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THE SAR/GALILEO OPERATIONNAL CONCEPT TO PROVIDE SAR FORWARD AND RETURN LINK SERVICES.

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Abstract

The SAR/Galileo Service is Europe's contribution to the international COSPAS-SARSAT MEOSAR System, which is a satellite-based Search and Rescue system allowing distress alerts detection and distribution. The service uses the protected 406 MHz frequency band and is available to maritime and aviation users or land users carrying a compatible distress beacon.

Since 2013, the French Space Agency (CNES) embodies the SAR/Galileo Data Service Provider (SGDSP) for the European Union Agency for the Space Programme (EUSPA). The SGDSP is responsible for operating the SAR/Galileo Ground Segment (SGS) to ensure the continuous provision of the SAR Forward Link (FL) and Return Link (RL) Services. It is also responsible for the continuous service monitoring and performance reporting in accordance to the minimum performance levels targets defined in the SAR/Galileo Service Definition Document.

The organization of the operations at SGDSP is framed by the EUSPA Service Provision Plan (SPP) and the associated Service Operations Procedures and Interfaces (SOPIs). This baseline documentation defines all the operational interfaces amongst the SAR/Galileo Service Provision stakeholders (SGDSP, EUSPA, European Space Agency (ESA), Galileo Service Operator (GSOp), Galileo Security Monitoring Center (GSMC), Galileo Service Center (GSC)). In this frame, SGDSP has derived a set of system level procedures that implement the interfaces with the remote entities operating the system (e.g. the hosting entities) and the different system maintainers. These procedures define the actors, interactions, data flows, timeliness and format of the exchanges between the maintenance levels 1, 2 and 3 to successfully run the operations, perform system evolutions and react to anomalies.

The implementation of this baseline documentation is resulting in operational processes that drive the day to day activities. These processes address topics like routine operations, anomaly management, incident management, performance reporting, planning, change management, training management, etc… Such processes are supported by a set of collaborative online tools facilitating the communication amongst all the key actors within the service provision (e.g. from a system Operator up to the L3 maintainer). For example, the JIRA/Confluence suite is used for ticketing, documentation, planning, reporting.

The paper will detail the operational processes in place at SGDSP in line with the high-level functions identified in the EUSPA Service Provision Plan providing concrete examples of the different operational process's execution. Particular attention will be put on the collaborative features of the on-line tool-kit (i.e. JIRA/Confluence) and how these are efficiently supporting sharing of information internally and externally amongst relevant stakeholders. The paper will also focus on the specific issues linked to the high levels of complexity of the Galileo Program (e.g. the different actors; the various dependencies between the stakeholders; system evolution versus exploitation phase) and how SGDSP has addressed them describing how these challenges have driven innovation at all levels (operations, engineering and at management level), with the ultimate objective to ensure the delivery of a high quality Service.

Last but not least, the paper will briefly touch on how the current SGDSP concept of operations and its associated tools and processes will be affected/impacted by the introduction the future SAR/Galileo services.

Keywords: (maximum 6 keywords)

Nomenclature

ARB	=	Anomaly Review Board	MTCF	=	MEOLUT Tracking Coordination Facility
CCB	=	Change Control Board	MTP	=	Mid Term Planning
C/S, CS	=	Cospas/Sarsat	RCC	=	Rescue Coordination Centre
CNES	=	French Space Agency	RL	=	SAR Return Link
EC	=	European Commission	RLM	=	Return Link Message
EUSPA	=	European Union Agency for the Space Program	RLS	=	Return Link Service
EWS	=	Emergency Warning Service	RLSP	=	Return Link Service Provider
FL	=	SAR Forward Link	S/W, SW	=	Software
GMS	=	Ground Mission Segment	SAR	=	Search and Rescue
GNSS	=	Global Navigation Satellite System	SGS	=	SAR/Galileo Ground Segment
KPI	=	Key Performance Indicator	SGSC	=	SAR/Galileo Service Centre
LTP	=	Long Term Planing	SGDSP	=	SAR/Galileo Data Service Provider
MARTINI	=	Monthly Automatic Reporting Tool for INdicators Integration	SGDSP OPS	=	SAR/Galileo Data Service Provider OPerationS team
MCC	=	Mission Control Centre	SLA	=	Service Level Agreement
MEO	=	Medium-altitude Earth Orbit			
MEOLUT	=	MEO Local User Terminal			
MEOSAR	=	MEO Search And Rescue			

1 Introduction

Since 2016, the Galileo Program entered its initial services provision phase with commitment to the user community in providing Galileo Initial Services. The SGDSP is responsible for operating the SAR/Galileo Ground Segment (SGS) to ensure the continuous provision of the SAR Forward Link (FL) and Return Link (RL) Services. It is also responsible for the continuous service monitoring and performance reporting in accordance to the minimum performance levels targets defined in the SAR/Galileo Service Definition Document.

Fig. 1 below presents the SAR/Galileo Ground segment supporting the Forward Link and Return Link services (light green SGDSP blocks). It also provides an overview of its inclusion within the Cospas-Sarsat and Galileo systems. The description of these two systems is not part of the present paper, the focus is kept on the SAR/Galileo ground segment under SGDSP responsibility.

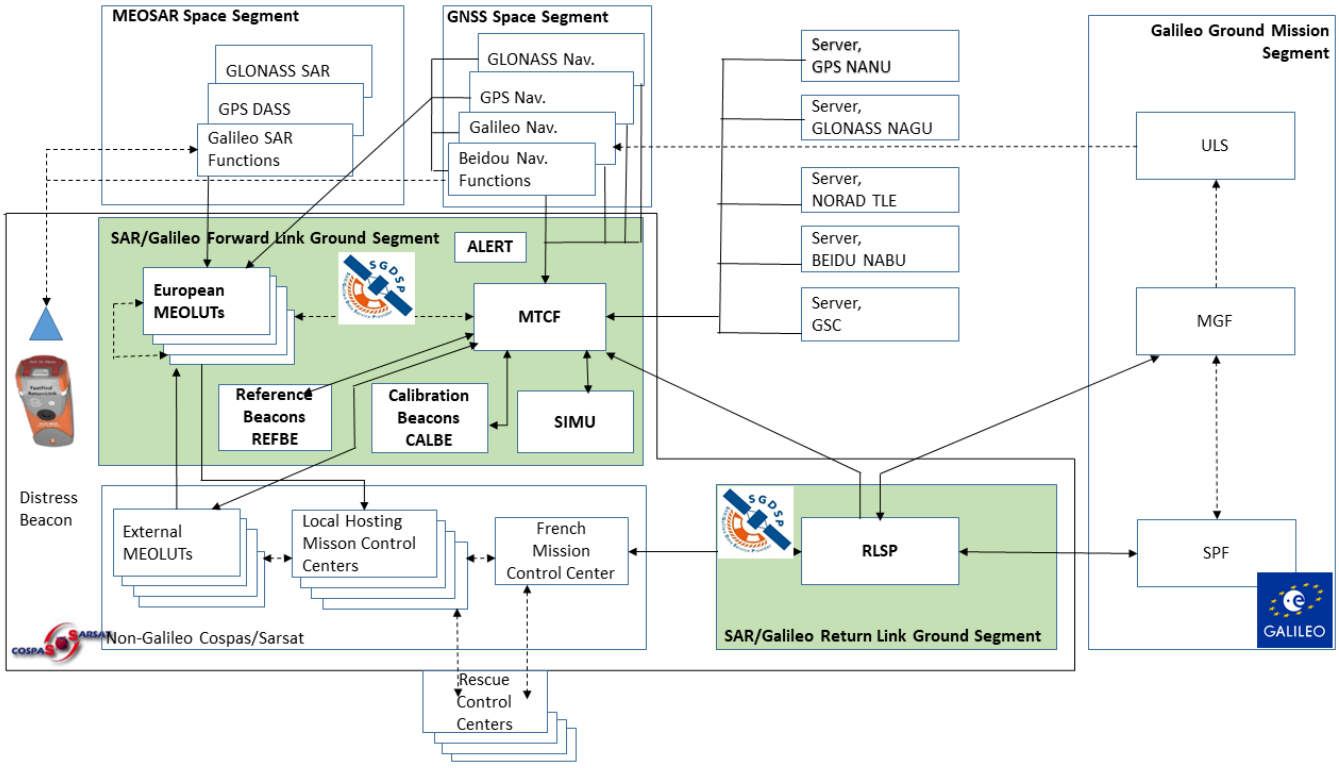


Fig. 1 - SAR/Galileo Ground Segment

The SAR/Galileo Ground Segment (SGS) is composed by:

- 4 European MEOLUTs located in Maspalomas, Spitsbergen, Larnaca and La Reunion,
- 1 MEOLUT Tracking Coordination Facility located (MTCF) in Toulouse with the KPI Collection Platform functionality (KCP) (OPE and VAL chains),
- 6 SAR/Galileo Reference Beacons located in Maspalomas, Spitsbergen, Larnaca, Santa Maria, Toulouse, and Greenland to cover the European Coverage Area (ECA),
- 2 SAR/Galileo Reference Beacon in La Reunion and Kerguelen to cover the Indian Ocean Coverage Area (IOCA)
- 1 SAR/Galileo Reference Platform for simulation and validation purpose (made of the VAL chains),
- 1 IOT-MEOLUT
- 1 SAR Network (SARN) connecting all these entities together as well as the 4 MEOLUTs with their local MCC,
- 5 Calibration beacons located in Maspalomas, Spitsbergen, Larnaca and La Reunion (x2),
- 1 Return Link Service Provider segment (RLSP) in Toulouse (OPE and VAL chains),
- 1 automatic notification system ALERT in Toulouse.

