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EUMETSAT Data Processing as Services: Preparing for the future missions

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Abstract

To date, EUMETSAT's Payload Data Processing (PDP) systems used for our operational mission serving critical data for half a billion of end users have been bespoken solutions, necessitating substantial effort in both development and operational preparations. The PDP facilities are specifically tailored for each mission, with a close integration of all the system including the scientific development of the data processors. This results in powerful systems but leads to complex and costly maintenance, with limited synergies between different missions. While this approach was suitable for large-scale missions in the past, it presents challenges for future missions.

This paper describes EUMETSAT current efforts to address the needs of future missions, going towards a multi-mission service-oriented architecture for data processing, creating the Core PDP: a framework to use as the foundation in the data processing solution for EUMETSAT mandatory and EUMETSAT-participated Copernicus missions.

The success reached in Jason-CS / Sentinel 6 by reusing key assets, demonstrated the feasibility and desirability of having a set of reusable elements for new missions. The solution adopted for the Core PDP is modular and following a strict Integration, Verification and Validation plan. It has a lightweight, well-defined REST interfaces that facilitates integration for new missions and all common infrastructures of EUMETSAT. This clear interface and modularity have also enabled partial adoption of the Core PDP for evolutions of existing missions, simplifying the transition to the new concept.

All modules are developed using Continuous Integration and Continuous Deployment (CI/CD) and containerization, shortening the maintenance cycle and allowing to quickly create prototyping versions of a full PDP to decouple scientific processors development and the preparation of the complete PDP infrastructure

The computational cluster is handled using HTCondor, a robust and widely adopted solution within the high throughput computing community. Alternative backend modules, such as Kubernetes, can be employed based on specific use case requirements.

The result is an ongoing harmonisation of EUMETSAT's response for future missions with improved efficiency and cost-effectiveness in the provision of data processing services, adaptable to different sized missions.

The Core PDP solution is already used in the development of CO2M PDP and will be operational during 2025 in the frame of EPS-SG Cal/Val activities. Additionally, other projects such as EPS-Sterna are set to adopt this solution.

The paper presents a comprehensive overview of how this strategy can lead to a reduction in the total cost of ownership. This encompasses maintenance, the transition to operational status, and the optimization of system upgrades.

Keywords: Data Processing, Service Oriented, Future Missions, Modular Framework, Multi-Mission

Acronyms/Abbreviations

CIMR: Copernicus Imaging Microwave Radiometer
CO2M: Copernicus CO2 Monitoring
CRISTAL: Copernicus Polar Ice and Snow Topography Altimeter
DAG: Directed Acyclic Graph
DID: Data Ingestion and Distribution
EARS-NG: EUMETSAT Advanced Retransmission Service - Next Generation
EPS-SG: EUMETSAT Polay System Second Generation
IPF: Instrument Processing Facility
LMC: Local Monitoring and Control
MMEPI: Multi Mission Element – Processing Infrastructure
MSG: Meteosat Second Generation
MTG: Meteosat Third Generation
PDP: Payload Data Processing
PF: Processing Framework
PMON: Production Monitoring
T-GPS: Temporary Ground Processing System

1. Introduction

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) plays a pivotal role in monitoring weather, climate, and environmental changes from space, providing critical data to meteorological services and climate researchers worldwide. EUMETSAT's satellite data processing infrastructure must be highly reliable, scalable, and efficient to ensure timely delivery of meteorological and environmental information.

EUMETSAT operates multiple Payload Data Processing (PDP) facilities, supporting both Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) missions. From at all these facilities it is possible to deduce a generalized system model that incorporates distinct components for:

- product and data circulation and distribution
- production chain orchestration
- production state monitoring (e.g., timeliness, completeness)
- infrastructure component control for operational event response
- computational nodes for data processing execution.

Historically, mission-specific PDP implementations provided powerful solutions, but have exhibited limited reusability, hindering tool transfer and knowledge dissemination between projects, increasing development and maintenance complexity. The Jason/CS mission successfully reused from EPS the Processing Framework (PF) demonstrating the feasibility of reusing the Orchestrator and the benefits for the project.

To address these challenges, the Core Payload Data Processing (Core PDP) framework was developed. Core PDP provides a standardized architecture for constructing mission-specific PDP systems, leveraging a shared set of modules and a unified administration interface to minimize development overhead and streamline operational maintenance. The framework comprises core modules, each addressing a specific aspect of the generalized system model, integrated within a CI/CD pipeline. Furthermore, a suite of tools facilitates rapid prototyping for new missions and the evolution of existing systems.

