Dallas EEProm Equipment Profile for Rapid Integration and System Modeling

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Introduction

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DEEP: Dallas Eeprom Equipment Profile

DEEP enables *subsystem-level embedded operational intelligence, system modeling, and rapid integration capabilities*

Presentation Order:

- Need for Rapid Integration
- Past RIT Success
- Motivation
- Scope
- DEEP Concept
- DEEP Implementation
- Future Work
- Conclusion

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Need for Rapid Integration

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RI&T Need
Past RIT Success
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Scope
DEEP Concept
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Problems Faced in Satellite Integration:

- Complex system interactions
  - Weeks or Months
- Competing Proprietary Protocols
- Interface Control Documents (ICD)
  - Consumes time and resources

Goals of Rapid Integration:

- Provide Plug-and-Play functionality
  - similar to USB
- Increase Modular Design
- Create Standard Interface
- Decrease Integration Time
  - Days

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Past Rapid Integration Success

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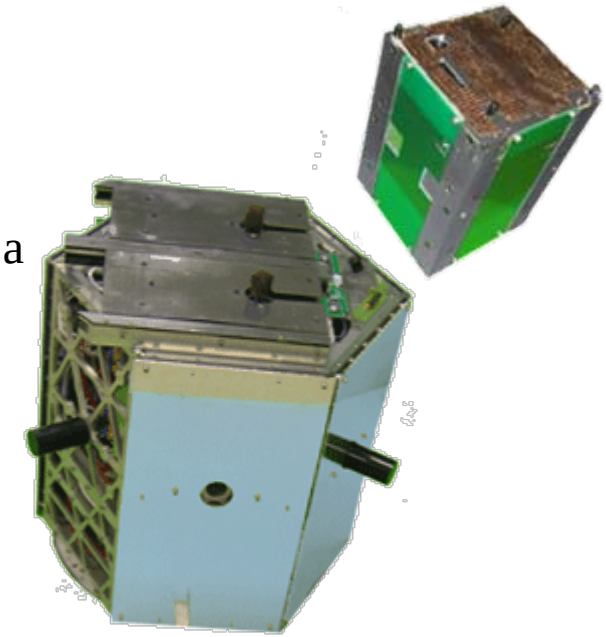
Successful RI&T Demonstration

2006 AIAA/USU Conference on Small Satellites

• Functional Integration of Akoya and ONYX via a common bus within 30 minutes



Flight Integration:

April 2007:

- Full Spacecraft Integration: 10 days!
  - Akoya and ONYX integration in parallel
- Rapid Integration of SCU payload: 126 seconds!

Based on Emerald Protocol:

- Standard Power and Data Bus
- I^2C and Dallas 1-wire Interfaces
- Distributed Computing Architecture

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Motivation

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Issues Encountered in RIT Demo

- Conflicting Addresses
- System Interactions must be known prior to integration
- Commands and Responses required external definition
- System configuration required external maintenance
- No way to recognize new system integrated onto bus

DEEP eliminates pre-integration coordination and create subsystem-level embedded operational intelligence.

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Scope

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Motivation
Scope
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DEEP is designed to meet the needs of University Class and other small satellites

University Class Satellites

- Are small, low-cost satellites with short design timelines
- Take higher risks with potentially larger pay-offs

Many of the DEEP concepts are applicable to more complex spacecraft designs and other plug-and-play systems

DEEP Concept

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Past RIT Success
Motivation
Scope
DEEP Concept
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- Embedded EEPROM memory device on functional elements
  - Contains conceptual model of operational traits:
    - Operational state definition
    - System characteristics (thermal, power, physical, etc)
    - Commands and responses
    - Onboard Datasheet

- Enables dynamic generation of functional model
- System-wide service awareness
- Automated software generation

