

ORACLE FAMILY OF SYSTEMS

SPACE SITUATIONAL AWARENESS MISSIONS BEYOND GEOSYNCHRONOUS ORBIT

WHAT IS THE ORACLE FAMILY OF SYSTEMS?

The Oracle Family of Systems is comprised of two Air Force Research Laboratory, or AFRL, programs designed to develop cislunar space situational awareness, or SSA, capabilities. The two programs are Oracle-Mobility, or Oracle-M, and Oracle-Prime, or Oracle-P.

With renewed interest in lunar exploration, increased traffic to the Moon will require monitoring to ensure safety of flight and collision avoidance. Oracle-M and Oracle-P are satellites being developed in order to provide the foundations for safe operations in cislunar space in support of responsible and sustainable lunar exploration. As AFRL's first foray into cislunar space, Oracle-M will focus on operating and demonstrating mobility in cislunar space, and experiment with tracking known cislunar objects. Oracle-P will build on these foundations as a dedicated SSA experiment to detect and track both known and unknown objects in cislunar space. AFRL expects to use similar ground systems, satellite operations personnel, and data analysis for both Oracle systems. Data from both experiments will be available via the Unified Data Library. Military, civilian, and contractor scientists and engineers will analyze the data from these experiments over the next several years, enabling the transition of technology, knowledge, and vision of future space capabilities for the United States Space Force.

WHAT IS THE ORACLE-MOBILITY AND HOW DOES IT WORK?

Oracle-M is a satellite developed by AFRL to path find for experiments operating within cislunar space. Oracle-M is highly mobile and will transit throughout cislunar space and experiment with techniques to maintain custody of objects in this region. This mission will allow AFRL to assess strengths and weaknesses of navigation techniques needed for future operational systems. The program is on track for its manifested launch as a secondary on a scheduled USSF mission.

WHAT IS THE ORACLE-PRIME AND HOW DOES IT WORK?

Oracle-P is a satellite that will conduct experiments on space object detection and tracking in cislunar space. The satellite will be inserted into an area of gravitational stability between the Earth and the Moon to test techniques to monitor space traffic that travels throughout that region. It will use a wide field sensor and a more sensitive narrow field sensor to discover and maintain custody of objects operating within this region. Further, AFRL will pioneer the implementation of innovative on-board image processing techniques to reduce data downlink volume. This effort will leverage the navigation techniques honed through the Oracle-M experiment.

WHAT IS THE TECHNICAL CHALLENGE?

Currently, most satellite tracking sensors are designed to detect and track objects at GEO (~36,000 km) distances or closer. The span of space that cislunar objects operate in is at least 10 times farther than GEO, giving a potential coverage volume of >1,000x. This means objects are much farther from sensors than in traditional orbits, and therefore more difficult to observe. Observation of objects in cislunar space are limited by both lunar and solar exclusion zones when viewed from the Earth or traditional orbits. The Oracle satellites overcome solar exclusion zones by their placement in cislunar space, but that creates new technical challenges. First, the distance the Oracle satellites will be from the Earth means that communications are more challenging and require more capability on-board the satellite to overcome those limitations. Second, in order to perform SSA, Oracle-M and Oracle-P must have accurate knowledge of their own position, which is difficult to do in cislunar space with no GPS-like systems available and limited precision from available Earth-based positioning solutions.

WHY IS IT IMPORTANT?

In the next decade, the amount of traffic to the Moon is expected to increase significantly. It is critical these endeavors are supported by robust awareness to ensure a safe operating environment. The Oracle Family of Systems benefits all space operators by providing the techniques needed for object tracking beyond GEO and will provide space situational awareness data to the space community and assist NASA with its mission to create sustained human presence at the Moon. Both systems may also contribute to NASA's Planetary Defense mission, as they will likely serendipitously collect data on potentially hazardous near-Earth objects such as asteroids.



Image of the Oracle-M satellite, courtesy of Blue Canyon Technologies