An Approach to Payload Data Ground Segment Development based on Component Re-use

Marc Niezette[1]
VEGA Space GmbH, Darmstadt, 64293, Germany

The Sentinel-3 mission of the GMES (Global Monitoring for Environment and Security) programme will provide medium-resolution and high-accuracy optical and surface topography data with a suitable revisit frequency, coverage and timeliness for both near real time and offline marine and land applications. A major element of the mission Ground Segment is the Payload Data Ground Segment (PDGS), currently implemented by ESA in conjunction with EUMETSAT. The development of the Core PDGS is carried out by a VEGA-led Consortium including ACS, WERUM, and Telespazio. The many years of experience of ESA, EUMETSAT and of the VEGA Consortium in the implementation of EO ground segments infrastructures has provided the possibility of re-using many system components implemented and validated in other missions. This paper will present and highlight the advantages of an approach based on component re-use for the safety and cost-effectiveness for the S3 PDGS solution.

I. Introduction

The The GMES (Global Monitoring for Environment and Security) programme is a European initiative, headed by the European Commission (EC) in partnership with the European Space Agency (ESA) and the European Environment Agency (EEA) for the implementation of information services dealing with environment and security, based on observation data received from Earth Observation (EO) satellites and ground based information.

Within this context, ESA is developing five families of Sentinel missions specifically designed for the GMES programme purposes. The Sentinels will provide a unique set for the Earth observations and in particular Sentinel-3 will provide medium-resolution and high-accuracy optical, radar and altimetry data with adequate revisit frequency, coverage and timeliness for marine and land applications.

The access to the Sentinel data will be provided through a dedicated Ground Segment infrastructure where the Payload Data Ground Segment (PDGS) is one building block. For Sentinel-3, this is currently implemented by ESA in conjunction with EUMETSAT, with VEGA as prime for the Core PDGS implementation part.

The Core PDGS is primarily in charge of receiving and processing the Sentinel-3 instrument payload data, ensuring that satellite tasking is performed according to the overall GMES user requirements and satellite capabilities, and guaranteeing that suitable Sentinel-3 products meeting the expected quality and timeliness constraints are available to the GMES Users.

The many years of experience of ESA, EUMETSAT and of the European space industries in the implementation of EO ground segments infrastructures has provided the possibility of re-using many system components implemented and validated in other missions. This paper will present and highlight the advantages of an approach based on component re-use for the safety and cost-effectiveness for the S3 PDGS solution. It will introduce the main drivers for the implementation of the PDGS, present the system architecture, and summarize the benefits of the approach.

II. Sentinel-3 Mission

Within the GMES programme, the GMES Service Segment (GSS) is composed over several GMES Service Projects (GSPs) is in charge of providing value-added data and services to the GMES final users, while the GMES Space Component (GSC) is responsible for providing to the GMES Service Segment the necessary Earth-Observation (EO) data and services.

[1] Business Development Manager, Ground Segment Systems, Marc.Niezette@vega.de.

ESA is currently developing the space-based capability required to provide the GSS with satellite data with the implementation of GMES dedicated Earth Observation Missions, the Sentinels missions, including Sentinel-3.

The Sentinel-3 mission objectives include the operational provision of data for the following broad applications:

- Open Ocean and Ice Monitoring
- Global Land Monitoring Applications
- Coastal Zones Monitoring
- Atmospheric Weather Forecasting
- Global and Climate Change

The operational character of the Sentinel missions in general and of the Sentinel-3 mission in particular implies the "provision of services in a routine, long-term and continuous fashion, with a consistent quality and a very high level of availability". This implies that the Sentinel-3 Ground Segment shall:

- Be continuously available and robust with backup systems in case of failures (dependability and continuity)
- Be able to ensure timely delivery of Level 1/Level 2 to the users (timeliness)
- Ensure a high level of quality and stability of the products that it delivers

In order to satisfy large coverage and high revisit requirements, the Sentinel-3 mission is designed as a constellation of (at least) two identical satellites, Sentinel-3A and Sentinel-3B, both designed for a nominal life-time of 7 years (extensible to 12 years). Each satellite will operate in a reference orbit with a repeat cycle of 27 days for the overall duration of the mission.

