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Sentinel-2 Agriculture

Technical Specifications



Milestone	Milestone 1
Authors	CS - Mickael SAVINAUD, Thierry RABAUTE UCL - Guadalupe SEPULCRE CANTO, Sophie BONTEMPS, Pierre DEFOURNY
Distribution	ESA - Benjamin KOETZ

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Table of recorded changes

Issue record sheet

Issue/Rev.	Date	Reason
0.1	15/06/2014	Document creation
0.2	15/07/2014	First preliminary version for PI review
0.3	22/07/2014	Second preliminary version for consortium review
1.0	29/07/2014	First version for ESA review
1.1	15/10/2014	First update of the first version, following RIDs, for ESA review
1.2	20/02/2015	Last update, following RIDs

Detailed record sheet

From version 1.0 to 1.1

RID	Section	Problem description	Change
D3.15	General	The development and implementation plan for the processing system is missing	The Software Development Plan (SDP) is provided in this new delivery.
D3.16	General	Product accuracies are missing and they have to guide the system design	References to the PSD have added in section 6.2.5
D3.17	1.1	Correct the claim that the toolbox will be solely based on the OTB	Text rephrased
D3.18	1.1	The performance expectations shall also include the product accuracy	Text rephrased
D3.19	5.1	Hardware requirements for the system to fulfil the processing and storage shall be included considering to be stand-alone system and the requirements in terms of data volume and product timeliness	Two requirements about a minimum platform and a reference platform have been added in the text (new section 6.1.3)
D3.20	5.1	Clarify the implications of the operating system in terms of hardware and considering the IT setup of the involved users	Text clarified (section 6.1 in this new TS version)
D3.22	5.1	Interfaces for adequate (potentially external systems existing at user entities) archiving system and to ancillary data (e.g. for calibration and validation) shall be included to the system requirements	Information added (new section 6.1.2)

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D3.24	A-C	In the SoW required integration in the S2 toolbox was meant to be on a higher level than just by command line interface. Provide the necessary interface requirements for full plug-in integration to the algorithm in the S2 toolbox.	Text modified
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From version 1.1 to 1.2

RID	Section	Problem description	Change
D3.21	5.1	Include in the high-level requirements that the system shall be adaptable to a cloud based and/or cluster platform installation in order to deal with certain higher volume processing use cases	A high-level requirement has been added (section 6.1.1, TS-REQ-063) about the necessity to be able to process high volumes of data
D3.22	5.1	The system shall also consider interfaces to ancillary data (not only EO data). Further, the interfaces need to be designed flexible enough in order to accommodate different archiving/output options	A high-level requirement has been added (section 6.1.2, TS-REQ-064) about the ancillary data Two high-level requirements have been added (section 6.1.15, TS-REQ-065 and TS-REQ-066) about storage and archiving

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1. Introduction

1.1 Purpose and scope

This document is the Technical Specifications document (TS) of the Sentinel-2 for Agriculture (Sen2-Agri) project funded by the European Space Agency (ESA).

The overall objective for the Sen2-Agri project is to provide the international user community with (i) validated algorithms to derive Earth Observation (EO) products relevant for crop monitoring, (ii) open source software and (iii) best practices to process Sentinel-2 (S2) data in an operational manner for major worldwide representative agriculture systems. The project outputs are of different natures. It will deliver (i) a core of processing strategies and (ii) an open source and portable solution to convert the S2 Level 1c (L1C) data into relevant EO products. This system will rely on the Orfeo Toolbox (OTB) framework, making use of existing algorithms when relevant and integrating new ones identified through a benchmarking exercise.

The TS defines all Sen2-Agri EO products and services, including data formats and metadata based on the User Requirement Document (URD). It also provides:

- the specifications of the different functions of the Sen2-Agri processing system;
- the performances expectations in terms of product quality, products accuracies and processing performance of the Sen2-Agri processing system;
- a development and an implementation plan of the Sen2-Agri processing system.

The aim of this system is to produce the different EO products required by the users based on the processing of the S2 L1C product. These different products are:

- composites of cloud free surface reflectance values (REQ-1_URD);
- dynamic cropland masks (REQ-2_URD);
- cultivated crop type maps and area extent (REQ-3_URD);
- vegetation status indicators (REQ-4_URD).

This system should be as much as possible an operational system designed to offer different types of services to the users. The way to deliver the Sen2-Agri EO products and services to the end-users is presented in this document. To do this, the different interfaces of users with the system will be defined.

Some analysis activities are also reported in this document:

- the atmospheric correction and cloud detection capabilities offers by Sen2Cor;
- the selection of compositing algorithms that will be tested in the benchmarking;
- the interface of the Sen2-Agri processors with the S2 ToolBox.

This TS document is the key input of the other activities of the task 3 (Figure 1-1) as it defines the expected performances of the system, the requested quality of the products and the development plan. The TS is also one of the key inputs of the Task 4 to implement the system.

