Analyzable 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 <u>Standard</u> of an Architecture Definition Language

<u>Formal</u> Specification of Systems:

- Real-time
- Embedded
- Fault-tolerant
- Securely partitioned
- Dynamically configurable (e.g. reversion logic)

Software <u>task</u> and <u>communication</u> architectures

How they are <u>bound to HW</u> 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

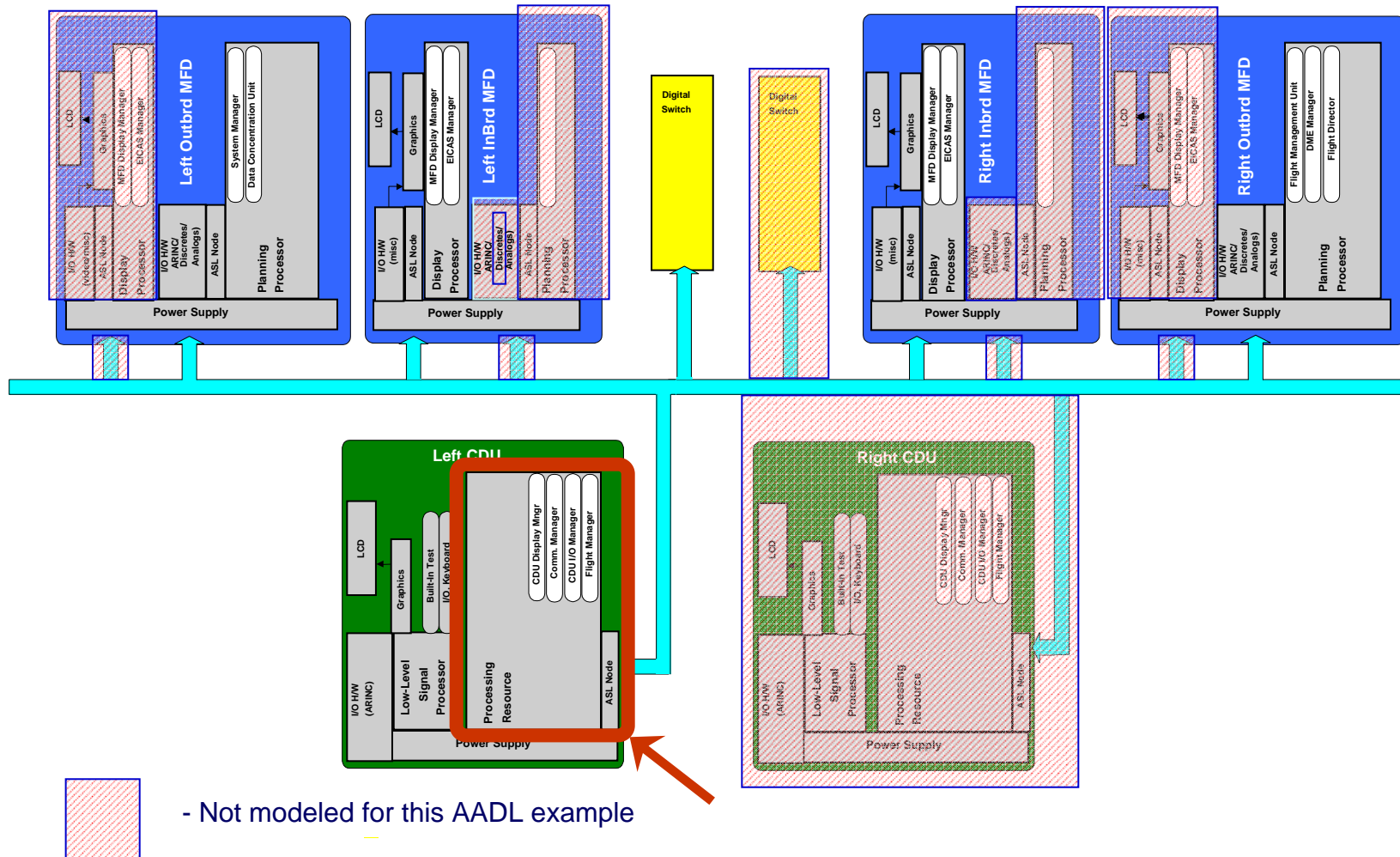- 5 Common Processing Modules
- 13 Virtual Machines
- 90 Threads
- 165 End-to-end Data Flows