III. Sentinel-3 PDGS

A. Context

In the overall GMES Sentinel-3 ground Segment, the Payload Data Ground Segment is primarily in charge of receiving and processing the Sentinel-3 instrument payload data, including HKTM data; ensuring that satellite tasking is performed according to the overall GMES user requirements and satellite capabilities; guaranteeing that suitable Sentinel-3 products meeting the expected quality and timeliness constraints are available to the GMES Users; and of all necessary support activities.

Figure 1 summarizes the external interfaces to the PDGS.

The interface to the FOS (Flight Operations Segment) relates to:

- The generation of the instrument sensing schedule (the PDGS provides a consolidated and conflict free sensing schedule that is checked by the FOS against the space segment constraints).
- The provision by the PDGS to the FOS of the Housekeeping Telemetry (HKTM) extracted from the telemetry flow downloaded to the PDGS Core Ground Stations (CGS).

The PDGS interfaces to the two satellites of the Sentinel 3 Space Segment for the reception of the on-board telemetry.

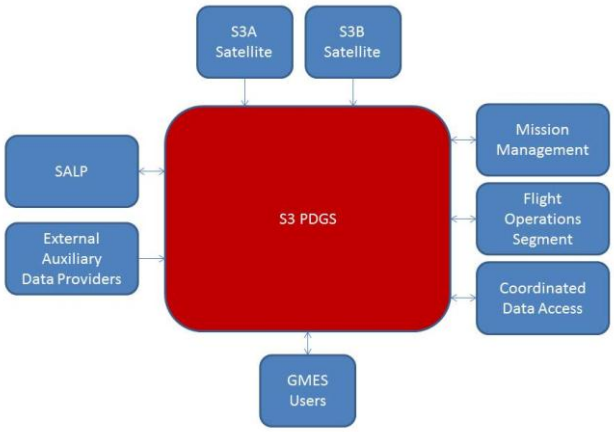

Figure 1. Sentinel-3 PDGS External Interfaces.

The Mission Management is the authority deciding upon mission directives on the basis of the reporting provided by the PDGS. The Mission Management is in particular entitled to decide upon the allocation of free sensing opportunities to the background mission.

The GMES Users interact with the PDGS through the CDS-SCI (Coordinated Data System, Service Projects Coordinated Interface) for subscription request, while the end users entitled by each service provider to access Sentinel-3 products receive them electronically, either via satellite broadcast link, or via access to a pick-up point when ready products are made available. Still, the Sentinel-3 PDGS can serve "non GMES" users, which will interact with the PDGS via the users service interface provided by the Agencies (ESA and EUMESAT).

The External Auxiliary Data Providers provide the auxiliary data needed for processing.

SALP (Service d'Altimétrie et de Localisation Précise) is a service provided by CNES for producing, validating, distributing and archiving data used in the area of altimetry and precise localization. The SALP is composed of a space segment part (including instruments flying on different satellites), a multi-mission Ground Segment (SSALTO - Segment Sol multi-missions d'ALTimétrie, d'Orbitographie et de localisation précise) in charge of the processing and distribution of data to users, various tools to assess the data quality and a DORIS beacon network with their associated tools. For Sentinel-3 mission, SALP interfaces with the Sentinel-3 Ground Segment. In particular SALP interfaces with the FOS to exchange command, HK telemetry data for DORIS and software uploads and it interfaces with the PDGS to receive satellite data/products and to provide auxiliary data for PDGS POD, SRAL instrument and associated processing

B. Functions

The high-level functions performed by the PDGS are illustrated in Figure 2.

The Acquisition and Ingestion function receives the payload science data down-linked to ground by the GMES Sentinel-3 satellite(s). This might be either real-time sensed data or payload data played back from on-board recorders. This function includes the demodulation of the downlinked data stream and the frame synchronization and reconstruction of the payload data (Instrument Source Packets) in a Computer Compatible Format (CCF).

