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Space Rider – Payload and Landing Control Center / Landing Sites

Alessandro Bellomo – Daniela Borla Tridon** – Rosa Sapone*** – Paolo Cergna*****
**ALTEC S.p.A.*
**Corso Marche 79 – 10146 – Turin – Italy – alessandro.bellomo@altecspace.it*
***ALTEC S.p.A.*
***Corso Marche 79 – 10146 – Turin – Italy – daniela.borlatridon@altecspace.it*
****ALTEC S.p.A.*
****Corso Marche 79 – 10146 – Turin – Italy – rosa.sapone@altecspace.it*
*****ALTEC S.p.A.*
*****Corso Marche 79 – 10146 – Turin – Italy – paolo.cergna@altecspace.it*

Abstract

Space Rider, the European Space Transportation System, will open a new era in the affordable and reusable space transportation. The system will perform experimentation and demonstration of multiple future missions in low Earth orbit, benefiting from existing technologies, but also addressing technological challenges. Its Payload and Landing Control Center, will allow Payload embarked on Space Rider to perform cutting-edge experimentation and demonstration. The Center, supported by the Landing Site, will control also the unique re-entry and landing of the vehicle.
Located at ALTEC, the Center is the focal point for European and International experiment activities aboard Space Rider.

1 Introduction

Space Rider is a reusable space transportation system designed to embark payloads, which will perform experimentation and demonstration of several future mission application in low Earth Orbit.
Space Rider will allow to perform in-orbit operation, experimentation and demonstration for different applications, such as for example micro-gravity and radiation exposure experimentation, and in-orbit demonstration and validation for exploration, Earth science and observation, telecommunication, orbital infrastructures servicing, reentry.
It is an ESA project in collaboration with Thales Alenia Space Italy (TASI) and AVIO as prime contractors responsible for the Space and the Ground Segments. The spacecraft is composed of two main parts: the AVUM Orbital Module (AOM) developed by AVIO, and Re-Entry Module (RM) developed by TASI. The system will exploit to the maximum extend existing technologies to be affordable to sustain several commercial mission flights. At the same time, it will made use of innovation re-entry technologies for reusable systems.
After a first demonstrative flight, the program foresees at least five more commercial flights. The first flight is foreseen to start in the first trimester of 2022 from the French Guiana with the VEGA-C launcher. Each mission flight will consist in two months of in-orbit operations and a subsequent de-orbiting, re-entry and landing of only the RM. The AOM will instead be separated from the RM and perform a destructive re-entry. Therefore, a new AOM will be built for each mission.
The mission is based on the Intermediate eXperimental Vehicle (IXV) mission, which was a successful re-entry demonstration mission performed in February [1].

The Space Rider mission is supported by the Ground Segment, which is composed by the following elements:

- Launch Site Control Center
- The Mission Control Centre, integrating:
  - In Orbit Control Center (IOCC);

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- Payload and Landing Control Center (PLCC);

- The Ground Stations;
- The Landing Sites and Landing Site Ground Station;
- The Logistics & Transportation facilities.

In Figure 1 Space Rider Ground Segment is outlined and in the following the main elements are described.

