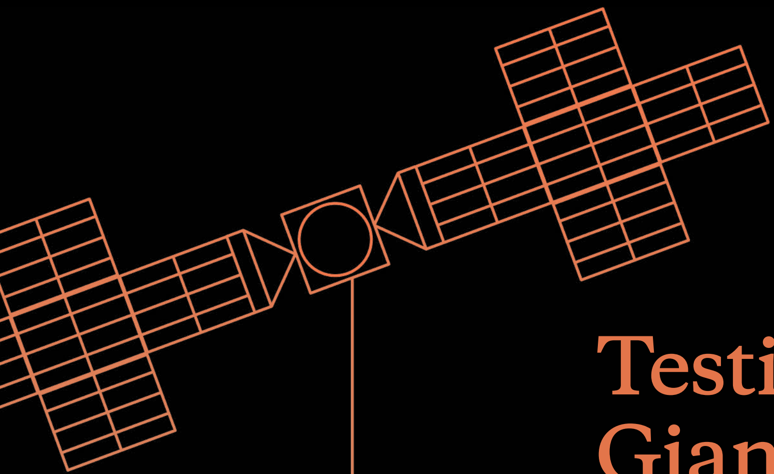
INTER-PLANETARY

As humanity once again seeks to plant its flag on the Moon, return samples from across our solar system, and push farther out into the stars, gentle giants at home — and the engineering experts behind the antennas — help ensure we make the right moves to achieve mission success.

Left: *Deep Space Station-14, a 70-meter-wide antenna dish at the Deep Space Network's complex in Goldstone, California*



Testing 1, 2, 3… Giant Leap

Until 2023, NASA had used only radio waves to communicate with missions traveling beyond the Moon.

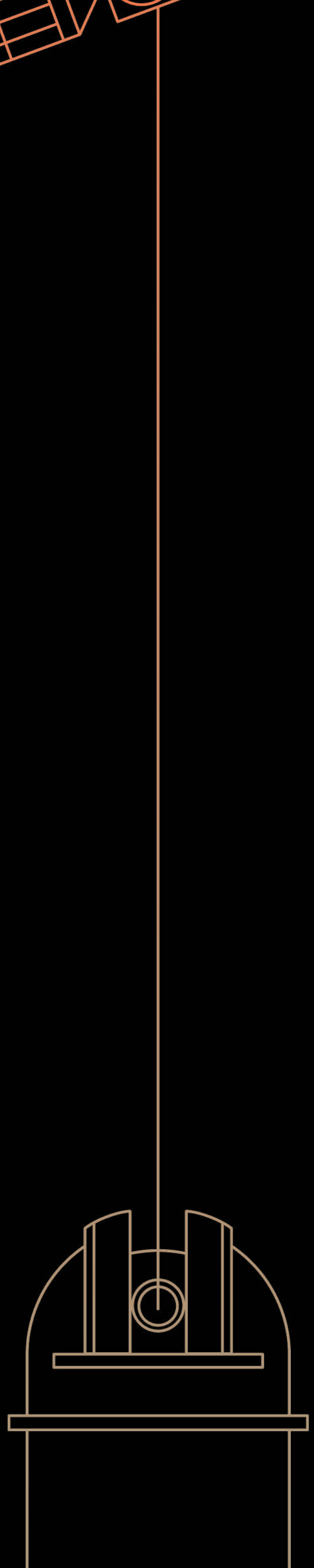
Now, as with the transition from copper phone lines to fiber optics on Earth, the leap from radio to optical communications in space will vastly increase data rates. Multiplied bandwidths will enable more powerful human and robotic missions for probing our universe.

Launched in October 2023 aboard the Psyche mission, NASA's Deep Space Optical Communications experiment is the agency's first demonstration of the technology beyond the Earth-Moon system. DSOC achieved "first light" in the early hours of Nov. 14, successfully beaming test data nearly 10 million miles to Earth. It was the farthest optical transmission in the history of space exploration. But what really got the world's attention? Less than a month later, the farthest video transmission (*see sidebar*).