Display System Architecture

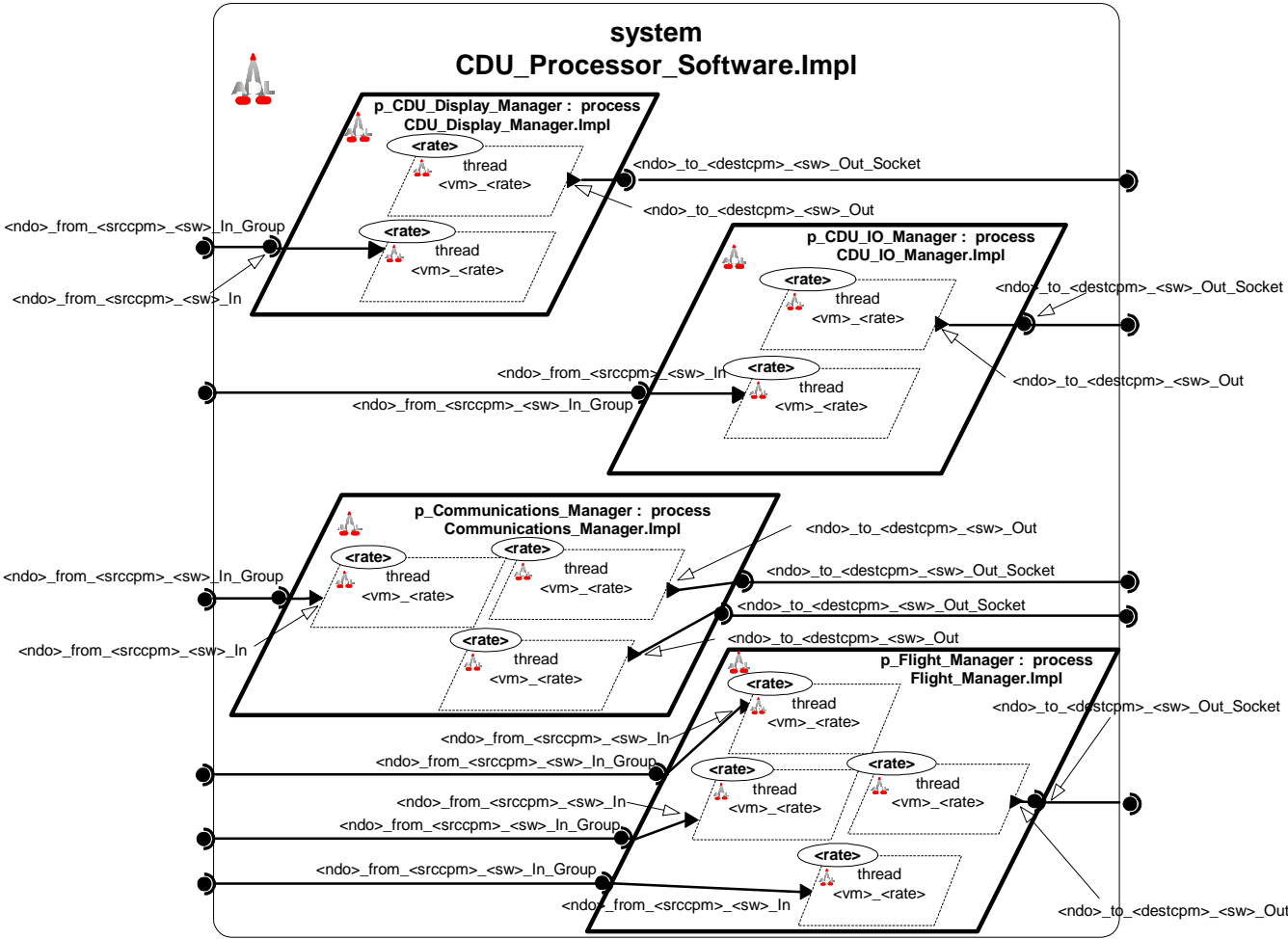- Not modeled for this AADL example

Slide 5
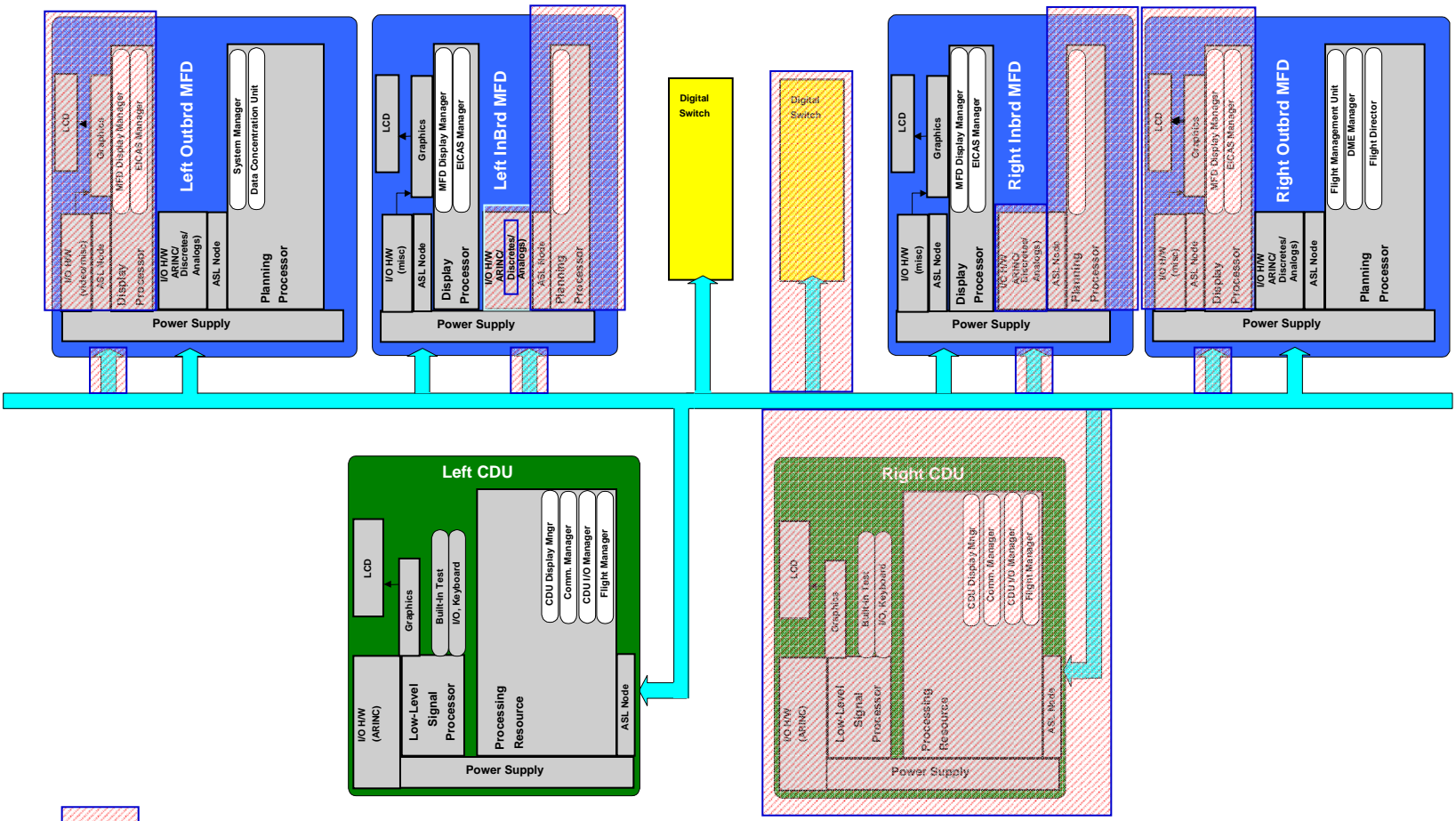