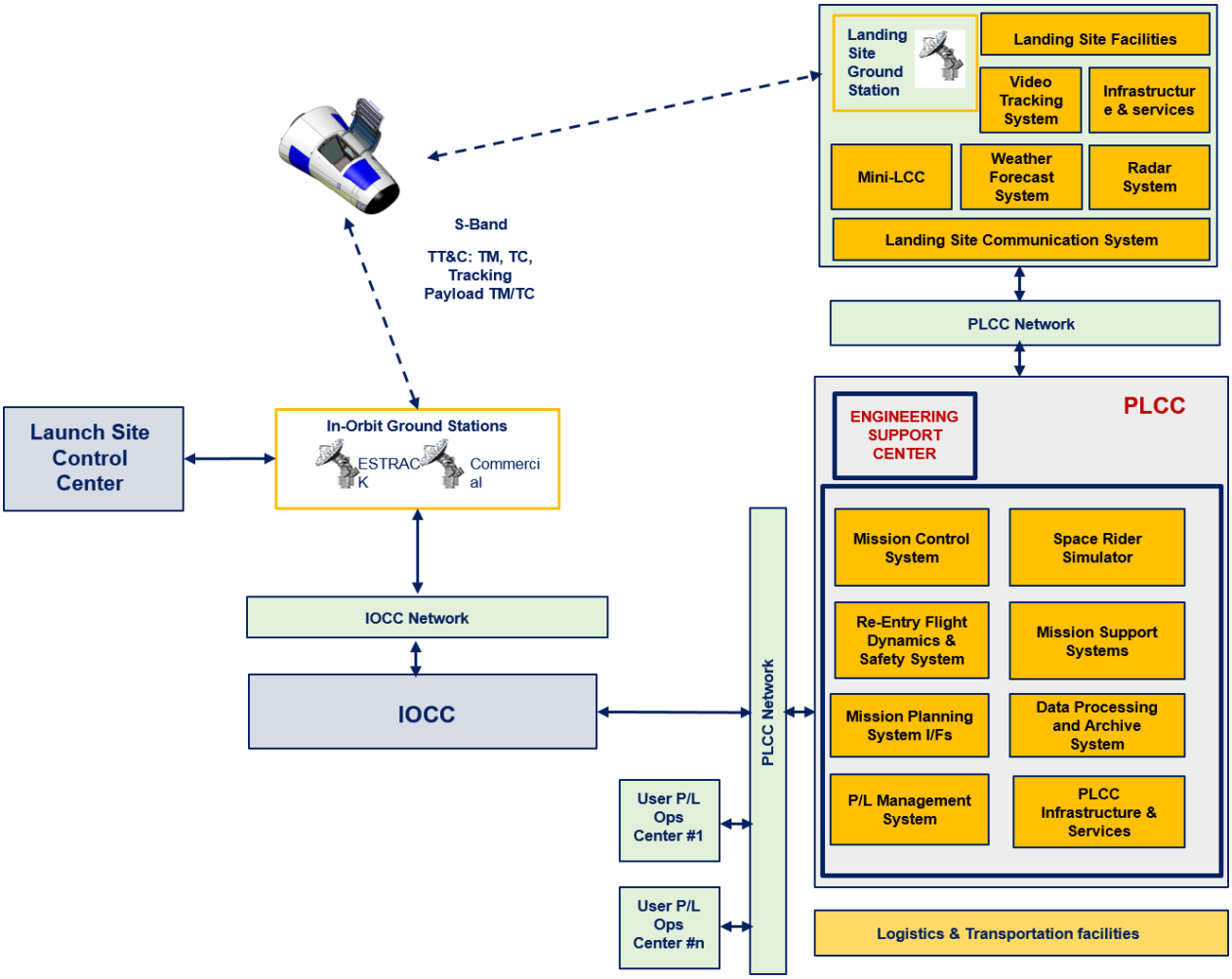

Figure 1 Space Rider Ground Segment elements

The Launch Site Control Center, located at the Guiana Space Centre (CSG), takes over the monitoring and control launcher from lift-off until the achievement of the Space Rider target orbit, including the separation of the various rocket stages, except the AVUM module, which is part of the AOM used as Service module for the Space Rider Mission. The control centre receives and centralizes all the data of the Vega's systems, including the launcher speed and trajectory during launch and ascent. Depending on launcher target orbit, downrange tracking and telemetry stations take over and relay telemetry received from the launcher to the CSG. The Galliot station in Kourou on the southern peak of the Montagne des Pères is the first on the flight trajectory. For northward polar-orbit launches, tracking data and telemetry are relayed by the Saint Jean du Maroni (French Guiana), Cooper's Island (Bermuda), Gatineau (Canada), New Norcia (Australia) and if needed Santa Maria (Azores, Portugal) and Aussaguel (France) stations. This stations network is coordinated by the CSG.

The In-Orbit Control Center (IOCC) is the center in charge of control and monitoring all the flight phases from the target orbit achievement (hand-over from CSG), where the commissioning starts, until the end of the payload operations, i.e. the Early Operations Phase and the Routine Operations Phase. The control center receives and

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centralizes all the data of the Space Rider systems during operational phase. It also takes care of the Station keeping and of attitude changes as required for the operations of the payload as well as the vehicle reconfiguration for de-orbit and re-entry event.

The Payload and Landing Control Center (PLCC) is in charge of payloads operations that start at the end of the commissioning phase and last until the end of P/L's operational phase. During the orbital phases the control center receives from IOCC and centralizes all the data of the Space Rider payloads (detailed description is reported in paragraph 2). It has to be noticed that the Ground-to-Space and Space-to-Ground interface is exclusive of the IOCC, which means that all the telemetry and telecommand data for the payloads is exchanged between PLCC and IOCC.
In addition, the center takes over the monitoring and the control of the Space Rider Re-entry Module (SR-RM), after its separation from the AVUM Orbital Module (SR-AOM), during the re-entry and the landing phases. The control center receives and centralizes all the data of the Space Rider SR-RM (detailed description of the PLCC is reported in paragraph 2). After the separation, until the landing, the unique Ground-to-Space and Space-to-Ground interface is the PLCC, via the Landing Site Ground Station.

The Engineering Support Center, located at ALTEC, will host the teams of expertise from the Design Authorities. They will monitor the vehicle data, to help solve challenges and to provide the required support in case issue(s) raise, by performing the required in-depth analyses to help decision makers in the IOCC, PLCC and at the landing sites during the entire mission.

The Ground Stations Network is the system of ground stations providing links between Space Rider in orbit and the IOCC. The essential task of all the ground tracking stations is to communicate with spacecraft, transmitting commands and receiving scientific data and spacecraft status information. Tracking is performed through all the in-orbit phases, i.e. Early Operations Phase and the Routine Operations Phase. Each station features one or more antenna terminals, each of which comprises a parabolic dish antenna and its associated radio signal processing equipment. Using the signals received from space, stations gather radiometric data to help mission controllers know the location, trajectory and velocity of their spacecraft. It is important to notice that the Ground Station Network is mission / orbit inclination dependent, therefore it will be "missionized" for each flight according to the System and Payloads needs.

A safe return of Space Rider on Earth is a must. The Landing Sites provide all the elements necessary to ensure a safe landing, e.g. the target landing area for the touch-down and slowing-down of the returning spacecraft, control and monitoring stations for re-entry and descent parameters acquisition and telecommand uplink (ground station and relevant antenna), radar tracking station, video stations and meteorological stations. Additionally, dedicated facilities are present at the landing sites to serve Space Rider and the embarked payloads after landing (detailed description of the Landing Sites is reported in next paragraph 4).

The Logistics & Transportation facilities ensure the proper processing of the Reentry Module and its payloads after landing, in preparation of the return shipment. They also provide a storage area for the GSE's required to the post-landing operations and the transportation.

In the following paragraphs, this paper provides a detailed overview of the Space Rider Payload and Landing Control Center (PLCC) and of the Landing Site(s).

