required to compute the value of a physical measure by applying this formula to the pixel data value:

$$L = X/A + B$$

where:

- L is the resulting physical value expressed in `<PHYSICAL_UNIT>`
- X is the data value at a given pixel location as stored in the raster file (unitless).
- A is the gain (`<PHYSICAL_GAIN>`)
- B is the bias (`<PHYSICAL_BIAS>`)

The <SOURCE_TYPE> record provides the type of the input file. The possible values for this record are:

- RAW: Raw Data
- L0: L0 Product
- L1A: L1A Product
- L1B: L1B Product
- L1C: L1C Product
- REF: Reference image for orthorectification
- CFG: Configuration file
- CCDB: Calibration and characterization DB
- DEM: Digital Elevation Model

6.15. GMES Optical Acquisition Report

This file is according to the standard interface defined by ESA between the GMES Contributing Missions (GCM) and the Coordinated Data access System (CDS), to provide or update information on acquisitions of Optical products. It is defined in [STD 3]. The customization to the DEIMOS-2 mission is described next.

Table 37: GMES Optical Acquisition Report

Field	Contents	Source	Filled in Product
<?xml version="1.0" encoding="UTF-8"?>			
<gsc:report xsi:schemaLocation="http://earth.esa.int/gsc ../gsc.xsd" xmlns:gsc=http://earth.esa.int/gsc xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance xmlns:gml=http://www.opengis.net/gml xmlns:opt=http://earth.esa.int/opt xmlns:eop=http://earth.esa.int/eop xmlns:xlink=http://www.w3.org/1999/xlink version="1.4.3">			
<gsc:responsibleOrgName>	DEIMOS	Fixed	L0
<gsc:reportType>	OPTICAL_ACQUISITION	Fixed	L0
<gsc:dateTime>	Time when this report is issued, in ISO 8601 format (UTC): *YYYY-MM-DDThh:mm:ssZ*		L0
<gsc:orderReference>	N/A	Internal	L0
<gsc:opt_metadata version="1.2.1">			

Field	Contents	Source	Filled in Product
<gml:metaDataProperty>			
<eop:EarthObservationMetaData>			
<eop:identifier>	*Product name*	Internal	All
<eop:parentIdentifier>	N/A	Fixed	L0
<eop:acquisitionType>	*One of:* • NOMINAL • CALIBRATION • OTHER *(similar to the "File Class" field in the FH of the EE Header File)*	Environment	L0
<eop:productType>	*III_XXX_LL* *(identical to the "File Type" field in the FH of the EE Header File)*	Internal	L0
<eop:status>	ACQUIRED	Fixed	L0
<eop:downlinkedTo>			
<eop:DownlinkInformation>			
<eop:acquisitionStation>	*One of:* • SGS *(Svalbard)* • DE1 *(Boecillo)* • DE2 *(Puertollano)*	RAW Data file names or scenario file	L0
<eop:acquisitionDate>	*End time of the downloading, in ISO 8601 format (UTC):* *YYYY-MM-DDThh:mm:ssZ*	RAW Data file names or scenario file	L0
</eop:DownlinkInformation>			
</eop:downlinkedTo>			
<eop:imageQualityDegradation uom="%">	*Percentage of low SNR and broken detectors.*	CCDB	L0
</eop:EarthObservationMetaData>			
</gml:metaDataProperty>			
<gml:validTime>			

Field	Contents	Source	Filled in Product
<gml:TimePeriod>			
<gml:beginPosition>	*Acquisition start date time, in ISO 8601 format (UTC):* *YYYY-MM-DDThh:mm:ssZ*	RAW data or scenario file	L0
<gml:endPosition>	*Acquisition stop date time, in ISO 8601 format (UTC):* *YYYY-MM-DDThh:mm:ssZ*	RAW data or scenario file	L0
</gml:TimePeriod>			
</gml:validTime>			
<gml:using>			
<eop:EarthObservationEquipment>			
<eop:platform>			
<eop:Platform>			
<eop:shortName>	SI-300-EOS-D	Fixed	L0
<eop:serialIdentifier>	N/A	Fixed	L0
</eop:Platform>			
</eop:platform>			
<eop:instrument>			
<eop:Instrument>			
<eop:shortName>	DEIMOS2	Fixed	L0
</eop:Instrument>			
</eop:instrument>			
<eop:sensor>			
<eop:Sensor>			
<eop:sensorType>	OPTICAL	Fixed	L0
<eop:resolution uom="m">	1.04	Fixed	L0
</eop:Sensor>			
</eop:sensor>			