CDU Subsystem Architecture

- Not modeled for this AADL example

Slide 6

Graphical Software (Logical) View

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	classifier
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
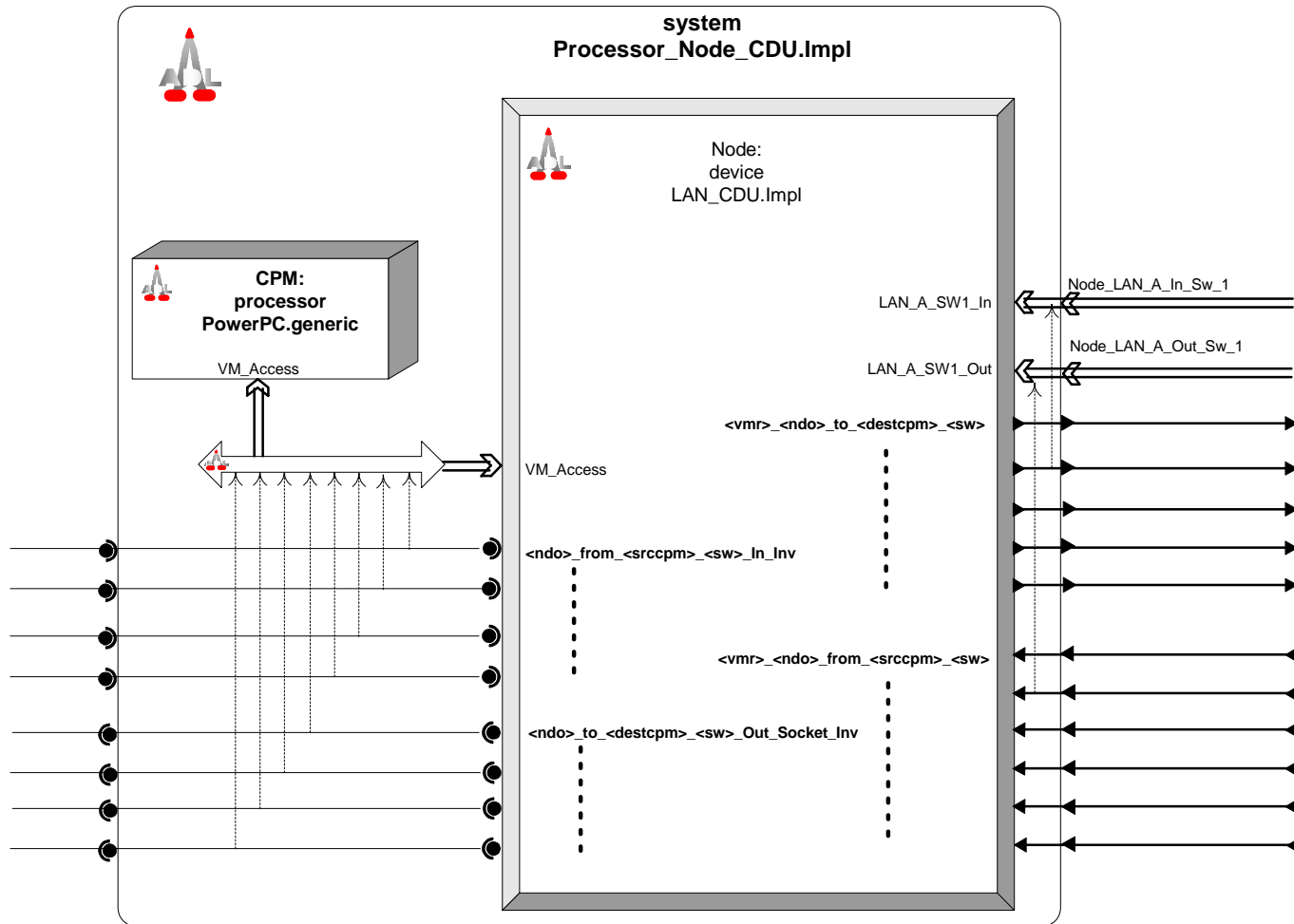
Overall System Integration