2 SAR/Galileo Ground Segment actors

The SAR/Galileo actors involveld in the service provision are described in Fig. 2 and Table 1 below :

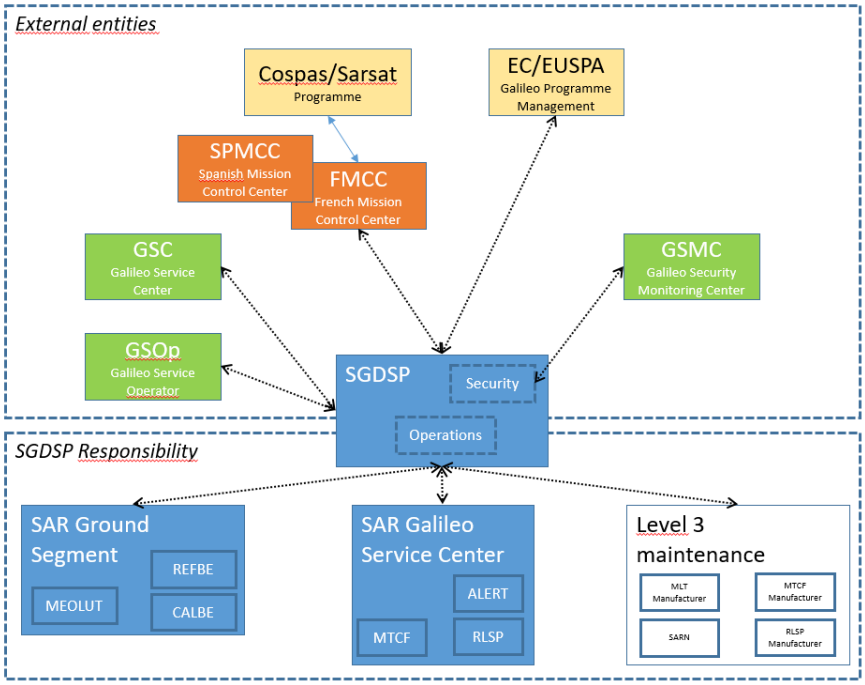


Fig. 2 - SAR/Galileo actors

The following table provides details for each of the entity depicted above (from top to down). The description provided is "operations" oriented to help understand the interfaces set up to manage the SGDSP operations.

The entities blue in the following table are the ones in the SGDSP responsibility perimeter and for which the processes described later in the document are applicable. The entities out of this perimeter are supposed to have their own operational management plan (when relevant).

Entity	Role / Responsibility	Type of OPS interface with SGDSP
EC (European Commission)	The European Commission is the Galileo Programme manager.	None
EUSPA (European GNSS Space Agency)	The EUSPA is the Contracting Authority for SGDSP. It is the Galileo Service Provider in the Galileo Program	Reporting, Problem management, Configuration Management, Planning.
COSPAS/SARSAT	The Cospas-Sarsat Programme is responsible for the provision worldwide of the SAR service through implementation and operations of the MEOSAR.programme. The European Commission provides a contribution to this programme through the SAR/Galileo Service.	Reporting (inc. availability of SAR Transponders)
FMCC (French Mission Control Center) – SPMCC (Spanish Mission Control Center)	The French MCC is in charge of coordinating the C/S service provided by France to C/S. From SGDSP perspective, the FMCC is interfacing with SGDSP to spread general status messages (SIT 605) to C/S community (MCCs) and to act as an interface between the Cospas-Sarsat network and the RLSP. The SPMCC acts as the backup of the FMCC for the Cospas-Sarsat/RLSP interface.	Routine operations, Planning, RLSP monitoring

Entity	Role / Responsibility	Type of OPS interface with SGDSP
GSC (Galileo Service Center)	The Galileo Service Center is the EUSPA entity in charge of interfacing with the user community. Through its website it broadcasts the Programme reference documents (SDD, ICD, etc..).	EUSPA SAR server, NAGUs, NASUs, Notifications
GSMC (Galileo Security Monitoring Center)	The Galileo Security Monitoring Center is the EUSPA entity in charge of the security monitoring of the system operations.	Security Incident management, Reporting (Cyber)
Galileo Core Infrastructure	The Galileo Core infrastructure is operated by the Galileo Service Operator (GSOp). Its role is to provide the Galileo Signal in Space with a committed quality. From SGDSP point of view, the GSOp is responsible of the SAR payload on-board the space segment and the upload of return link messages (RLMs).	Reporting, Routine OPS interfaces (planning, anomalies), Incident management, SSEG status
SGDSP (SAR Galileo Data Service Provider)	The SAR/Galileo Data Service Provider (SGDSP) is responsible for the management of the operations and maintenance (L2) of the SAR/Galileo service ground infrastructure and the monitoring of the performances of the SAR/Galileo service.	N/A
EU hosting sites (EUMLT + REFBE)	The hosting sites providers are the entities responsible for the hosting, on-site operations and 1st line maintenance of the SAR/Galileo facilities (MEOLUTs, Reference Beacons). They are located in Maspalomas, Spitsbergen, Larnaca, and La Réunion for the MEOLUT/REFBE and in Santa Maria for one REFBE	Routine operations, Planning, Problem management (anomalies and incidents), Reporting, Maintenance
SGSC (SAR Galileo Service Center)	The SAR Galileo Service Center is responsible for the hosting, on-site operations and 1st line maintenance of the facilities hosted in CNES (MTCF, RLSP, Toulouse REFBE).	Routine operations, Planning, Problem management (anomalies and incidents), Reporting, Maintenance,
L3 manufacturers	The SAR Ground Segment Manufacturers are responsible for the 3rd line and evolution maintenance of the SAR/Galileo facilities.	Maintenance (corrective and evolutive), Problem management
SARN Provider	The SAR network is managed by a CNES IT entity that is responsible of the 1st and 3rd line maintenance of the system.	Routine operations, Maintenance

Table 1 - SAR/Galileo actors and responsibilities

3 The need to frame the operational processes

The organization of the operations at SGDSP is framed by the EUSPA Service Provision Plan (SPP) and the associated Service Operations Procedures and Interfaces (SOPIs). This baseline documentation defines all the operational interfaces amongst the SAR/Galileo Service Provision stakeholders (SGDSP, EUSPA, European Space Agency (ESA), Galileo Service Operator (GSOp), Galileo Security Monitoring Center (GSMC), Galileo Service Center (GSC)). In this frame, SGDSP has derived a set of system level procedures that implement the interfaces with the remote entities operating the system (e.g. the hosting entities) and the different system maintainers. These procedures define the actors, interactions, data flows, timeliness and format of the exchanges between the maintenance levels 1, 2 and 3 to successfully run the operations, perform system evolutions and react to anomalies.

The implementation of this baseline documentation is resulting in operational processes that drive the day to day activities. These processes address topics like routine operations, anomaly management, incident management, performance reporting, planning, change management, training management, etc… Such processes are supported by a set of collaborative online tools facilitating the communication amongst all the key actors within the service provision (e.g. from a system Operator up to the L3 maintainer).

The choice was made to use the Atlassian JIRA/Confluence tool that provides features that are relevant to support the various operational processes required.

Confluence is a team workspace where knowledge and collaboration meet. Dynamic pages give the team a place to create, capture, and collaborate on any project or idea. Spaces help the team structure, organize, and share work, so every team member has visibility into institutional knowledge and access to the information they need.

Jira is a software application that allows teams to track issues, manage projects, and automate workflows.

More information on these tools are available on the Altassian webpage - https://www.atlassian.com/.

The structure of the JIRA databases is presented in Fig. 3 below. Some JIRA bases are dedicated to elements anomaly and change management (e.g. RLSP, MTCF, etc…), one base implements operational interfaces with EUSPA (SAR External) and other bases are used for operations and project management (planning, actions, etc…).

