# Small Satellites, Big Impact — MC3 Network Inspires Space Innovation at Naval Postgraduate School

*The Naval Postgraduate School's world-wide, satellite ground station network is unique among the nation's academic institutions.*

Naval Postgraduate School (NPS) Ph.D. student Noah Weitz, right, and Space Systems Academic Group (SSAG) research associate professor Giovanni Minelli, left, are pictured inside the NPS Mobile CubeSat Command and Control (MC3) ground station.

MONTEREY, CA, UNITED STATES, April 17, 2026 /EINPresswire.com/ -- On Jan. 14, 2025, a commercial SpaceX rocket successfully launched from Vandenberg Space Force Base in California, carrying a Naval Postgraduate School (NPS) small satellite, also known as a CubeSat, called Otter. Two hours later, a small team of NPS researchers huddled inside the school's Satellite Operations Center (SOC), the hub for interacting with NPS assets in space as well as the central node of its globe-spanning Mobile CubeSat Command and Control (MC3) ground network.

As the satellite deployed and arced across Canada into the Northern Pacific 515 km above the earth, several of MC3 sites within view of the vehicle across the United States began picking up its signal and the NPS team prepared to make first contact.

"We're tracking!" exclaimed Alex Savattone, a faculty associate for research in the Space Systems Academic Group (SSAG), as the satellite's beacon came into focus.

Over the next several days, the Otter team refined the vehicle's orbital parameters, transmitted several commands, and data began streaming to the SOC: good status confirmed via the MC3 network.

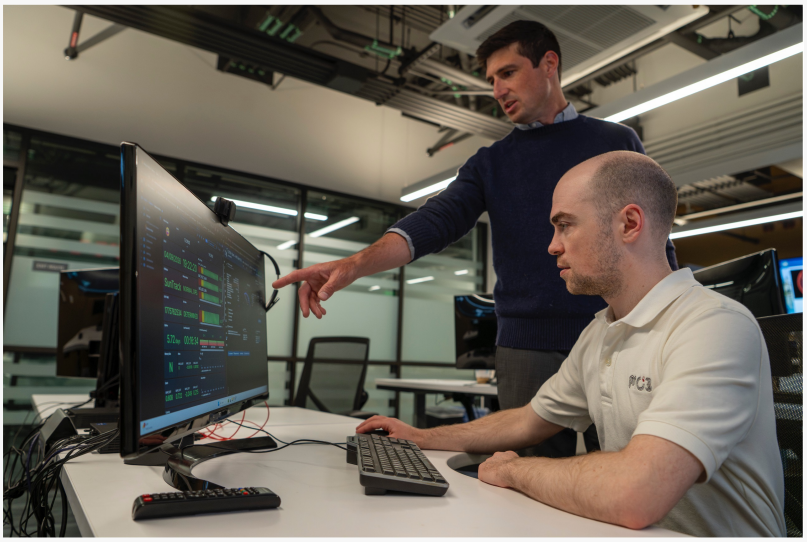
The MC3 system is an operational ground station satellite network now owned by NPS — unique

among the nation's academic institutions — which supports space operations and research in the proliferating domain of CubeSats across a community of users, including a wide range of U.S. government organizations, contractors, universities as well as foreign allies and partners.

"Having the MC3 owned and operated as a Navy system speaks to the steady success of the SSAG in its contributions towards CubeSat research infrastructure," noted SSAG chair Wenschel Lan.

"We have the unique opportunity to build on lessons learned from operating dozens of spaceflight missions over the last 15 years and continue that momentum going forward," she continued. "Space is truly interdisciplinary, and MC3 enables NPS faculty across campus to expand their research in the space domain. As a result, students are empowered to make significant contributions throughout the course of their graduate education at NPS."

"It will be exciting to see MC3 grow with the needs of the space community, not just within the Navy and the DOD, but the industry at large," she added.



Naval Postgraduate School (NPS) Space Systems Academic Group research associate professor Giovanni Minelli, left, and Ph.D. student Noah Weitz, right, track CubeSat orbital data in NPS' Satellite Operations Center.

Naval Postgraduate School (NPS) graduate student U.S. Marine Corps Capt. Chris Henderson is using the NPS Mobile CubeSat Command and Control network and telescope to conduct cutting-edge, satellite optical communications research.

