National Aeronautics and Space Administration

NASAfacts

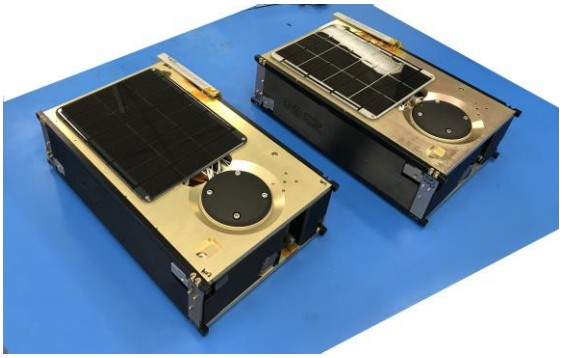
Realizing Rapid, Reduced-cost high-Risk Research (R5)

Pathfinding Lean Development and Accelerating Payloads to Orbit

The Realizing Rapid, Reduced-cost high-Risk Research project, or R5, is a series of CubeSats that are intended to rapidly and affordably get technology prototypes into Low Earth Orbit (LEO). By accelerating the on-orbit demonstration of technologies, engineers and scientists will be able to more quickly prove them and make them available to NASA missions and other users.

In order to create spacecrafts fast and cheap enough to hit project objectives, R5 is leaning heavily on commercial-off-the-shelf (COTS) hardware and is developing processes to intelligently select and screen these components for the space environment. R5 is also reducing cost and schedule by substantially reducing the traditional process used to build spacecraft. As R5 develops these new methodologies, the findings will be shared with the small spacecraft community so that others can follow the successes and avoid repeating the failures.

The baseline R5 spacecraft configuration is a 6U (2x3U) bus and of that approximately 3U is payload volume. The bus form factor and included subsystems can be tailored extensively to best match payload needs. As R5 is intended to support a broad variety of payloads and missions, the bus must have reliable telemetry systems for beaconing, an attitude determination and control system (ADCS), relatively high-performance compute, flexible flight software system, and a very flexible internal configuration. While some subsystems are completely COTS, others are combinations of custom hardware and integrated COTS components. The demonstration of these systems will enable the use of traditionally expensive and long-lead time subsystems (like propulsion) on much shorter timescales and for a small fraction of the cost.



R5 Spacecraft 4 (left) and Spacecraft 2 (right) after assembly. Image Credit: NASA

The spacecraft series is using an incremental development strategy, where each spacecraft will feature improved performance over the previous. Each evolution of the spacecraft bus will be suitable for a variety of payloads. While each spacecraft will be built around a primary payload and mission, the intent is to then add on as many secondary payloads and objectives as possible.

If successful, R5 will directly demonstrate many technology payloads (enabling their adoption by end users) and will pioneer new approaches to build and operate spacecraft, reducing timelines from years to months and spacecraft costs by a factor of 10.

Objectives:

- Operate multiple technology demonstration payloads in LEO without levying traditional flight system requirements on them
- Demonstrate new processes to select COTS components suitable for LEO
- Demonstrate new processes suitable for building low-cost spacecraft
- Demonstrate delivery cadence of more than one mission per year

Fast Facts:

- R5 traces some of its technologies and processes to the Seeker 1 mission that operated in 2019
- The first R5 spacecraft, R5-S1, launched 8 months after development started and cost $14.5k (not including labor or launch)
- R5 is also developing relative navigation capabilities that are enabling technologies for in-space inspection
- R5 has already collected more than 100 lessons learned and intends to release them in 2024
- R5 is flying the NASA COTS Star Tracker and similarly intends to release hardware/software the project is developing for the community to use

The R5 project is managed and funded by the Small Spacecraft Technology (SST) program within the Space Technology Mission Directorate. The SST expands U.S. capability to execute unique missions through rapid development and in-space demonstration of capabilities for small spacecraft applicable to exploration, science, and the commercial space sector.

For more information about the SST, please visit: https://www.nasa.gov/smallspacecraft

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