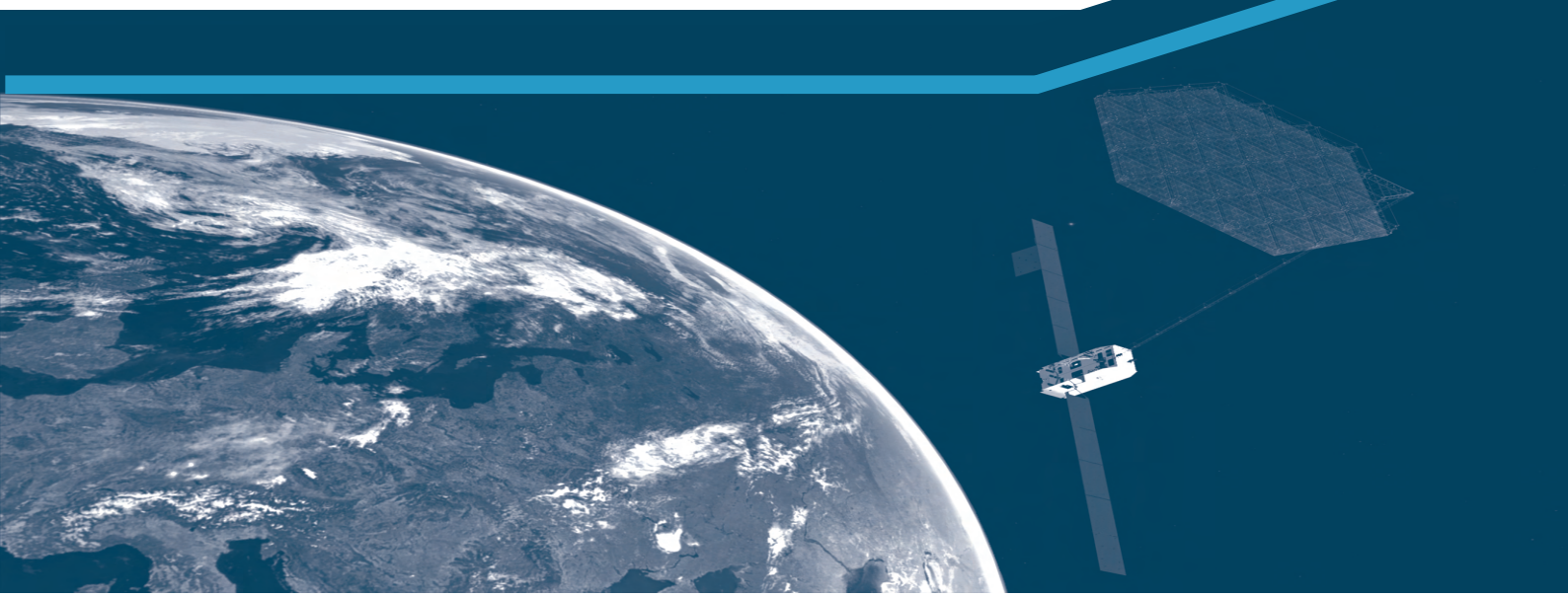
PERIOD

PERASPERA In-Orbit Demonstration

Newsletter 02



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Dear Reader,

I would like to welcome you to the Issue #2 of the PERIOD Newsletter.

We have reached the mid-term of PERIOD's lifetime and successfully completed the Preliminary Requirements Review (PRR). During the last period, we focused our efforts on fine-tuning the mission objectives and the ambitious demonstration concept.

From the factory accommodation at the Bartolomeo platform of the International Space Station (ISS) and the operational architecture concept up to the maturation of the selected In Space Manufacturing and Assembly (ISMA) technologies and the benchmarking of the Standard Interconnects (Sis), the PERIOD team is working towards updating and upgrading the different elements of this mission.

In the present newsletter issue you will find a comprehensive summary of our recent activities and achievements, structured in four (4) thematic topics.

Enjoy the reading & stay connected with PERIOD via our communication channels!