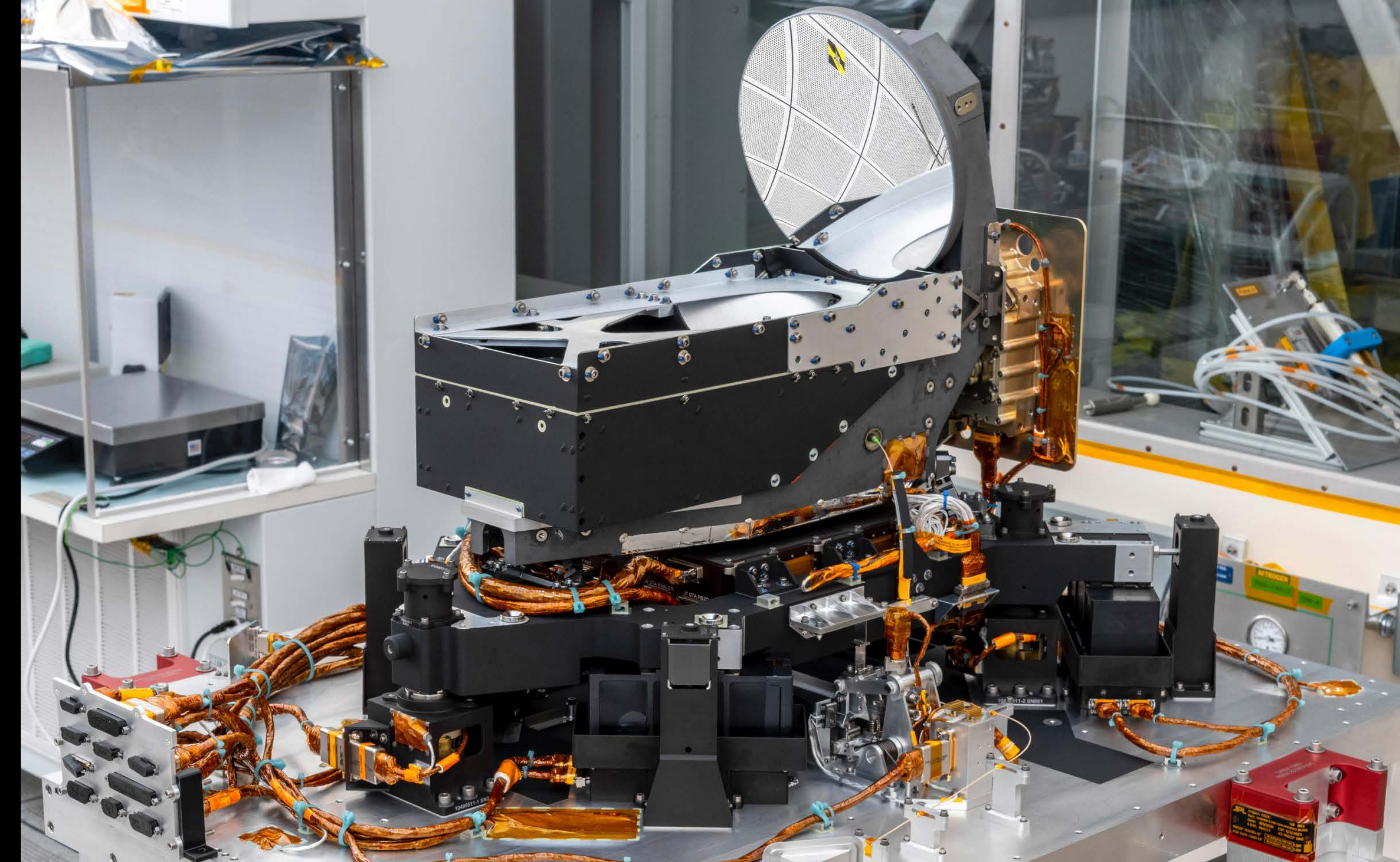
DSOC is forecast to achieve high-rate transmissions over distances up to 240 million miles — comfortably farther than the average distance to Mars of 140 million miles — during the first two years of Psyche's six-year journey to the asteroid belt.

Supported by the Deep Space Network in JPL's Interplanetary Network Directorate, DSOC consists of a flight laser transceiver, a ground laser transmitter, and a ground laser receiver. With first light, the DSOC team is working on refining the system to demonstrate high-bandwidth data transmission at steadily greater distances from Earth.

If it performs as expected, the technology will enable high-rate communications with streaming high-definition imagery to support humanity's next giant leap: setting foot on Mars.

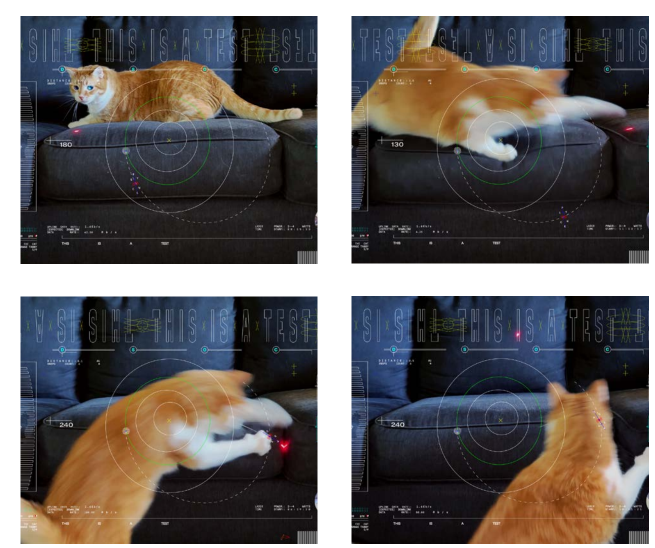


Left: *Illustration of Psyche communicating via laser with the Palomar Observatory*



Above: *DSOC's flight laser transceiver before being integrated with Psyche*

Ad Astra, Taters!