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DEEP Concept

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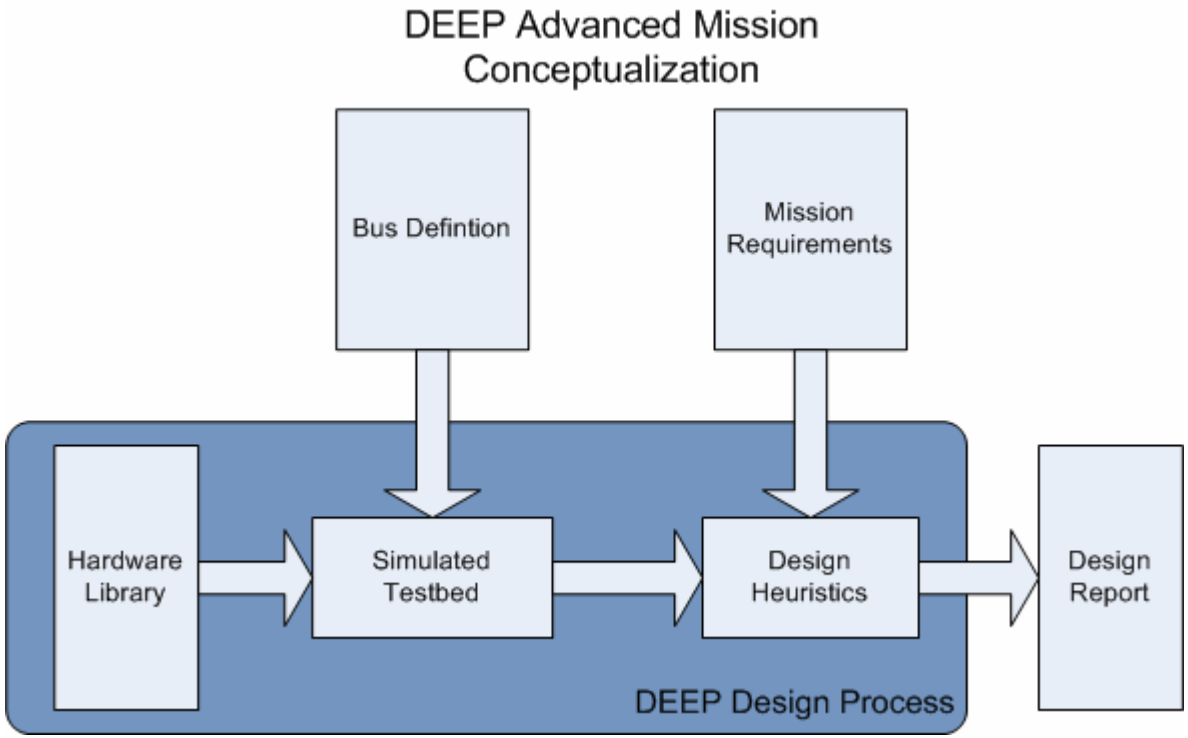
Past RIT Success
Motivation
Scope
DEEP Concept
DEEP Implementation
Future Work
Conclusion