A strategic version management approach is employed to mitigate operational version proliferation, incorporating mechanisms for seamless component migration. This strategy balances standardization with the need for agile hotfix support during critical mission phases (e.g., launch, commissioning).

2. Core PDP structure

The Core Payload Data Processing (Core PDP) framework is structured as a set of modular components, engineered for independent deployment and utilization. The principal Core PDP components include:

- Data Ingestion and Distribution (DID)
- Mission Monitoring, Execution, and Processing Infrastructure (MMEPI)
- Production Monitoring (PMON)
- Local Monitoring and Control (LMC)
- Computational Cluster (HTCondor)

A key advantage of this modular design, facilitated by well-defined interfaces, is the ability to incrementally transition existing missions to the new infrastructure, minimizing adoption costs and operational disruptions.

All the elements are built in a “multi-mission, multi-satellite, multi-instrument” approach (i.e. they are completely agnostic of any specificities of these elements) to facilitate the usage in each mission. The model abstraction introduced with this approach also facilitates transferring improvements detected in the frame of a mission to the others.

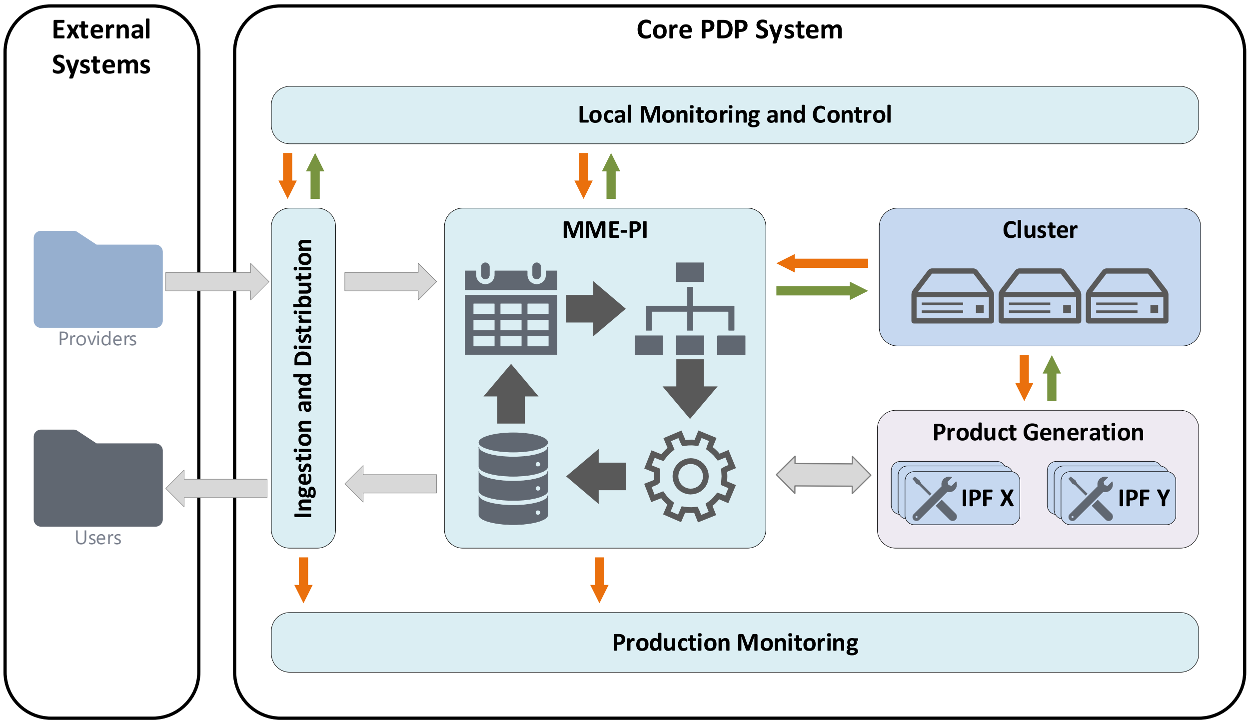


Fig. 1 Schema of the Core PDP main components

2.1 DID: Data Ingestion and Distribution

The Data Ingestion and Distribution (DID) component facilitates product transfer between the PDP system and external entities. Employing generic low-level protocols, the DID is capable of interfacing with diverse external systems, such as institutions providing FTP-based access. Notably, the component is optimized for seamless integration within the EUMETSAT ecosystem, affording enhanced operational advantages.

During the ingestion phase, the DID incorporates lightweight validation and reformatting capabilities, serving as an initial safeguard against corrupted or anomalous auxiliary data files.

Reformatting operations are intentionally restricted to fundamental transformations, including compression format conversion and file renaming to align with mission-specific naming conventions. This constraint aims to maintain data processing control within dedicated processing modules.