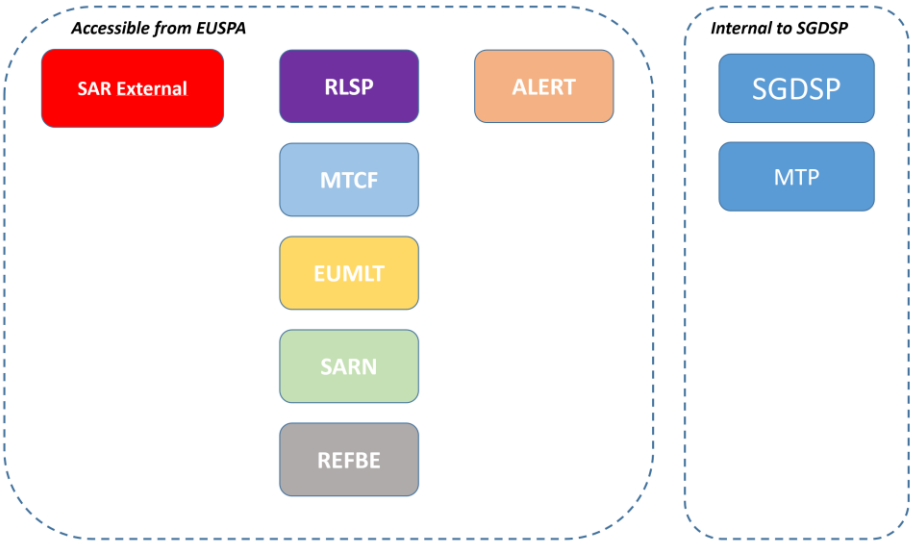


Fig. 3 - SAR/Galileo Jira databases organization

The "element level" JIRA databases are accessible from the SGS manufacturers and from the EUSPA (enabling the continuous access to and monitoring of the ticket status of the SGSC). The SGDSP and MTP databases are SGDSP internal.

The processes described in the present article are the following:

- The anomaly and incident management process (see section 4),
- The configuration change process (see section 6),
- The planning process (see section 5),
- The performance monitoring and reporting process (see section 7).

The following table describes the roles involved and their area of responsibility for the execution of the process itself.

		Anomaly Management	**Planning**	**Change & Configuration Management**	**Performance & reporting**
Role / Actor	**Description**				
EUSPA	Contracting authority responsible of the SAR/Galileo service provision contract with	Involved on ad-hoc basis (in case of major anomaly)	Reponsible for validating the major changes on a monthly	Involved on ad-hoc basis (in case of unplanned major change)	Recepient of the SAR Galileo reports

	SGDSP		basis		
SGDSP Project Manager	Manager of the SAR Galileo project	Involved on ad-hoc basis	Arbitration for Long Term planning activities	Involved on ad-hoc basis	No involvement
SGDSP Operations Manager	Manager of the operational team of the SAR Galileo project	Chair of the ad-hoc ARBs	Chair of the mid-term and short-term planning	Chair of the change control boards	Chair of the KPIs reporting to EUSPA
SGDSP Operations Coordinator	Coordinator of the operational processes within the operational team	Coordination of the anomaly process within the OPS team	Responsible of the SGS mid-term operational planning	Coordination of the change management process within the OPS team	Coordination of the performance and reporting process within the OPS team
SGDSP operational team	Team in charge of operations and L2 maintenance activities of the SAR Galileo ground segment	Involved for all anomalies impacting the system	Involved in the planning process	Involved in the planning process	Responsible of the performance reporting activities
SGDSP Security team	Team in charge of the security processes in the SAR Galileo project	Involved in case of anomaly impating the security of the system.	N/A	Involved in case of change impating the security of the system.	Responsible of the security KPIs reporting to EUSPA (not described in the paper)
SAR Galileo elements technical managers	SAR Galileo project technical responsible of the SAR/Galileo ground segment elements (e.g. RLSP, MTCF, etc…)	Chair of the element ARBs	Responsible of the element level planning and its reporting to the operational plans	Responsible of the element change preparation.	Responsible of the element performance.
Hosting entities	Entities in charge of the L1 operations and hosting of the SAR Ground segment elements	N/A	Reponsible of the provision of inputs to SGDSP plans for hosting level activities (e.g. maintenance)	N/A	Reponsible of the provision of monthly reporting on hosting level activities.
L3 SGS manufacturers	Industrial actor reponsible of the development and maintenance of the SAR/Galileo ground segment elements	Involved in the ARB process as L3 manufacturer (to discuss fixes, workaround, etc…)	Responsible of the L3 level planning and its reporting to their respective SAR Galileo elements technical managers	Inputs to the element changes preparation	Responsible of the element performance at industrial level as per SLA.

Table 2 - SAR/Galileo roles and process involvement

4 SAR/Galileo Ground Segment anomaly management process

4.1 *Overview*

All the anomalies are tracked in the CNES JIRA tool. Interfaces are in place with the SGS manufacturers to allow the acknowledgment and the updates of the anomalies.

For the anomalies that are security related, the CNES JIRA tool is also used by the SGDSP SEC Team. Only UNCLA information is available in the ticket description. Any sensitive information (up to R-UE, no C-UE, ex: IP addresses, etc..) that need to be attached to the ticket is encrypted with secured containers.

Anomalies classification is addressed in line with the SGDSP SLA. Reactivity to an anomaly notification is also in line with the SGDSP SLA. The SLA figures cover all kinds of anomalies including those that may result in severe service degradation.

The routine Anomaly Review Boards (ARBs) are scheduled monthly per SGS elements (MEOLUTs, MTCF/KCP, RLSP, SARN). The minutes are written in Confluence (with common access from the project, the L3 maintainer and the EUSPA) and all the tickets are stored in the relevant JIRA database.

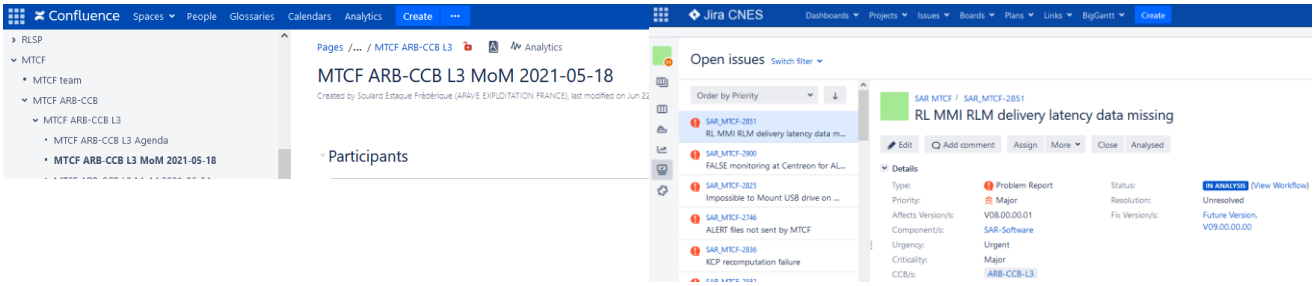


Fig. 4 - Examples of Confluence / JIRA use for routine ARBs

The ad-hoc Anomaly Review Boards (ad-hoc ARBs) are scheduled as necessary in case of major blocking anomaly impacting the SAR/Galileo ground segment. The minutes are made accessible to EUSPA in real time through the Confluence drive in the SAR External database.

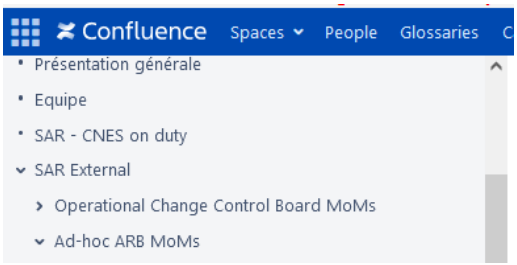


Fig. 5 - Access to ad-hoc ARBs from Confluence

The SGDSP also implements a process in case of classified anomaly (for the RLSP typically). This process is not described in the present paper.

4.2 *Anomaly notification with JIRA*

The project has implemented a notification process based on JIRA to warn the project team of all major blocking anomalies. The notification is made with an email sent to a team identified in JIRA as a group. The mechanism is based on the classification of the anomaly : when an anomaly is classified “major blocking” in the JIRA ticket, a filter that runs every 15mn triggers the sending of an email to the team. An example of JIRA filter for the ALERT element filter is described below :

(project = "SAR ALERT" OR project = "SAR SGDSP" AND component = ALERT) AND issuetype = "Problem Report" AND (createdDate > -16m OR updatedDate > -16m) AND Criticality = Major AND urgency = Urgent

The team identified to receive the email notification is the core SGDSP operational team (Project Manager, Operations Team, Technical Managers).

5 SAR/Galileo Ground Segment operational planning process

The stakeholders involved in the SGS planning process and their roles are recalled in section 3 Table 2 column “Planning”.