- Enable design and simulation of advanced concepts prior to implementation

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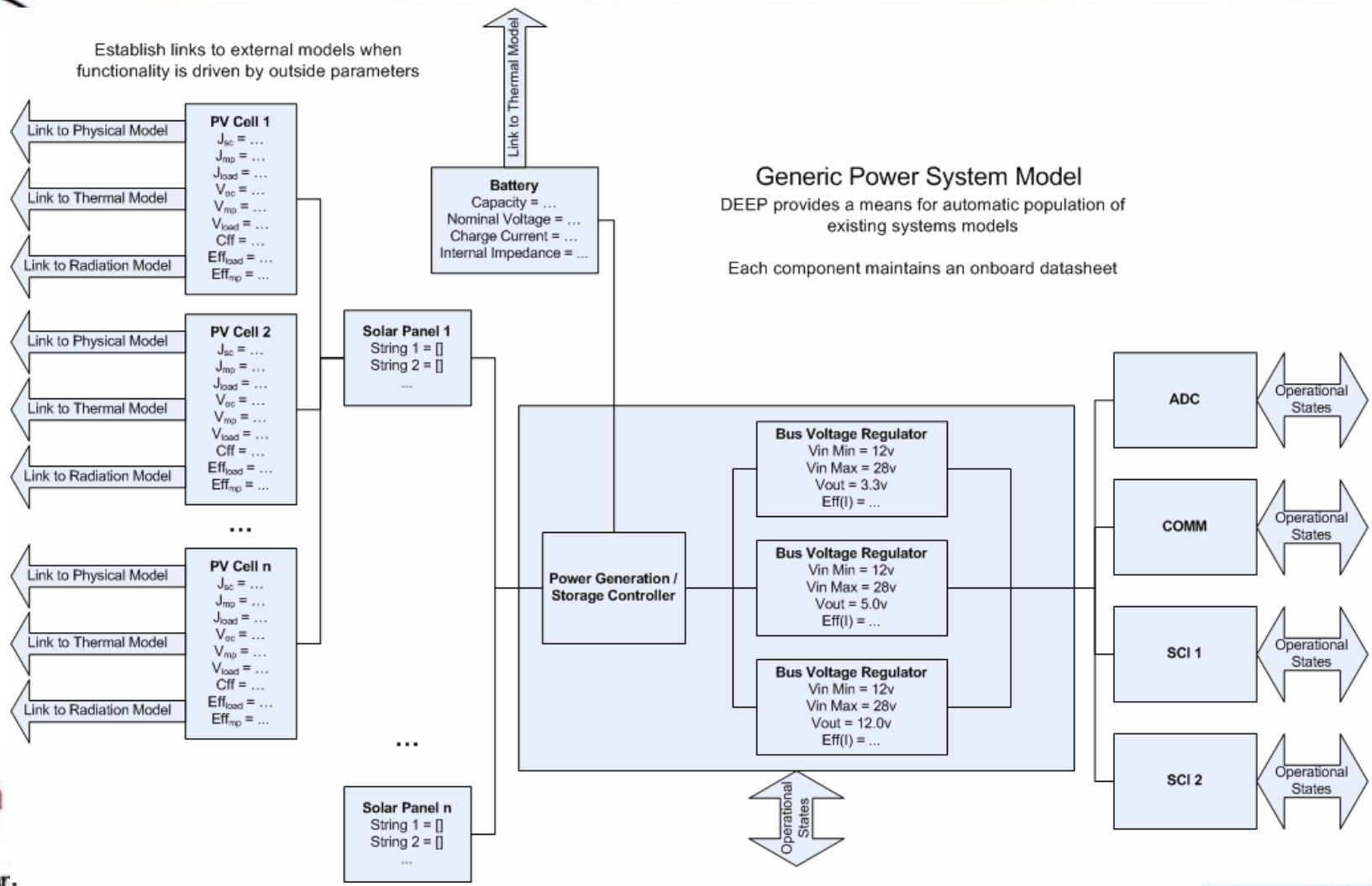
DEEP Concept



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DEEP Implementation

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Motivation
Scope
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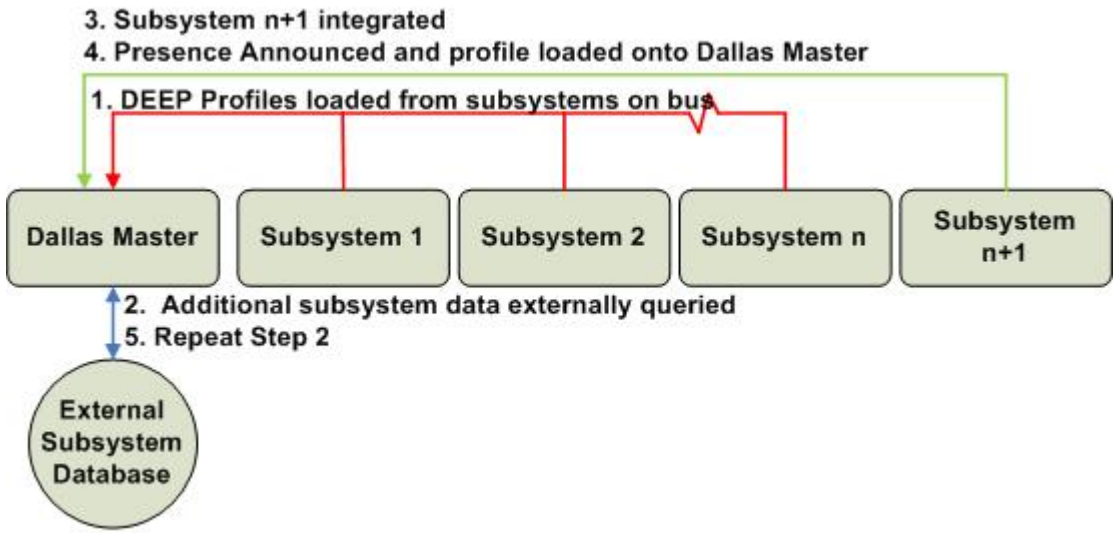
- Required Elements for DEEP Operation
  - Standardized Communications bus [Dallas 1-Wire]
  - Common Memory Device [Dallas 1-wire EEPROM Memory]
  - Common Memory Structure [Equipment Profiles]