On Dec. 11, DSOC went viral with — what else? — a cat video. That day, a DSN antenna on Earth received an ultra-high definition streaming video from DSOC as an optical transmission from a record-setting 19 million miles away. Uploaded before launch, the 23-second video featured an orange tabby cat named Taters, the pet of a member of the JPL design team that came up with the idea, chasing a laser pointer with overlayed graphics.

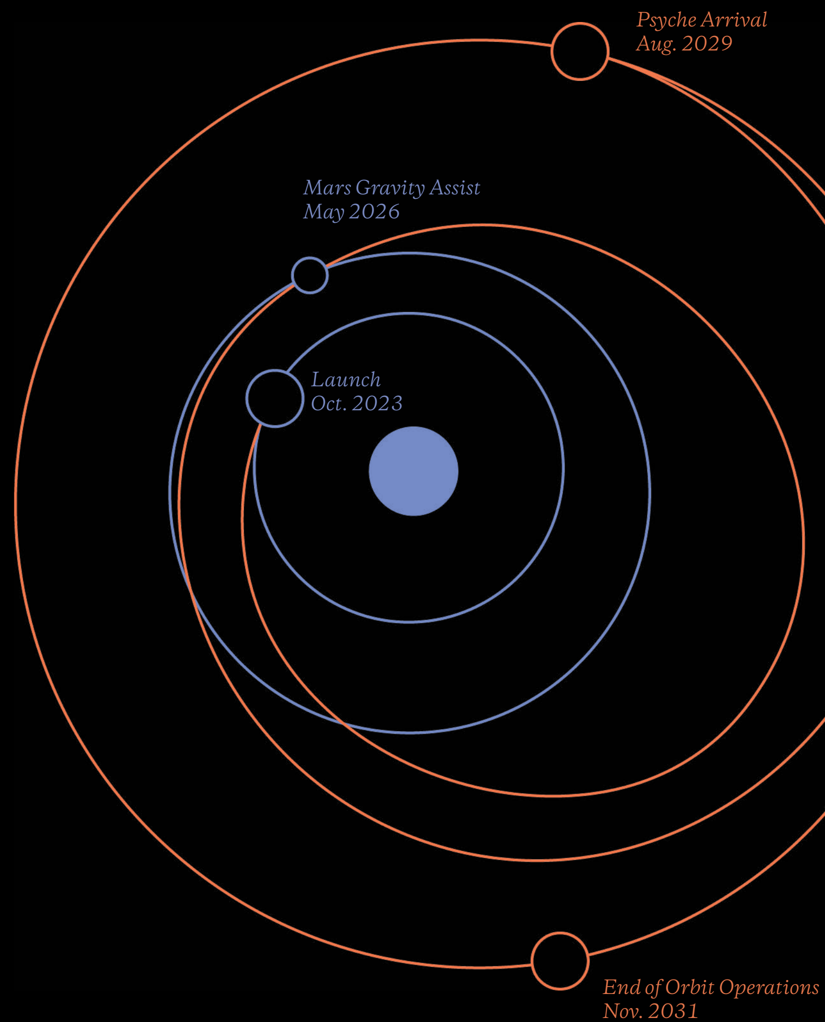
The graphics illustrated several features from the tech demo, such as Psyche's orbital path, Palomar's telescope dome, and technical information about the laser and its data bit rate. Tater's heart rate, color, and breed were also on display.

History, as much as popularity, inspired the choice of video subject. In 1928, RCA and NBC tested an invention called television with broadcasts of a small statue of the cartoon character Felix the Cat.

Right: *An illustration of Psyche's orbital plan and trajectory*

Psyche Orbit

Planetary Orbits



DSN Tracks Course for Asteroid Prospector

For many nineteenth-century American prospectors, the hope was to strike it rich. The Psyche asteroid mission is banking on a goldmine of insights into planetary evolution and our own world's core.

As it does with all NASA interplanetary missions, the DSN will receive data and send commands to Psyche. Those commands will chart a spiral path to the asteroid that will begin with a ride-along with Mars in May 2026. Psyche will ride along briefly on the Martian orbit, harnessing the Red Planet's gravity, to increase the spacecraft's speed and adjust its direction toward the asteroid belt.