Given the SAR/Galileo Ground Segment (SGS) context described in the sections above, the SAR/Galileo Data Service Provider builds the related operational planning according to the following inputs:

1. The preventive maintenance activities required for each SGS sub-systems (Weekly, Monthly, bi-Annual, Yearly). These activities are based on L3 maintainers recommendations and involved L1 and/or L3 teams,
2. The corrective maintenances required on each SGS sub-systems. For each anomaly, the correction delay is defined according to the Service Level Agreement between the SGDSP and the related sub-contractor and depends on the criticality of each anomaly,
3. The evolutions related to the Galileo program such as new SAR services using the Galileo infrastructure, their impact on the SGS sub-systems, and the required delays to integrate them within the SGS,
4. The evolutions required by SGDSP teams aiming at improving the operability of the SGS sub-systems,

5. The evolutions resulting from changes at Cospas/Sarsat consortium level,
6. The impact of the activities mentioned in 1., 2., 3., 4., and 5., on the SAR/Galileo services (Forward Link Service (FLS) in the European Coverage Area (ECA), FLS in the Indian Ocean Coverage Area (IOCA), and Return Link Service (RLS) worldwide) according to the Service Level Agreement established between SGDSP and EUSPA,

Depending on the source of the planning input, it will either be processed through the SGDSP project Long Term Plan (LTP), or directly through the SGDSP operational Mid-Term Plan (MTP).

The figure below depicts the overall planning process and how it is handled at operational level. This process is detailed in the following sub-sections.

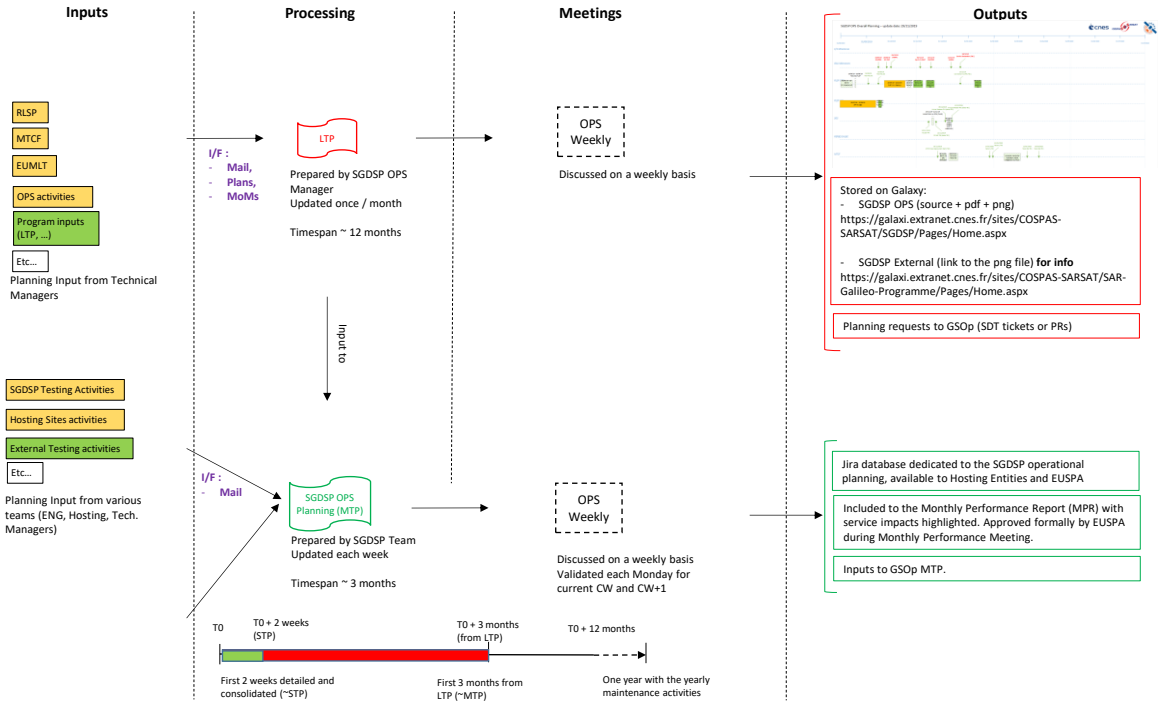


Fig. 6 - SGDSP overall operational planning process

5.1 *Long term plan (LTP)*

The LTP provides a high level view of the upcoming activities that require the support from SGDSP OPS Team. It spans over a period of 12 months and includes all the main activities, C/S milestones, and EUSPA milestones foreseen on each SGS operational subsystems. It is not used to follow the day-to-day activities (that is the purpose of the MTP, of which process is described in section 5.2).

The LTP is built and maintained at SGDSP Project Manager level based on the inputs provided by the SGDSP stakeholders. The SGDSP teams leaders (subsystems technical managers, engineering team manager, operations coordinator, operations manager) meet on a bi-monthly basis to build the LTP. During these meetings, the SGDSP Project Manager arbitrates in case of conflicts and ensures that the team resources are available when needed.

In order to ease the management of the potential conflicts, the LTP information are gathered in a single Microsoft Visio planning sheet. Each line of this sheet is dedicated to one SGS sub-system, and recall the dependencies between the sub-systems. Then, the LTP is made available to the whole of SGDSP teams on the SGDSP share-point.

Routine activities such as SGDSP teams internal tests activities on the SGS current operational sub-systems, preventive maintenance activities performed by L1/L3 teams, routine operational activities, and contingency operational activities are not part of the LTP. They are processed directly through the Mid-Term Plan (MTP).

An example of LTP is provided in the figure below:

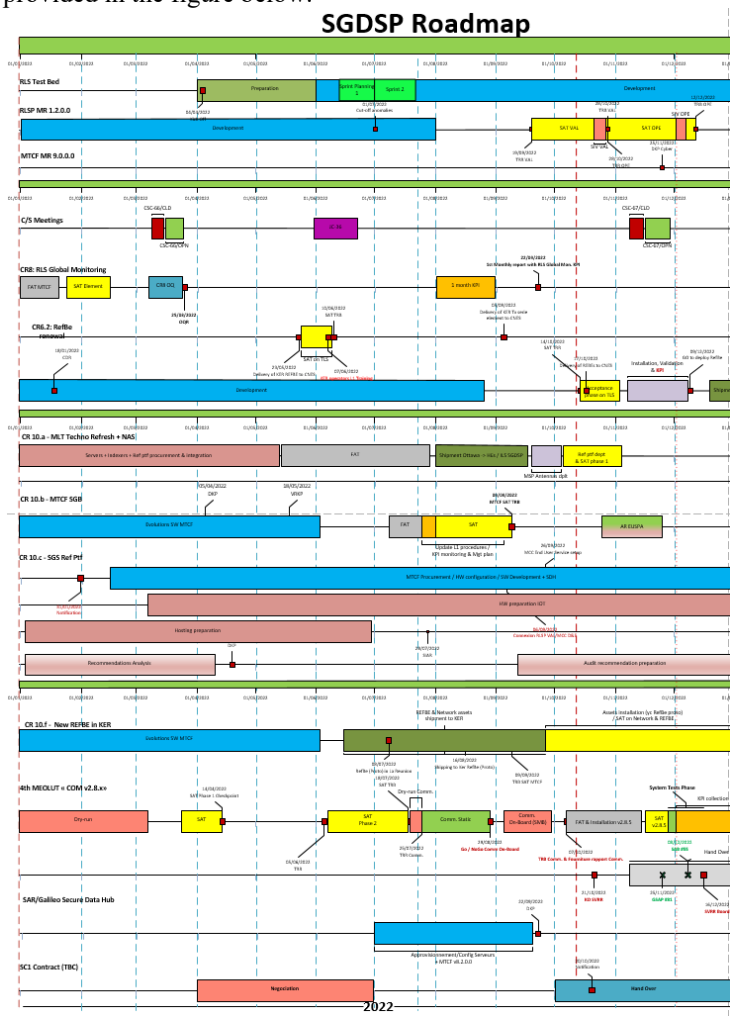


Fig. 7 - Example of SGDSP operational LTP

5.2 *Mid-term plan (MTP)*

The operational Mid-Term Plan (MTP) is built and maintained at SGDSP Operations Coordinator level. It is updated on a weekly basis and reviewed during the weekly OPS coordination meetings. The MTP spans over a period of 3 months and includes the detailed operational activities to be conducted by L1/L2/L3 teams. Typically, it includes all the activities performed on the SGS sub-systems or for which the support from the L1/L2 operational teams is required (preventive maintenance, software upgrades, network upgrades, input coming from the LTP, operational routine activities, …).

Each week, the SGDSP Operations Coordinator updates the MTP according to the new inputs. Each activity is divided in sub-tasks related to the various impacted SGS sub-systems. At this stage, routine activities such as preventive maintenance or daily operational tasks are already assigned to the appropriate operational teams members (L1 or L2). Then, the SGDSP Operations Coordinator defines the rough scheduling of the different activities.