Field	Contents	Source	Filled in Product
<eop:acquisitionParameters>			
<opt:Acquisition>			
<eop:orbitNumber>	*Absolute Orbit Number*	Orbit File	L0
<eop:orbitDirection>	ASCENDING	Fixed	L0
<eop:acrossTrackIncidenceAngle uom="deg">	*Across-track incidence angle. (TBD. This field is optional)*	Geolocation of center point	L0R, L1B
<eop:alongTrackIncidenceAngle uom="deg">	*Along-track incidence angle. (TBD. This field is optional)*	Geolocation of center point	L0R, L1B
<opt:illuminationAzimuthAngle uom="deg">	*Solar Azimuth Angle at center.*	Geolocation of center point	L0R, L1B
<opt:illuminationElevationAngle uom="deg">	*Solar Elevation Angle at center.*	Geolocation of center point	L0R, L1B
</opt:Acquisition>			
</eop:acquisitionParameters>			
</eop:EarthObservationEquipment>			
</gml:using>			
<gml:target>			
<eop:Footprint>			
<gml:multiExtentOf>			
<gml:MultiSurface srsName="EPSG:4326">			
<gml:surfaceMembers>			
<gml:Polygon>			
<gml:exterior>			
<gml:LinearRing>			

Field	Contents	Source	Filled in Product
<gml:posList>	*Acquisition footprint coordinates, described by a closed polygon (last point=first point), using CRS:WGS84, Latitude, Longitude pairs:* *LAT-UL LON-UL LAT-UR LON-UR LAT-LR LON-LR LAT-LL LON-LL LAT-UL LON-UL* *(where UL is "upper-left" pixel, LR is "lower-right pixel", etc)*	Geolocation of corner points	L0R, L1B
</gml:LinearRing>			
</gml:exterior>			
</gml:Polygon>			
</gml:surfaceMembers>			
</gml:MultiSurface>			
</gml:multiExtentOf>			
<gml:centerOf>			
<gml:Point srsName="EPSG:4326">			
<gml:pos>	*Centre of the acquisition footprint:* *LAT LON*	Geolocation of center point	L0R, L1B
</gml:Point>			
</gml:centerOf>			
</eop:Footprint>			
</gml:target>			
<gml:resultOf>			
<opt:EarthObservationResult>			
<eop:browse>			
<eop:BrowseInformation>			
<eop:type>	QUICKLOOK	Fixed	L0

Field	Contents	Source	Filled in Product
<eop:referenceSystemIdentifier>	*If the image is resampled:* WGS84 *If the image is not resampled, this parameter must be empty.*	Fixed	All
<eop:fileName>	*file name of the browse product*	Internal	All
</eop:BrowseInformation>			
</eop:browse>			
<eop:mask>			
<eop:MaskInformation>			
<eop:type>	CLOUD	Fixed	L0
<eop:format>	RASTER	Fixed	L0
<eop:referenceSystemIdentifier>	*If the image is resampled:* WGS84 *If the image is not resampled, this parameter must be empty.*	Fixed	All
<eop:fileName>	*file name of the mask file*	Internal	All
</eop:MaskInformation>			
</eop:mask>			
<opt:cloudCoverPercentage uom="%">	*Percentage of cloud pixels*	Internal	L1A, L1B
<opt:cloudCoverPercentageQuotationMode>	AUTOMATIC	Fixed	L0
</opt:EarthObservationResult>			
</gml:resultOf>			
</gsc:opt_metadata>			
</gsc:report>			

6.16. Orbit and Attitude Files

6.16.1. Orbit File

This file contains orbit state vectors covering the acquisition time of the input data. It is according to the standard interface used by the Earth Observation CFI software [RD 4].

The structure of the Orbit State Vectors is shown in the next table.

Table 38: Earth Explorer Orbit File

Format	Group	Parameter	Type	Dimensions	Description	Units
EE Orbit File (XML)	Orbit State Vectors	TAI	double	1	TAI date and time of OSV	MJD2000
		UTC	double	1	UTC date and time of OSV	MJD2000
		UT1	double	1	UT1 date and time of OSV	MJD2000
		Absolute_orbit	double	1	Absolute orbit counter	-
		X	double	[3] (pos[3])	X position in EF coordinate system	m
		Y	double		Y position in EF coordinate system	m
		Z	double		Z position in EF coordinate system	m
		VX	double	[3] (vel[3])	X velocity in EF coordinate system	m/s
		VY	double		Y velocity in EF coordinate system	m/s
		VZ	double		Z velocity in EF coordinate system	m/s
		Quality	double	1	Format. Default ("not used") value is "0000000000000"	-

6.16.2. Attitude File

This file contains a set of quaternions, wrt J2000 ECI Frame, covering the acquisition time of the input data. It is according to the standard interface used by the Earth Observation CFI software [RD 4].

The structure of quaternion list is shown in the next table.

Table 39: Earth Explorer Attitude File

Format	Group	Parameter	Type	Dimensions	Description	Units
EE Attitude File (XML)	Quaternions	Time	double	1	Date for the quaternions	MJD2000
		Q1	double	[4] (data)	Quaternion	-

		Q2	double		Quaternion	-
		Q3	double		Quaternion	-
		Q4	double		Quaternion. Real part	-

6.17. Execution Report

The format of the execution report files is described in the [STD-4].