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
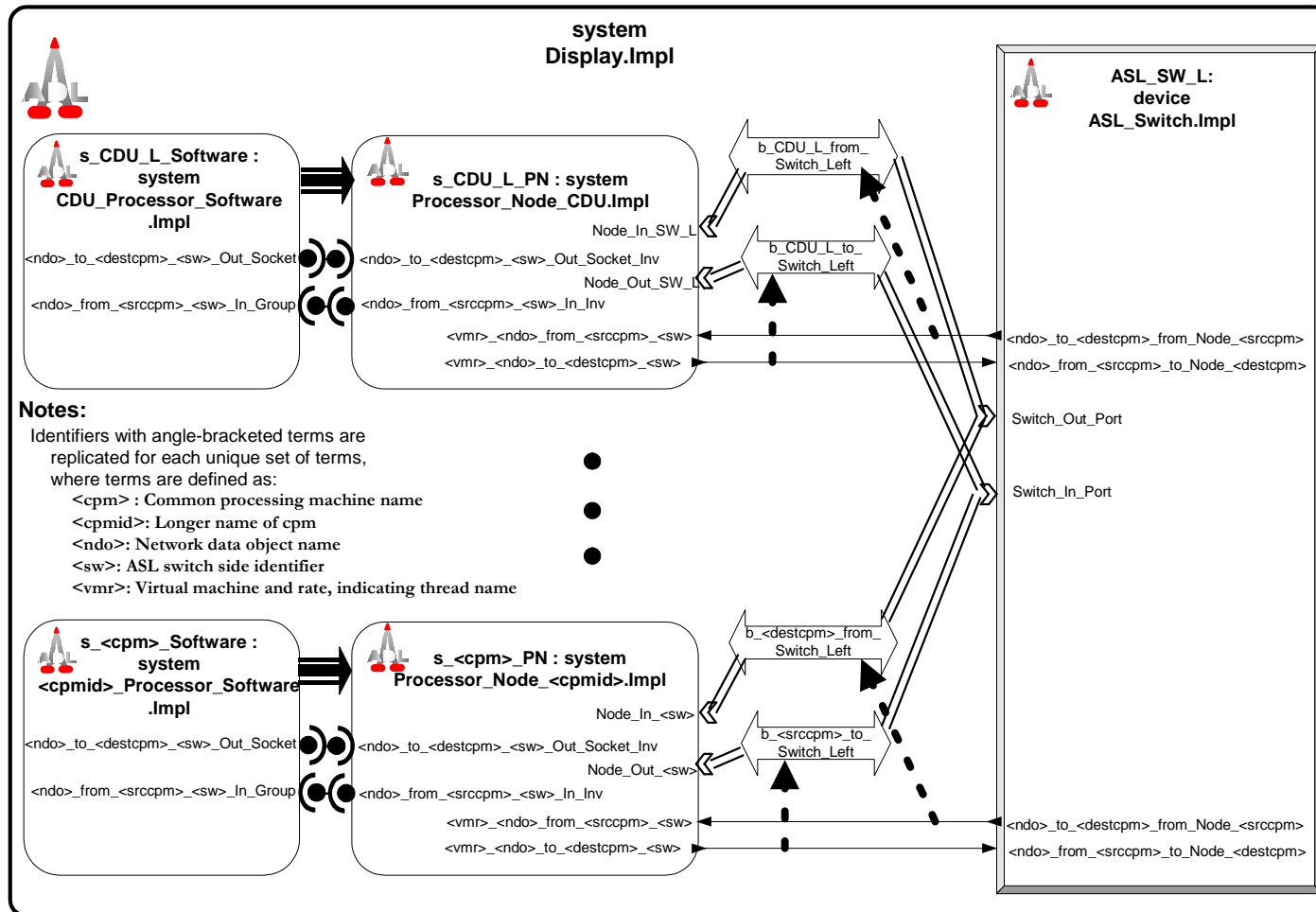
Analysis and Reconfiguration Tool
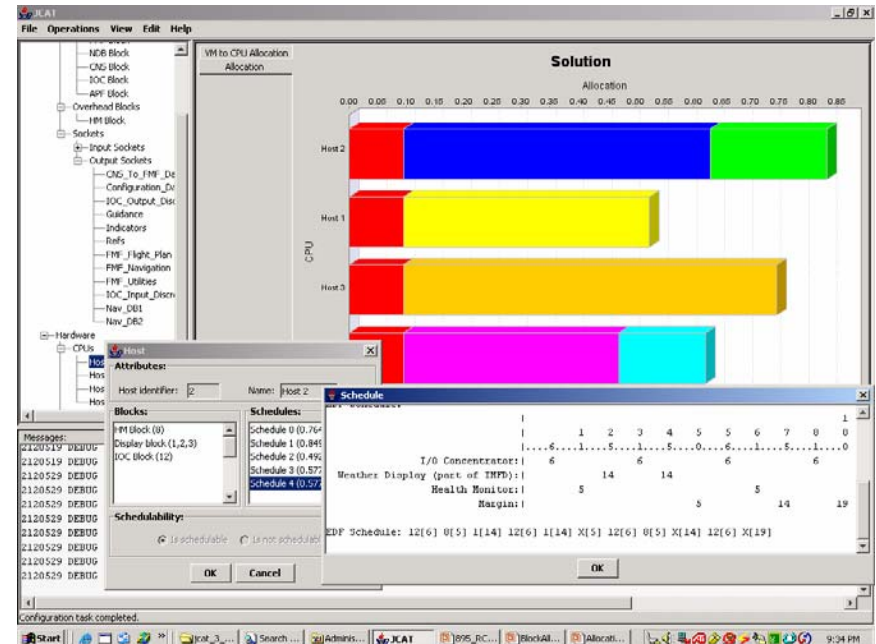
System generation from Translated XML AADL