The SGDSP Operations Manager reviews this preliminary MTP in weekly OPS meeting. During this meeting, each new MTP input is classified according to the Galileo change request classification described below:

Affected Chain	Classification Level	Remark
VAL	Routine	• Maintenance activities under L1 procedures • OPS/Maintenance recovery tasks based on Incident Tickets (unless changes on the configuration baseline have to be applied) • Troubleshooting sessions and fixing activities that do not have any Security or Accreditation impact or any impact/change in the configuration of the network • VAL chain data extraction • Public configuration file updates done by SGDSP based on operational needs/procedures
	CLASS-1	All change requests on VAL chain are considered Class 1 changes, except changes explicitly defined as Class 0, but including changes with possible security or system design impact detailed in the change request. Change requests created as a consequence of an already implemented Incident recovery are processed as Class-1 change request to document the applied change after the incident recovery.
OPE	Routine	• Maintenance activities under L1 procedures • OPS/Maintenance recovery tasks based on Incident Tickets (unless changes on the configuration baseline have to be applied) • The routine execution of the validated operational procedures and subsequent change of database content in the frame of such an execution • Troubleshooting sessions and fixing activities that do not have any Security or Accreditation impact or any impact/change in the configuration of the network • Public configuration file updates done by SGDSP based on operational needs/procedures
	CLASS-1	All changes not falling into the Class-0 definitions above and into Class 2 definition below are processed as Class 1 changes. Change requests created as a consequence of an already implemented Incident recovery are processed as Class-1 change request to document the applied change after the incident recovery.
	CLASS-2	• Minor/Major releases • Changes with impact on system design • All changes in OPE chain implemented as maintenance or evolutions or in the frame of the L2/L3 and that modify the baseline of the system • All changes in OPE chain that are implemented using a new operational procedure • Changes which have a direct impact on the SAR Galileo service provision and thus potentially affecting the continuous service provision • Changes which have possible Security or Accreditation impact • Changes which impact SGDSP external interfaces • Changes which impact the configuration of automation functions • Configuration changes resulting from a step in a procedure that specifically asks for the EUSPA approval. • Changes which cannot be fully validated on the validation chain due to defined limitations.

Table 3 – Galileo classification rules

CLASS-1 and CLASS-2 activities require EUSPA approval before their execution. On a monthly basis, the SGDSP Operations manager presents to EUSPA all CLASS-1 and CLASS-2 activities that have not been already approved. Then, if EUSPA does not approve an activity, it is sent back to the planning process, in order to refine the activity sequence leveraging EUSPA recommendations.

Finally, the SGDSP Operations Coordinator updates the MTP according to the authorized CLASS-1/CLASS-2 activities (Tasks assignment to L1/L2 team members, scheduling refinement, …).

In case some activities are impacting the Galileo Service Operator (GSOp) planning, they are forwarded as per operational interfaces to the MTP/LTP GSOp planning process. This interface is not described in the present paper.

This MTP process is recalled in the figure below:

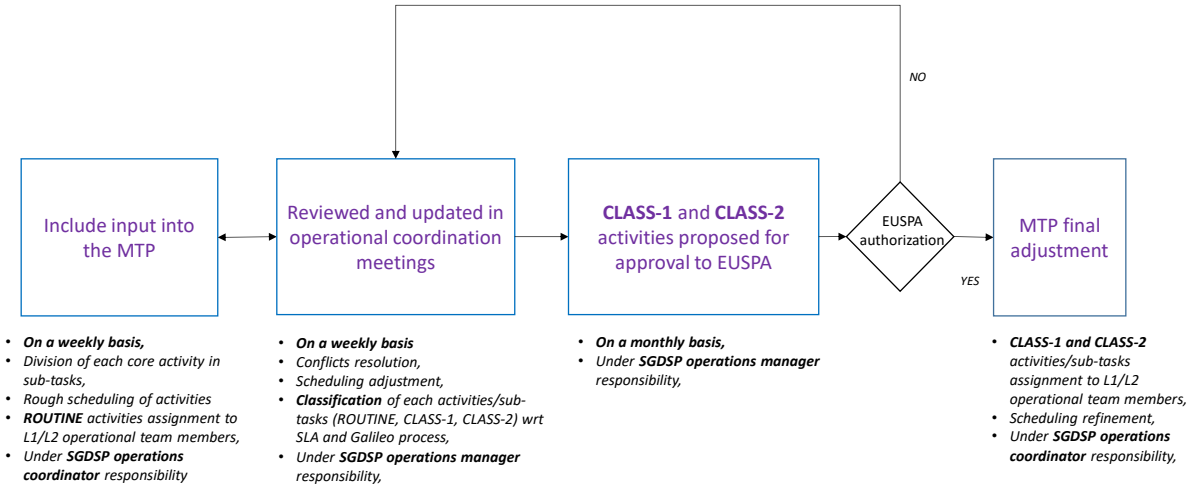


Fig. 8 - SGDSP operational MTP process

5.3 *How SGDSP integrated the SAR/Galileo MTP to the Jira/Confluence framework*

In early 2020, the CNES implemented the Jira/Confluence framework instance dedicated to the SGDSP project. The new features offered by this collaborative environment opened the way to a new MTP implementation aiming at facilitating the creation, sharing, and follow-up of the MTP in the SAR/Galileo context.

5.3.1 The SGS MTP Jira database

The SGDSP operational team implemented the MTP in a dedicated Jira database. Each operational activity and its related sub-tasks are described in a single Jira ticket of this database.

Apart from the usual generic Jira ticket fields, the MTP Jira database is configured with additional customs fields:

- The SGS components impacted by the activity. A component is defined by the Sub-system/Location/Chain-type triangle. As an example, SGDSP OPS has defined one component related to the Operational MEOLUT located at Maspalomas, and another component related to the Validation MEOLUT located also at Maspalomas.
- The type of activities (Configuration change, Planned maintenance, Upgrade, …),
- The impact on the SGS sub-systems with regards to the SLA (Nominal, Degraded, Not operational),
- The classification of the activity (Routine, CLASS-1, CLASS-2) from the Galileo program point of view.

Each sub-task coming from a main activity is defined in a child Jira ticket within the activity main ticket, thus gathering all the information related to an activity at a single place.

Here is an example of MTP Jira ticket related to the operational qualification of the MEOLUT La Réunion sub-system:

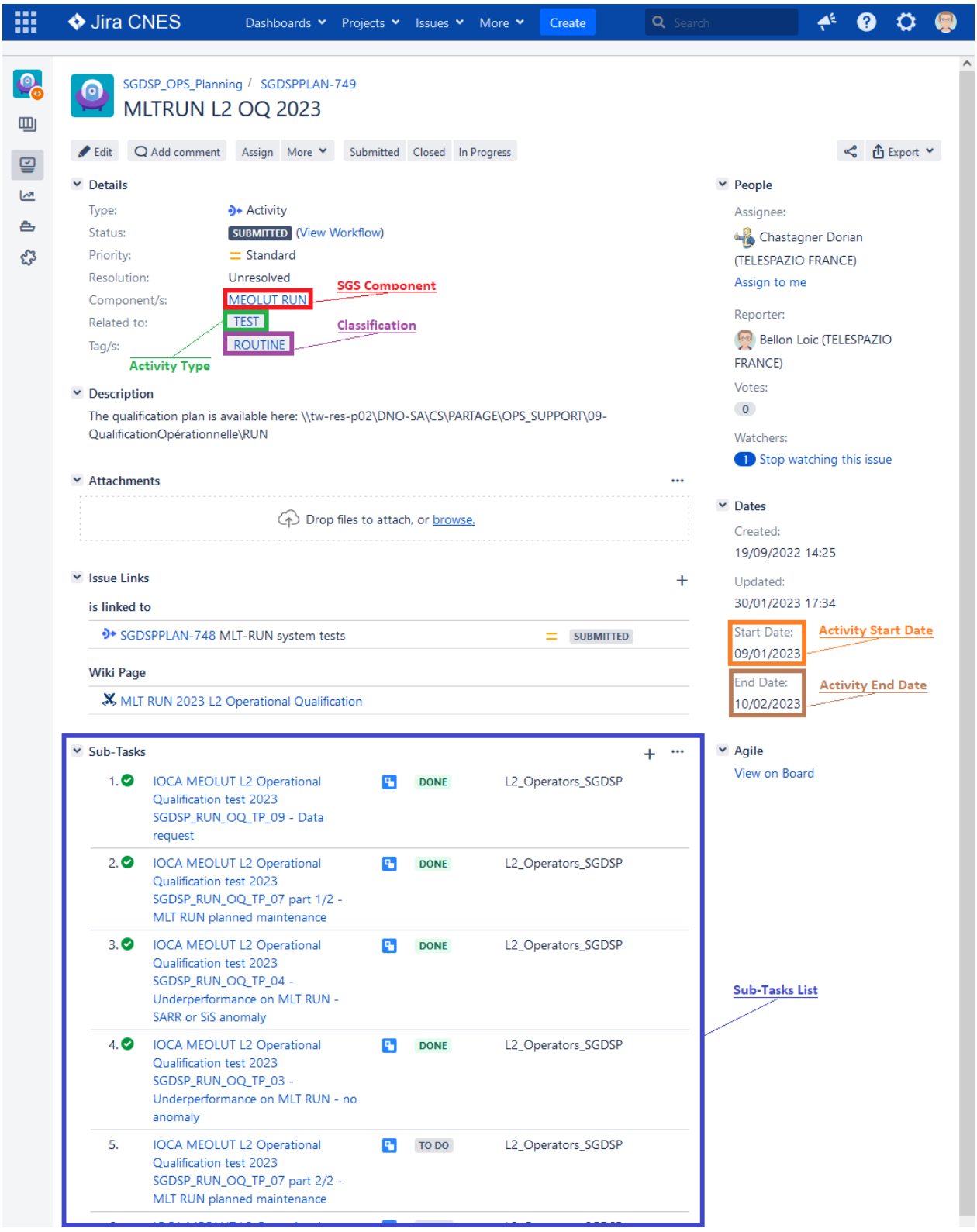


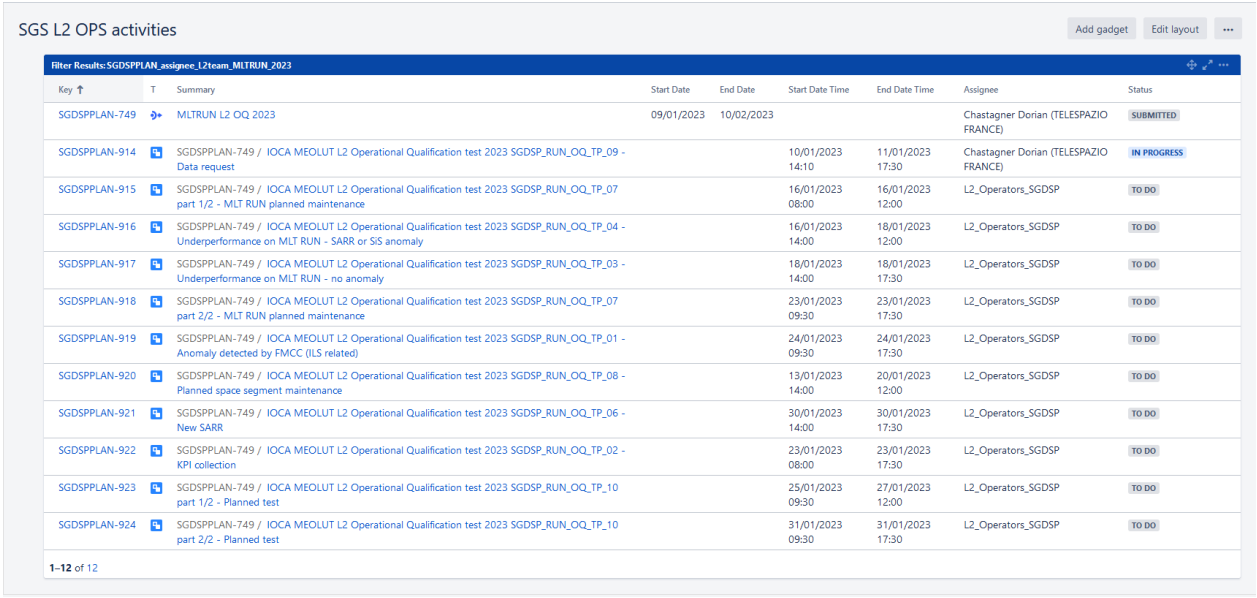
Fig. 9 - Example of SGDSP MTP Jira ticket

All the SGS operations stakeholders (SGDSP Operational team, SGDSP Engineering team, L1 teams, SGDSP managers, EUSPA, …) can access the MTP Jira database.

That gives each user the possibility to create his own Jira Dashboard, Jira periodic e-mail notifications, etc, thus having a close follow-up of the MTP subsets relevant from his point of view. An MTP subset is obtained by using the Jira filtering feature.

As an example, Fig. 10 here below shows the Jira Dashboard extracting the MEOLUT RUN sub-system Operational Qualification campaign tasks assigned to L2 team members. Here is the Jira filter used to obtain this dashboard:

> *project = SGDSP_OPS_Planning AND component in ("**MEOLUT RUN**", "**REFBE RUN**", "**CALBE RUN**") AND assignee in (bellonl, chastagnerd, salazab, duchengu, fabrej, lamarquf, burlacua, pasquim, gregoig, lafonc, colombee, lalandv, gourdouf, L2_Operators_SGDSP) AND (status not in (Closed,Done) OR (status in (Closed,Done) AND resolution not in (Duplicate,Duplicated,"Not Reproduced",Cancelled,Rejected,"RFW Accepted","Won't Do","Cannot Reproduce")))*



SGS L2 OPS activities

Add gadget | Edit layout

Filter Results: SGDSPPLAN_assignee_L2team_MLTRUN_2023

Key	T	Summary	Start Date	End Date	Start Date Time	End Date Time	Assignee	Status
SGDSPPLAN-749		MLTRUN L2 OQ 2023	09/01/2023	10/02/2023			Chastagner Dorian (TELESPAZIO FRANCE)	SUBMITTED
SGDSPPLAN-914		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_09 - Data request			10/01/2023 14:10	11/01/2023 17:30	Chastagner Dorian (TELESPAZIO FRANCE)	IN PROGRESS
SGDSPPLAN-915		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_07 part 1/2 - MLT RUN planned maintenance			16/01/2023 08:00	16/01/2023 12:00	L2_Operators_SGDSP	TO DO
SGDSPPLAN-916		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_04 - Underperformance on MLT RUN - SARR or SiS anomaly			16/01/2023 14:00	18/01/2023 12:00	L2_Operators_SGDSP	TO DO
SGDSPPLAN-917		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_03 - Underperformance on MLT RUN - no anomaly			18/01/2023 14:00	18/01/2023 17:30	L2_Operators_SGDSP	TO DO
SGDSPPLAN-918		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_07 part 2/2 - MLT RUN planned maintenance			23/01/2023 09:30	23/01/2023 17:30	L2_Operators_SGDSP	TO DO
SGDSPPLAN-919		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_01 - Anomaly detected by FMCC (ILS related)			24/01/2023 09:30	24/01/2023 17:30	L2_Operators_SGDSP	TO DO
SGDSPPLAN-920		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_08 - Planned space segment maintenance			13/01/2023 14:00	20/01/2023 12:00	L2_Operators_SGDSP	TO DO
SGDSPPLAN-921		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_06 - New SARR			30/01/2023 14:00	30/01/2023 17:30	L2_Operators_SGDSP	TO DO
SGDSPPLAN-922		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_02 - KPI collection			23/01/2023 08:00	23/01/2023 17:30	L2_Operators_SGDSP	TO DO
SGDSPPLAN-923		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_10 part 1/2 - Planned test			25/01/2023 09:30	27/01/2023 12:00	L2_Operators_SGDSP	TO DO
SGDSPPLAN-924		SGDSPPLAN-749 / IOCA MEOLUT L2 Operational Qualification test 2023 SGDSP_RUN_OQ_TP_10 part 2/2 - Planned test			31/01/2023 09:30	31/01/2023 17:30	L2_Operators_SGDSP	TO DO

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Fig. 10 - Example of Jira dashboard based on the SGDSP MTP

5.3.2 SGS MTP enhancement using the Atlassian Team Calendar plugin

Since late 2021, the Atlassian Team Calendar plugin is available within the CNES Jira/Confluence framework. This plugin offers the possibility to perform a high level management of the planning through a simple and graphical representation of a Jira planning database. It is also an easy way to share the planning with various stakeholders including the one not being familiar with the Jira ticketing tool.

The SGDSP project was one of the first CNES projects to use this plugin for its operational MTP, leveraging the link between Team Calendar and Jira.

Based on the MTP Jira database described here above, a Team Calendar dedicated to SGDSP operational activities has been setup. Team Calendar gives the possibility to create planning Events based on saved Jira filters output. First, the MTP Jira database components have been grouped according to the couples Sub-system/Chain-type. Then, for each group, SGDSP OPS has defined one filter in the MTP Jira database, which returns all the tickets related to the group. In addition, another filter has been defined in order to return all the tickets related to activities that have an impact on the SGS sub-systems availability (sub-systems in Degraded or Not operational status). Given the amount of operational activities on the SGS sub-systems, this last filter aims at providing EUSPA with a clear

view of the activities that have an operational impact on the SGS sub-systems. Finally, for each of these filters, a dedicated Event has been defined in the MTP Team Calendar.

This kind of Team Calendar Event requires custom dates within the Jira tickets to be displayed. These custom dates are defined as follows:

1. For the main activities, the required planning granularity is one day. Therefore, each MTP main activity Jira ticket includes a “Start Date” and an “End Date” fields, which are defined as calendar days,
2. For the sub-tasks related to a main activity, the required planning granularity is one minute. Therefore, each MTP sub-task activity Jira ticket includes a “Start Date Time” and an “End Date Time” fields, which are defined as calendar days and time.