Validation procedures are limited to basic sanity checks, such as string presence verification and XML/JSON schema validation, avoiding complex product-specific analyses.

In the distribution phase, the DID manages transparent data replication and multi-client transfer, functioning as a centralized hub for circulation rule enforcement. This phase also allows for the application of transformation rules, analogous to those employed during ingestion.

The DID leverages the EUMETSAT File Transfer System (EFTS) Agents, a software suite validated across multiple operational missions, which supports a wide range of transfer protocols, including FTP (FTPS, FTES), SFTP, and filesystem-based operations (e.g., copy, hard link, move).

2.2 MMEPI: Multi Mission Element Processing Infrastructure

The processing Infrastructure constitutes the core component of the PDP, functioning as a production orchestrator composed using a set of loosely coupled sub-modules.

Production initiation is event driven, allowing for data-driven, time-driven productions and even externally generated triggers (e.g. events generated from flight dynamic information or user requests)

Mission-specific processing logic is encapsulated within configurable workflows, enabling individual mission teams to implement their unique processing requirements. The most common scenario is a Task Table with the selection rules to provide the inputs to the data processor, but the MMEPI design allows complex data flows as detailed in the WFM section 2.2.4.

The interface between the Processing Infrastructure and data processing elements is standardized, utilizing established UNIX interfaces (standard streams and status codes) and a single job file conforming to an Interface Control Document (ICD). This simplified and robust protocol facilitates the development of new processing elements, enabling development teams to integrate processors directly into their Continuous Integration (CI) pipelines.

Inter-module communication is done using an internal REST API that allows to install each one in different nodes. This architecture supports independent scaling and resource allocation, accommodating diverse mission requirements. Configurations range from single-machine deployments for rapid development to distributed deployments across container orchestration platforms, such as Kubernetes, for operational scalability.

2.2.1. Monitoring & Control (MC)

This sub-component collects activity events from all the other MMEPI elements and exposes them to external monitoring tools (like the LMC and PMON)

The most important constraint in the MC design is the responsiveness, to not block the processing chain while the information coming from the other components is collected. This is achieved relying in the solidity of the PostgreSQL database to handle simultaneous insertions and deletions without performance loss.

It also exposes a common REST API to perform actions in the system, but the main objective of this component is to be robust and as simple as possible, so it is limited to expose safe actions for the operator (e.g. enable or disable a scheduler, cancel a job)

2.2.2. Rolling Archive (RA).

This sub-component of the MMEPI provides temporary storage for elements necessary for continuous production processes. This component abstracts the storage solution from other MMEPI modules, managing all production-related storage operations.

Metadata extraction from products is a core function of the RA. The standard configuration offers mission teams robust tools for extracting metadata directly from product filenames using pattern matching or regular expressions. Furthermore, missions can extend existing metadata extraction capabilities through in-depth product inspection, such as Quality Assurance (QA) analysis using a plugin interface, based on inheritance.

The RA provides an endpoint for querying products based on predefined selection policies. Like metadata extraction, the default deployment offers a set of selection policies that mission teams can extend by extending and customizing existing policies.

Data rolling is performed according to configurable criteria, including total storage size, file count, and product age, prioritizing the removal of least-utilized products. A two-stage deletion process is implemented to prevent the premature removal of frequently accessed files and to provide an operational safety net. This approach ensures that product unavailability is detected prior to permanent deletion.

The RA is designed to use POSIX-compliant file system as well as object storage solutions, providing flexibility in storage infrastructure.

2.2.3. Scheduler Management (SCM)

The Scheduler Manager controls the initiation of diverse workflows based on received event notifications.

The component natively supports common event types, including:

- data-driven events reported by the RA
- external events received via a REST API
- time-driven events, based on calendrical or periodic expressions.

Furthermore, a plugin architecture facilitates integration with alternative event sources, such as orbit-based events provided by flight dynamics facilities.

Mission teams define event-to-workflow associations using schedules, defined in files easily readable by the operators. These schedules enable the mapping of one or more events, selected through customizable filters, to the execution of one or more workflows. During operational phases, individual schedules can be dynamically enabled or disabled to accommodate non-nominal conditions.

2.2.4. Workflow Management (WFM).

This sub-component handles the execution of the workflows. A workflow defines the set of Tasks to be run (i.e. Processing Functions, which include algorithm Processors or any other type of housekeeping activity), how they are linked together (the order in which they are executed) and dependencies among them.

Each workflow is an independent function that uses a python module to dialogue with the WFM, to request the result of a selection policy at the RA or the execution of a task in the RM.