The Processing function applies all the necessary data processing levels, starting from the reconstructed payload science data (Instrument Source Packets) to produce Level-0 to the algorithms and formatting techniques to generate higher level products. The processing function is capable of producing the desired products in a systematic way.

The Auxiliary Data Coordination function is responsible for the coordination of the auxiliary data required by the system, both internal and external, and will interface to the necessary external auxiliary data providers for the receipt of data.

The Archiving, Storage and Inventory function ensures the long-term and short-term storage of the payload data products and of the auxiliary data according to the long-term/short-term storage policy. This function includes all operations to be put in place to store and to circulate the data within the PDGS and to ensure their integrity according to the applicable requirements. It also includes the inventory (at the appropriate level) of the stored data to enable their retrieval by the PDGS for internal purposes and by the PDGS users.

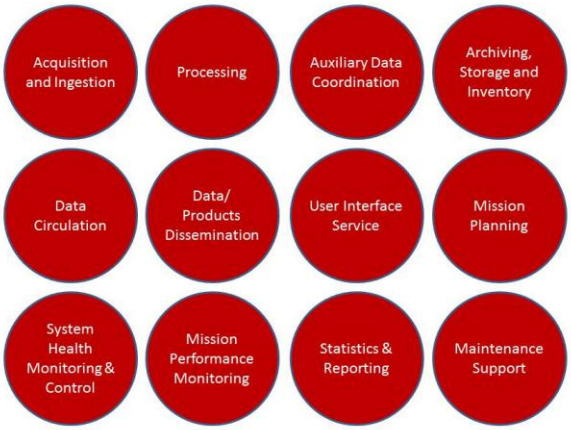

Figure 2. High-level PDGS Functions.

The Data Circulation function is responsible for the circulation of all data both within and between PDGS physical sites.

The Data/Product Dissemination function delivers, upon successful availability notification, the GMES Sentinel-3 products to the end-user, by means of electronic distribution (e.g. satellite broadcast, ftp-push) or electronic server access (e.g. ftp-pull, online data provision).

The User Interface Service function includes several different capabilities for permitting and supporting the successful handling of submitted user subscriptions, including the user access management, responsible for managing all the information related to a user, and both Documentation & Help Desk capabilities.

The Mission Planning function defines, and exchange with the GMES Sentinel-3 FOS, the detailed payload sensing and downlink schedule according to the mission observation strategy defined at GMES Sentinel-3 Mission Management level. The Mission Planning is also in charge of planning additional downlink of local data to the receiving X-Band users' local ground stations for users who subscribed for such service.

The System Health Monitoring & Control function is responsible for ensuring that all available resources (i.e. hardware, software and network) required to operating the PDGS according to its functional and performance requirements are operating nominally.

The Mission Performance Monitoring function monitors and reports on the status of fulfillment of the mission objectives in terms of performance, timeliness, validation, instrument calibration performance, scientific validation etc.

The Statistics and Reporting function collects statistics and provides a reporting capacity to define, edit and generate reports.

Finally the Maintenance Support function covers all hardware, software and documentation management functions such as configuration management, maintenance and evolution and includes the PDGS support and reference platform(s) to enable this to take place.

IV. Sentinel-3 Instruments, Products and Timeliness

A. Instruments

The S3 satellite embarks four main observation instruments, together with navigation devices. The Ocean and Land Colour Instrument (OLCI), is a spectrometer imaging in push broom mode with an across-track electronic scan, strongly inherited from the flight-proven ENVISAT MERIS instrument. The Sea and Land Surface Temperature Radiometer (SLSTR) is a conical imaging radiometer with a dual view (near-nadir and inclined) capability, inherited from the ENVISAT AATSR instrument. The SAR Radar Altimeter (SRAL) is a dual-frequency altimeter derived from the line of products such as SIRAL of Cryosat, and Poseidon-3 of Jason-2, and providing Low Resolution Sea surface measurements and sea-ice, land-ice and inland water monitoring in Nadir SAR mode. A Microwave Radiometer (MWR) supports the SRAL to achieve the overall altimeter mission performance by providing the wet atmosphere correction. A GNSS Assembly provides the data for the Precise Orbit Determination (POD) on ground, required to achieve the overall altimeter mission performance. Finally, a DORIS Assembly constitutes a complementary POD data provider for the Ground Segment.

