Analyzeable and Reconfigurable AADL Specifications for IMA System Integration

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Outline

- Description of Model
- Description of Analysis
- Tool Status
Architecture Analysis & Design Language

An SAE Standard of an Architecture Definition Language

Formal Specification of Systems:
- Real-time
- Embedded
- Fault-tolerant
- Securely partitioned
- Dynamically configurable (e.g. reversion logic)

Software task and communication architectures

How they are bound to HW in
- Integrated Modular Architectures (IMA)
- Federated Hardware Architectures
Proof of Concept Example

Generic Display System with Rockwell Collin’s Switched Ethernet LAN

- Only LAN-related entities modeled
- Model generated from Input/Output & Thread data stored in Database

Model Size

- 5 Common Processing Modules
- 13 Virtual Machines
- 90 Threads
- 165 End-to-end Data Flows
Display System Architecture

- Not modeled for this AADL example
CDU Subsystem Architecture

- Not modeled for this AADL example
Textual Software View

system CDU_Processor_Software
features
    CDU_Disp_EICAS_Cmds_to_LI_MFD_SW_L_Out_Socket : port group
    PG_CDU_Disp_EICAS_Cmds_Out;
    CDU_DM_Display_Buffer_NDO_from_CDU_L_SW_L_In_Group : port group
    PG_CDU_DM_Display_Buffer_NDO_In;
...
end CDU_Processor_Software;

system implementation CDU_Processor_Software_Impl
subcomponents
    p_CDU_Display_Manager : process CDU_Display_Manager_Impl;
    p_CDU_IO_Manager : process CDU_IO_Manager_Impl;
    p_Communications_Manager : process Communications_Manager_Impl;
    p_Flight_Manager : process Flight_Manager_Impl;
connections
...
flows
...
end CDU_Processor_Software_Impl;
XML Software View

- **systemType**
  - name: CDU_Processor_Software
  - comment (5)
  - flowSpecs
  - features
    - portGroup (130)

- **systemImpl**
  - name: CDU_Processor_Software_Impl
  - compType: #CDU_Processor_Software
  - connections
  - flows
  - subcomponents
    - processSubcomponent (4)
      - name
        1. p_CDU_Display_Manager: #CDU_Display_Manager_Impl
        2. p_CDU_IO_Manager: #CDU_IO_Manager_Impl
        3. p_Communications_Manager: #Communications_Manager_Impl
        4. p_Flight_Manager: #Flight_Manager_Impl
HW (Physical) View with Mappings
Overall System Integration

Notes:
Identifiers with angle-bracketed terms are replicated for each unique set of terms, where terms are defined as:
<cpm>: Common processing machine name
<cpmid>: Longer name of cpm
<ndo>: Network data object name
<sw>: ASL switch side identifier
<vmr>: Virtual machine and rate, indicating thread name

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Analysis and Reconfiguration Tool

System generation from Translated XML AADL
- Automatic schedule generation
- Allocation of VMs to hosts

System analysis
- Schedulability, rate-monotonic analysis
- Network analysis

Editing and visualization
- Direct manipulation, tree view
- Graphs, tables, trade studies
Multiple Configurations for Trade-Off Studies

Original configuration from AADL

New configuration #1

New configuration #3
AADL Tool Status

**Current Rockwell Program**

- Common AADL Front-end {Eclipse-Open Source from CMU}
- Textual ADL {AADL}
- AADL Data Interchange
- As XML Schema

**Future Work**

- Graphical AADL
  - Via UML Profile
- Honeywell DoME
- Eclipse {Near Completion}

- AADL Code Generation Tool {Future Tool Vendor}
- CPU & LAN Analysis Tool {Rockwell Scientific}

**AADL Code Generation Tool**

- Future Tool Vendor

**Current Rockwell Program**

- {Eclipse-Open Source from CMU}

**Future Work**

- {Near Completion}
Project Accomplishments

Creation of Display System in AADL (Textual compiled to XML format)

Translation to Analysis /Reconfiguration Tool

Analysis of Initial Configuration for Fit
- CPU Schedulability/Schedule
- Network Latency

Generation of Alternate Configurations