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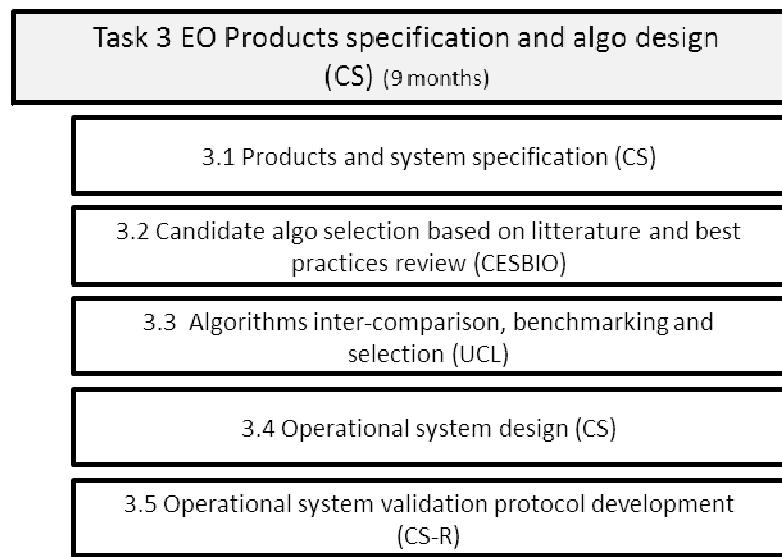


Figure 1-1. Organization of the Task 3 activities (from [AD.2])

1.2 Structure of the document

After this introduction, this document contains **5** main sections and e annexes:

- Section 2 summarizes the main findings of the UR analysis that guide the specifications of the Sen2-Agri products and system;
- Section 3 makes the link with the Product Specification Document (PSD), which defines the four Sen2-Agri EO products and details their specifications;
- Section 4 presents the Software Development Plan (SDP), which defines the software development strategy that will be set-up to produce the Sen2-Agri system;
- Section 5 provides an overview of the Sen2-Agri system;
- Section 6 defines the technical specifications of the Sen2-Agri system;
- Annexes A and B present analyses that have been conducted about the atmospheric correction and cloud detection capabilities offers by Sen2Cor and the S2 ToolBox.

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1.3 References

1.3.1 Applicable documents

Table 1-1. Applicable documents

ID	Title	Reference	Issue/Rev.	Date
AD.1	Sentinel-2 for Agriculture Statement of Work	EOEP-DUEP-EOPS-SW-13-0004	1.0	26/03/2013
AD.2	Sentinel-2 for Agriculture Technical Proposal		1.0	
AD.3	Sentinel-2 for Agriculture User Requirements Document	Sen2-Agri_URD_1.2	1.2	25/07/2014
AD.4	Sentinel-2 for Agriculture Product Specification Document	Sen2-Agri_PSD_1.1	1.1	15/10/2014
AD.5	Sentinel-2 for Agriculture Software Development Plan	Sen2-Agri_SDP_1.0	1.0	15/10/2014

1.3.2 Reference documents

Table 1-2. Reference documents

ID	Title
RD.1	Sentinel-2 User Consultation, April 2012. Presentation available on: http://due.esrin.esa.int/meetings/meetings281.php
RD.2	GSC Sentinel-2 PDGS Products Definition Document, Issue 2, revision 3 – 30.03.2012 GMES-GSEG-EOPG-TN-09-0029
RD.3	Sen2-Agri – Action KOM_4: Sen2Core ATBD review – Issue 1.0 – 02/07/2014
RD.4	Sen2-Agri – Benchmarking: compositing algorithms – Issue 1.0 – 01/07/2014

1.3.3 Acronyms and abbreviations

Table 1-3. List of acronyms and abbreviations

Acronym	Definition
AD	Applicable Document
ATD	Acceptance Test Document
CESBIO	Centre d'Études Spatiales de la Biosphère
CNES	Centre National d'Études Spatiales
CS	Communication & Systèmes

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CS-R	CS Romania
DUE	Data User Element
ECSS	European Cooperation for Space Standardization
EO	Earth Observation
ESA	European Space Agency
GEO	Group on Earth Observation
GEOGLAM	GEO Global Agricultural Monitoring
GEOSS	GEO System of Systems
L1C	Level 1C
HMI	Human Machine Interface
OTB	Orfeo ToolBox
RD	Reference Document
PSD	Product Specification Document
RPM	Redhat Package Manager
S2	Sentinel-2
SDP	Software Development Plan
Sen2-Agri	Sentinel-2 for Agriculture
SoW	Statement of Work
SUM	Software User Manual
TDS	Test Data Set
TS	Technical Specifications
UCL	Université Catholique de Louvain
UR	User Requirement
URD	User Requirement Document

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2. Synthesis of users requirements

In the context of the ESA Data User Element (DUE) programme, a user-oriented approach drives the entire project in order to address concrete user needs and requirements.