B. Products

The Sentinel-3 mission contributes to provide the EO data required by the GMES Service Component as part of the GMES Space Component Data Access system (GSCDA).

The data and services provided via the GSCDA are accessible through a portfolio of Data Sets derived from the GMES Service Requirements and described in the Data Access Portfolio (DAP).

The DAP is at the core of the definition of the mission, and users (the GMES Service Projects) will nominally get access to the mission products by subscribing to Data Sets via s subscription mechanism.

The Sentinel-3 mission contributes to the Marine, Land, Atmosphere, Emergency and Security Services identified in the DAP requirements. The table below summarizes the contribution of the mission to these services.

The OLCI and SLSTR instruments constitute the ocean/land colour part of the S3 mission, whilst the SRAL and MWR form the backbone of the topography part of the mission. OLCI and SLSTR have a certain degree of interaction, specifically their data are used to create the so called synergy products.

The Sentinel-3 products shall be made available to the users according to three levels of timeliness:

- Near-Real-Time (NRT): within 3 hours after sensing, applicable to the entire payload, but excluding the SYN products;

- Short-Time-Critical (STC): within 48 hours after sensing, applicable to SRAL products only.
- Non-Time-Critical (NTC): within 1 month after sensing, applicable to all products.

Table 1. Sentinel-3 Contribution to the GMES Services.

Domain	Project	Service	Applicable Payload
Marine	Fast Track FP7 Marine Core Service (MCS)	MCS_003 – Global and regional sea level	SRAL
Marine	Fast Track FP7 Marine Core Service (MCS)	MCS_004 – Global and regional Sea Surface Temperature	SLSTR
Marine	Fast Track FP7 Marine Core Service (MCS)	MCS_005 – Global and regional Sea Ocean Colour	OLCI
Marine	Fast Track FP7 Marine Core Service (MCS)	MCS_016 – Global and regional services for data reanalysis	OLCI SLSTR SRAL
Marine	GMES Service Element (GSE) / MARCOAST	MGSE_016 – MARCOAST: Water quality monitoring	OLCI SLSTR
Land	Fast Track FP7 Land Monitoring Core Service (LMCS)	LMCS_005 - Seasonal/annual land change monitoring: Africa wall-to-wall (MR& LR)	OLCI SLSTR SYN (OLCI+SLSTR)
Land	Fast Track FP7 Land Monitoring Core Service (LMCS)	LMCS_006a – Europe, continuous wall-to-wall coverage (MR)	OLCI
Land	Fast Track FP7 Land Monitoring Core Service (LMCS)	LMCS_006b – Globe wall-to-wall coverage (LR)	OLCI SLSTR SYN (OLCI+SLSTR)
Land	GMES Service Element (GSE) / Global Monitoring for Food security	LGSE_001 – Global Monitoring Food Security: Crop mapping: Africa selected areas (HR)	SYN (OLCI+SLSTR)
Land	GMES Service Element (GSE) / Global Monitoring for Food security	LGSE_002 – Global Monitoring Food Security: – Early Warning & hot-spot analysis	OLCI SYN (OLCI+SLSTR)
Land	GMES Service Element (GSE) / Polar View: snow monitoring	MGSE_013 – Polar View: Snow Monitoring – Euro-Russian Arctic (LAND)	OLCI
Land	GMES Service Element (GSE) / Polar View: snow monitoring	MGSE_014 – Polar View: Snow Monitoring – Central Europe (LAND)	OLCI
Land	GMES Service Element (GSE) / Polar View: snow monitoring	MGSE_015 – Polar View: Snow Monitoring – Norway/Sweden (LAND)	OLCI
Atmosphere	FP7 Atmosphere Service (ATMS)	ATMS_001a – ESA Envisat Meris Aerosol	OLCI
Atmosphere	FP7 Atmosphere Service (ATMS)	ATMS_001b – ESA Envisat AATSR Aerosol	SYN (OLCI+SLSTR)
Land	Fast Track FP7 Emergency Response Core Service (ERCS)	ERSS_010b_Modis - Fire Monitoring at Medium Resolution (MODIS)	OLCI SLSTR

