**DEFINITIONS**

A **Distributed Spacecraft Mission (DSM)** is a mission that involves multiple spacecraft to achieve one or more common goals.

A **Constellation** is a space mission that, beginning with its inception, is composed of two or more spacecraft that are placed into specific orbit(s) for the purpose of serving a common objective (e.g., Iridium).

**OBJECTIVES**

- Provide a framework to perform pre-Phase A mission analysis of Distributed Spacecraft Missions (DSM)
  - Handle multiple spacecraft sharing mission objectives
  - Include sets of smallsats up through flagships
  - Explore trade-space of variables for pre-defined science, cost and risk goals, and metrics
  - Optimize cost and performance across multiple instruments and platforms vs. one at a time
  - Create an open access toolset which handles specific science objectives and architectures
  - Increase the variability of orbit characteristics, constellation configurations, and architecture types
  - Remove STK licensing restrictions

**SCIENCE REQUIREMENTS - INPUTS**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
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<tbody>
<tr>
<td>L1</td>
<td>Sensor model</td>
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<tr>
<td>L2</td>
<td>Payload</td>
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<tr>
<td>L3</td>
<td>Propagation</td>
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<td>L4</td>
<td>AOI</td>
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**TRADESPACE SEARCH ITERATOR (TSI)**

- TSI reads user inputs given to the GUI to create iterator inputs (JSON files). Uses default values from Landsat 8 (w/ ETM+ payload) if no inputs
- TSI generates DSM architectures for a combination of variable values that satisfy iterator inputs
- A DSM architecture is a unique combination of variable values (altitude, inclination, FOV, number of satellites, etc.)
  - For each arch, TSI creates files and send commands to module ‘Reduction & Metrics’ to compute architecture performance and to module ‘Cost and Risk’ to compute architecture cost

**ORBIT & COVERAGE MODULE**

- Purpose of Module
  - Model orbits balancing accuracy and performance
  - Compute coverage metrics for constellation/sensor set
  - Compute ancillary orbit data for performance, cost, and risk
  - Development Approach

**REDUCTION & METRICS MODULE**

- Reduction & Metrics is responsible for calling module ‘Orbits & Coverage’ to propagate the orbit of every sat and compute coverage given payload specs.
- Reduction & Metrics integrates coverage and computes all performance metrics.

**COST & RISK MODULE**

- Motivation
  - Constellations require that traditional cost estimation assumptions be challenged
  - Previous work highlighted limitations of existing models w/r to constellations
  - No comprehensive cost model for constellations has been developed
- Implementation
  - Aggregate model consisting of Cost Estimating Relationships (CERs) from widely accepted, publically available models
    - Output: Proba density function showing most likely cost for mission lifecycle + selected mission components, including recurring, nonrecurring, spacecraft bus, and payload

**GRAPHICAL USER INTERFACE (GUI)**

- Proposed “TROPICS” Mission Analysis
- TRADESPACE SEARCH ITERATOR (TSI)
- ORBIT & COVERAGE MODULE
- REDUCTION & METRICS MODULE
- COST & RISK MODULE
- KNOWLEDGE BASE
- FUTURE DIRECTIONS

**FUTURE DIRECTIONS**

- Various constellations
- Launch vehicle and manifest framework
- Various sensor models
- Add on-off maintenance abilities
- Comparative risk model
- Knowledge Base development
- Complete GUI/Visualization development

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**Trade-space Analysis Tool for Constellations (TAT-C)**

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