In April 2012, a first users' consultation exercise was organized by ESA with about 50 members of the agricultural user and expert communities [RD.1]. From this group, around 15 organizations, centers, universities or companies - our "Champion Users" - agreed to remain actively involved in the Sen2-Agri project.

These Champion Users were involved in a consolidated User Requirement (UR) analysis that was held during the first three months of the project. The tasks carried out during this analysis were:

1. Provide a broad review of agricultural monitoring community UR from the scientific literature and through assessing the proposal of the Global Agricultural Monitoring (GEOGLAM) initiative and the GEOSS Community of Practice;
2. Analyze in more detail the outputs of the initial UR consultation organized by ESA in 2012;
3. Interview some Champion Users to further investigate the expected use of the products and clarify some specific points of the initial UR;
4. Design a new survey and submit it to a variety of potential users to have a broader overview of the agricultural monitoring community UR and assess if they match with those expressed by the Champion Users;
5. Participation in the first User Workshop to discuss the UR and actively engage scientific dialogs with and among the agricultural community.
6. Summarize all inputs to make clear recommendations for the products and system specifications.

The findings of the UR analysis are presented in details in [AD.3] and summarized in Table 2-1. Based on this outcome and on external constraints (technical, time frame of the project, etc.), the specifications for the products and the system are defined. The strategy is to specifications which can be met in most agricultural areas and which go as far as possible in taking UR into account.

Table 2-1 : Summary of UR, which are identified by the source (Statement of Work (SoW), URD) and a number

ID	Requirement
EO products characteristics and attributes	
REQ-1_URD	<p>Cloud-free surface reflectance composite</p> <p>1.1 Coverage: local (over sites) to regional</p> <p>1.2 Time period: current</p> <p>1.3 Temporal frequency*: 1 month</p> <p>1.4 Delivery time*: 3 days or less after the end of composite period</p> <p>1.5 Spatial resolution: full S2 spatial resolution</p> <p>1.6 Spectral content: all land bands (10)</p>

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	<p>1.7 Geometric accuracy: sub pixel location error</p> <p>1.8 Thematic accuracy: atmospherically corrected surface reflectance, with highly accurate cloud and cloud shadow mask (the accepted residual cloud cover being dependent on the quality of the cloud/cloud shadow/snow masks)</p> <p>1.9 Including quality flags indicating (i) the number of valid observations and (ii) the status of the pixel (valid, cloud, cloud shadow, snow, gaps and filled values (which are typically values derived from a longer compositing period than the month))</p>
REQ-2_URD	<p><u>Dynamic cropland masks</u></p> <p>2.1 Coverage: local (over sites) to regional</p> <p>2.2 Time period*: current</p> <p>2.3 Temporal frequency*: 1 month, with a 12 months moving window</p> <p>2.4 Delivery time: within 72 hours after the end of each month</p> <p>2.5 Spatial resolution: 10 meters</p> <p>2.6 Legend: binary (crop - no crop for annual cropland)</p> <p>2.7 Geometric accuracy: sub pixel location error</p> <p>2.8 Thematic accuracy*: 10 % (maximum error of omission and commission of annual cropland mask)</p> <p>2.9 Including quality flags indicating (i) the number of valid observations and (ii) the status of the pixel (valid, cloud, cloud shadow, snow, gaps and filled values (which are typically values derived from a longer compositing period than the month))</p>
REQ-3_URD	<p><u>Cultivated crop type and area extent</u></p> <p>3.1 Coverage: local (over sites) to regional, over annual cropland areas</p> <p>3.2 Time period*: current</p> <p>3.3 Temporal frequency: seasonal products, with a first delivery as soon as possible but not before the first half of the season (for accuracy reasons)</p> <p>3.4 Delivery time: 1-2 weeks after the end of the season</p> <p>3.5 Spatial resolution: 10 meters</p> <p>3.6 Legend: main regional crop types or crop groups, including the distinction between rainfed and irrigated crops. The main crops correspond to those for which the cumulated area reaches more than 75 % of the annual cropland in the given region at the end of the season.</p> <p>3.7 Geometric accuracy: sub pixel location error</p> <p>3.8 Thematic accuracy: 10 % (maximum error of omission and commission of area extent per crop type or group).</p> <p>3.9 Including quality flags indicating (i) the number of valid observations and (ii) the status of the pixel (valid, cloud, cloud shadow, snow, gaps and filled values (which are typically values derived from a longer compositing period than the month))</p>
REQ-4_URD	<p><u>Vegetation status indicator</u></p> <p>4.1 Coverage*: local (over sites) to regional, including no crop areas</p> <p>4.2 Time period: historical records required for detection of anomalies</p> <p>4.3 Temporal frequency: decadal products</p>