2 Payload and Landing Control Center

2.1 Overview and Purposes

The Payload and Landing Control Center is in charge of planning and monitoring the operations of science and research experiments aboard Space Rider. The team in charge of that, coordinates the use of valuable on-orbit resources, orchestrates delivery and retrieval of payloads and coordinates the plans for payload activities with scientists and control centers.
The Payload and Landing Control Center is also in charge of monitoring and managing the vehicle from the Payload End-of-Operation until its landing. All the analyses for safe De-Orbit, Re-Entry and Landing phases, as well as the necessary maneuvers are performed together with detailed timeline planning and validation, considering different

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subsequent de-orbit opportunities. The handover of responsibilities between IOCC and PLCC takes place during the De-Orbit phase, when both centers are monitoring the system.

2.2 Functionalities

The PLCC has the following functionalities related to the Payloads operations:

- Acquisition and analysis of the User Operations Requirements;
- Preparation of the Payload Operations Request and relevant Payload Operation Planning;
- Definition, preparation and validation of the P/L's telecommand packets
- Collection of System and P/L telemetry data and orbital data from the IOCC;
- Processing of ancillary data to generate the mission products, and together with the payload telemetries and science data delivery to the UPOCs;
- Payload control: the commands necessary to operate and control the payload are generated at the PLCC. The command plan is sent to the IOCC, which uplinks it directly to Space Rider;
- Archiving of all the exchanged data: all the data will be stored and securely saved, as they are the mission memory.

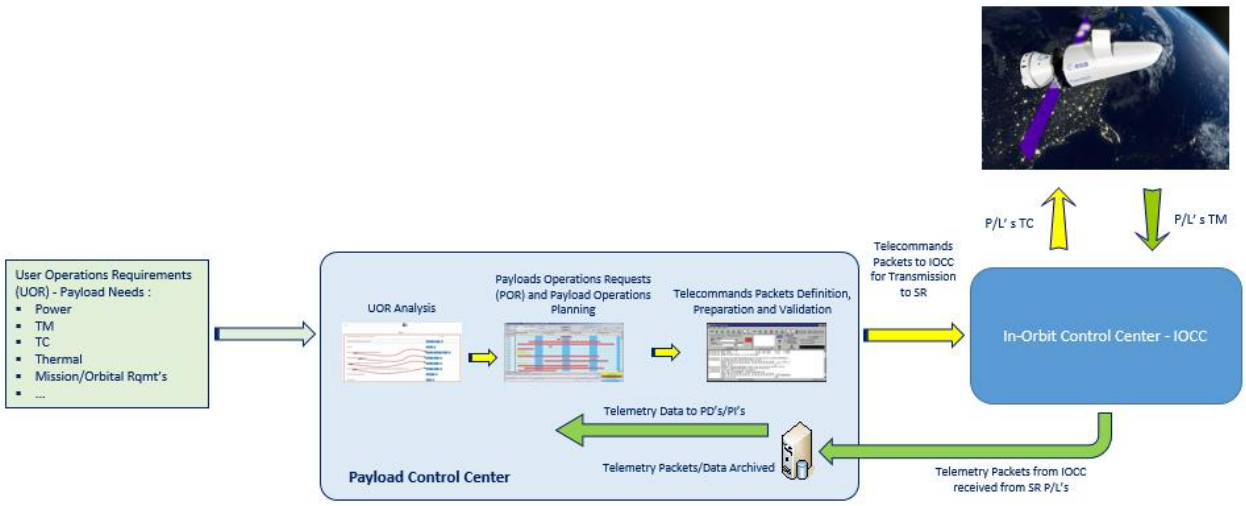

Figure 2 Payloads control and monitor processes

All the analyses required for a safe Space Rider De-Orbit, Re-Entry and Landing are performed by the re-entry Flight Dynamic team, at the Landing Control Center. Additionally, the detailed timeline planning and validation for different subsequent de-orbit opportunities are developed until final authorization for Deorbit (IOCC will retain space to ground uplink until SR-AOM/SR-RM separation).

The required Spacecraft reconfiguration, timeline uplink, and subsequent execution (following an authorization for Deorbit based on the readiness of the Landing site) will be monitored from this Center.
After SR-AOM/SR-RM separation the PLCC will take full operational control of the SRS-RM. SRS-RM will be followed until landing and up to the final power-off. All the above described activities are conducted in strict coordination with the landing site, which will be able to follow all landing operations in parallel to the PLCC and with the possibility to take the control in case of needs (with the mini-LCC, see section 3.3).
For the re-entry and landing monitoring and control, the PLCC has the following functionalities:

- Analysis of re-entry opportunity windows;
- Preparation and validation of de-orbit maneuvers and associated de-orbit and re-entry configuration products;
- Coordination with the Landing Site for landing preparation, monitoring and control;

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- Confirmation to IOCC of authorization for Deorbit conditions (based on Flight System status, weather conditions in the Landing area and on Landing Site readiness);
- Monitoring of de-orbit, re-entry and landing;
- Uplink of the wind tables during the descent phase

2.3 Systems

The main system devoted to the operability of the Payloads is the

- Payload Management Systems". The P/L Management Systems is the element that provides all the necessary capabilities to allow the P/L users to execute to mission operations of their P/Ls embarked on Space Rider. It provides also the capabilities necessary to the PLCC operations team to coordinate, integrate and validate input and requests coming from the different users, in such a way to optimize and maximize SRS resources as well as P/L return. P/L users can be both locally hosted at PLCC, or remotely connected from their User Payload Operations Centres (UPOC's). The system consists of four components each one dedicated to provide a group of services, and a front-end to present relevant information to end-users. The front-end allows end-users to provide information and data needed to perform P\L monitoring and control. The components are:

  - ✓ P/L Planning Services;
  - ✓ P/L Commanding Services;
  - ✓ P/L Data Services;
  - ✓ Access control Services.