- Automatic schedule generation
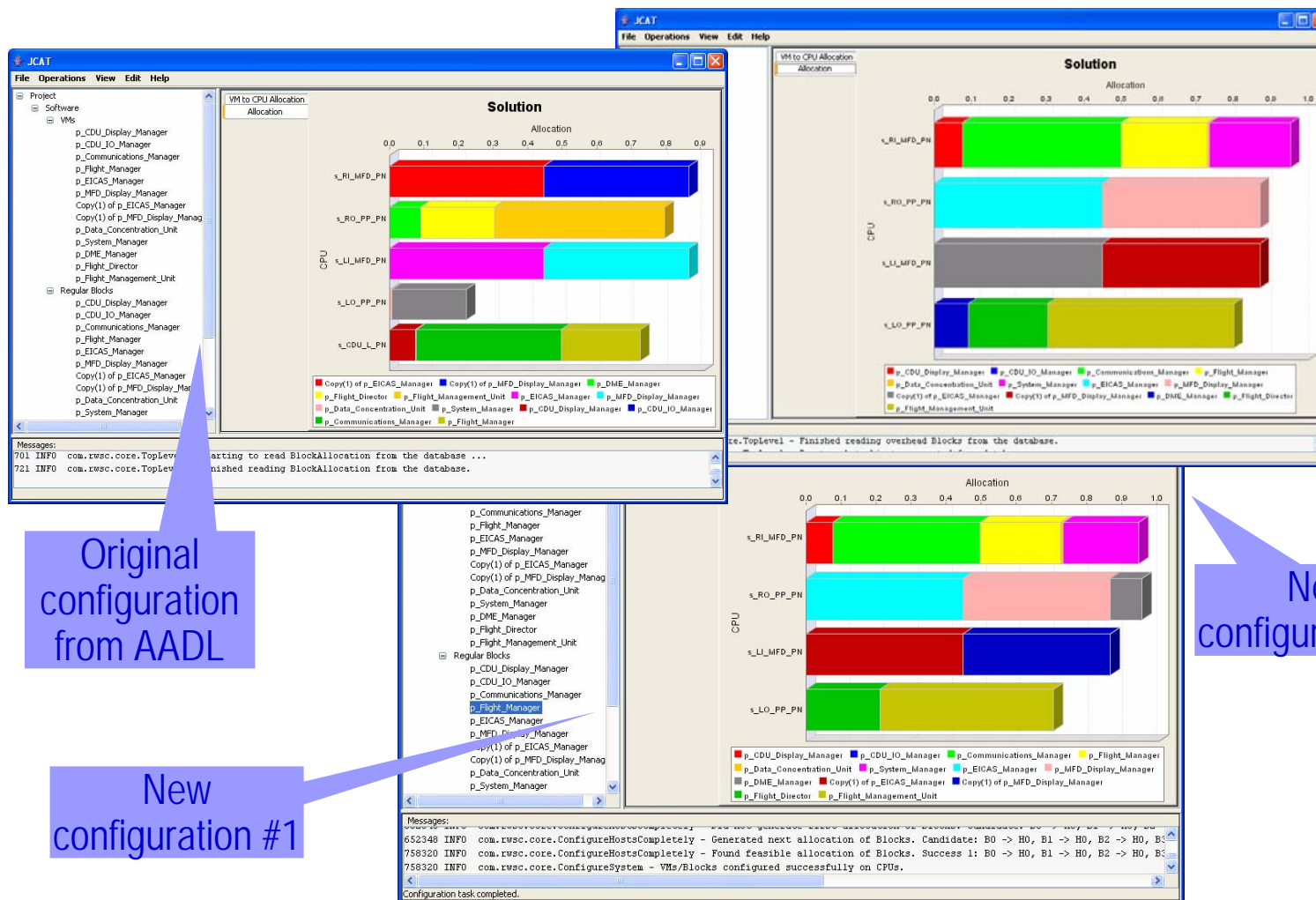- Allocation of VMs to hosts