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	<p>4.4 Delivery time: ideally 24 hours after the decadal period and never more than 72 hours</p> <p>4.5 Spatial resolution: 20 meters</p> <p>4.6 Geometric accuracy: sub pixel location error</p> <p>4.7 Thematic accuracy: >85 % accuracy</p> <p>4.8 Possible indicators: NDVI, NDWI, LAI, FAPAR, phenology indices</p> <p>4.9 Including quality flags: number of observations, cloud and cloud shadow masks, snow mask, gaps and filled values (which are typically values derived from a longer compositing period than the 10 days)</p>
REQ-5_URD	<p>Aggregated products (REQ-2_URD, REQ-3_URD, REQ-4_URD) at lower spatial resolution for the sake of compatibility with long-term time series available at medium resolution and required for anomalies monitoring</p> <p>5.1 REQ-2_URD: Cropland proportion at 1 km or 300 m resolution</p> <p>5.2 REQ-3_URD: Crop type proportion at 1 km or 300 m resolution</p> <p>5.3 REQ-4_URD: Aggregated vegetation status at 1 km or 300 m</p> <p>5.4 Coverage: local (over sites) to regional, including non-crop areas for the REQ-4_URD</p>
REQ-6_URD	A standard raster format is requested for all data and products (e.g. GEOTIFF)
REQ-7_URD	The standard UTM and WGS84 projections are requested for all data and products
REQ-8_URD	Clear metadata are requested for all data and products, using standard data formats (e.g. similar to the Landsat MTL.txt files)
REQ-9_SOW	All higher-level products (REQ-2_URD, REQ-3_URD, REQ-4_URD) are requested to be delivered for administrative/national entities
REQ-10_SOW	All products shall be validated against in-situ data and quality controlled
REQ-11_SOW	Uncertainties of the products shall be specified and quality flags provided as part of the metadata
REQ-12_SOW	The documentation of the data production and validation shall be publicly available
REQ-13_SOW	All data and products shall be open and freely available
Sen2-Agri system	
REQ-14_URD	The system should allow users parameterizing the proposed products to better match particular environments or uses (e.g. compositing period, time series smoothing algorithm)
REQ-15_SOW	The system (tools and algorithm) required for the EO products should be developed under an open source code licence
REQ-16_URD	All algorithms processing modules shall be accessible into the S2-ToolBox
REQ-17_SOW	The system should be scalable to handle local site or national site
REQ-18_SOW	The system should not be site specific, to tackle the global dimension
REQ-19_URD	All data and products are required to be delivered in a open, free, easy and automated way

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REQ-20_URD	The system should be designed to allow installation into existing facilities.
REQ-21_URD	The system should be maintained and exploited by end-users after the end of the project
REQ-22_URD	All the documentation about how to install, use and maintain this software shall be available.

* indicating specifications coming from the UR consolidation which slightly differ from the initial specifications listed in the SoW

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3. Sen2-Agri EO products technical specifications

The Sen2-Agri EO products specifications are defined in the Product Specification Document (PSD) [AD.4].

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4. Software development plan

The development and implementation plan of the processing system are defined in the Software Development Plan (SDP) [AD.5].

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5. System overview

According to software design standards, the following aspects should be considered, as a whole, to ensure a cost-effective design, implementation and maintenance of an operational system:

- **Configurability:** in terms of functionality (e.g. to be modular and parameter driven) to facilitate usage, accommodate evolution and enable re-use across environments;
- **Scalability:** to facilitate expansion of the hardware or software configuration of the system without major redesign. The system must be expandable to support additional future processing needs;
- **Portability:** to reduce the cost of transferring the system to new computer platforms or operating systems. This is especially important to cope with the obsolescence of hardware or software;
- **Openness:** to facilitate usage, integration of new functionality and interfacing with other systems without major redesigns;
- **Re-usability:** to permit re-usability across environments. Customization to specific environments should not involve massive modifications.
- **Standards:** i.e. wherever possible, widely used (including de-facto) standards should be utilized.

To achieve the above mentioned goals, two key points need to be addressed into the system specification:

- Modular design and standardization of interfaces;
- Efficient resource monitoring and management.

As per the SoW [AD.1], the Sen2-Agri system can be broken down in two main components that will be further decomposed in the following sections. Those two main components are:

- A set of Sen2-Agri Software Components (SC): Each Sen2-Agri_SC is an independent executable that represents an algorithm or a set of algorithms;
- An Sen2-Agri Orchestrator: the main component which is used to manage the above Sen2-Agri_SC on the system: monitor and execute processing jobs.

A global view of the proposed system is provided in Figure 5-1.