Psyche will then travel into the main asteroid belt, where the gravity of its namesake asteroid is expected to capture the spacecraft in July 2029. The spacecraft's orbital operations will start in Aug. 2029.

Psyche's cruise, arrival, and orbital paths will accelerate the potential of striking it rich in our understanding of our solar system, our home planet, and the elements common to rocky planets.

NASA Deputy Notches DSN Hat Trick

Below: *NASA Deputy Administrator Pam Melroy and NASA Administrator Bill Nelson in front of a giant antenna dish at DSN's Goldstone site*

Top right: *The massive DSS-23 antenna dish was fabricated in Aviles, Spain, before being shipped to Goldstone.*

Bottom right: *An antenna dish at DSN's Canberra site in Australia*

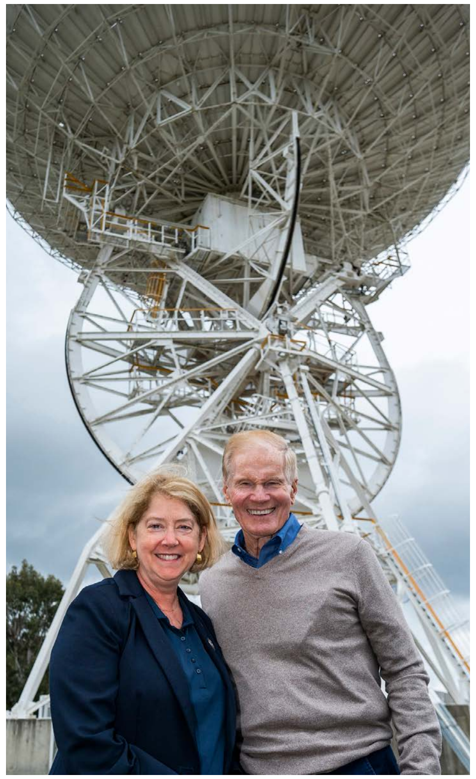
In summer 2023, NASA's Deputy Administrator Colonel (USAF, Ret.) Pamela Melroy toured all three DSN locations in the U.S., Spain, and Australia, walking amongst the giant antenna dishes that support all of NASA's human and robotic missions.

Melroy learned of the improvements DSN will undergo in the next few years to ensure it has the capability to support the human phases of the Artemis program to the Moon and the robotic ventures to explore ever deeper into space. Those improvements include the addition of K-band transmission to two antennas, a necessary upgrade for lunar exploration that is expected to be complete in 2025.

The DSN is also adding a new 34-meter (112-foot) antenna at the Goldstone site in California. Scheduled to begin transmissions in 2026, the antenna structure and its 3,000 pieces were fully fabricated in Aviles, Spain, with electronics scheduled for installation in 2024.

When these antennas fix their focus on the incoming signal — be it from humans, robots on the surface of other worlds, or spacecraft sailing through the solar system and beyond — they will continue to give the world front-row seats to some of the greatest events in history.

The DSN's silent giants connect us to humanity's reach for the stars and allow us to imagine where we, as a species, go next.



All the Right Moves

Above: *OSIRIS-REx sample return capsule shortly after touching down in the desert at the Department of Defense's Utah Test and Training Range*

Opposite, top: *An artist's concept of OSIRIS-REx landing on the asteroid Bennu*

Opposite, bottom: *A training model of the sample return capsule parachuting down to Earth during a drop test in preparation for retrieval of the capsule*

Seven years after launching to space, the OSIRIS-REx spacecraft flew by Earth in Sept. 2023 to deliver a pristine sample from the near-Earth asteroid Bennu.

Since OSIRIS-REx lifted off in 2016, the DSN team has communicated with the spacecraft through several correctional moves to ensure the success of the mission.

The first move took place three months after launch in Dec. 2016 with the successful firing of its main engines, increasing its velocity by 964 miles per hour and setting up the spacecraft for its gravity-assisted ride in Earth's orbit.

Almost a year later, OSIRIS-REx got its gravity assist, gaining about 8,500 mph to begin its two-year journey to the asteroid Bennu. Then in 2018, the spacecraft aced its next move with its arrival at Bennu, where it set two records: the smallest body ever orbited (diameter of 1,640 feet), and the closest orbit of a small body, at just 1 mile from the surface.

The spacecraft collected its sample with a flawless touchdown in Oct. 2020 that lasted just six seconds. In May 2021, it set off on a return trip to Earth, traveling 3.86 billion miles in total to Bennu and back.

In its final mission move in Sept. 2023, the spacecraft successfully dropped the sample capsule — containing an estimated 8.8 ounces of asteroid rocks and soil — to Earth a few minutes ahead of schedule.

Right: *The SamCam imager's view as OSIRIS-REx approached asteroid Bennu's surface to collect a sample*