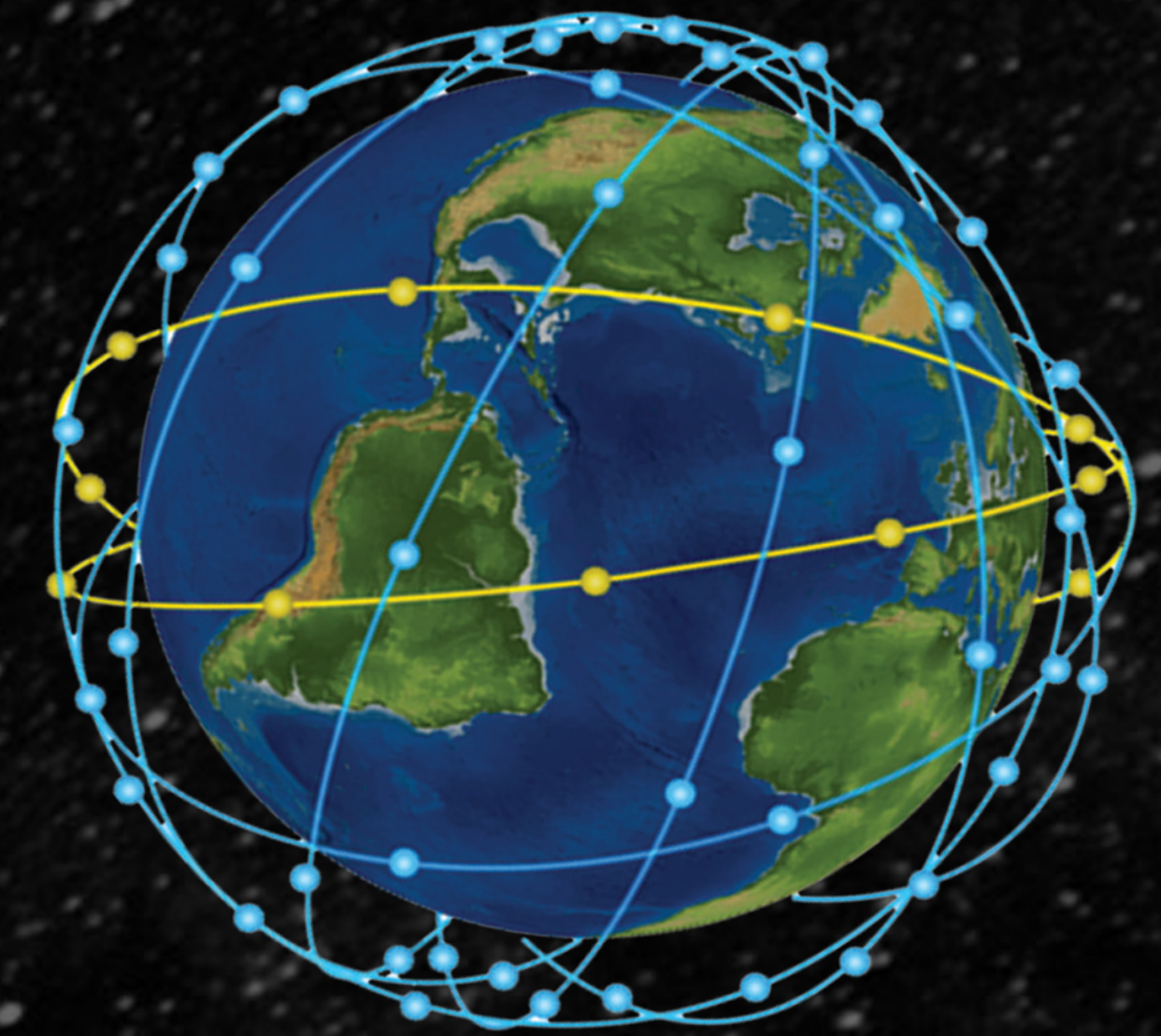




PROLIFERATED LEO CONSTELLATION MODELING & SIMULATION WITH INFORMATION ASSURANCE

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OVERVIEW

Proliferated Low Earth Orbit (pLEO) constellations allow for network, on-orbit processing, and battlefield management resiliency through disaggregation of the traditionally small number of high-value space assets. pLEO constellations present unique challenges. Developing a complex mesh network able to dynamically recover from active counterspace, cyber-security, and environmental threats, while providing uninterrupted data-center-like processing, requires advanced modeling capability throughout its buildout. Management of resource utilization, task migration, data fusion, software and firmware updates, and distribution of intelligence across the constellation requires complex integration and autonomy. Mission execution requires secure communication between the pLEO constellation and all consumers. The path to developing solutions to these challenges has been three-fold. 1. Creation of a constellation level modeling & simulation (M&S) testbed. 2. Connecting digital to physical through hardware-in-the-loop (HWIL) and software-in-the-loop (SWIL) integration. 3. Ingraining security within enabling technologies.

MODELING & SIMULATION (M&S) SOLUTIONS

SEAKR has created a M&S environment that facilitates the integration of software and hardware representative of constellation and mission autonomy. It is also cloud deployable and can be elastically scaled within the cloud to meet any mission or constellation level needs.

A M&S testbed enables digital engineering of all system components and conduction of experiments and trades over multiple mission scenarios. This "digital twin" provides supervised test-before-you-fly (TBYF) capabilities that reduce program risk and increase mission fidelity. This digital environment provides key insights into mission constraints and helps identify the optimal path to mission implementation.