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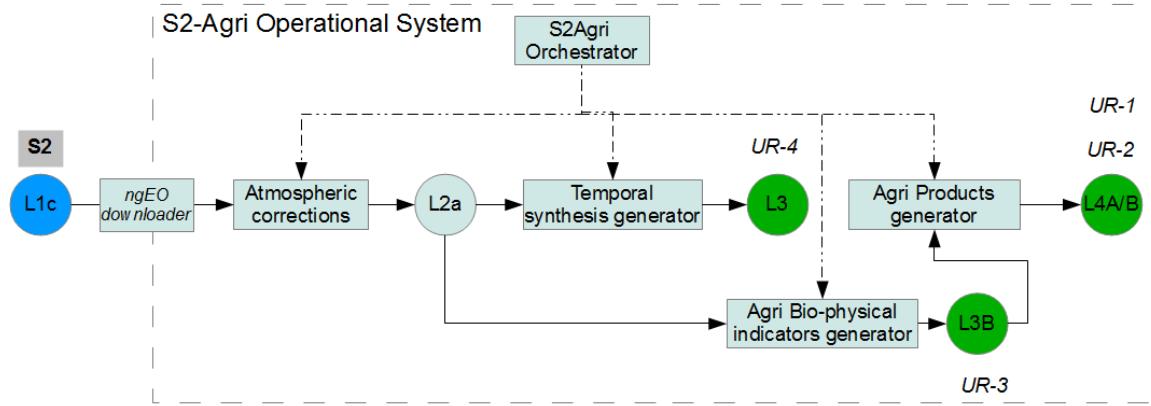


Figure 5-1. Global overview of the architecture

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6. Sen2-Agri system requirements

6.1 Common Sen2-Agri system requirements

6.1.1 High Level requirements

TS-REQ-001:

LINUX CentOS version 6 and higher shall be used as the reference Operating System.

Note: The selection of a Linux distribution is motivated by the fact that the Linux distribution is free, compatible with the RedHat one (which is commonly used in production facilities). Moreover, it can be easily used into a virtual machine framework. This choice has no involvement on the hardware.

Parents: None

TS-REQ-002:

The design of the components shall allow adapting to software and hardware evolutions (e.g. OS system upgrade to minor/major release):

- in a controlled cost manner;
- without negative impacts on operations during the upgrade activities.

Parents: None

TS-REQ-003:

The components shall perform preliminary consistency checks over the data received at their input interface before using or forwarding the data to external entities of Sen2-Agri System.

Parents: None

TS-REQ-004:

The components exposed to the public Internet shall have enabled and configured a host-based firewall according to the defined and implemented network access control measures.

Parents: None

TS-REQ-063:

The Sen2-Agri system should ensure the high data volume processing and should be as simple as possible. The national case (500.000km²) is used as test case to demonstrate this requirement.

Parents: SoW

6.1.2 External Interface requirements

TS-REQ-060:

The main external interface is the Sentinel-2 catalogue and the current Sentinel-2 L1C product definition.

Parents: None

TS-REQ-064:

The main auxiliary data of the system are:

- the DEM data:
 - by default, the CGIAR-CSI data will be integrated into the system;

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- the system should provide the possibility to the users to upload its own DEM if he has a better one;
- the system should be able to support the 30m spatial resolution DEM from USGS if it is provided by the user.
- the water bodies data:
 - by default, the CCI Water Bodies map will be integrated into the system;
 - the system should provide the possibility to the users to upload its own water body product if he has a better one;
 - the system should be able to support the high spatial resolution water body product.

Parents: SoW

The other auxiliary data for L2A processing are managed by the CFI tool used.

No other interfaces are known for the moment. Other technical requirements related to interface could be potentially defined at the benchmarking exercise.

6.1.3 Hardware requirements

TS-REQ-061:

The minimum platform is designed to process local case on a personal computer with the following characteristics:

- Processor speed at 2.66 GHz with a minimum of 4 cores;
- Minimum of 2GB of RAM by core;
- Minimum of 1TB of disk which can split into 250GB for processing and 750GB for archiving.

Note: The final definition of the Minimum Platform will be provided at the end of the benchmarking exercise.

Parents: None

TS-REQ-062:

The reference platform is designed to process local and national case on a server with the following characteristics:

- Processor speed at 3 GHz with a minimum of 8 cores
- Minimum of 2GB of RAM by core
- Minimum of 5TB of disk which can split into 500GB for processing and 4,5TB for archiving.

Note: The final definition of the Reference Platform will be provided at the end of the benchmarking exercise.

Parents: None

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6.1.4 Software Quality requirements

The Sen2-Agri system is an operational system, ECSS-E-ST-40C are applicable to the engineering processes of the project. No extra requirements have been identified.

6.1.5 Coding Standards requirements

As required by the European Cooperation for Space Standardization (ECSS), the software components will follow the coding standards as defined in [AD.2]. The extra requirements have been identified in [AD.5].

6.1.6 Human Machine Interface requirements

This section is only applicable for components providing a Human Machine Interface (HMI), including a Web Interface.

TS-REQ-005:

English language shall be used for information displayed.

Parents: None

6.1.7 Testing and Validation requirements

TS-REQ-006:

All Sen2-Agri components shall be available as stand-alone system and accessible for testing and validation purposes.

