NASA Mission Assurance

NASA classifies spacecraft missions by cost, significance, priority, lifetime, and launch constraints.
- Class A: High-cost, highly significant like a space telescope, low risk tolerance, useradiation hardened (rad-hard) parts
- (Sub) Class D: Low-cost, short lifetime like CubeSats, high risk tolerance, use commercial off-the-shelf (COTS) parts
  - Unknown radiation hardness of COTS parts is a reliability issue

Mission assurance is moving toward a model-centric paradigm where model-based representations of the spacecraft replace requirement and interface documents.

NASA Reliability & Maintainability Template

NASA’s Reliability & Maintainability (R&M) template uses a modified GSN structure to graphically present an objectives-based approach to reliability and maintainability.

R&M template was used to create general structure for top-level goals for GSN example assurance case.

GSN Isolate Parts Hierarchy

**Goal (blue boxes):** Claims of the argument
**Solution (orange boxes):** Items of evidence
**Strategy (green boxes):** Reasoning step, nature of argument
**Context (yellow boxes):** How the claim or reasoning step should be interpreted
**Assumption (white boxes):** Needed for goal or strategy to be valid

**Parts of GSN [1]**

**Justification (teal boxes):** Explain why a claim or argument is acceptable

In **Context of** (dotted lines): Contextual relationships

Supported by (solid lines): Inferential or evidential relationships

M of N options (diamond): M out of N paths can be completed to prove goal


WebGME

WebGME used to develop modeling framework for GSN.

**WebGME:** Web-based Generic Modeling Environment for collaborative domain specific modeling platforms [https://webgme.org/]
- Customizable modeling rules specify the syntax and semantics of the model
- Support for model interpretation algorithms
- Developed by Vanderbilt’s Institute for Software Integrated Systems [https://github.com/webgme]

Single-Event Latch-up Testing

Single-event latch-up (SEL) testing investigates the energy of a particle that causes the part to latch into a sustained high-current state.

Total Ionizing Dose Testing

Total ionizing dose (TID) testing investigates parametric changes in a packaged semiconductor device as a result of cumulative ionizing radiation over a period of time.

Preliminary Results

- Graphically describe mitigation strategies
- Graphical model can be used as a deliverable for reviews
- Makes assumptions and justifications explicit
- Shows what lack of evidence does to the argument