The MC3 system was initially founded in 2011 at NPS with DOD sponsorship to meet a surge of interest in CubeSats. In a complete paradigm shift from the large, multibillion-dollar enterprise investments of traditional space operations and research, the military pursued relatively cheap, quick-launch CubeSat systems. In creating a federated network, users could contribute to a pool of resources to conduct space operations and foundational research while keeping costs low.

The first MC3 prototypes were rack-mounted, easily transportable systems with antennas that could be swiftly assembled, according to Giovanni Minelli, SSAG research associate professor and principal investigator (PI) for the MC3 network.

Naval Postgraduate School (NPS) graduate student U.S. Marine Corps Capt. Chris Henderson is using the NPS Mobile CubeSat Command and Control network and telescope to communicate with CubeSats using optical methods to transmit data.

"The idea was you could build the CubeSat and the ground segment very quickly, ship it off somewhere and then respond with a very fast launch and get eyes over whatever you need to as quickly as possible," he recalled.

The MC3 network has since grown to nine other tracking facilities nationwide, including three other DOD service institutions, civilian institutions, industry partners and government agencies. Additional stations are located in New Zealand and the United Kingdom, making the MC3 network a truly global space operations asset.

Together, these organizations share satellite tracking and communications responsibilities through parallel ground stations, allowing missions to benefit from increased contact opportunities, redundancy, and resiliency.

Over the past decade, the network has supported nearly 40 spacecraft across more than 20 missions for a wide range of DOD organizations, Otter being the most recent built by NPS.

Administrative ownership of MC3 resides completely inside NPS, including day-to-day operations, technical maintenance and mission support. So too is responsibility for managing and growing the network, allowing the university to guide MC3's future direction while continuing to support current users.

"We have the ability to shape where it goes next — how it grows, who we partner with, and how we use it for education and research," Minelli said.

"In effect, the program functions as a fully integrated capability. We designed and built the system, understand its operation and own the equipment, spectrum and associated licenses – eliminating the need for new acquisitions," he added.

One of MC3's distinguishing features is its ability to operate to DOD cybersecurity standards while remaining an unclassified government-owned network. This enables MC3 to support

missions ranging from unclassified research to highly sensitive national security applications, something commercial or civilian networks cannot easily do. MC3 fills that gap, providing a rare capability tailored specifically to low-cost research and operational satellites.

Another defining element involves the relationships formed with other partner institutions which include other service schools like the Naval Academy, Coast Guard Academy and Air Force Institute of Technology, as well as civilian institutions that conduct government research.

“That central position we occupy—where we are part of the DOD but also a government institution — gives us strong connections across other government research organizations,” said Noah Weitz, SSAG researcher and MC3 co-PI along with Minelli.

“We’re looking forward to expanding both the amount and the types of research we can do, not only at NPS but beyond it, by bringing more partners into what we’re doing,” he continued. “We have a strong desire to work more closely with them — not just informally, but through established processes. We understand what it takes to develop Cooperative Research and Development Agreements (CRADAs) or Memorandums of Understanding (MOUs) and to formalize those relationships around shared goals, with the ability to provide final approval to move the research forward.”

MC3 already supports student thesis research across multiple disciplines, including satellite communications, alternative position, navigation and timing (PNT), energy security and systems engineering, and faculty anticipate broader collaboration across departments and with international partners, including Five Eyes allies and NATO-affiliated researchers.

“MC3 gives students access to real infrastructure, real missions, and real constraints,” said Weitz. “It’s not just theory: students can design something, test it, and see how it performs in an operational environment.”

Weitz’s own academic work itself draws on the collaborative nature of the NPS environment.

In addition to being co-PI on the MC3 program, he is also a Ph.D. candidate in the Systems Engineering (SE) department. In conjunction with the Electrical and Computer Engineering (ECE) department, Weitz is exploring how the MC3 platform can support microgrid technology and operations in locations where traditional communications infrastructure does not exist.

“My dissertation focuses on conceptual design architectures for microgrids in austere environments,” he said. “That includes places like the Arctic Circle, remote Pacific islands, and even lunar infrastructure for future bases. Communications are a finite resource in such places. If you’re deploying power infrastructure quickly, you also need communications. That’s where MC3 fits naturally.”

In combining microgrid technology with satellite communications capabilities, he’s investigating

whether compact, containerized systems could provide both power and connectivity for forward operations. Such systems could potentially be transported to remote locations and quickly activated to support small operational sites.

This is not just theoretical work, however. Working with SE professor Douglas Van Bossuyt and ECE professor Giovanna Oriti, Weitz is building a microgrid system on the roof of Spanagel Hall at NPS. The platform will incorporate solar panels and other energy components designed to test whether MC3 systems can remain operational during scheduled or unexpected power outages.