Parents: None

TS-REQ-007:

The testing and validation procedure should be based on Test Data Set (TDS) and corrupted data derived from the TDS to simulate errors situation.

Parents: None

TS-REQ-008:

The testing procedure should include regression tests in order to ensure that upgrades will not impact the existing operational and already validated Sen2-Agri functionalities.

Parents: None

TS-REQ-009:

The test specifications and scenario shall be described into the Acceptance Test Document (ATD).

Parents: None

6.1.8 Software configuration constraints requirements

TS-REQ-010:

Configuration files shall be designed as ASCII data structure, use of XML is advised.

Parents: None

TS-REQ-011:

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Each component software shall deliver all the generation procedures (User Manual or Installation Manual) including the configurations packages (specification files for Redhat Package Manager (RPM) Configuration).

Parents: None

TS-REQ-012:

Deliveries shall allow the build on a separate platform from the installation target i.e. the delivery tree and the execution tree can be on separate machines.

Parents: None

6.1.9 Software building constraints requirements

TS-REQ-013:

For every software component, all the internal and external dependencies shall be provided and identified in the design document:

- Libraries source code (in RPM format with version);
- Libraries binary code (in RPM format with version);
- Licenses (for Build and Run Time environments).

Parents: None

TS-REQ-014:

The delivery package shall be self-content and not dependent of the component development environment (no hard-coded path in the source code or in the generation procedure).

Parents: None

TS-REQ-015:

The building process shall be automatic without any human interaction.

Note: All necessary parameters/questions shall be set up into a configuration file at the beginning of the code generation.

Parents: None

6.1.10 Software packaging constraints requirements

TS-REQ-016:

Delivery shall be performed with separate RPM package files:

- one package for source files (including the build script to generate the binary package);
- one package for binary (including the script to deploy the package on a target machine);
- one package for configuration files;
- one package for tests: data and scripts.

The configuration files package and the tests package shall be delivered only in case of significant changes

Parents: None

6.1.11 Software delivery constraints requirements

TS-REQ-017:

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The activation of a specific component version shall be made using symbolic links in order to have an easily update of the various directories to the latest release generated.

Parents: None

TS-REQ-018:

The packaging shall permit to choose the target folder. No full path shall be hard-coded.

Parents: None

TS-REQ-019:

The run-time environment of the facilities has to be made of the following directories:

- bin: to contain the binary files;
- lib: to contain the libraries;
- scripts: to contain the executables scripts to launch the different functionalities of the dedicated software;
- conf: to contain the configuration files;
- data: to contain the retrieved and locally generated data logs: to contain the log files generated by any script;
- docs: to contain the documentation for the command lines and theirs parameters.

Parents: None

TS-REQ-020:

For every facility delivery, a release note shall be joined, which has to contain:

- names of added, modified and removed files;
- all the dependencies (Build and Run Time);
- description of the build process;
- checksum;
- reported/corrected anomalies.

Parents: None

6.1.12 Network/DNS constraints requirements

TS-REQ-021:

No IP address shall be hard-coded

Parents: None

6.1.13 Logging constraints requirements

TS-REQ-022:

English language shall be used for logs produced.

Parents: None

TS-REQ-023:

All the logs shall be referenced in Annex of the related Software User Manual (SUM) for every component.

Parents: None

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TS-REQ-024:

The log files shall be respected according to the following format: date–criticity–msg. Date shall respect the ISO 8601 format. Severity shall be “Error” or “Warning” or “Info” or “Debug”.

Parents: None

TS-REQ-025:

Comprehensive debug messages have to be included in every component. The objective is to facilitate the debug.

Parents: None

TS-REQ-026:

The debug log shall be able to be switched on/off.

Parents: None

6.1.14 Access rights constraints requirements

TS-REQ-027:

The components shall be designed to require positive confirmation of the user/operator for dangerous commands or the erasure of important data files.

Parents: None

TS-REQ-028:

The components shall allow the restriction of access to all its generated data based on user authentication and authorisation mechanisms.

Parents: None

TS-REQ-029:

The components shall run with the necessary minimum level of privileges (standards operator with write access when necessary) and be designed to access the necessary minimum information and resources needed to its legitimate purpose (least privilege principle).

Parents: None

TS-REQ-030:

The components shall implement well-defined access control measures at the level of network, system, application and data.

Parents: None

TS-REQ-031:

The components shall not embed any hard-coded root and/or administrative passwords.

Parents: None

6.1.15 Back-up constraints requirements

TS-REQ-032:

A well-defined back-up strategy shall be defined for operating system configuration, applications and data. This strategy will be under the responsibility of the administrator of the system.

Parents: None

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TS-REQ-065:

Before the first run, the Sen2-Agri system shall inform users about the expected data volume according to the users' parameters. If this data volume is not compatible with the data storage capability, the Sen2-Agri system must not run.

Parents: None

TS-REQ-066:

The Sen2-Agri system shall warn the user about the disk storage availability, the archiving strategy defined by default and how to modify it.

