# LANTRN

## Lunar Autonomous Navigation and Timing Relay Network

NASA ORBIT Space Pathway

Sun Devil Orbital Systems | Arizona State University


## Abstract

Sun Devil Orbital Systems has designed the **Lunar Autonomous Navigation and Timing Relay Network (LANTRN)** using NASA's LAR-TOPS-361 patent, *Lunar Surface Navigation System*. LANTRN addresses NASA's Civil Space Shortfall for Autonomous Guidance and Navigation for Deep Space Missions by enabling persistent navigation and communication support for critical assets operating on the lunar surface.

The lunar South Pole is a high-priority region for future NASA exploration, sustained development, and long-duration surface operations. However, its geographic terrain creates significant communication and navigation challenges. Crater rims, terrain masking, permanently shadowed regions, and limited visibility to Earth can interrupt direct connections to terrestrial assets. These interruptions may affect lander coordination, mission timing, astronaut tracking, rover operations, and emergency communications. Although inertial navigation systems can provide short-term position estimates, those estimates drift over time without consistent external updates. Long-duration missions therefore require persistent local infrastructure capable of supporting navigation and communication without continuous direct visibility to Earth.

LANTRN is an 18-satellite constellation operating in highly elliptical lunar polar orbits and designed to provide persistent coverage over the lunar South Pole. The constellation primarily relies on solar power supported by battery storage for long-duration operations. At least three satellites are intended to remain available over the lunar South Pole at any given time, providing continuous support for critical surface assets and communication between mission control and lunar operations. Each satellite functions as both a communication relay and a navigational measurement node, enabling reverse-ephemeris navigation to estimate and regularly update the positions of lunar surface users.

LANTRN's feasibility is supported through thermal, mechanical, communications, and orbital trajectory analyses. The current concept estimates a cost of approximately $150,000 per satellite for the 18-unit constellation, offering a cost-effective initial infrastructure layer with room for future expansion. LANTRN strengthens crew safety, supports consistent communication between Earth and lunar assets, enables persistent navigation and relay services, and improves long-duration Artemis mission planning. The architecture is also scalable to additional lunar regions and future destinations such as Mars, Europa, and other Solar System bodies.



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