A Model Based Toolset for Supporting Rapid Integration and Verification of Spacecraft Electronics

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Overview

- CASM
- Goal: Support online verification of rapidly integrated spacecraft
- Visual Design Environment for modeling devices
- Platform Specific Middleware
- On board Self – test
Challenges in Rapid Integration

- Responsive Space Initiative: USB-based plug-n-play electronics
  - Rapid System Integration
  - xTED: Electronic Data Sheet
  - Middleware for dynamic device integration

- Question: How to verify the integrated system?
  - Were the proper devices “plugged in”?
  - Does the system have all the necessary components?

- Our Approach:
  - Model-based toolset for capturing integrated system
  - Synthesis of platform-specific communications middleware
  - Generation of on-board-self-test for verifying system integration
GME: Generic Modeling Environment

- Visual modeling tool to create graphical models
- Capable of creating a domain–specific modeling environment
- It has the capabilities for rapid code generation
Working of the GME

Meta-Modeling Language
Meta-Meta-Model

specify

Meta-Modeling Language
Meta-Model

specify

Domain Modeling Language
Model

specify

Computer-Based System
Using GME for Modeling Spacecraft Electronics
Modeling Device Communication

- Device-specific message sequences
- Facilitate determining health status of device
USB

- USB host controller provides device recognition and enumeration for plug and play
- **libusb** is used to write user space drivers for device I/O
- **libusb** gives us the capability to read and write directly to the endpoints of USB devices
- **libsub** is cross-compiled for the target platform and ported onto the target platform
xTED

- Models the USB device completely
- Contains all information about configurations, interfaces and endpoints of the device.
- xTED augmented to contain message sequences for each device
Platform-Specific Middleware Generation

- Device communication middleware automatically generated from system models
- Built on libusb infrastructure
- Middleware is user-accessible for data and control I/O
Program Synthesis

Source Code
Process Flow

Model Interpreter

GME Model

Middleware

libusb

libusb API

Cross - compiler

Cross - compiler

libusb.so

Acts On

Self Test
Target platform

- TS – 7260
  - ARM based processor
  - Linux
USB Device

- DLP Sensor
  - Temperature Sensor
  - Re – programmable PIC
  - USB-Serial Interface
Questions