A Digital Risk Twin for the Design and Certification of Distributed Space Based Space Surveillance Systems

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Decisions better made

Objectives

- Development of a Digital Risk Twin (DRT) of a Distributed Satellite System Mission to perform Preliminary Mission Reliability Estimates
- Quantify mission reliability considering platform reliability and required System of System s (SoS) configuration for mission assurance
- Provide ability to perform rapid trade studies on Mission Reliability given varied SmallSat platform and distributed configuration requirements

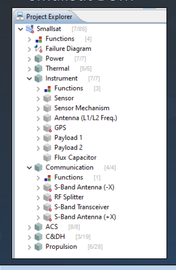
The Digital Risk Twin

- Model-based engineering (MBE) has proven to be a key technology facilitator to achieve detailed, representative RAMS analysis of complex systems.
- Requires a suite of interlinked models with a common pool of data and system structure.
- In the MADe™ software, these suites of models that each capture different safety viewpoints are fused to generate a Digital Risk Twin (DRT) of our system
- The core capability of the DRT is the explicit modelling of system dependency simulation in the context of Safety & Mission Assurance Risk Assessment

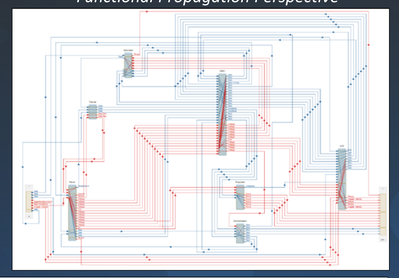
NASA SmallSat Reference DRT

- Built by Goddard Space Flight Center (GSFC), in collaboration with PHM Technology
- SmallSat model used a basis for DSS SBSS Mission (RBD Perspective)

SmallSat BOM



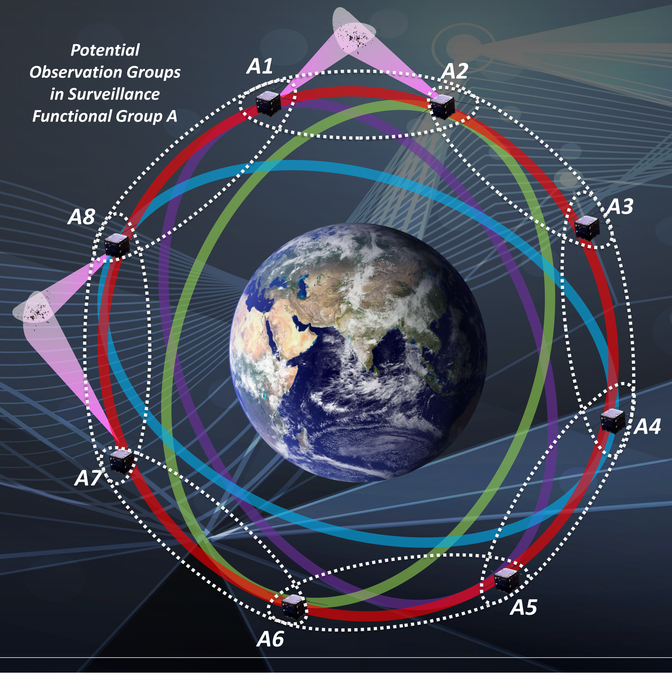
Functional Propagation Perspective



System Level RBD Perspective

Example DSS Mission Description

- DSS Mission consists of 36 SmallSat platforms split over between 4 planes A,B,C,D with an evenly distributed RAA
- Each SmallSat Platform are equipped with Optical Sensors for RSO tracking



Mission Requirements

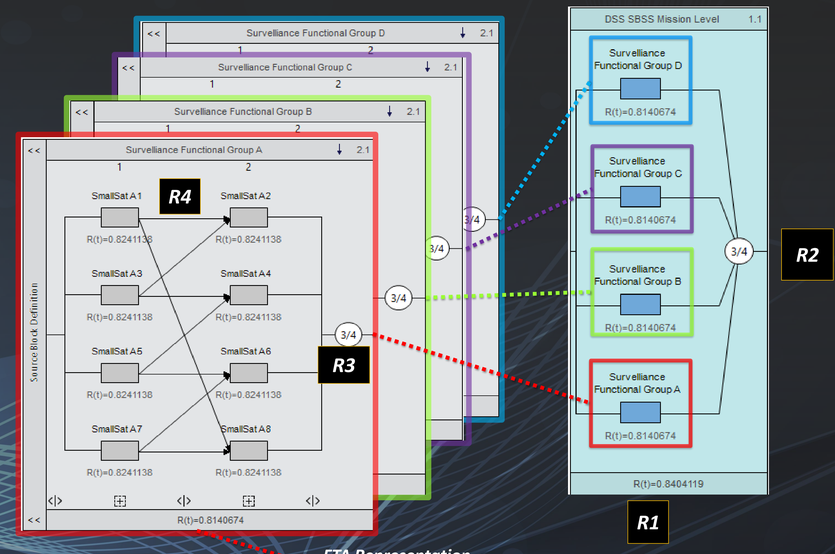
R1 DSS Mission shall demonstrate required probability of success for Class D Mission

R2 DSS mission shall provide at least 3 out of 4 functional surveillance groups (orbital planes)

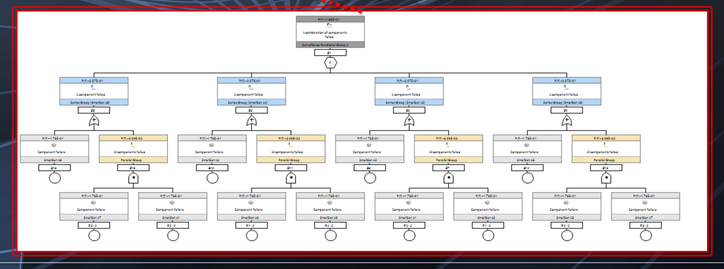
R3 Surveillance groups shall provide at least 3 functioning observation groups within each plane

R4 An Observation group shall require two adjacent SmallSat platforms in each respective plane.

Systems of Systems SmallSat Configuration for Initial Mission Reliability Estimates



FTA Representation



Conclusions

- DRT enables efficient creation and validation of system of system architectures for DSS missions

Future Work

- Simulation driven assessments to quantify effects of downtime from orbit maintenance and collision avoidance manoeuvres on DSS Availability