DEEP Flow-diagram

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DEEP Implementation

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Past RIT Success
Motivation
Scope
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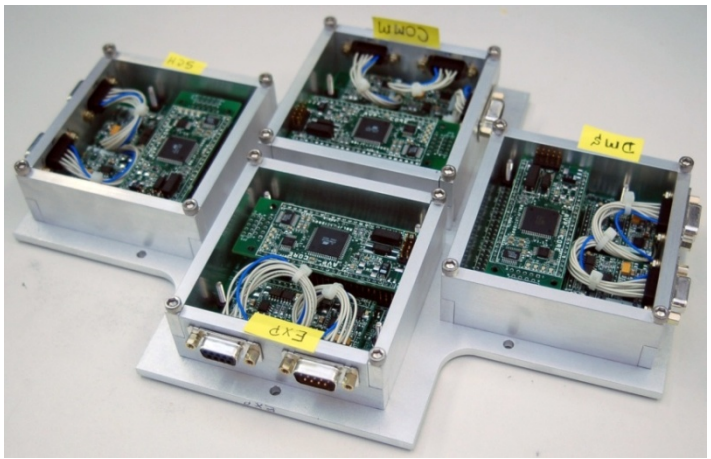
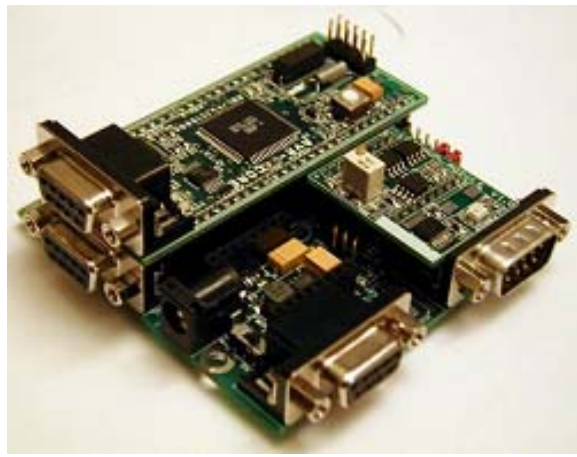
- Heritage hardware design (AVRSat Modules)
  - Hardware utilizes existing bus standard Emerald Protocol suite
  - DEEP services tailored to existing hardware
  - EEPROM devices chosen based on existing bus implementation (Dallas 1-Wire)





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Future Work

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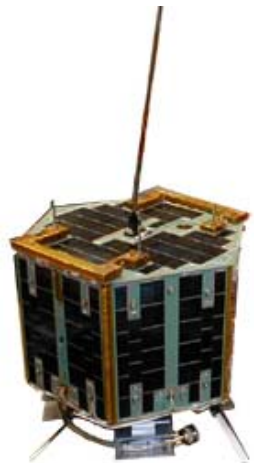
Motivation
Scope
DEEP Concept
DEEP Implementation
Future Work
Conclusion

Future Work:

- Continued development of DEEP Concept
  - Develop Model Interactions
  - Model Based Reasoning Anomaly Management
  - Expand Sensor and Hardware Model Library
  - Automated Software Generation
  - Mission Conceptualization Framework



Conclusion

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DEEP enables *embedded operational intelligence, system modeling, and rapid integration capabilities in small satellites*

AUTOMATION • STANDARDIZATION • SPEED • EDUCATION
ONYX Nanosatellite

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small SATELLITE

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