Domain	Project	Service	Applicable Payload
Land	Fast Track FP7 Emergency Response Core Service (ERCS)	ERSS_011a - Volcanic events outside Europe	OLCI SLSTR
Land	Fast Track FP7 Emergency Response Core Service (ERCS)	ERSS_013b - Volcanoes in Europe	OLCI SLSTR
Land	Security Pilot FP7 Project (SEC)	SEC_003a – Critical assets monitoring	OLCI SYN (OLCI+SLSTR)
Land	Security Pilot FP7 Project (SEC)	SEC_003b – Critical assets event assessment	OLCI SYN (OLCI+SLSTR)

V. Design Drivers

The Sentinel-3 PDGS development must integrate a number of key technical drivers, including:

- The Near Real Time data latency of 3 hours after sensing for most products, which puts a significant constraints on the system performances;
- The high data rates and volumes, as the Sentinel-3 satellite will be able to transmit data on ground over two X-band channels at a net rate of 260 Mbps per channel, for a net data rate of 520 Mbps;
- Two identical satellites in operation, with S3B launched circa 18 months after S3A, requiring the system to be easily upgradable for S3B and support parallel operations;
- Long term operational mission duration , with a nominal mission duration is 7 years (+5) for each satellite.
- The applicable GMES ESA Data Policy.
- Distributed centre locations on six sites, which requires careful configuration control.
- Long term data preservation of 25 years after the end of the mission.
- Minimisation of operational costs through automation and effective MMIs.
- Systematic instrument acquisition fully driven by a pre-defined plan based on events (geographic zones, day or night, etc.).
- Routine mission planning implementing the need of the relevant GMES services supported by the mission with no user order required to drive the satellite's activities.
- Data processing chain entirely data driven, in a sense that each level of processing is triggered as soon as all the data (satellite data and auxiliary data) required for it to take place are available.
- Systematic Dissemination through a subscription mechanism, whereby the users subscribe to data sets, which are then automatically and systematically delivered.

VI. Sentinel-3 PDGS Deployment

The Sentinel-3 PDGS functions are distributed across a number of centers and locations, as illustrated in Figure 3, where the processing and archiving functions are further decomposed.

- A Primary Core Ground Station (CGS) at Svalbard, providing X–Band service, and where the acquisition and ingestion function is deployed, together with the NRT processing chains for the Land products.
- A Backup CGS that provides a backup X-Band service covering for planned unavailability of the Prime CGS X-Band service.

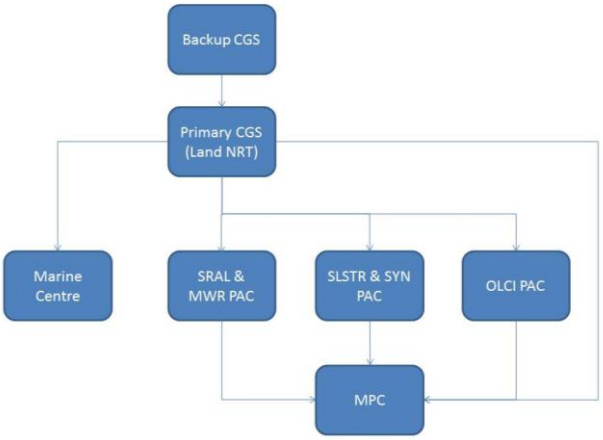

Figure 3. Sentinel-3 PDGS Centers. *The diagram depicts the center layout and the main data flows.*

for the NTC production of the OLCI products.

