

## MOONLIGHTER

Reliance on space-based capabilities is driving the development of solutions to address in-orbit challenges. This rising likelihood stems from both competition and potential conflict in the space environment. To maintain and strengthen domain supremacy for the nation, The Aerospace Corporation (Aerospace) actively supports our government partners to identify collaborative strategies and tools to bolster resiliency and responsiveness.

Moonlighter is a cyber test platform developed in partnership with Space Systems Command (SSC) and the Air Force Research Laboratory (AFRL). This 3U CubeSat will provide the national security space community with the ability to test and learn in realtime in orbit.

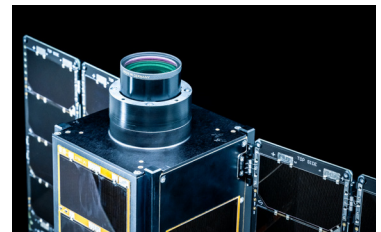
Moonlighter is the world's first and only hacking sandbox in space, designed and launched to advance the understanding of cybersecurity for space systems. It will serve a critical role in exercising defensive cyber operations (DCO); developing cyber tactics, techniques, and procedures (TTPs); and verifying end-to-end cyber threat assessment and prevention across the space enterprise. Aerospace engineers have built both the vehicle and ground segments. Moonlighter successfully launched in June 2023 on a Commercial Resupply (CRS) mission to the International Space Station (ISS) and was deployed in early July. On-orbit operations will begin August 2023.

### Moving from the Laboratory to Low Earth Orbit

Cybersecurity testing for space usually occurs in a laboratory or during a simulation activity on the ground. Applying cyber defense theories and approaches in the space domain has been restricted by the limited availability of suitable existing vehicles in that environment.

Moonlighter is a dedicated in-space system developed to bridge this gap. Teams from across Aerospace came together to build the Moonlighter CubeSat from the ground up, crafting the satellite for cyber testing activities.

Moonlighter carries a dedicated cyber payload with a firewall to isolate the subsystem. It also features a fully reprogrammable payload computer that behaves like a flight computer. This allows cyber experiments to be repeatable, realistic, and secure, while maintaining the health and safety of the satellite.



Moonlighter is the world's first and only hacking sandbox in space, purposely designed to advance the understanding of cybersecurity as it applies to space systems.

### Moonlighter Quick Facts

- › 3U CubeSat with stowed outer dimensions of 34 cm x 11 cm x 11cm
- › Flight configuration outer dimensions of 50 cm x 34 cm x 11 cm
- › Deployed solar panel array dimensions of 34 cm x 30 cm
- › Space Applications: Experiment results and analysis of cybersecurity technologies could change how future space missions are designed, resulting in more cyber resilient architectures
- › Earth Applications: Understanding cyber threat identification and prevention strategies benefits future design and testing of space systems, building in cyber resiliency by design

- The cyber payload will test cybersecurity technologies to support defensive cyber operations
- An incorporated cyber monitor enables high-speed processing and monitoring of traffic transiting the communications pipeline. The monitor has the capability to apply artificial intelligence and machine-learning to cyber event detection algorithms
- Supplementary attitude sensors, in addition to vehicle sensors, allow for more exquisite monitoring techniques involving corroborating evidence.

Moonlighter uses a ground segment that is cloud-based, allowing for an environment that can be rapidly reset to a known good state while maintaining a separation between cyber activities and critical health and safety operations.

### Delivering Innovation Through Competitive Collaboration

Moonlighter will be part of Hack-A-Sat 4, an annual space security challenge hosted jointly by the U.S. Air Force and U.S. Space Force. Hack-A-Sat encourages security researchers of all levels and the broader hacking community to participate in finding novel solutions to space cyber challenges.

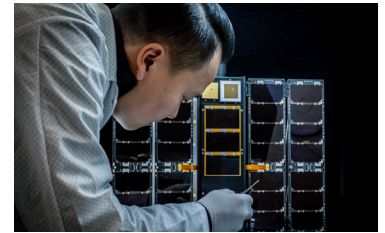
Aerospace has supported this cybersecurity competition since its inaugural year in 2020.

Previously, teams were presented with complex hacking challenges to solve via physical flatsat hardware or digital twin simulation. This year, finalists can look forward to hacking the Moonlighter satellite in orbit.

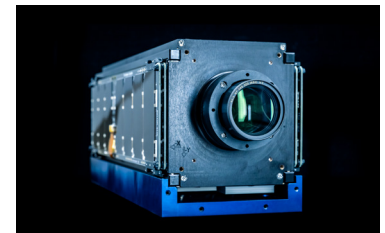
This is a milestone for advancing national security space efforts. Moonlighter will be the first on-orbit asset used for a Hack-A-Sat competition and the first-ever in-space platform used in a Capture-the-Flag exercise. With Moonlighter as the final arena for Hack-A-Sat, team members will problem-solve and innovate together with their actions and outcomes affecting the CubeSat in realtime.

The public can tune in for periodic updates as the five finalist teams experiment and apply cybersecurity methodologies to Moonlighter. The knowledge and information gathered during Hack-A-Sat and the satellite's post-competition days will be made available to the government and wider community.

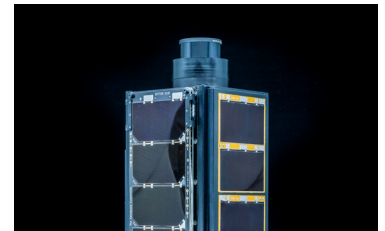
Ultimately, Moonlighter is paving the way for spacecraft and their supporting architectures to display greater resiliency. During the satellite's time in low Earth orbit, operators and other enterprise stakeholders will improve awareness and evolve existing best practices to successfully defend our nation's space systems from potential threats.



Aerospace engineers are responsible for building the Moonlighter vehicle and ground segments.



Moonlighter is the first Aerospace 3U CubeSat with bi-fold panels.



Moonlighter will provide the national security space community with the ability to test and learn in realtime.

## The Aerospace Corporation

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has more than 4,600 employees. With major locations in Chantilly, Virginia; El Segundo, California; Albuquerque, New Mexico; and Colorado Springs, Colorado, Aerospace addresses complex problems across the space enterprise and other areas of national and international significance through agility, innovation, and objective technical leadership. For more information, visit [www.aerospace.org](http://www.aerospace.org).