Parents: None

6.2 Sen2-Agri Software Components (SC) specific requirements

6.2.1 Requirements for the L3 composite Sen2-Agri_SC

TS-REQ-033:

The L3 composite Sen2-Agri SC shall be able to perform the processing of a series of S2 L1C products to generate a L3 composite product.

Parents: REQ-1_URD

TS-REQ-034:

The L3 composite Sen2-Agri SC shall be able to perform the processing of a S2 L1C product to generate L2A internal products.

Parents: REQ-1_URD

6.2.2 Requirements for the L3 biophysical indicator Sen2-Agri_SC

TS-REQ-035:

The L3 biophysical indicator Sen2-Agri SC shall be able to perform the processing of a S2 L1C product to produce a L3 biophysical indicator product.

Parents: REQ-4_URD

TS-REQ-036:

The L3 biophysical indicator Sen2-Agri SC shall be able to perform the processing of S2 L1C product to generate L2A internal products.

Parents: REQ-4_URD

6.2.3 Requirements for the L4 crop mask Sen2-Agri_SC

TS-REQ-037:

The L4 crop mask Sen2-Agri SC shall be able to perform the processing of a series of S2 L2A and L2B products to generate a L4 crop mask product.

Parents: REQ-2_URD

6.2.4 Requirements for L4 crop type map Sen2-Agri-SC

TS-REQ-038:

The L4 crop type map Sen2-Agri SC shall be able to perform the processing of a series of S2 L2A and L2B products to generate a L4 crop type product.

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Parents: REQ-3_URD

6.2.5 Product generation performances requirement

6.2.5.1 L3 composite processing performance requirements

TS-REQ-039:

An average delivery time of 3 days after the reception of the last S2 tile of the compositing period shall be reached.

Parents: REQ-1.4_URD

TS-REQ-040:

The geometric accuracy of the L3 composite shall be the same that the series of L1C product used as input.

Parents: REQ-1.7_URD

TS-REQ-041:

The L3 composite Sen2-Agri SC shall be able to produce high quality masks about:

- the number of valid observations;
- the validity of the pixel: valid or not
- the status of the pixel: land, snow, cloud, cloud shadow, invalid;
- the origin of the pixel value: computed or filled (from previous composite).

Parents: REQ-1.9_URD

6.2.5.2 L3 biophysical indicator processing performance requirements

TS-REQ-042:

The L3 biophysical indicator Sen2-Agri SC shall be able to produce different types of vegetation status indicator:

- NDVI
- LAI
- NDVI metrics

Parents: REQ-4.8_URD

TS-REQ-043:

An average delivery time of 2 days after the reception of the last S2 tile of the 7-day period shall be reached (with an ideal delivery time of 1 day).

Parents: REQ-4.4_URD

TS-REQ-044:

The geometric accuracy of the L3 biophysical indicator shall be the same that the original L1C product used as input.

Parents: REQ-4.6_URD

TS-REQ-045:

The thematic accuracy of the L3 LAI retrieval shall follow the product accuracy defined in the PSD [AD.4].

Parents: REQ-4.8_URD

TS-REQ-046:

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The L3 biophysical indicator Sen2-Agri SC shall be able to produce high quality masks about:

- the number of valid observations;
- the validity of the pixel: valid or not
- the status of the pixel: land, snow, cloud, cloud shadow, invalid;
- the origin of the pixel value: computed or filled (from previous periods).

Parents: REQ-4.9_URD

6.2.5.3 L4 crop mask processing performance requirements

TS-REQ-047:

The Sen2-Agri L4 crop mask SC shall deliver a crop mask product every month using the 12 previous months

Parents: REQ-2.3_URD

TS-REQ-048:

An average delivery time of 3 days after the reception of the last S2 tile of the monthly period shall be reached.

Parents: REQ-2.3_URD

TS-REQ-049:

The geometric accuracy of the crop mask product shall be in the same order of magnitude that the series of L1C product used as inputs.

Parents: REQ-2.7_URD

TS-REQ-050:

The thematic accuracy of the L4 crop mask shall follow the product accuracy defined in the PSD [AD.4].

Parents: REQ-2.8_URD

TS-REQ-051:

The Sen2-Agri L4 crop mask SC shall be able to produce high quality masks about:

- the number of valid observations;
- the validity of the pixel: valid or not
- the status of the pixel: land, snow, cloud, cloud shadow, invalid;
- the origin of the pixel value: computed or filled (from previous periods).

Parents: REQ-2.9_URD

6.2.5.4 L4 crop type map processing performance requirements

TS-REQ-052:

The Sen2-Agri L4 crop type map SC shall begin to deliver a L4 crop type map after the first half of the season.

Parents: REQ-3.3_URD

TS-REQ-053:

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An average delivery time of 15 days after the first half of the season for the 1st delivery and after the end of the season for the last delivery shall be reached.