Fig. 11 is an example of what is displayed in the MTP Team Calendar for a one-week period:

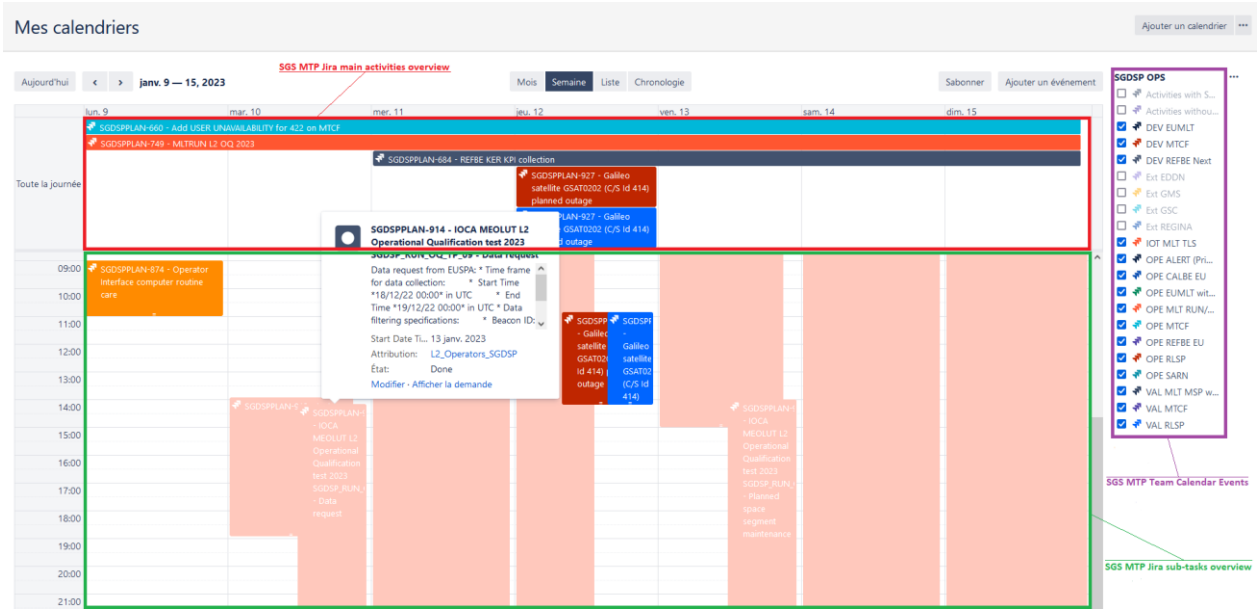

Fig. 11 - SGDSP operational MTP Team Calendar view

The MTP Team Calendar view offers several advantages:

- A synoptic overview of the MTP,
- The possibility to easily display any combination of defined MTP Team Calendar Events,
- Dragging and dropping an activity or sub-task from one timeslot to another. The start date and end date are automatically updated in the related MTP Jira ticket, and the Jira ticket assignee and watchers are immediately notified about the changes,
- Have a quick access to the Jira ticket related to an activity or a sub-task, thus allowing to get further details about it, or to update the ticket.

These features are much appreciated when it comes to managing the MTP content during meetings such as the weekly OPS meeting.

Last but not least, each SGS MTP Jira database user is given the possibility to create his own Team Calendars, including Team Calendar Event based on the MTP Jira filters of his choice. Then, the user can share each of his Team Calendar with any subset of SGDSP project stakeholders, add it into Confluence pages (MoM, Report, …), etc.

The implementation of this integrated MTP has significantly improved the MTP information sharing between all the different SGDSP stakeholders, from L1 operational teams to SGDSP management teams and EUSPA. Another remarkable feedback is that this collaborative MTP facilitates the reporting for each activity, which is now done directly into the MTP Jira ticket by the defined assignee.

6 SAR/Galileo Ground Segment operational change management process

6.1 *Overview*

Inside the Galileo Programme, the changes are classified depending on their impact on the service provision activities (see previous section).

SGDSP has implemented several Configuration Control Boards (CCBs) to control the changes made to the operational system configuration or operational products (documents, databases, etc.) necessary for successful implementation of the tasks. This boards are managing the documentation baseline evolutions.

The operational chains changes are managed under the MTP process as described above. Nevertheless, for unplanned changes and in case the MTP lifecycle cannot be respected (e.g for urgent changes), an operational change control board has been setup.

6.2 *The operational change control board (OCCB)*

The SGDSP Operational Configuration Control Board is the authority that authorizes any deployment or configuration update on the operational platforms.

It is triggered on an ad-hoc basis by:

- An evolution of one element proposed by the element technical manager (following the acceptance of the element and, if relevant, its operational qualification),
- A patch deployment following a major blocking anomaly (and the subsequent ad-hoc ARB),
- An operational procedure modification out of the Procedure Configuration Control Board process.

The SGDSP OCCB has the responsibility to review the changes classification and to forward the relevant ones to the EUSPA OCCB, as per operational interfaces, for approval.

The SGDSP OCCB is involved in the SAR Ground Segment elements evolution lifecycle as per figure below:

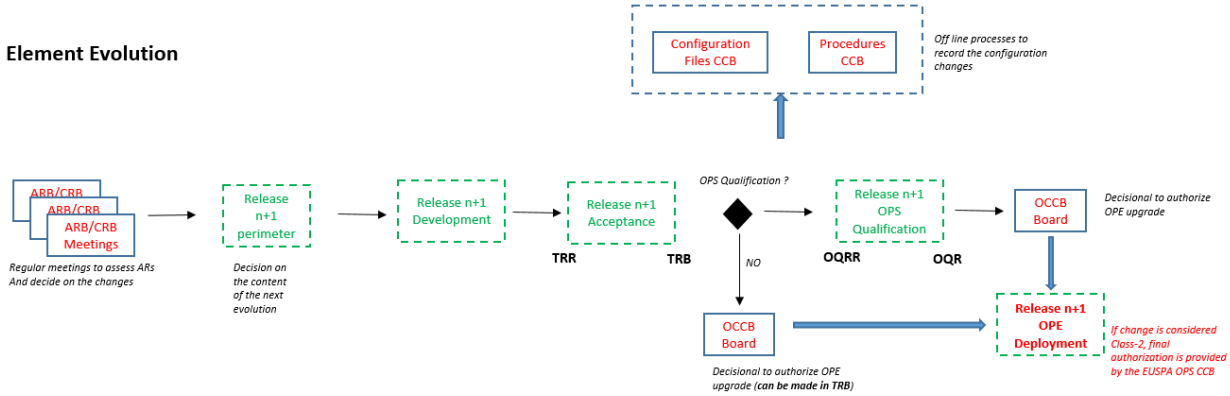

Fig. 12 - SGS element evolution lifecyle

The use of JIRA/Confluence will allow direct access to the OCCB MoMs to EUSPA. Once agreed, the MoMs are made static at Confluence. Once static, the MoM should not be modified, except for comments. To make static a Confluence CCB MoM in presence of all attendants is equivalent to validate and sign the MoM. This ensures that the JIRA content inside the Confluence MoM is always an image of the JIRA content at the date of the meeting.

7 SGS Key Performance Indicators reporting

Each month, the SGDSP Operational team is reporting to EUSPA the SGS Key Performance Indicators (KPI) according to the requirements linked to the SAR/Galileo service commitments (Beacon distress detection probability, location accuracy, Latency of the Return Link Messages dissemination to the user, SGS sub-systems availability, …).

This reporting covers the last calendar month, and follows a straightforward process. First, the SGDSP operational team is responsible for generating the SGS KPI monthly report. The SGDSP operational team has developed the MARTINI toolkit (Monthly Automatic Reporting Tool for INdicators Integration) aiming at reducing

to its minimum the human actions related to several steps of the KPI report generation process. Further details about the KPI report generation are presented in section 7.1. Then, the SGDSP operational team presents the SGS KPI to EUSPA during a monthly meeting chaired by the SGDSP Operations manager.

The KPI reporting stakeholders and their roles are recalled in section 3 Table 2 column "Performance and reporting".

7.1 *KPI report generation process*

The SGDSP operational team builts the SGS monthly KPI report as follows:

1. Extract the SGS data used for the KPI computation from various input (pre-formatted input provided by the SGS Key Performance Indicators Platform (KCP), rawdata coming from the SGS sub-systems, etc). At this stage, the data are in various format depending on their sources (csv, xml, …),
2. Extract the SGS sub-systems planned degraded and not operational periods from the MTP. **This step relies on Jira filters applied on the MTP Jira database** (see section 5.3.1 for a description of this database),
3. Extract SGS sub-systems unplanned degraded and not operational periods from the operational outage follow-up file. This file is currently a Microsoft Excel sheet gathering all the SAR/Galileo outage which have an impact on the SAR/Galileo service. It is updated on a daily basis by the SGDSP operational team,
4. Standardize the format of the data collected in 1., 2., and 3., and compute SGS KPI,
5. Automatically generate the KPI report based on the standardized SGS input data, and on a Microsoft Word template generated using the Jinja template engine,
6. Amend the KPI report according to the output automatically generated at step 5.