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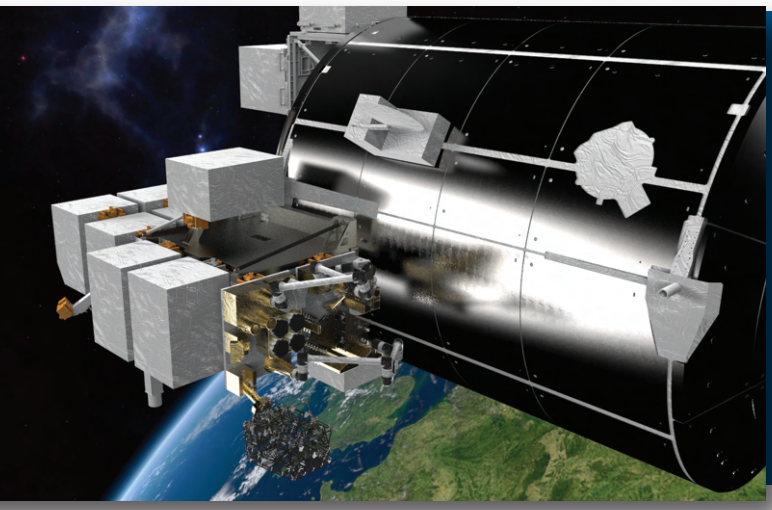
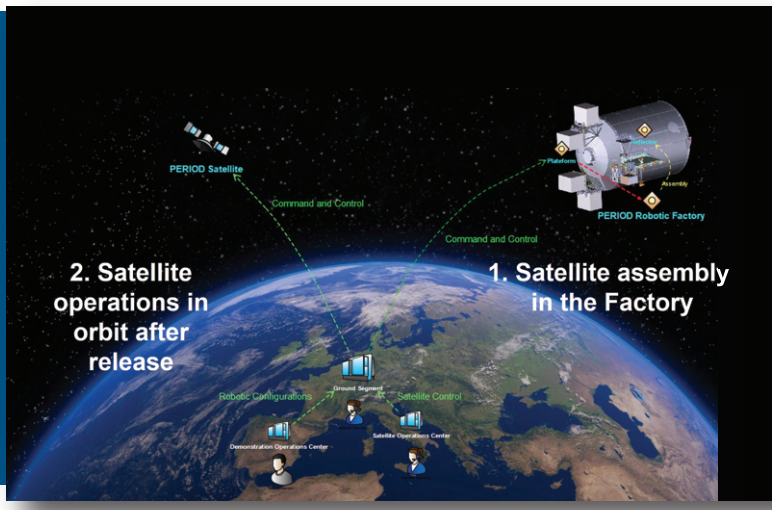
1 Mission Definition

The mission definition was actualized with a refinement of the mission phases and the definition of the overall mission architecture concept.
For each of the main demonstration phases, the more detailed operations including the interactions between the operational entities were described in the MBSE mission model. In addition, the mission definition has undergone a value analysis to assess the key requirements and main system functions w.r.t. the product and cost breakdowns.
The overall costing of the project phases B2/C/D was generated based on the defined system concept and development and verification logic. The definition of the specific scientific mission based on the VLF payload satellite (Very Low Frequency) has been continued for the mission phase coming after the release of the built satellite from the ISS. The results of the combined mission definition, value analysis and costing process have been formalized in the documentation delivered for the Preliminary Requirements Review (PRR).

In the next project phase, a new iteration of the analysis of the mission, operations, functional architecture, logical architecture will be started again taking the PRR findings into account to provide a deeper insight into the overall mission and system concept definition. The definition of the lower level operations and components will be started to provide the next level of decomposition and requirements.



Rendered image of the envisioned orbital factory attached on the Bartolomeo platform



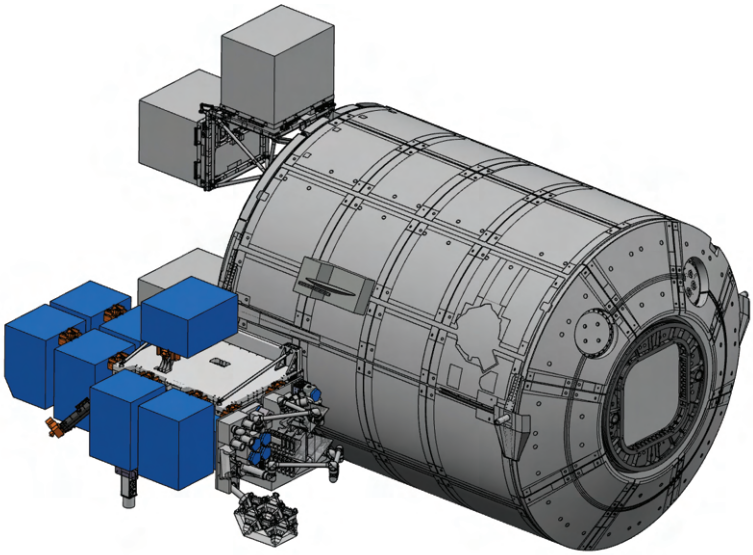
Selected ISMA demonstrations focused on the applications with the expected highest economic values