  The P/L planning system receives, collects, assess and validates the User Operations Requirements that are the P/L instruction provided by the End-Users (Payload Investigator / Payload Developer). It allows the creation and validation, i.e. ensuring consolidation and consistency (in terms of onboard resources and constraints) of the Payloads Operations Requests. It provides also the Payloads planning operation request and relevant timeline management to be submitted to the IOCC for upload to the spacecraft. Additionally, the planning system provides the visibility on Space Rider system status, resources and communication availability together with the Payloads Operations Requests monitoring.

  All the P/L's commanding data and sequence are pre-planned before the start of the mission. During the mission execution, the commands, sequences and timeline will be regularly updated, according to the most recent SRS TM information and new or changed P/Ls needs. In case of P/L s troubleshooting, the P/L Commanding Services provides the capability to submit an urgent request for P/L command uplink.

  The Payload Data Service receives the Payloads house-keeping data, the Science telemetry data transmitted as data dump from the Spacecraft, allowing the required monitoring during a specific pass. Indeed, the automatic monitoring of P/L status and command implementation based on the received H/K telemetry is performed. It also implements the P/L raw data processing based on user's provided pipelines and distributes the results.

  The Access Control Services provides and guarantees controlled access to the services and visibility of P/L operations to the P/L developer / UPOC and implements P/L data retention and archiving policy.

- The Mission Planning Interface System is the element that interfaces internally with the P/L Planning Services, and externally with the IOCC. The system receives from the IOCC the information about the status of the SRS and its available resources, including resources availability and allocation, trajectory and ground stations visibilities, spacecraft operations constraints. This information is used by the system for the planning of the P/L activities. The system formats and sends then the PLCC generated products to the IOCC Mission Planning System to be integrated in the general timeline.

- The Data Processing and Archiving System (DPAS) consists of data management and processing software components integrated to fulfil the PLCC P\L data retrieval, processing, archiving and distribution requirements. Moreover, the DPAS manages also SR TM\TC data, planning data and Landing Site data in order to create a consolidated archive of linked and correlated data.

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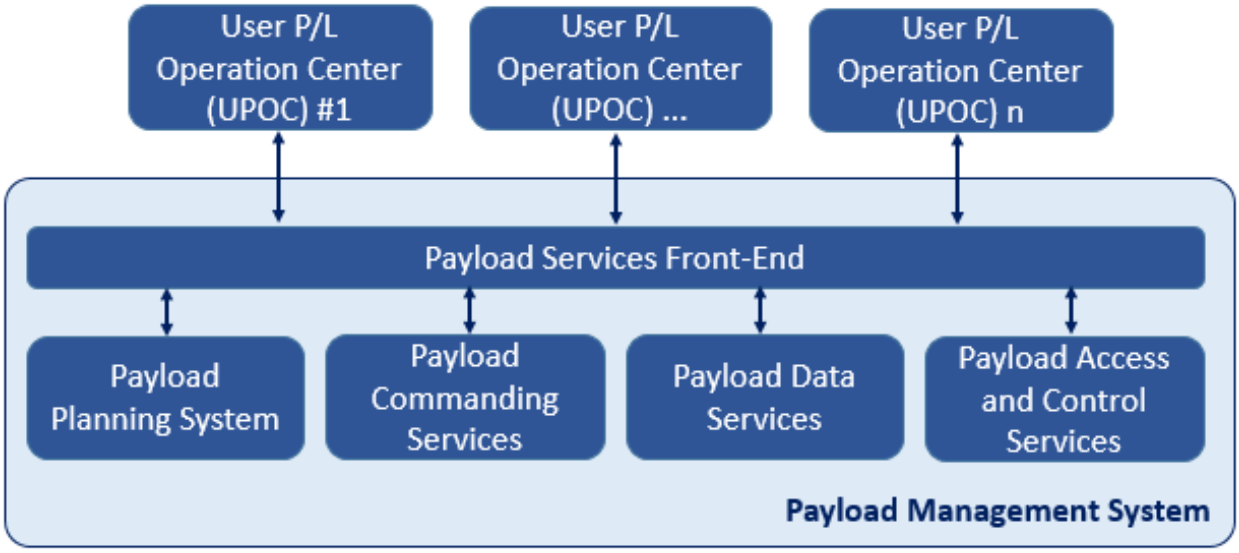

Figure 3 Payload Management System

In order to implement the functionalities needed for the re-entry and landing monitoring and control, the PLCC uses the following systems:

- Mission Control System (MCS) Interface System
- Re-Entry Flight Dynamics & Safety System
- Mission Planning System Interfaces
- Landing Site Ground Station Interface

The MCS establishes the connection with the Ground Station at the Landing Site via the Landing Site Ground Station Interface for the TMTC exchange, and with the MCS at the mini-LCC to forward real-time TM data. It supports the assessment for the "Authorization to Deorbit" and it acquires and monitors real-time telemetry received by the Ground Station located at the Landing Site. If required, it sends the TCs for wind parameters update during the descent phase.

The Re-entry Flight Dynamics and Safety System allow to perform the de-orbit and re-entry analysis opportunities and plan the required maneuvers. Thereafter, it monitors the maneuvers executions and the SRS trajectory.