Workflows are designed as comprehensive programs capable of implementing complex processing logic, encompassing multiple interconnected tasks and extending beyond DAG production schemas. As an example of a complex workflow, it is simple to implement a flow that waits for a complete download of the sensing data while under certain conditions is able to process using a different processor if some data gaps are present. This kind of flow is complex to write it as a DAG diagram.

2.2.5. Resource Management (RM)

The Resource Manager sub-component serves as an intermediary between the MMEPI system and computational clusters. It facilitates parallel utilization of multiple computational clusters, employing a priority queue policy to determine the appropriate backend and resource allocation for each task requested by the WFM.

The RM architecture is designed around a "backend" abstraction, simplifying integration with existing computational environments through a thin adaptation layer.

This component can generate execution snapshots of tasks in the event of execution failures, enabling post-hoc analysis by processor maintainers. Furthermore, the RM can produce execution reports for external monitoring tools, eliminating the need for direct access to operational areas.

2.3 Computational Cluster

The design of the Core PDP allows to use different solutions for the cluster management (even simultaneously) although up to now the two solutions used are:

- Kubernetes, as a well-known container orchestration platform to manage a distributed system.
- HTCondor, a leading solution in the sector of High Throughput Computing, extensively used in scientific community.

Any of the cluster management solutions provides the capacity to manage the resources independently of the production, allowing to drain, replace or prioritize the usage of individual nodes without impacting the rest of the PDP.

They enable also the usage of computational clusters where a subset of the nodes has GPU-enabled processing capabilities, a requisite of many new data processors.

The preferred solution is HTCondor, as its computational model fits better the kind of workload that the EUMETSAT missions require but having the possibility of using any of the backends provide a useful flexibility to respond to the computational needs of the new missions.

The data processors are usually packaged as container images (i.e. docker images) as it provides many advantages in the development and integration of these components. However, to facilitate the integration of existing systems designed to have the data processors deployed directly in the processing nodes, HTCondor offers the advantage of handling this scenario transparently.

2.4 PMON: Production Monitoring

The Production Monitoring (PMON) component provides real-time monitoring of mission product generation, encompassing the full lifecycle from input data ingestion to the distribution of generated products and auxiliary data to ground segment entities. A web-based user interface facilitates operational oversight, enabling operators to track production completeness and timeliness.

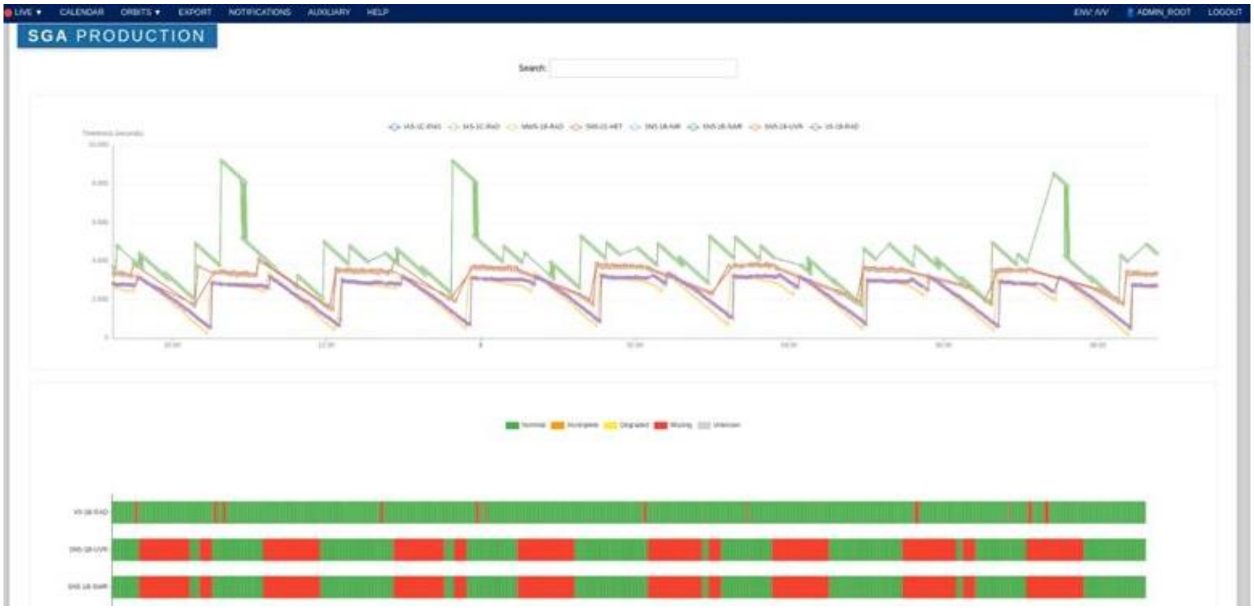


Fig. 2 PMON Screenshot for T-GPS

Completeness monitoring focuses on the presence of expected data at each processing stage and the system can generate alerts in response to anomalous data presence.

