

Goddard's Core Flight software chosen for NASA's Lunar Gateway

February 12 2021, by Katherine Schauer and Karl Hille



This illustration shows the Gateway lunar platform orbiting the Moon. Credit: NASA

NASA is improving a flight software system to help create and certify essential software for the lunar Gateway.

As part of the Artemis program, NASA will send astronauts to the Moon and establish a sustained lunar presence by the end of the decade. The

Gateway will provide a waypoint for lunar exploration and allow astronauts to live and work in lunar orbit as well as host science instruments and experiments.

While Gateway will not be continuously inhabited like the International Space Station, every system onboard must be at a high standard that guarantees astronaut safety. Class A certification assures that all of Gateway's systems meet these rigorous requirements.

NASA, industry partners, and international space agencies are working together to develop Gateway. Goddard Space Flight Center in Greenbelt, Maryland, is collaborating with NASA's Johnson Space Center in Houston to Class A certify the core Flight System (cFS).

The cFS will be essential to Gateway's day-to-day operations, and provides the foundation for Gateway [flight](#) software, including the Vehicle System Manager, which manages spacecraft instruments and systems while maintaining core functions.

Gateway's software builds on cFS's dynamic development environment and component-based, adaptable design. Its flexible, layered architecture allows engineers to rapidly assemble significant portions of a software system for new missions. This results in cost and time savings, as mission teams can avoid developing brand new software for each mission.

Conceived in 2004, the open-sourced cFS software has been improved both internally and through recommendations from independent developers around the world. "We're working on making it easier to test, easier to trace requirements from mission applications, and easy to adapt," said Jacob Hageman, team lead for the ongoing certification effort for Gateway's cFS. "The Artemis program provides resources to help us improve the product, which benefits everyone who uses it."

Goddard developers envisioned an independent, reusable software framework for routine spacecraft tasks, including telemetry, health and safety, and stored commanding. In 2008, the Lunar Reconnaissance Orbiter launched, operating on the core Flight Executive—a plug-and-play foundation for what would become cFS.

Goddard flight software architect Jonathan Wilmot has worked on cFS from its beginning, when the idea was born out of a need for efficiency. "We had two big missions at Goddard at one time, the Solar Dynamics Observatory and the Global Precipitation Measurement," he said. "There wasn't enough staff to do both independently, so we worked with Goddard's software and mission teams to establish a set of requirements."

This experienced team defined the software framework and application suite that was common to NASA missions so that future missions would just have to add their [mission](#)-unique functions. Since then, NASA has employed cFS on missions like the Lunar Atmosphere and Dust Environment Explorer, the Magnetospheric Multiscale Mission, Orion's Ascent Abort—2 Flight Test, and more.

In July 2020, cFS was named NASA's Software of the Year for its combination of "app store" delivery of solutions, stability, and adaptability. "One of the great things about cFS is that it's always evolving," said Hageman. "We work on maybe two or three missions a year, but outside of NASA, people are trying it out, finding new ways to use it and making suggestions for improvement."

Currently, the Goddard software development team is certifying the cFS by testing it to ensure it meets the requirements set forth by the agency for Gateway. After testing at Goddard, it will be delivered to Johnson for additional testing, possible modifications for Gateway-specific features, final implementation, and human rating certifications.

The first elements of the Gateway are anticipated to launch together in 2024 and will allow NASA greater access to the lunar surface. The Class A-certified flight [software](#) for Gateway will ensure all systems operate properly and that NASA's astronauts have a safe environment to live and work.

Provided by NASA's Goddard Space Flight Center

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