With the Mission Planning System Interface within the whole PLCC, the planning of the de-orbit maneuvers are passed to the IOCC for subsequent uplink.

3 Landing Sites

3.1 Overview and Purposes

The basic characteristic of Space Rider to be: "*reusable"* imposes to ensure that the vehicle safely lands on Earth at the end of its mission and be ready, after the needed refurbishments, for the subsequent mission.

Additionally, the applicable safety requirements aimed to safeguard, other than the vehicle itself, the landing sites personnel and public as well as the landing sites property (e.g. assets) and the environment, have to be taken under consideration.

It has to be noted that only the Re-Entry Module (SR-RM) of Space Rider will land on Earth while the AVUM Orbital Module (SR-AOM) will be expendable element and will return to Earth splashing-down in the Ocean.

Different Landing Sites will be selected to support landing operations from different Orbital inclination and, in particular Santa Maria (Azores), suitable for orbits with inclinations greater than 37° and Kourou (French Guiana)

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for orbits with inclination lower than 37° and in particular for quasi-equatorial missions both being subject of careful evaluation in the frame of dedicated Working Groups..
The landing sites shall be suitable to perform the required operations during the vehicle pre-landing phase, landing and post-landing phases.

- The pre-landing phase checks and operations are devoted to verify that the weather conditions are favorable for a safe vehicle landing maneuver, the ground-to-space and space-to-ground communications are guaranteed, all the spacecraft tracking systems are in full operation and the surrounding landing area is safe.

The landing phase is characterized by the final vehicle maneuvers that will allow the "gently" touch-down of Space Rider on ground and rollout for deceleration until its final stop.

The post-landing phase tasks and operations will be performed to inspect the vehicle and to ensure that no risks are in place for the personnel that will approach Space Rider; indeed, the further activities to be executed on the spacecraft, payload included, are dedicated to the preparation for the shipment to the refurbishment premises and, for the P/L's, to the PI's.

The Landing Sites activity relies on accurate and timely coordination with local authorities and entities such as:

- Airport for possible weather measurement and radar data provision, Air Traffic safety during reentry and shipments;
- Government and Air Transportation authorities for regulation affecting the reentry and post-landing phases in terms of safety, security, pollution and need of new infrastructures
- Port for possible sea shipments
- Service providers in terms of terrain works, infrastructures construction or renewal such as roads, facilities, maneuvering and storage areas

3.2 Functionalities

The purposes of the landing sites are implemented providing the functionalities hereafter described (see Figure 4).

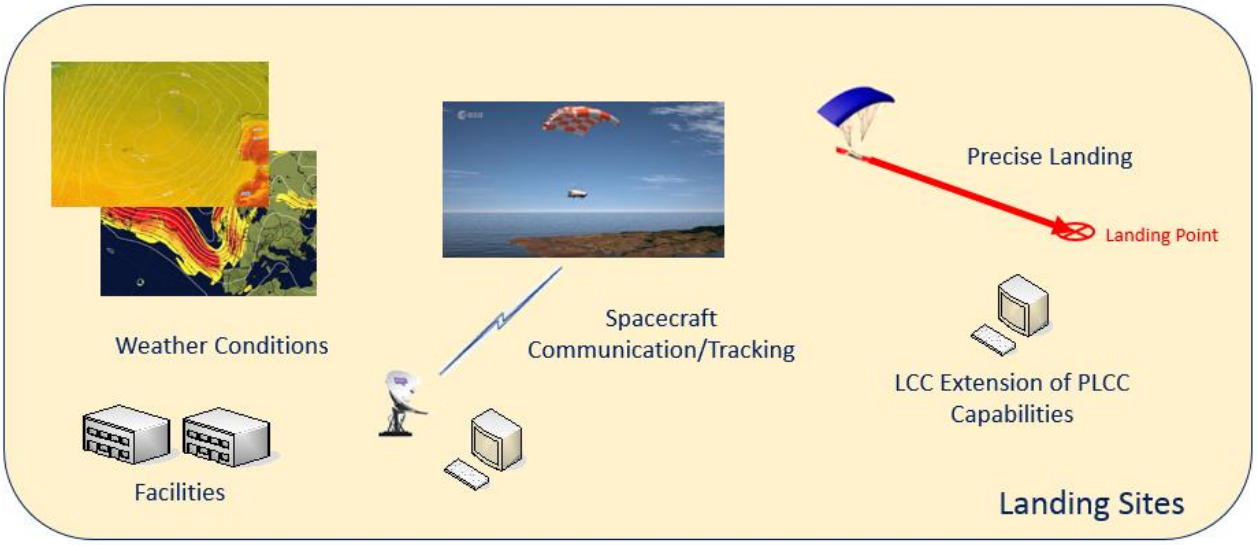

Figure 4 Landing Site Functionalities

The weather condition the days before the landing and the day of landing are fundamental for a safe landing of the spacecraft. Indeed, the weather conditions are one of the "GO"/"No GO" criteria for the landing. In case of bad weather condition the landing will be postponed until the safe conditions are confirmed. Additionally, the high altitude wind data (e.g. direction and speed) are inputs to be given to the Space Rider Guidance and Navigation System for the landing parameters definition.

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During approach and landing, that are critical phases, fundamental is the need to perform a continuous monitoring of the RM during its trajectory path and to transmit commands.

A target landing area compliant with the needs of the Space Rider system in terms of landing accuracy, stopping distance and safe area has to be available and prepared for landing.

The de-orbit, re-entry and landing operations are managed by the Landing Control System within the PLCC. The critical functionalities of the Landing Control Center will be also available at the Landing Site through the mini-LCC in order to ensure the continuity of the operations also in case of issues at the PLCC. s.