2 Mission Definition

The architecture and accommodation of the orbital factory to be commissioned on Bartolomeo in order to demonstrate the robotic manufacturing and assembly as well as attachment and refueling operations in orbit were defined more in detail.
Two neighboring Bartolomeo (https://www.airbus-.com/space/space-infrastructures/bartolomeo.html) slots will be used to mount two payload boxes in parallel.
The Factory Box will accommodate all robotic technologies to provide the required functionality comprising two manipulators equipped with end-effector cameras and tool exchange interfaces to allow flexible configuration for different tasks.
The tools are stored in a magazine and workbench elements serve as holding and alignment devices to support the manufacturing and assembly processes. The robot control unit interfacing to all robotic devices and executing the control software to perform autonomous operations is also hosted in the Factory Box.
The Satellite Kit Box will be mounted in the neighboring Bartolomeo slot and contains all elements of satellite and reflector to be manufactured and assembled mounted in dispensers and storages.

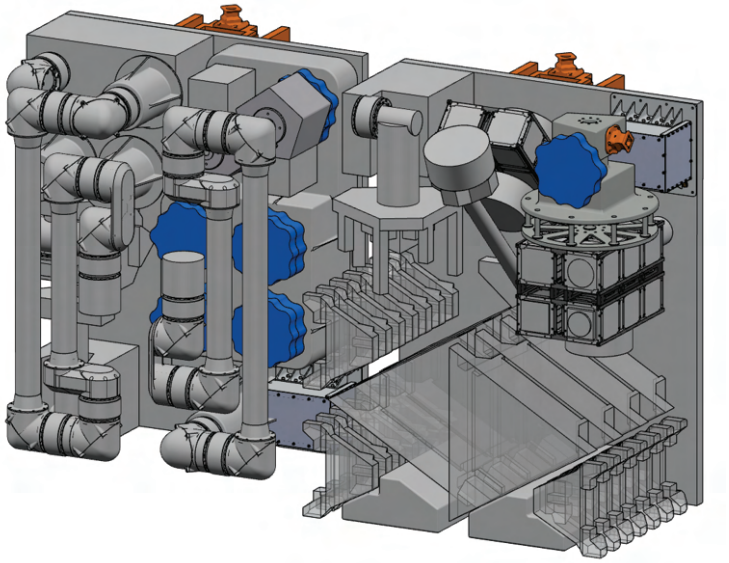
Preparing the paradigm shift for changing the way space systems are designed, built and operated

After testing and deploying the assembled satellite the Satellite Kit Box will be exchanged by a third box, the Refueling Box, which Implements an attachment and refueling experiment which will also be operated by the robotic system accommodated in the Factory Box.



CAD model of the envisioned orbital factory

Design decisions such as how many manipulators are required in the factory and which connections of the satellite to be assembled will be established utilizing a Standard Interconnect or a specific mechanism and dedicated tooling have been taken based on results of performed analyses and trade-offs.



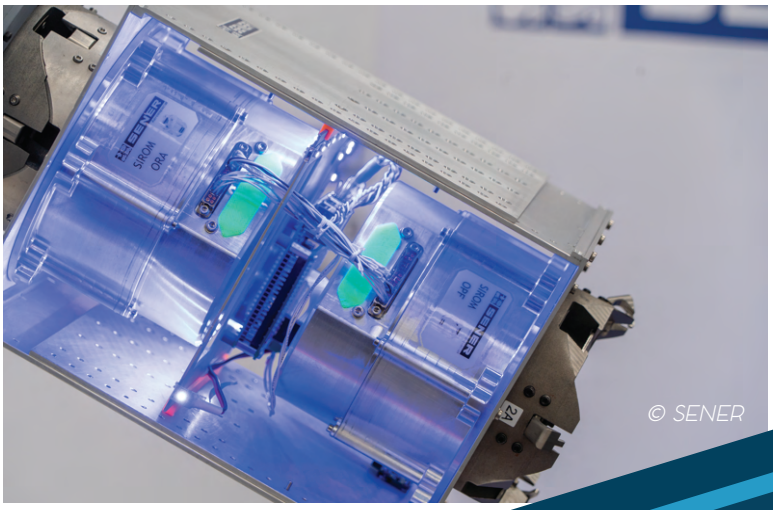
Factory Boy (left) and Satellite Kit Box (right) in stowed configuration

In the next steps, the architecture definition and interface specification, which was so far mainly concentrating on the external ones, as well as requirements to the subsystems will be defined more in detail based on analyses with regard to various criteria such as function, structure, electrical, computing power, thermal, performance, etc.