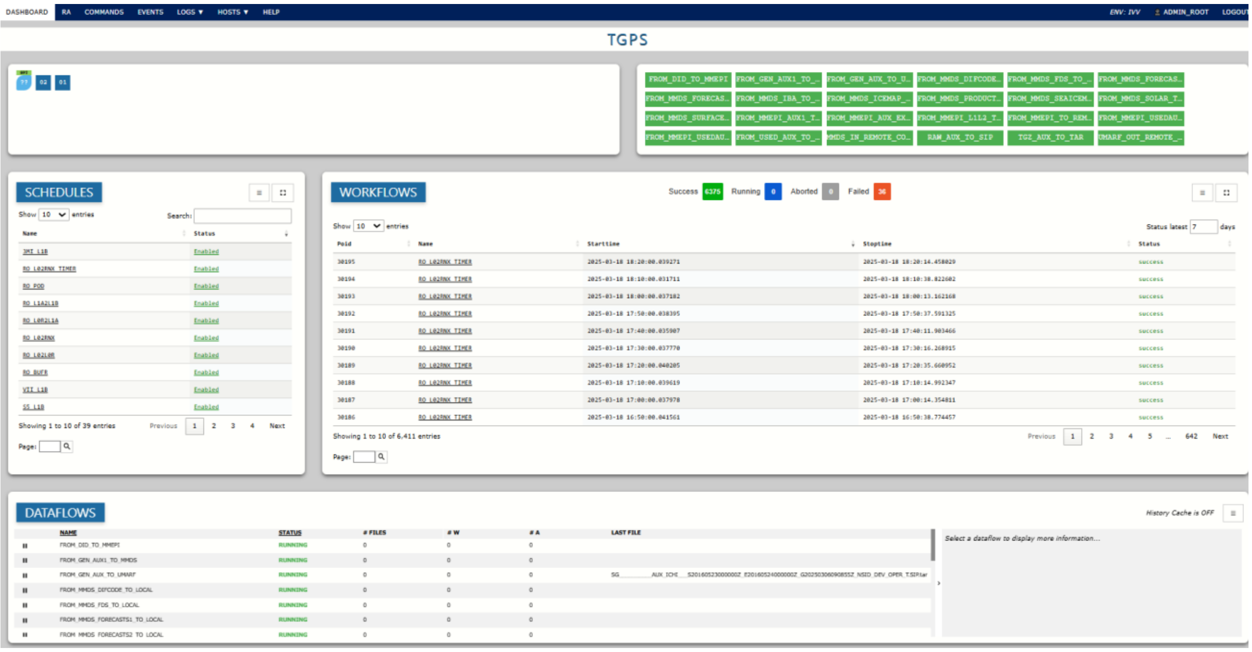
Timeliness monitoring assesses adherence to production delivery schedules, quantifying the system's ability to deliver data within specified deadlines or real-time requirements.

PMON also provides a real-time, qualitative assessment of production quality focused on the immediate needs of the operations team. This functionality aims to provide a high-level, synthetic overview of product content, enabling operators to evaluate product status qualitatively.

The PMON system facilitates the export of data acquired from the PDP into a variety of report formats. These range from simple data serialization in CSV or JSON to more sophisticated, templated reports generated using Jinja2, especially useful for the periodic reporting requirements of the Operations team.

2.5 LMC: Local Monitoring and Control

This component collects in real-time the state of the critical components of the PDP -mainly DID and MMEPI- and provides the operator a quick view of the health status of the system. It also provides access to the most common operator inquires, like the different services status and logs.



SCHEDULES

Show 10 entries Search:

Name	Status
3MI_L1B	Enabled
RO_L02RNX_TIMER	Enabled
RO_POD	Enabled
RO_L1A2L1B	Enabled
RO_L0R2L1A	Enabled
RO_L02RNX	Enabled
RO_L02L0R	Enabled
RO_BUFR	Enabled
VII_L1B	Enabled
SS_L1B	Enabled

Showing 1 to 10 of 39 entries Previous 1 2 3 4 Next

Page:

WORKFLOWS

Success 6375 Running 0 Aborted 0 Failed 36

Show 10 entries Status latest 7 days

PoId	Name	Starttime	Stoptime	Status
30195	RO_L02RNX_TIMER	2025-03-18 18:20:00.039271	2025-03-18 18:20:14.458029	success
30194	RO_L02RNX_TIMER	2025-03-18 18:10:00.031711	2025-03-18 18:10:38.822602	success
30193	RO_L02RNX_TIMER	2025-03-18 18:00:00.037182	2025-03-18 18:00:13.162168	success
30192	RO_L02RNX_TIMER	2025-03-18 17:50:00.038395	2025-03-18 17:50:37.591325	success
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30190	RO_L02RNX_TIMER	2025-03-18 17:30:00.037770	2025-03-18 17:30:16.268915	success
30189	RO_L02RNX_TIMER	2025-03-18 17:20:00.040205	2025-03-18 17:20:35.660952	success
30188	RO_L02RNX_TIMER	2025-03-18 17:10:00.039619	2025-03-18 17:10:14.992347	success
30187	RO_L02RNX_TIMER	2025-03-18 17:00:00.037978	2025-03-18 17:00:14.354811	success
30186	RO_L02RNX_TIMER	2025-03-18 16:50:00.041561	2025-03-18 16:50:38.774457	success

Showing 1 to 10 of 6,411 entries Previous 1 2 3 4 5 ... 642 Next

Page:

DATAFLOWS

NAME	STATUS	# FILES	# W	# A	LAST FILE
FROM_DID_TO_MMEPI	RUNNING	0	0	0	
FROM_GEN_AUX1_TO_MMDS	RUNNING	0	0	0	
FROM_GEN_AUX_TO_UMARF	RUNNING	0	0	0	SG_________AUX_ICHI___S20160523000000Z_E20160524000000Z_G20250306090855Z_NSID_DEV_OPER_T.SIP.tar
FROM_MMDS_DIFCODE_TO_LOCAL	RUNNING	0	0	0	
FROM_MMDS_FDS_TO_LOCAL	RUNNING	0	0	0	
FROM_MMDS_FORECASTS1_TO_LOCAL	RUNNING	0	0	0	
FROM_MMDS_FORECASTS2_TO_LOCAL	RUNNING	0	0	0	

Select a dataflow to display more information...

Fig. 3 LMC Screenshot for the T-GPS mission

The LMC has a client-server architecture. It uses a collection of Widgets that connect to the different PDP components (namely the MMEPI and DID) and retrieve information that is sent to the LMC server. This information is then parsed, stored and presented to the user in a web-based interface.

It also provides control capacity over the other components, focusing on the most common actions that the operator performs with safety.

2.6 Integration functionality

To facilitate the development and integration of Core PDP systems across diverse missions, a suite of non-operational elements is provided, essential for the evolution and maintenance of Core PDP-based implementations.

Firstly, a comprehensive integration with a GitLab CI/CD pipeline is implemented, adhering to a strict "tested-is-deployed" methodology. The pipeline is structured to generate installation artifacts (primarily RPM packages) conforming to EUMETSAT librarian policies. These artifacts are subsequently installed within a virtual environment, and automated tests are executed against the deployed components. Only upon successful completion of all automated tests are the artifacts published internally for use in nominal integration, verification, validation, and operational environments.

Secondly, the PDP Sandbox provides a Docker Compose-based infrastructure, enabling the creation of micro-PDP instances on a single machine for rapid assessment of data circulation and workflow functionalities using simulated processors. This facility empowers mission teams to prototype new missions or system evolutions via a web interface, even prior to deployment in a development environment, thereby reducing planning effort. It also serves as a critical tool for component development teams, enabling the detection of integration issues prior to software release to EUMETSAT, shortening and making more cost-effective the system integration phases of Core PDP.


Drop service 'drop AUX new name' is now enabled

Fig. 4 PDP Sandbox sample

The PDP Sandbox tool offers flexibility in simulated environment configuration, allowing for the creation of diverse application layouts that replicate the specific component groupings employed in individual missions.

It is even possible to connect the simulated environment to a real computational cluster, to perform rapid assessment with real data processors.

2.7 Configuration management

A significant challenge for a system designed for multi-mission support lies in managing the proliferation of operational software versions. The employed strategy must incentivize consistent system updates while accommodating mission-specific requirements, such as version freezes during launch campaigns.

Fig. 5 Core PDP Versioning

The Core PDP utilizes a dual versioning scheme to address this challenge:

- Components adhere to a standard semantic versioning scheme (X.Y.Z), ensuring strict backward compatibility in API, configuration and behaviour within patch (Z) increments
- The Core PDP itself follows a Calendar versioning scheme (YYYY.n) with a low release cadence (nominally one annual release, with an optional mid-cycle release). Each release integrates a set of components that have undergone comprehensive compatibility testing. They are fixed by the minor versions (X.Y) and includes any patch release.

