

**A DOMISTAT  
INITIATIVE**

# First Light

Engineering the Interplanetary Broadband Revolution  
Inside NASA's Deep Space Optical Communications (DSOC) Milestone



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## A 15-SECOND HISTORIC MILESTONE

Payload:	15-second Ultra-High Definition (UHD) video of 'Taters' the cat.
Vessel:	NASA's \$1.2 billion Psyche asteroid probe (launched October 2023).
Status:	Transmitted to Earth on December 11 as a side mission to its main 2.2-billion-mile journey to a metal-rich asteroid.



# BREAKING THE DEEP SPACE SPEED LIMIT

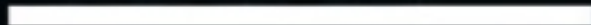
## TRANSIT TIME:

101 seconds for the signal to reach Earth.

## THROUGHPUT:

Maximum bit rate of 267 megabits per second (Mbps).

STANDARD ORBITAL TELEMETRY



AVERAGE HOME BROADBAND



DSOC ACHIEVEMENT



DEEP SPACE SPEED LIMIT

*"It was able to send the video faster than most broadband internet connections. In fact... that connection [over the terrestrial internet to JPL] was slower than the signal coming from deep space."*

— Ryan Rogalin, Receiver Electronics Lead at JPL



THE SCALE OF THE ACHIEVEMENT

# 19,000,000 MILES

(OVER 30 MILLION KILOMETERS)

80x THE DISTANCE BETWEEN  
EARTH AND THE MOON.