During the final phase of the mission and after the landing of the spacecraft some activities will be performed with the aim to safe the Vehicle, retrieve the embarked payloads and prepare Space Rider for Packaging Handling Storage and Transportation (PHS&T). These activities require the availability of specific facilities properly equipped for the execution of the foreseen tasks.

3.3 Systems and Facilities

The implementation of the above listed functionalities is implemented providing the landing sites with the following elements and facilities.

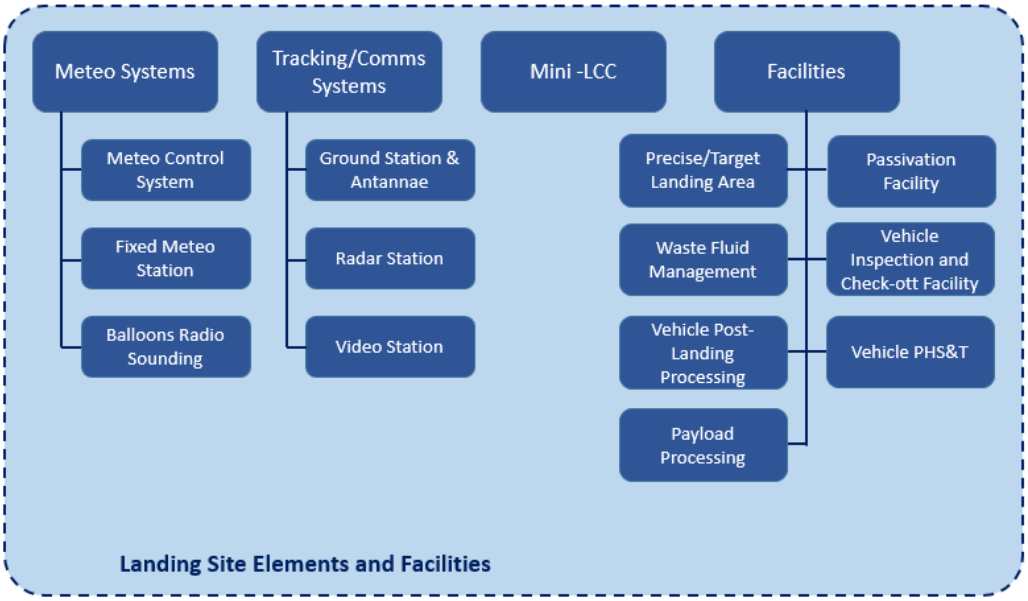

Figure 5 Landing Site Elements and Facilities

The weather forecast and now-cast is performed by means of the Weather Management System that collects different type of information like:

- local weather forecast;
- real-time / off-line data collected by the different weather stations, namely:
  - ✓ fixed weather stations;
  - ✓ balloon radio sounding, able to operate up to 30-40 km altitude.

The surveillance of the space-craft during the de-orbit, re-entry and landing phases is done by means of different individual elements; in particular the landing sites will be provided with:

- Ground Station;
- Radar Station;
- Video Station.

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The Ground Station are also equipped with antenna/ae that allow the communication to/from the vehicle. In particular the ground station(s) will be able to receive all the necessary telemetry and be able to track the vehicle with S-band antenna and with the Doppler and ranging functions, which ensure high precision in the tracking.

The currently identified telecommands to be sent to Space Rider are the:

- Updating of the high altitude wind data for updating of the GNC software;
- Direction and intensity of the wind at low altitude
- "neutralization" command to abort the landing and force a fall over of the Reentry Module in the Ocean by cutting the bridles of the parafoil.

.
The radar station is typically provided by local authorities for traffic control at the landing site. Space Rider will be equipped with a transponder able to communicate with the on-ground radar.

The last system in charge to monitor the final mission phase of Space Rider is the video station which will be able to visually track the vehicle during the final landing phase up to 21 km (TBC).

To ensure the safe landing operations in case a failure at the Landing Control Center and/or in the communication chain between the PLCC and the Landing Site, a so called "Mini-LCC" will be provided at the landing site. Indeed, the Mini-LCC represents an extension at the Landing site of some PLCC capabilities. It covers the following aspects:

- local coordination of all activities at the landing site until mission completion is declared by PLCC:
- local collection, aggregation and distribution of data and information generated at the landing site by specific equipment (e.g. weather data and forecast, radar data, video tracking data):
- local monitoring of the last part of the mission up to landing, through the usage of the local available Ground Stations:
- local emergency and safety TC issuing toward SR-RM for cutting the parachute ;
- data retrieval from the local storage of the landed vehicle and its subsequent transmission to PLCC.

The precise/target landing area is the designated to the landing of the spacecraft. It has been designed to have a diameter of at least 500 m which includes a touchdown zone of at least 150 m radius and a rollout zone of at least 100 m beyond the touchdown zone. The all landing area will have a flat and compact surface, and must be free of obstacle on the windward side that could potentially cause turbulences. In addition, it will have a water drainage system to avoid standing water after rainfall.

The Landing Sites will provide the availability of fire and rescue service, to operate in case of anomaly during landing and recovery operations.