This strategy offers several advantages for operational teams and system maintainers. Operational teams have a stable baseline to track in the procedures while system maintainers can incorporate an annual alignment with the latest Core PDP release in their system maintenance plans. Release notes from the Core PDP facilitate efficient identification of necessary modifications.

Mission-specific deviations, such as skipping a Core PDP release, are managed through coordinated planning with Core PDP product owners, ensuring support for hot-fix releases and a subsequent update strategy.

This closed-loop cycle promotes the dissemination of best practices and lessons learned across missions, and the strict backward compatibility policy simplifies proactive system adjustments by mission teams.

3. Use Cases

Core PDP framework is currently deployed within EUMETSAT for several missions nearing operational status and serves as the foundational system for upcoming mid-term missions. It functions also as a rapid assessment tool for long-term missions in early development, enabling preliminary evaluations of production complexity and resource requirements.

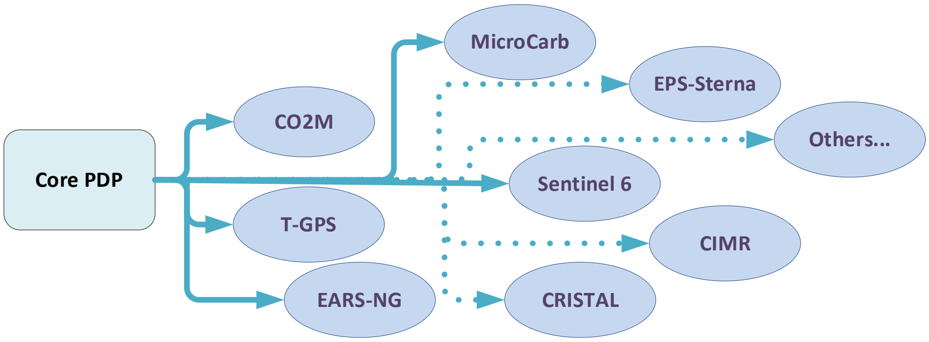

Fig. 6 Diagram of some of the Core PDP based developments

All the developments are done using small groups with direct communication with the Core PDP team. This working schema improved the feedback provided to the data processors providers and the System Operation team.

3.1 Short-term Missions

The following missions are going to enter in their operational phase in the next months:

- MicroCARB: aims to precisely measure global carbon dioxide (CO2) distribution to enhance understanding of the Earth's carbon cycle. The launch date is foreseen for 2025. This is the first mission to use the Core PDP structure except for the MMEPI, that uses a custom Processing Facility reused from Jason/CS and EPS.
- EPS-SG T-GPS: A Temporary Ground Processing System to support EPS-SG commissioning and CAL/VAL activities. Core PDP allowed to create a quick and cost-efficient parallel processing facility to complement the nominal chain in few months and with the required flexibility for a commissioning phase. The launch date for MetOp-SG-A1 is foreseen for August 2025.
- EARS-NG: The reengineering of the EUMETSAT Advanced Retransmission Service uses the Core PDP, integrating information from multiple stations and satellites with thigh timeliness constraints.

3.2 Medium-term Missions

These are missions that are in their development phase, using Core PDP as their baseline for the processing facility

- The CO2M mission aims to monitor human-caused carbon dioxide emissions by precisely measuring atmospheric CO2 concentrations, providing data to support climate policy and track progress towards emissions reduction goals. It uses the full set of Core PDP Components to support a production chain with challenging constraints in data volume and computational resources needed to reach timeliness. The standard interface with the data processors facilitated the development, verification, and integration workflows. Using HTCondor provided the necessary scalability to expand the hardware platform in parallel with the mission development needs.

- The Jason-CS mission provides high-precision measurements of sea surface height to monitor global sea level rise and support ocean forecasting. During the Re-engineering activities to address system obsolescence, the production orchestrator is planned to be replaced with the MMEPI and LMC. The modular design of Core PDP allows the replacement of inner critical components maintaining the current production monitoring and data collectors.

3.3 Long-term Missions

EUMETSAT has several missions in early phases of development, where the Core PDP is providing quickly responses the foreseen resources needed for production. It is expected that these missions will use the Core PDP solutions in their operational phase, driving the Core PDP evolution to fully support them is necessary.