- A Land PAC for the NTC production of the SLSTR and SYN products.
- A Land PAC for the STC/NTC production of the SRAL and MWR products.
- A Mission Performance Centre hosting the Mission Performance Monitoring function for Land products
- A Marine Centre hosting the NRT and STC/NTC production for all Marine products, as well as their own Mission Performance Monitoring function.

Specific platforms are deployed at the centers to support different activities: operational platform for the routine operations, reference platform for validation, reprocessing platform to support reprocessing campaigns, and development platforms to support maintenance and evolution of the system.

Figures 4 to 6 illustrate the functions deployed on the operational platforms of the Prime CGS, Marine Center, and a Generic Land PAC.

VII. Technical Approach

The development of the Sentinel-3 PDGS relies heavily on the re-use of services and software provided by ESA, EUMETSAT, and the VEGA Consortium in charge of the development and integration of the core PDGS.

The PDGS functions are implemented by components and services as illustrated in Table 2. The components are then integrated into platforms and

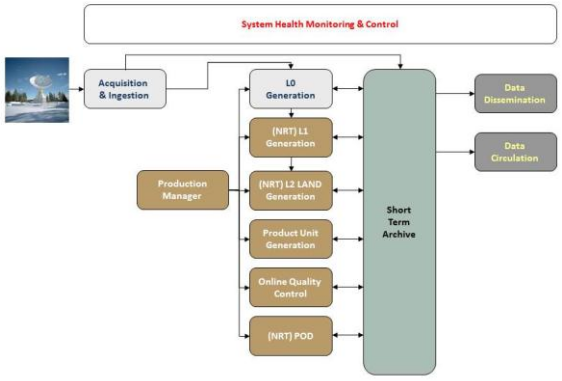

Figure 4. PDGS Function at CGS.

- A Land Processing and Archiving Centre (PAC)

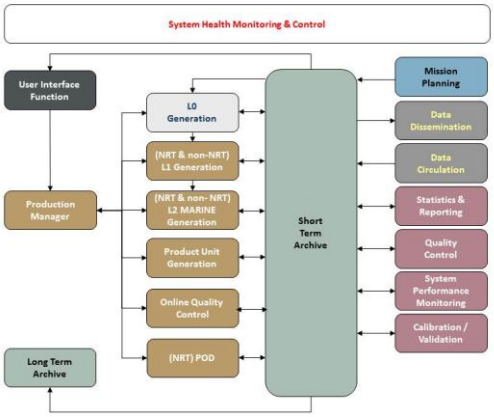

Figure 5. PDGS Functions at Marine Center.

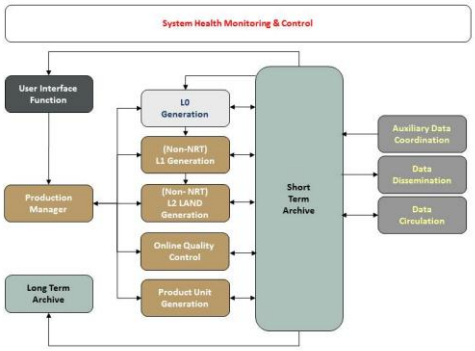

Figure 6. PDGS Functions at Land center.

centers. The cost-effectiveness and safety of the solution is ensured by re-use at several levels:

- ESA and EUMESAT provide to the project CFI's and services for the functionality that can be shared across the missions, or for development whose criticality and close dependency on other elements of the mission requires the direct involvement of the Agencies.
- The development Consortium relies on a solution that takes full advantage of the re-use of components developed in other ESA projects to implement the core of the system.

Table 2 provides the list of services and components implementing each function of the PDGS. The components are characterized by their level of re-use. Only the components that are mission specific (such as the processors) are actually new development.