Parents: REQ-3.4_URD

TS-REQ-054:

The geometric accuracy of the L4 crop type map shall be in the same order of magnitude that the series of L1C product used as inputs.

Parents: REQ-3.7_URD

TS-REQ-055:

The thematic accuracy of the L4 crop type map shall follow the product accuracy defined in the PSD [AD.4].

Parents: REQ-3.8_URD

TS-REQ-056:

The Sen2-Agri L4 crop type map SC shall be able to produce high quality masks about:

- the number of valid observations;
- the validity of the pixel: valid or not
- the status of the pixel: land, snow, cloud, cloud shadow, invalid;
- the origin of the pixel value: computed or filled (from previous periods).

Parents: REQ-3.9_URD

6.3 Sen2-Agri Orchestrator specific requirements

TS-REQ-057:

The Sen2-Agri Orchestrator shall be capable to dispatch the different processing according the user product requested by user.

Parents: None

TS-REQ-058:

The Sen2-Agri Orchestrator shall be capable to dispatch the different processing according the area of interest requested by user.

Parents: None

TS-REQ-059:

The Sen2-Agri Orchestrator shall be capable to dispatch the different processing over the reference platform.

Parents: None

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Annex A. Sen2Core Analysis

This analysis is documented in an external technical note [RD.3].

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Annex B. Preliminary interface analysis with the S2-ToolBox

The S2 ToolBox should be able to launch each Sen2-Agri SC as an external processor. To launch a processor, the S2 ToolBox provides a universal launcher based on a command line interface. In a preliminary analysis, the Sen2-Agri SC is based on OTB applications used in the command line mode. Therefore, the component can be easily integrated as a processor of the S2 ToolBox. Moreover, technical feasibility of the launch of OTB application has been already done.

GUI interface is already possible through this framework as shown in the following figure. This proof of concept demonstrates the feasibility of the integration of the Sen2-Agri components into the S2-Toolbox. More information will be available with the next release of the toolbox planned in March 2015.

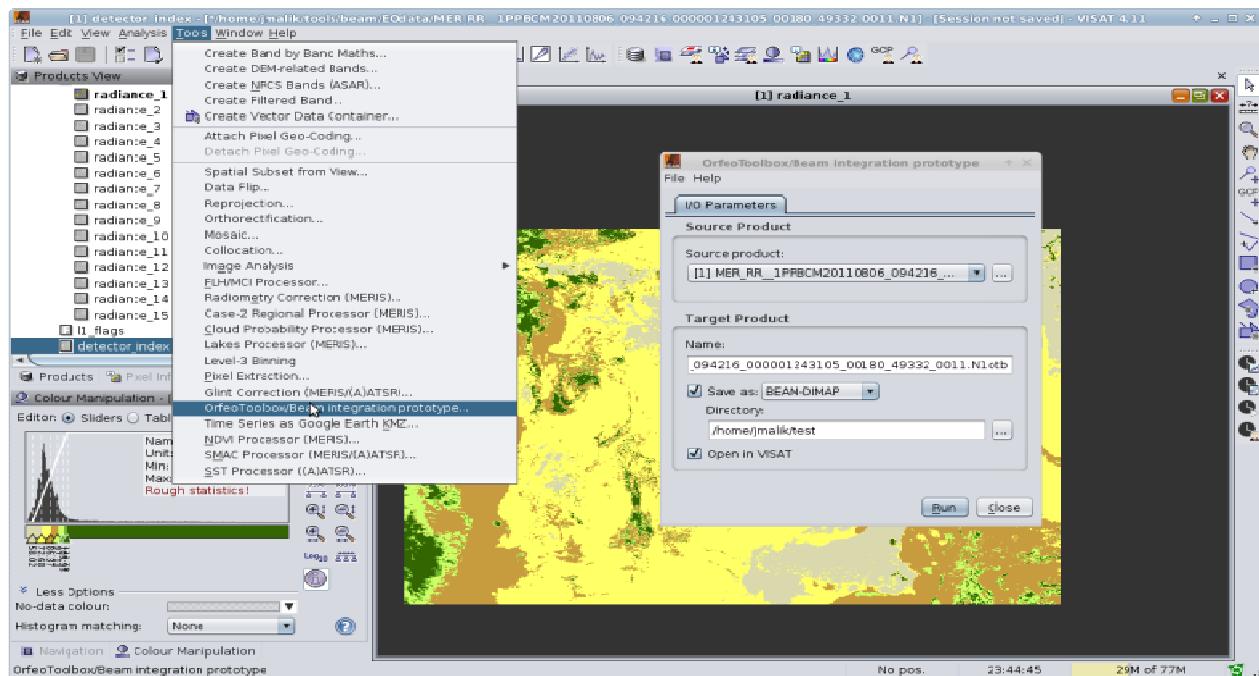


Figure A-1: Integration of an OTB-Application into the S2 toolbox with an interface to set parameters.