- The EPS-Sterna mission is a future EUMETSAT constellation of microsatellites designed to enhance numerical weather prediction by providing improved global temperature and humidity observations through advanced microwave sounding.
- The CIMR (Copernicus Imaging Microwave Radiometer) mission is designed to provide high-resolution, multi-frequency microwave measurements of key sea ice and sea surface parameters, including sea-ice concentration, sea-surface temperature, and sea-surface salinity, to enhance monitoring of polar regions and support climate studies.
- The CRISTAL (Copernicus Polar Ice and Snow Topography Altimeter) mission will provide multi-frequency radar altimetry to monitor and map sea ice thickness and land ice topography, contributing to improved understanding of polar climate change.

The Core PDP sandbox provided good estimations of the processing workloads expected and the synergies between the missions, showing the possibilities to share resources between them in the context of the phase A studies performed in EUMETSAT.

4. Experience and future evolutions

The Core PDP development as a product and the evolution of the components, done alongside the implementation of the initial PDP systems for EPS-SG T-GPS, EARS-NG and CO2M, with the experience from MICROCARB mission. This strategic approach will culminate in the operational deployment of these missions, commencing with EPS-SG T-GPS in 2025.

The near-simultaneous development of these PDPs highlighted the advantages of a unified CI/CD pipeline and the rapid prototyping capabilities afforded by the PDP Sandbox. Notably, issues encountered during EARS-NG development were promptly addressed within the T-GPS environment, mitigating potential developmental bottlenecks. Consequently, development teams were streamlined, enabling a focused approach to data processor integration.

4.1 Operational Benefits

The preparation of the operational teams for missions utilizing the Core PDP architecture shown significant inter-team synergies. The implementation of a standardized deployment and command logic facilitated a streamlined training process, allowing personnel to concentrate on mission-specific operational aspects. Future efforts will focus on establishing thematic PDP, organized by instrument function rather than individual satellite missions, to further optimize resource utilization and knowledge transfer.

Furthermore, the integration of the Core PDP with the EUMETSAT software librarian team structure has yielded substantial benefits in platform deployment and contingency planning. The commonality across missions enables efficient knowledge sharing and direct application of lessons learned, thereby enhancing overall system resilience and recovery capabilities.

4.2 Migration of active missions

Initially conceived for novel developments, the Core PDP framework's modular design and well-defined internal interfaces have demonstrated its adaptability to existing operational missions. The anticipated obsolescence of the processing facility for Jason-CS/Sentinel-6 presented an opportunity to implement an incremental integration strategy. A focused development team has successfully prepared the integration of the MMEPI and LMC components with the existing infrastructure. Following the operational deployment of these core components in a subsequent phase, the entire platform will transition to the Core PDP. Additionally, any component enhancements required to ensure functional parity with the current Jason-CS platform will confer benefits across all missions utilizing the Core PDP framework.

4.3 Expansion to Geostationary missions

While the Core PDP concept was initially implemented for Low Earth Orbit (LEO) missions, the successful deployments for EARS-NG and Radio Occultation missions have validated the robustness of its design. Consequently, feasibility studies are currently underway to assess the applicability of the Core PDP framework to EUMETSAT's geostationary missions, addressing their specific requirements. This effort aims to facilitate the future adoption of the Core PDP for Meteosat Third Generation (MTG) and to inform the Meteosat Second Generation (MSG) maintenance and obsolescence program, leveraging the integration strategy employed for Jason-CS/Sentinel-6.

5. Conclusions

Core PDP solution is improving the Data Processing activities of EUMETSAT by providing a common, standardised mechanism to handle Payload Data Processing infrastructure. It enhances the efficiency, avoids vendor lock-ins and secures EUMETSAT autonomy in the development of new data processing systems minimising schedule and cost risks.

This methodology has proven effective for new mission preparation, offering a cost-efficient, reusable solution and enhancing collaboration within EUMETSAT teams.

Developments like EPS-NG T-GPS has been feasible in few months with a reduced team, including an initial prototype that probed useful to address the planning. The overall impact is a reduction of 60% thanks to reusing the PDP instead of using a classical development approach.

It is also a powerful tool for the re-engineering existing missions, facilitating the migration of the different aspects of an existing PDP once at a time.

Core PDP sandbox used as a tool for rapid prototyping and testing of new technologies (e.g. usage of GPU processors) provides quick and solid assessments, showing the potential it has for future missions in EUMETSAT.

The good results and the experience acquired in the PDP developed using Core PDP shows the next step in the strategy, building "thematic PDPs" that mix different instruments from different missions sharing similar objectives and characteristics (same auxiliary files, similar orchestration, same level of complexity)

Initial candidates for this strategy include dedicated PDPs for Radio Occultation and Altimetry missions. Furthermore, plans to extend this approach to other mission profiles, such as MTG, indicate a period of significant expansion and development for the Core PDP framework.