“We want to see if we can run our current MC3 infrastructure without changing how it works,” Weitz said. “Can a microgrid keep the system operational during outages? What are the limitations? What do we learn from actually trying it?”

The experiments are designed not only to answer technical questions but also to demonstrate how different research efforts across campus can integrate with MC3.

“With NPS behind the network, we have the opportunity to explore unique applications of the technology,” Weitz said. “We can maintain our mission support for partners while also using the platform to experiment and collaborate with other departments.”

The interdisciplinary possibilities are what make MC3 particularly exciting, he added.

“It’s like opening a box of Legos with no instructions,” Weitz said. "We have the hardware infrastructure, the institutional support, and the relationships across campus and with our partners. That gives us the freedom to explore new ideas and bring people together to see what’s possible.”

That spirit of experimentation and collaboration is already translating into hands-on research opportunities for students across campus.

U.S. Marine Corps Capt. Chris Henderson, an NPS student in the space systems operations curriculum at NPS, is using the MC3 network to conduct cutting-edge, hands-on research that could help shape the future of military communications.

His thesis centers on free-space optical communications, a method of transmitting data using visible light rather than traditional radio frequency (RF) signals. Often compared to “fiber optics without the cable,” optical communications rely on lasers or LEDs to send information through space at extremely high data rates.

In fact, the recent Artemis II mission demonstrated their O2O system (Orion Artemis II Optical Communications) as a proof of concept. Using infrared light, NASA confirmed that the O2O system crossed the 100 GB threshold of data sent back to Earth within the first four days of the mission, much higher capacity than traditional radio signal.

“There’s been a big push toward space-to-ground and ground-to-space optical links,” Henderson explained. “The physics of it allow for much faster data transfer and far more available bandwidth than RF.”

That research became possible when NPS installed a new telescope in August, just as Henderson began his thesis work. Using the telescope, he is developing an optical receiver capable of detecting and decoding light-based signals transmitted from orbiting satellites. Those satellites include NPS-owned spacecraft such as Mola and Otter, which carry LED payloads designed for experimental communications.

Otter, in particular, plays a key role in Henderson’s work. Through the MC3 network, operators can command the satellite to transmit encoded messages using a blinking LED.

“It’s essentially like Morse code,” Henderson said. “You set it up through MC3, the light blinks on and off, and the receiver decodes the information.”

The MC3 network is central to that process, enabling students and researchers to schedule satellite passes, send commands, and collect data from multiple ground stations working in parallel. For Henderson, having direct access to the network has been critical.

“Having MC3 fully under NPS control just gives us more flexibility,” he said. “We can experiment more freely, integrate new capabilities, and work more closely with partners.”

Those partners include allied organizations, such as Five Eyes collaborators, that operate satellites equipped with more powerful laser transmitters. Henderson is coordinating with those teams to observe optical signals beyond NPS’ own spacecraft, expanding the scope of his research.

The advantages of optical communications extend well beyond academia. Compared to RF systems, optical links are far harder to detect, intercept, or jam—a feature known as low probability of detection and low probability of intercept. For the Marine Corps, that has clear operational relevance.

“As a Marine, I think about expeditionary forces,” Henderson said. “If Marines are operating forward, you don’t necessarily want to broadcast where they are. Optical communications can help with that.”

While Henderson will graduate this summer, his work is intended to outlast his time at NPS. A major goal of his thesis is to develop a system that can be replicated across other MC3 sites, enabling future students to build on his foundation.

“We’re really starting from ground zero,” he said. “But ideally, this becomes something that other

students can pick up and continue. That's what makes MC3 such a great opportunity — it lets students do real, hands-on research that matters."

For NPS, ownership of MC3 reinforces its role as a leader in applied space research and military-relevant education. For the broader defense and research communities, it ensures that a unique, low-cost and highly capable satellite ground network remains available – and continues to evolve — at a time when small satellites are playing an increasingly central role in national security and scientific discovery.

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Naval Postgraduate School (NPS) is located in Monterey, California, provides defense-focused graduate education, including classified studies and interdisciplinary research, to advance the operational effectiveness, technological leadership, and warfighting advantage of the naval service. Established in 1909, NPS offers master's and doctorate programs to Department of War military and civilians, along with international partners, to deliver transformative solutions and innovative leaders through advanced education and research.

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