Table 2. Sentinel-3 PDGS Implementation. *The table gives the type of the implementation in terms of service, CFI component, Re-used component, or New development.*

Function	Implementation	Type	Description
Acquisition and Ingestion	X-Band Acquisition Service	Service	The X-Band Acquisition Service will be procured according to an ICD and Service Requirements that are defined by the project.
	DFEP	CFI	The Demodulator and Front-End Processor (DFEP) is shared by all Sentinel missions, and is provided by ESA for integration into the Prime and Backup CGS.
	Direct Data Capture	Re-use	The Direct Data Capture (DDC) is used to capture the downlink stream coming from DFEP and to write it on the local storage area.
	Level 0 Pre-processor	Re-use	The Level-0 Pre-Processor component is in charge of reading the incoming VCDU/ISP data and the generation of sorted and merged ISP granules for higher level processing.
	NRT Acquisition Pipeline	Re-use	This component reacts on the arrival of ISP/VCDU data (dumped on disk by the DDC). It initiates a workflow to manage the Level-0 pre-processor and to circulate the granules to the respective inbox of the processing management layer in order to drive L0 processing.
Processing	Production Control	Re-use	The Production Control (PC) is a workflow engine driving the Processing Management (PM) and the Product Distributor (PD). PC can initiate workflows based on the occurrence of a certain event or the combination of several events.
	Processing Management	Re-use	The Processing Management (PM) manages Instrument Processing (IPFs), maintains a queue of processing requests and schedules the data processing i.e. the execution of the IPFs.
	Level 0 Processor	New Dev	The Level-0 Processors (L0P) is used for the generation of L0 products from ISPs and Auxiliary products.
	Level 1 Processors	New Dev	The Level-1 Processors (L1P) are used for generation of L1 products from L0 and Auxiliary products.
	Level 2 Processors	New Dev	The Level-2 Processors (L2P) are used for generation of L2 products from L1 and Auxiliary products.
	Product Unit Generation	New Dev	The Product Unit Generation (PUG) is used within a processing workflow to slice or merge L1 or L2 products in order to generate Product Dissemination Units (PDU) like Frames, Stripes

Function	Implementation	Type	Description
			etc. which are provided to the end user. It includes Browse Products generation.
	NRT POD	CFI	The NRT POD acts as a processor, and provides precise orbit data to the PDGS for NRT processing.
	POD Service	Service	The POD Service provides precise orbit data to the PDGS via the Auxiliary Data Coordinator for STC/NTC processing.
Auxiliary Data Coordination	Auxiliary Data Coordination	Re-use	The Auxiliary Data Coordination (ADC) provides auxiliary data from external auxiliary data providers in a co-ordinated fashion. It is based on the re-use of the OCADA system, tailored to the Sentinel 3 auxiliary data providers and S3 PDGS requirements.
Archiving, Storage and Inventory	Data Import	Re-use	The Data Import (DI) component receives files (products, reports etc.) for ingestion into the Inventory (INV) and Data Storage (DS). It extracts the metadata to be stored in the Inventory and produces the internal data structures used to inventory the received data.
	Inventory	Re-use	The Inventory (INV) is responsible for maintaining product metadata and references of the products stored in each S3 PDGS platform archives.
	Data Storage	Re-use	The Data Storage (DS) acts as a unified interface to Short Term Archive (STA) and Long Term Archive (LTA). Moreover, it also manages the transfer of data from STA to LTA.
	Product Distributor	Re-use	The Product Distributor (PD) is responsible for the management of circulation of data/products which have been archived. PD can initiate workflows based on the occurrence of a certain event or the combination of several events.
	LTA Service	Service	Each Land Centre provides its Long Term Archiving Service for the products generated at the centre.
	U-MARF	Service	The EUMETSAT UMARF is integrated as a service for long term data storage at the Marine Centre at EUMETSAT.
Data Circulation	Data Circulation	Re-use	The Data Circulation (DC) component provides interfaces that can be used by other PDGS components for circulating data/products among them. Circulation also contains transfer between centres.
Data/Product Dissemination	EUMETCast	Service	EUMETCast is the EUMETSAT generic Multi Mission dissemination system based on the standard DVB-S multicast technology. EUMETCast is the main dissemination mechanism for distribution of data to EUMETSAT's end users.
	Online Data Access	Re-use	The Online Data Access (ODA) provides a fully transparent unified, clean and multi-protocol access point to Sentinel-3 products for the user. The details about the physical location of the products at the respective pickup-points are hidden from the user.