System analysis

- Schedulability, rate-monotonic analysis
- Network analysis

Editing and visualization

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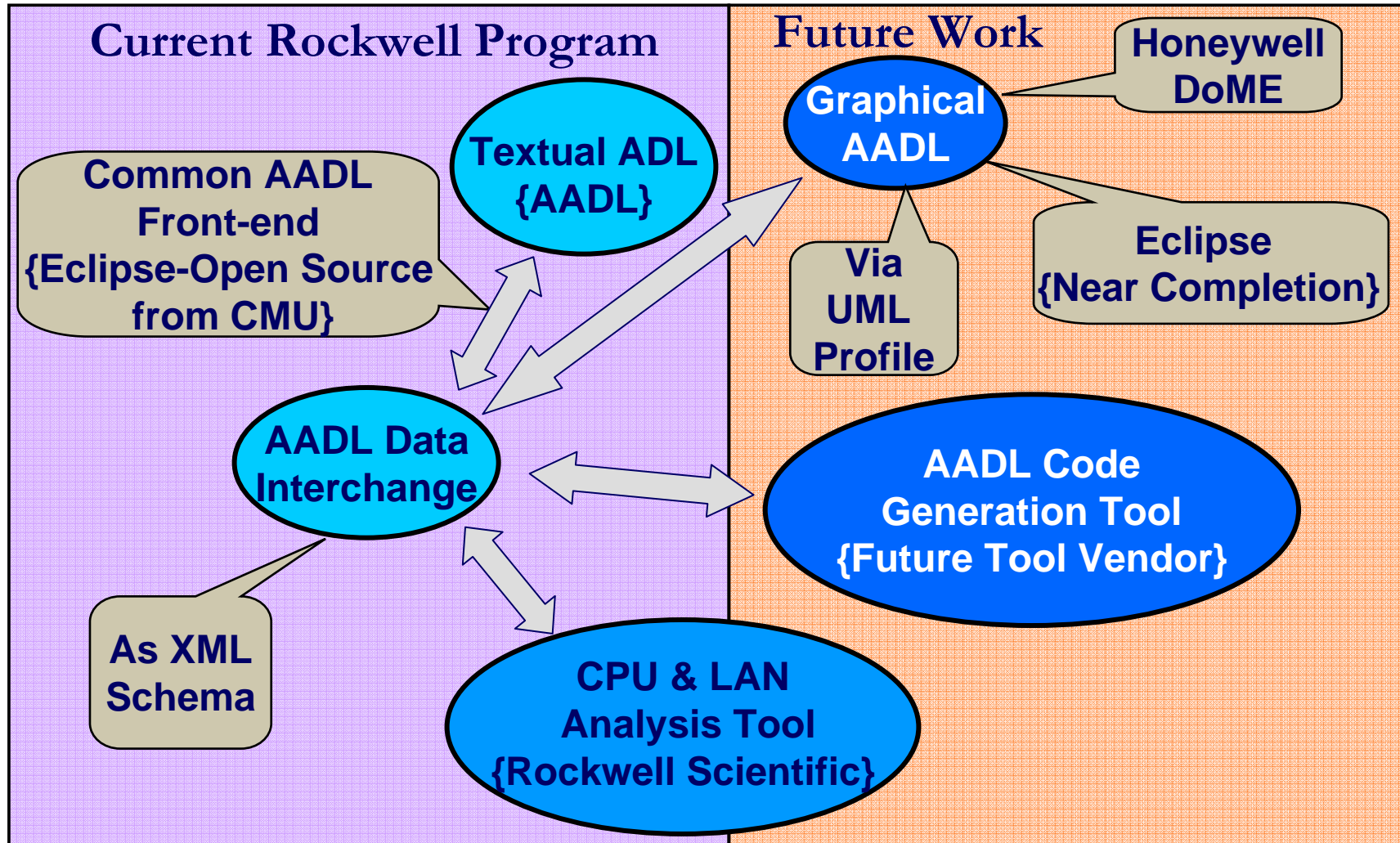
Multiple Configurations for Trade-Off Studies

Original configuration from AADL

New configuration #1

New configuration #3

Slide 13

AADL Tool Status

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