# UPGRADING THE ARCHITECTURE: RF VS. OPTICAL



## RADIO FREQUENCIES (RF)

The Shotgun

- Wide dispersion
- Lower data bandwidth
- Traditional standard for spaceflight



## OPTICAL LASERS (DSOC)

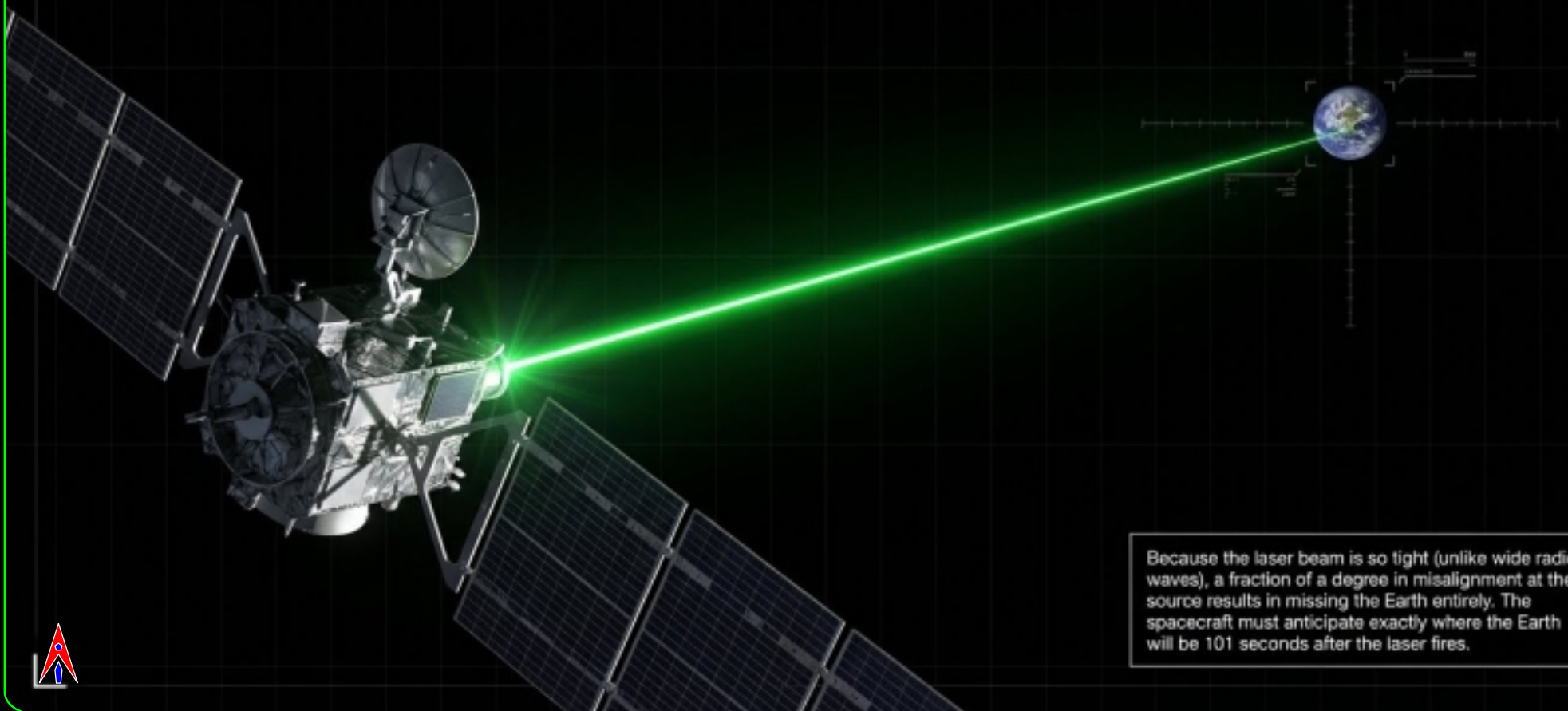
The Sniper

- Near-infrared laser technology
- Hyper-focused beam
- Massively scaled data throughput (broadband video capable)



## CHALLENGE I: ABSOLUTE PRECISION

Targeting a receiver on a planet millions of miles away requires incredible precision from the spacecraft.



Because the laser beam is so tight (unlike wide radio waves), a fraction of a degree in misalignment at the source results in missing the Earth entirely. The spacecraft must anticipate exactly where the Earth will be 101 seconds after the laser fires.

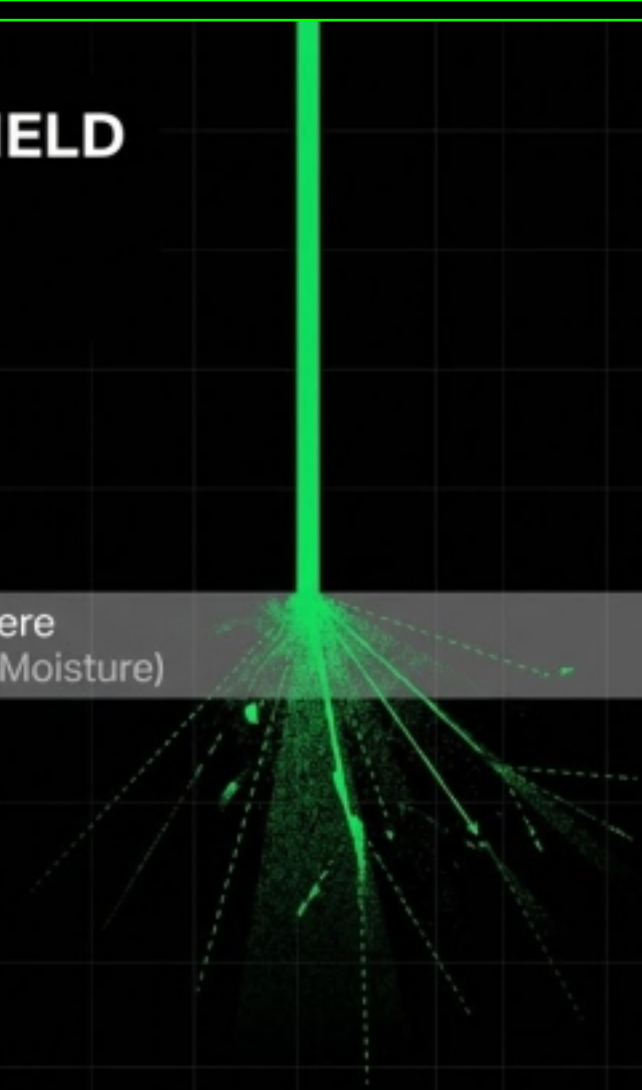


## CHALLENGE II: THE ATMOSPHERIC SHIELD

Atmospheric Attenuation heavily degrades near-infrared optical signals.