The MARTINI toolkit is involved in steps 1., 2., 4, and 5.. MARTINI relies on several scripts written in Python, and is acting as an Extract Transform and Load (ETL) tool for the SGS data.

When extracting the SGS sub-systems status from the MTP Jira database, the connection to the Jira database and the execution of the related Jira filters are encapsulated within MARTINI.

Fig. 13 here below is a synoptic view of the SGS KPI report generation process:

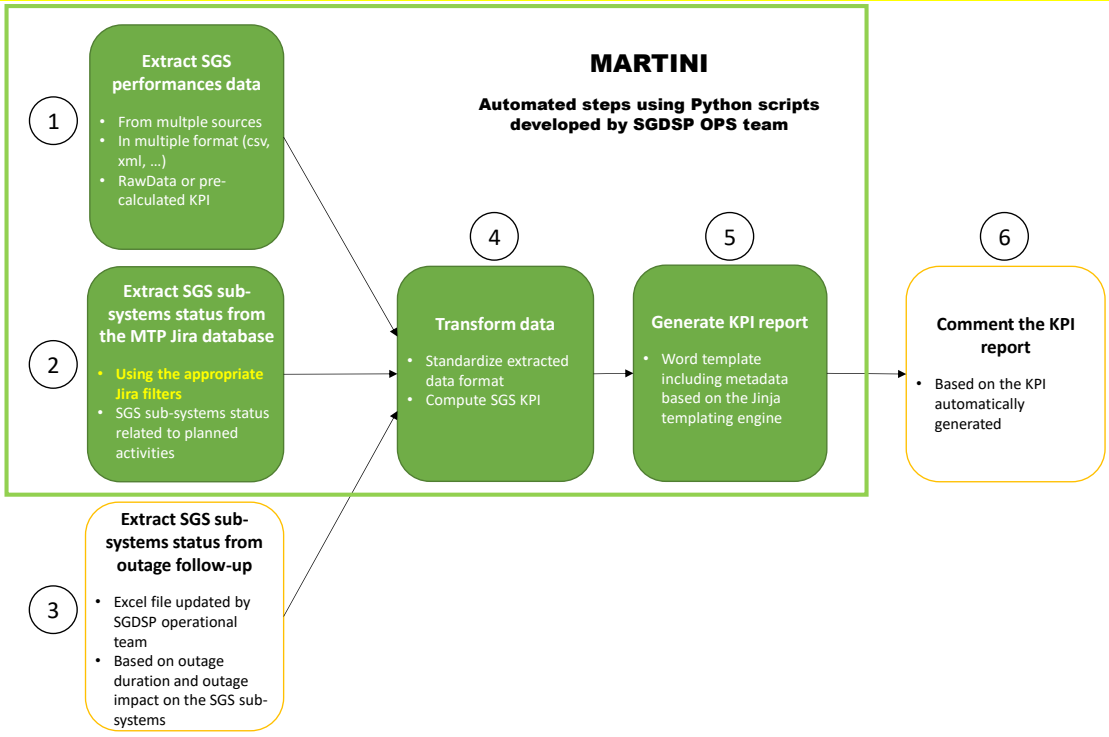

Fig. 13 - SGS KPI report generation process

7.2 *Link between the KPI reporting process and the SGS MTP process*

The KPI reporting process is closely linked to the MTP process presented in section 5.2. Indeed, in addition to the MTP Jira database and Team Calendar shared among all the SGDSP stakeholders, MTP CLASS-1 and CLASS-2 activities that required EUSPA approval are listed in the SGS KPI report.

When MARTINI extracts the SGS sub-systems status from the MTP Jira database (Step 2 of the KPI report generation process described in section 7.1), the MTP data are collected not only for the previous calendar month (Data used for the KPI reporting over the last calendar month), but also for the 3 upcoming calendar months. By applying the appropriate Jira filters ont the MTP database, this MTP extract is used to list all CLASS-1 and CLASS-2 upcoming activities that have not already been approved by EUSPA. Then, EUSPA is approving or not these activities during the monthly KPI report presentation meeting, thus allowing the planning process to resume.

Fig. 14 here below summarizes the KPI reporting process and its link with the MTP process.

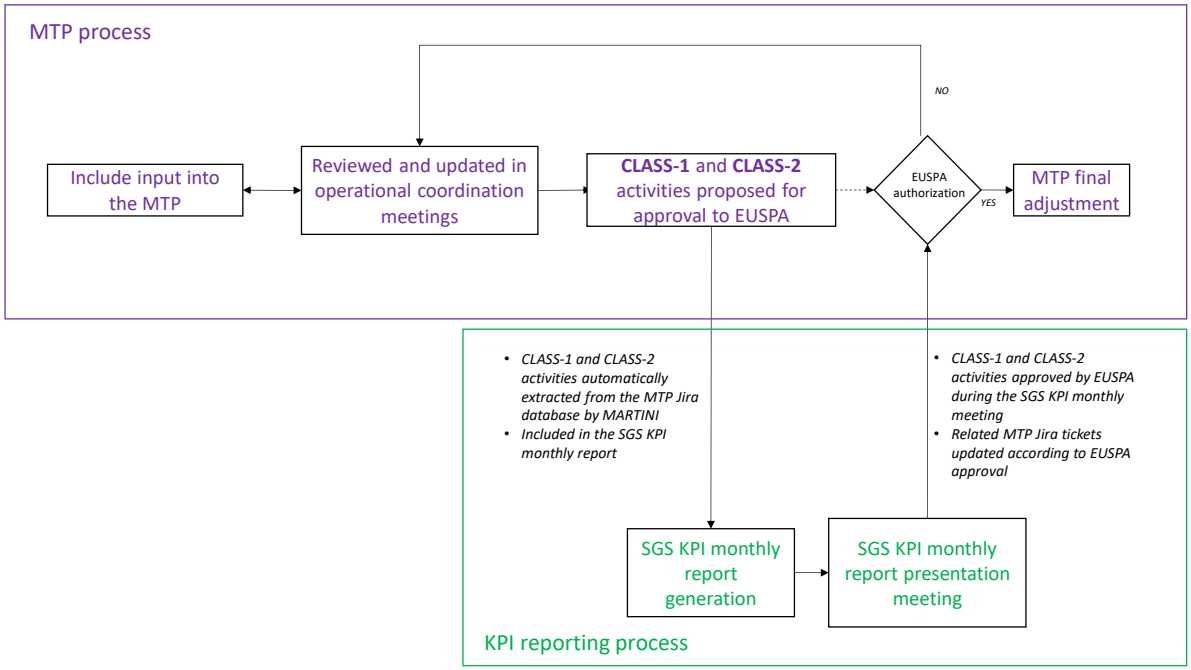

Fig. 14 - KPI reporting process and its link with the MTP process

8 Future evolution of the SGDSP operation concept

In preparation of the introduction of future services based on the Return Link Service (see paper [1]), SGDSP has already indentified some evolutions of the operational concept and is currently assessing the best way to adapt the above described processes. This analysis is on going but some key features are already foreseen and presented hereafter.

Extensive use of Confluence for the operational baseline management

The operational procedures will be all ported into the Confluence to ease the operational execution (navigation between procedures via hyperlinks, documentation attachement, generic layout and templates, etc…).

The change management process of the documentation baseline will also be supported by the Confluence features like versioning, validation capabilities, workflow definition.

Use of JIRA for chain of command implementation

Based on its experience of the tool, SGDSP is assessing the implementation of a “chain of command “ tool based on JIRA. The idea would be to use the ticketing feature to enable taking operational critical decisions or authorize deviation from the baseline in case of contingency with a strict and framed sequence of acknowledgements from the people involved in the operations. As an example, a decision to trigger an alert to population (see the Emergency Warning Service details in paper [1]) would require a sequence of “GO/NOGO” from the operators, the operation manager, external authorities etc…A note could be issued based on JIRA and this note would be validated and finally authorized before implementation.

9 Conclusion

The SGDSP implementaion of key operational processes is contributing to a safer and more efficient management of the operational activities. The intrinsic collaborative features of the tools used make it much easier to manage the interactions between the various actors involved in the service provision. All domains of operations benefit from the possibilities they offer : operations management, scheduling, team management, reporting, etc… The range of functionalities is still to be fully exploited and the introduction of future services will push for additional evolutions of the operational concepts’ toolbox.

Acknowledgements

All of the authors thank other members of the SGDSP project: European Union Agency for the Space Programme, European Commission for providing useful information from their various publications.

References

[1] M. Fontanier, S. Delattre, P. Novell, A. Rolla, E. Guyader, Galileo RETURN LINK SERVICE Evolutions, 17th International Conference on Space Operations, Dubai, United Arab Emirates, 6 - 10 March 2023.