The required facilities of which the landing sites will be equipped will be:

- Passivation Facility required for propellant (hydrazine) neutralization (removal from vehicle) as first operation after landing and before transport of SR in indoor processing facilities. The utilization of a movable light tend mounted around the vehicle at landing position is considered as baseline protecting the vehicle and passivation operators from external environment (precipitation, gusts, etc.);
- Support facilities (e. g. hangar) will be made available for the post flight space-craft and payload processing and preparation for vehicle shipment to the AIT site for refurbishment and payload delivery to the payloads owner. The Vehicle Inspection, the Post-Landing Processing and the PHS&T facility, which can be combined in the same physical building;
- Specific rooms will be assigned to the payloads Processing and Packaging

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4 Ground Segment Elements Interconnections

4.1 General

All the above described ground segment components do not work on a stand-alone mode rather they are interconnected such to ensure the exchange of data which is a paramount for the mission success.

The Payload and Landing Control Center interfaces with the other centers by means of direct and indirect interfaces. The direct interfaces are with:

- the In-Orbit Control Center (IOCC);
- the Landing Site(s);
- the User Payload Operations Centres (UPOCs)[1].

These interfaces are in place in order to properly operate the payloads during the in-orbit mission and to operate/monitor the spacecraft during the de-orbiting, re-entry and landing phases.
The indirect interfaces are implemented through the IOCC connection, and connect the PLCC with:

- AIT/AIV sites;
- Launch Site;
- ESTRACK or Commercial Ground Station (if required / available for re-entry monitoring).

4.2 Data Exchange

Considering only the direct interfaces, the exchanged data among the PLCC and the other cited centers are the Telemetry and Telecommand relevant to the Spacecraft and the Payloads status and operations, the data relevant to the mission and the voice communication.
In particular, the telemetry data are the Spacecraft and Payload housekeeping (HK) for safety and health checks and the Payload Science.
The data relevant to the mission collect all the mission specific parameters pertinent to the in-orbit flight dynamic, re-entry flight dynamic, mission support data, , etc.).
The main data that are shared among the ground Segment elements are shown in figure 6 and, hereafter, briefly summarized and descripted.

[1] In case of remote interface with experiment team(s)

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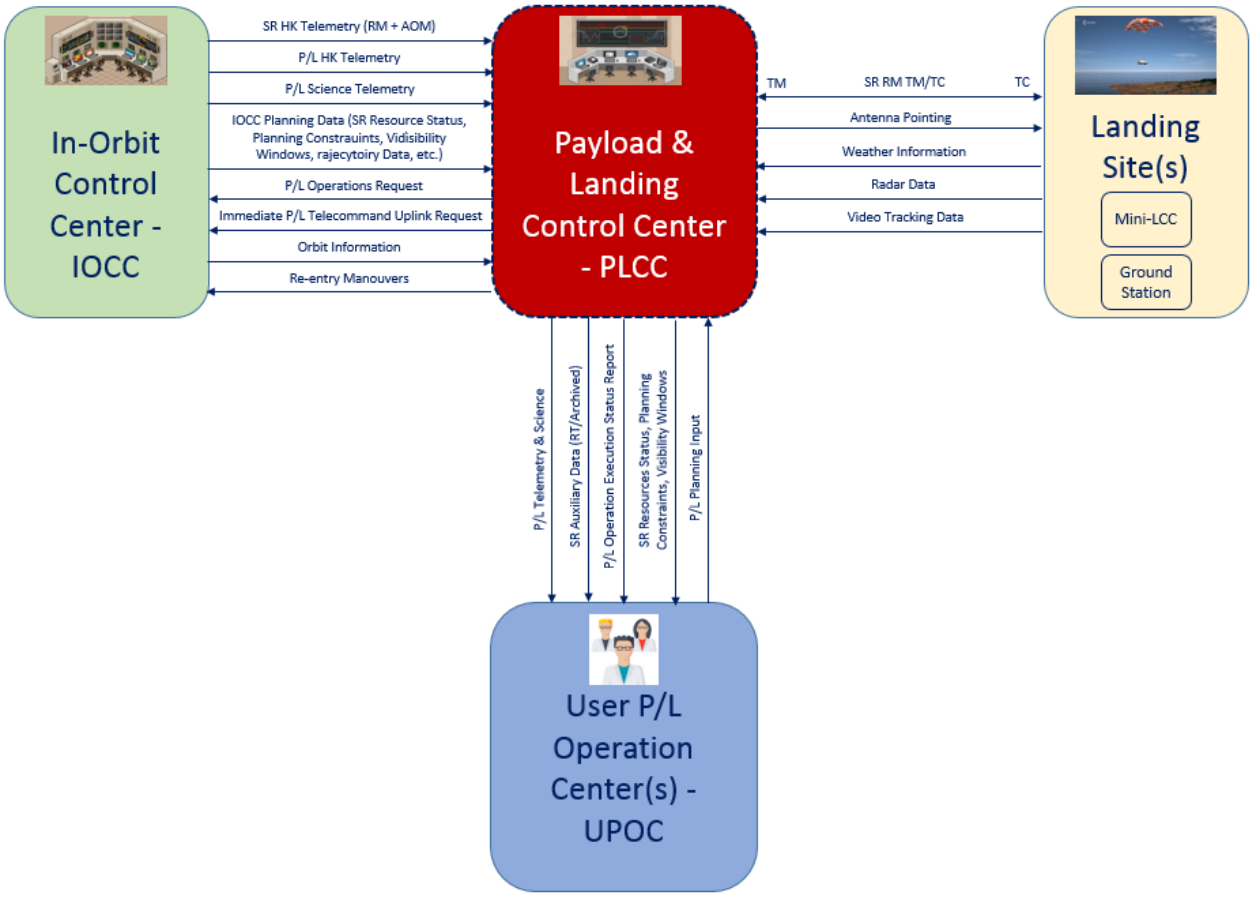

Figure 6 Ground Segment Elements Data Exchange

The Space Rider housekeeping (HK) telemetry are routed from the IOCC to the PLCC in order to prepare the landing phase and to have all systems ready to support re-entry and landing operations, so as to operate in accordance to the real status of the vehicle. The same is done also for archiving, together with the Payload HK and Science telemetry, these last two will also be made available at the User P/L Operation Center(s).
The planning data (i.e. SRS Resource Status, Planning Constraints, visibility windows, Trajectory data, etc.) will be sent from IOCC to PLCC being data required to support the P/L operations and Re-entry planning. In addition, these data are also provided to the UPOC in order to allow the PI' s to have a complete picture of the scenario faced by their payloads.