- Laser beams are actively scattered by Earth's atmosphere.
- Cloud cover, atmospheric moisture, and thermal turbulence break the integrity of the data stream before it can reach standard sea-level receivers.

Troposphere  
(Clouds & Moisture)



# THE GROUND STATION SOLUTION

## LOCATION:

Hale Telescope at Caltech's Palomar Observatory (San Diego County, California).

## THE MECHANICS:

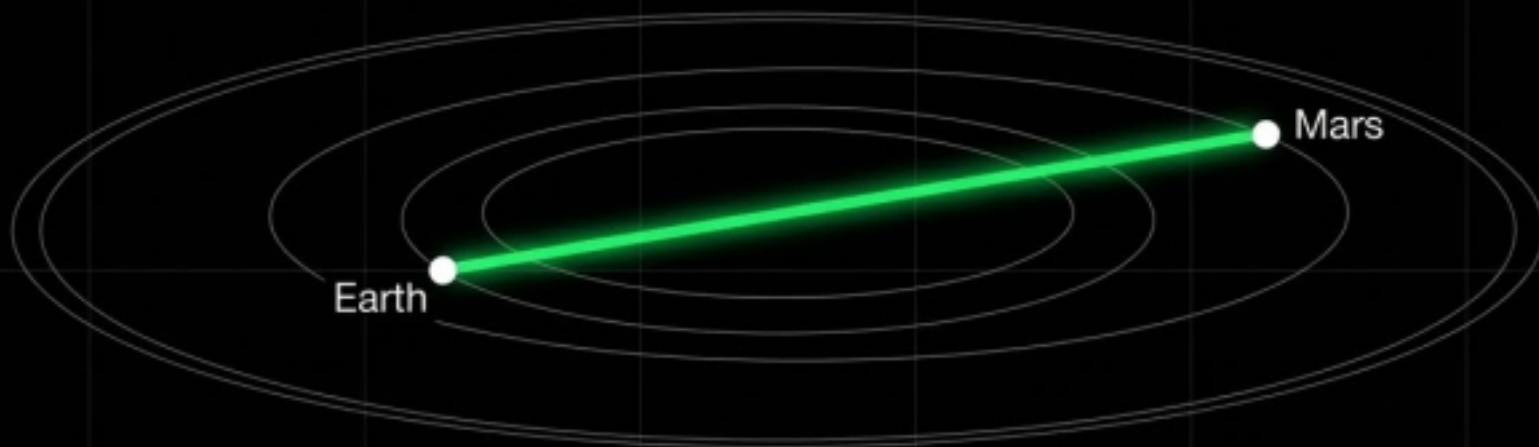
To bypass severe atmospheric attenuation, the receiver must be located in a specialized, high-altitude, and highly dry location.

## THE LINK:

The encoded near-infrared laser successfully coupled with the Palomar receiver, downloading the 15-second UHD video directly from the cosmos.



# The Interplanetary Internet



## Future State:

As Psyche continues toward the asteroid belt between Mars and Jupiter, it will continue sending high-data-rate signals back to Earth.



## Scalability:

Future systems require higher power lasers and more sensitive receivers to support exponential data demands.

## The Ultimate Goal:

This exact technology is the missing communications bridge required for crewed missions to Mars.

Increasing our bandwidth is essential to achieving our future exploration and science goals.

— Pam Melroy, NASA Deputy Administrator