Function	Implementation	Type	Description
User Service Interface	ESA MM User Services	Service	The ESA Multi-Mission User Services provides the user interface functionality for the Land Centers. The service defines a set of generic interfaces that are tailored for the Sentinel 3 case. The interface contains elements for the submission of product metadata and for the request of data from the Land Center.
	EUMETSAT User Services	Service	The EUMETSAT User Services will be integrated based on ICDs to be jointly defined with the Agency based on existing ICDs provided by EUMETSAT. The EUMETSAT User Services interact with U-MARF to provide their full functionality. For V1 a simulated service will be used.
	User Service Interface	New Dev	The User Services Interface (USI) interacts with the ESA and EUMETSAT user services as well as the Coordinated Data Access system (CDS). It therefore acts as a link between the S-3 PDGS and the user communities.
Mission Planning	Mission Planning	CFI	The Mission Planning (MP) is a specific development that is provided for integration to the Marine Center as a CFI.
System Health Monitoring & Control	GEMS	CFI	The EUMETSAT GEMS allows sending events to a Generic Event-Monitoring Server, and is provided as a CFI for system health monitoring of the complete PDGS.
	GS M&C	Re-use	The GS M&C (MC) supports remote and local monitoring of various hardware resources and supports various protocols to control and monitor the state of other software components.
	Operating Tool	Re-use	The Operating Tool (OT) is a graphical unified user interface for the following components: PM, PD, PC, USI, DI, INV.
Mission Performance Monitoring	Online QC	New Dev	The OnLine-QC (OLQC) is used within the processing workflow to perform basic quality checks on L0, L1 and L2 products.
	MPM Facility	New Dev	The MPM Facility (MPMF) is in charge of: • performing a detailed level of quality checks on all the S-3 scientific products (L0, L1, and L2) as well as on the auxiliary products and provides reports to interpret the quality of the product. • allowing the execution of calibration/ validation algorithms to monitor the instruments and S-3 products. It provides reports detailing the results of monitoring activities. • monitoring the processing and dissemination performances with respect to the product availability to satisfy different timeliness categories (NRT, STC, and NTC).
Statistics & Reporting	Statistics & Reporting	New Dev	The Statistics and Reporting (S&R) gathers various types of information generated by the Mission Performance Monitoring Facility (MPMF) and components, and uses it to calculate statistics and generate reports to be sent to different entities.
Maintenance Support	Maintenance & Support	Re-use	The Maintenance Support (MS) provides tools for configuration management of hardware, software and documentation as well as anomaly reporting.

VIII. Summary and Conclusion

The cost-effective and safe development of the Sentinel-3 PDGS relies on a procurement approach and a technical solution that benefit from the re-use of proven components in line with the architecture for the Sentinel programmes. In addition to the CFIs provided by the Agency to implement or support the development of some PDGS functions, the solution relies on COTS deployed in the context of other missions and proven in operation; software elements developed in the context of other ESA missions by the Consortium partners, and adapted to be integrated in the Sentinel-3 PDGS; and concepts developed by ESA for the development of other missions' PDGS, and in the context of studies prior to the development of the Sentinel PDGS's.

The implementation of the Near Real-Time processing chain draws on Consortium heritage in the development of data-driven NRT processors based on processing pipeline.

The solution relies on an effective approach to data-driven processing. Managed data-driven processing is based on a data flow accompanied by management and requests that can be visualized and followed from one component to the next. The solution selected for the processing management allows for flexible configuration of the workflow.

The component-based approach ensures the scalability of the solution, where distributed components that can be configured, instantiated and deployed any number of times to implement the functionality of the various centers.

The solution is adaptable and will support future technology evolution through upgrades of the system on a per component basis, and minimization of the use of proprietary interfaces and protocols. The component interfaces rely on standard protocols and ESA and EUMETSAT interfaces and protocols are used whenever possible.

Acknowledgments

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