The Integrated Payload Operation Request and the Immediate P/L Telecomand Uplink Request will be sent from PLCC to IOCC in order to operate the Payloads in the most secure and appropriate way in relation to the available S/C resources, assets and status (POR case) and to face unexpected situation or conditions that require a manual intervention on the P/L, operating through a subset of pre-authorized commands (Immediate P/L TC request case).
Orbit information are routed from the IOCC to the PLCC to provide PLCC and PI's, through UPOCs, with most up to date information on SRS orbit and thus of P/L operating conditions. These information are also quite peculiar for archiving purposes as those may be very important during re-processing of the received P/L data and for data preservation in order to always have the availability of the environmental and operating condition into which those data have been generated.

The re-entry maneuvers commands will be provided by the PLCC to the IOCC in order to uplink most up-to-date weather information prior to starting of the re-entry maneuver to the vehicle, while it is still in SRS configuration. Moreover there might be condition where the re-entry maneuver itself has to be re-planned and reengineered, this is a task PLCC will perform through IOCC that will take care of physically uplink of the information.
One of the PLCC function is to predict the trajectory of the RM during the re-entry and landing phase; as such the PLCC will provide to the landing site the relevant data for the pointing of the antenna in charge to trace the vehicle.

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The weather conditions will be transferred from the landing site to the PLCC to allow the development of the most updated re-entry analyses.
The radar and video data are routed from the landing site to PLCC such to allow proper control of the re-entry phase and to make sure that this is performed in a safe manner. PLCC has the responsibility to verify that the system is behaving nominally during re-entry, these data are key, along with telemetry, to perform such an assessment.

5 Programmatic Aspects

The program is currently in the middle of its Phase C. The Phase B2 ended at the end of year 2018 with the successful Preliminary Design Review.
The Critical Design Review (CDR) is planned for the end of year 2019 and, its successful achievement will allow the program to enter in the detailed design and implementation phase (D phase). This phase will last 24 months and will allow to proceed with the Operational Phase. It has to be noticed that the Operational Phase is composed by:

- Phase E1: Launch Campaign and Launch during which the Vehicle and the Payloads are shipped to the launch site where all the activities in preparation of the launch will be executed. The launch is part of this phase. This phase lasts 1 month.
- Phase E2: this is the Operations in orbit, including landing and post flight early OPS phase. This phase lasts at minimum 2 months.
- Phase F: this phase is devoted to the vehicle refurbishment, including Launch Readiness Review (LRR) for next flight and lasts 6 months.

The first SR flight, the Maiden flight, is currently planned for March 2022.

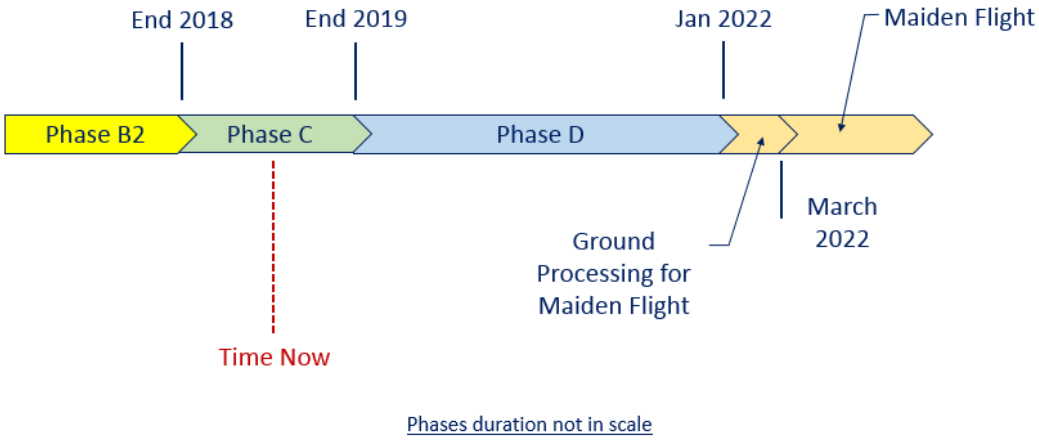

Figure 7: Programmatic Aspects

6 Conclusions

The Space Rider program is an innovative mission that opens new perspectives for affordable and reusable space transportations. The Payload and Landing Control Center is currently under development to fulfill the need of the Space Rider Mission. In particular, it serve as Center to control and monitor the cutting-edge experiments and activities of Payload embarked on the Space Rider. The Center, in strict coordination with the Io-Orbit Control Center and the Landing Site, is also in charge of the monitor and control of the re-entry and landing of the vehicle. The re-entry and landing of a spacecraft is one of the most challenging operations and has never been performed in Europe. The proper execution of the activities required to develop, to design, to implement, to deploy and to operate the PLCC and Landing Site are paramount for the success of the mission and the involved teams, with the experience gathered in previous similar programs, ensure such a success.

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7 Acknowledgment

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8 References

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