Benefits

- Demonstrates Distributed Processing Across pLEO Constellation and Multi-Theatre Events
- Provides Insight into Program Characteristics
 - Latency
 - Packet Delivery
 - Coverage/Custody
 - Handoff/Connectivity
- Autonomy Architecture
 - Foundation for satellite tasking on individual spacecrafts and entire constellation
 - Execution of autonomy software in M&S environment to establish anticipated operating state prior to launch.

HWIL TECHNOLOGY

HWIL integration with the M&S environment allows for testing and exercising a large constellation with one or a few physical components. Incorporating various subsystems of the spacecraft reduce the risk of in-flight anomalies.

- Spacecraft Bus
 - Test Flight Software & Control
- Payloads
 - Test Processor & Sensor Integration Performance
 - Test Data Acquisition & Mission Execution Performance
- Communication
 - Test Network Reliability & Security Implementation
 - Test Constellation Interconnectivity
 - Test CSfC Performance

SWIL TECHNOLOGY

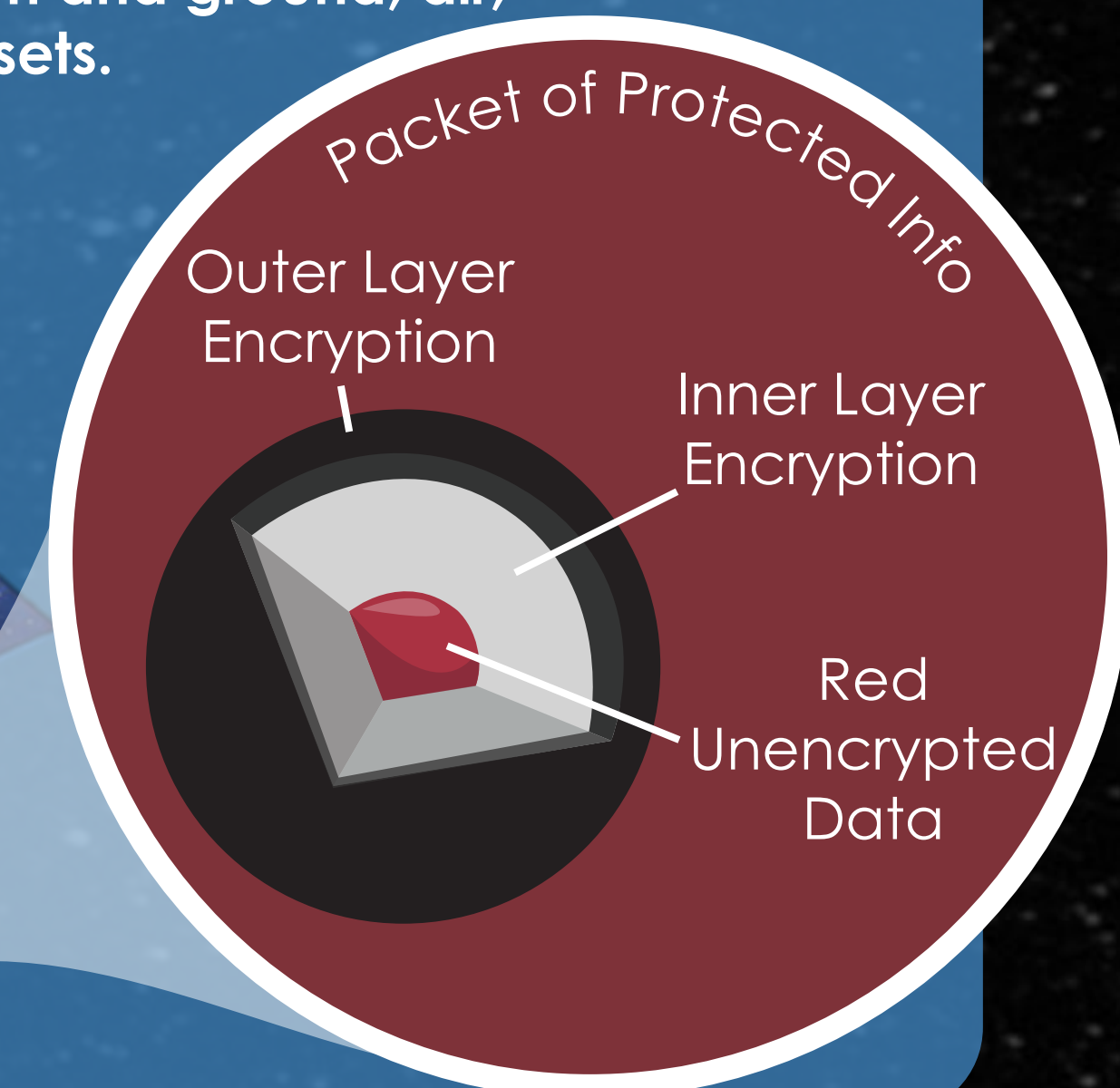
SWIL integration with the M&S environment allows for examination of the constellation representation, autonomy execution, and the implementation of mission use cases.

Constellation Representation

- 100s of Satellites | 10,000s of users
- Test Payload Data Distribution
- Test Distributed Data Processing
- Test Mission & Constellation Autonomy
- Test Mission Use Case Execution

SECURITY/INFORMATION ASSURANCE

SEAKR is leading the first application of NSA's Commercial Solutions for Classified (CSfC) in space. SEAKR's CSfC solution will expedite NSA approval for classified communication between pLEO constellation and ground, air, and sea assets.



CONCLUSIONS

- Increase System Fidelity via Test-Before-You-Fly (TBYF) Mentality
- Increase Development Efficiency
 - Improve Mission Success
 - Simulate Constellation Before Launch in Space