3 Technology Development

The main results of the activity achieved till the Preliminary Requirements Review (PRR) consist out of **a.** implementation of further development activities to close identified implementation gaps and advance the building blocks to TRL 5, **b.** drafting of a test and validation plan of the building blocks to evaluate their technology readiness assessment (TRA) and **c.** validate their usage with respect to the envisioned technical specification of the project.

The drafted test and validation plan described is based on the ECSS-E-ST-40C standard which has been tailored/adapted for the specific characteristics and constraints of the PERIOD project. To this end the document integrates the software (unit/integration) test plan, software validation plan as well as software validation specification.



Standard Interface For Robotic Manipulation (SIROM)

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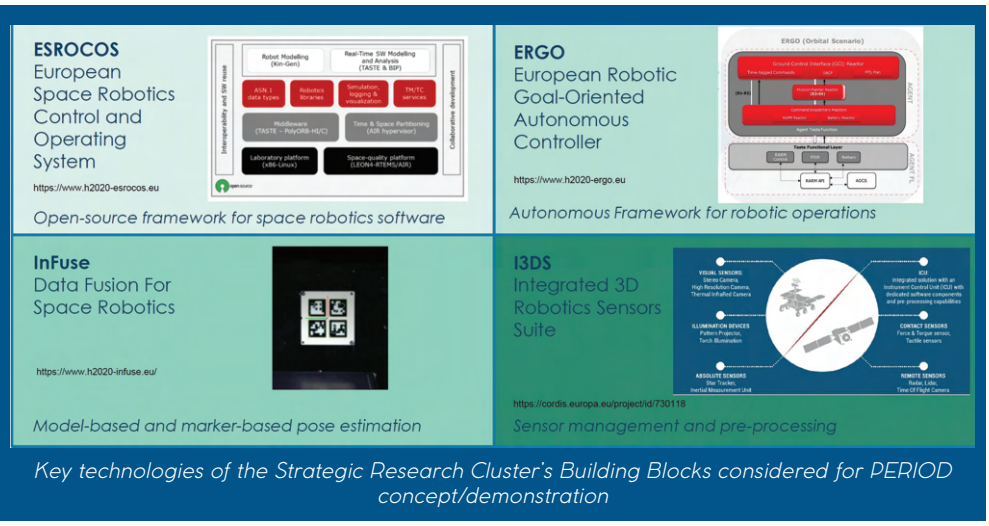

Key technologies of the Strategic Research Cluster's Building Blocks considered for PERIOD concept/demonstration

Next steps of the activity planned till the System Requirements Review (SRR) will involve in the first-place further implementation of building blocks to close the remaining gaps and advance the software in question till TRL 5. At the same time, the testing phase will be initiated according to the defined test and validation plan to assure that the pre-development software is ready to be integrated onto the envisioned breadboard.
Finally, the software validation phase will follow and will conclude with the assessed TRL of the software building blocks.

Challenges & Opportunities 4

PERIOD will integrate many complex tasks from the In-Space Manufacturing and Assembly (ISMA) domain like the manufacturing of reflectors and satellites, as well as their reconfiguration, maintenance and inspection. Each one of them requires the development of dedicated demonstration boxes, tools, skills and operational procedures. And all of these constituents need to be safe, dependable and resilient in their work environment. Thus, the challenges are the development and verification of all those single robotic and autonomy technologies and also their integration into a working and coherent system operated in Earth orbit.
Due to the remoteness of space being one key aspect in the future utilization of the system, a high level of autonomy will already be implemented in the demonstration mission. If the ISMA activities will be successfully demonstrated within the scope of the PERIOD demonstration, this will be an enabling factor to a possibly large commercial market.

One of the next challenges to be tackled would be the logical integration of PERIOD on the Bartolomeo Platform attached to the ISS. It will be demonstrated that the PERIOD manufacturing and assembly operations can be performed in these real space conditions wrt micro-gravity, temperature, radiation and illumination.

The Bartolomeo platform on the International Space Station

Preparing the paradigm shift for changing the way space systems are designed, built and operated

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