ASAAC Modelling with AADL

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Contents

- The AADL Notation
- ASAAC Platform Modelling
- ASAAC Application Modelling
- ASAAC Refinement Approach
- Summary
AADL Graphical Primitives >> Components

Software
- Data
- Thread
- Process

Platform
- Device
- Memory
- Processor
- Bus

Composite
- System
AADL Graphical Primitives >> Features

Ports

- Data Port
- Event Port
- Event Data Port

Subprograms

- <name>

Connections

- Immediate
- Delayed
- Server Subprogram Binding
  - call
  - server
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ASAAC Platform >> Module Types

- **DP** Data Processing
- **GP** Graphics Processing
- **SP** Signal Processing
- **MM** Mass Memory
- **NS** Network Switch
- **PC** Power Conversion
ASAAC Platform >> Data Processing Module (DPM)

MSU ... Module Support Unit
RU ... Routing Unit
NIU ... Network Interface Unit
DP ... Data Processing (Payload)
ASAAC Platform >> Module Software Layers

Application Layer (AL)
- App #1
- App #2
- App #3

OS Layer (OSL)
- Operating System & Extensions
- Config Manager (CM)
- Blueprint Manager (BPM)

Module Support (MSL)
- Module Support Package & Network Independent Interface (NII)

APOS  … Application to Operating System Interface
MOS  … Module to Operating System Interface
SMOS  … System Management to Operating System Interface
SMBP  … System Management to Blueprint Interface
ASAAC Platform >> Module Software Integration

- Application Layer (AL)
- OS Layer (OSL)
- Module Support (MSL)

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<th>MSB</th>
<th>CB</th>
<th>PB</th>
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<td>Message Router</td>
<td>Buffer Handler</td>
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ASAAC Platform >> Modelling Approach

Step 1
Refinement of system component P2

Step 2
Refinement of system component P1
ASAAC Platform >> Modelling Example

Application.RW

Reader

Virtual Channel

Writer

APOS Services

Platform.Abstract

DPM_APOS (Abstract Processor)

APOS Services

DPM_APOS (Abstract Processor)

Transfer Connections (Logical Bus)
ASAAC Platform >> Remaining Questions

- The proposed modelling approach assumes that ASAAC applications can be captured by AADL processes, threads, connections, and ports. Is this feasible?

- How can the ASAAC inherent system configuration feature be modelled?

- How can reconfiguration be modelled?
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ASAAC Threads >> Definition

- No particular scheduling policy imposed by ASAAC Standard
- Soft or hard deadline
- Periodic or bounded aperiodic release, defined by blueprints
ASAAC Threads >> Modelling

Dormant

Ready

Waiting

Running

startThread

stopThread

suspendThread

resumeThread

sleep

waitForSemaphore

rcvMessage

terminateSelf

schedule

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ASAAC Processes >> Definition

- Denotes an address space that contains executable code for one or more threads, one main thread
- Is NOT subject to scheduling and does not have attributable temporal characteristics
- Always executes on a single processor
process implementation <pname>
subcomponents
  -- the main thread of the process which is always active
  t1 : thread <tname_1>;
  -- all other threads which have to be started by t1
  t2 : thread <tname_2> in modes { config1; config2 }
  ... 
  tn : thread <tname_n> in modes { config2 }
connections
  -- mode specific connections which correspond to the
  -- different configurations of this process
modes
  started : initial mode;
  config1 : mode;
  config2 : mode;
  started  -[ t1.startThread_t2 ]-> config1;
  started, config1  -[ t1.startThread_tn ]-> config2;
  started, config2  -[ t1.stopThread_tn ]-> config1;
  ... 
end <pname>

- All threads started / stopped by main thread via startThread and stopThread APOS calls
- Modelled in terms of AADL events and moding
ASAAC Virtual Channels >> Definition

- Means for asynchronous communication between threads
- Unidirectional and data oriented, i.e. one data structure per vc
- 1:N communication scheme with send / receive buffers in FIFO or LIFO mode; M:N variant for signal processing domain
- Configuration defined by blueprint
- Reconfigurable in the case of a system error
• Modelled in terms of AADL connections and AADL data ports
• 1:N Virtual Channel modelled by set of \(<N>\) data connections
• AADL ports provide for buffering mechanism and policy
• (Re)configuration captured in terms of moding (see process)
• Network mapping defined by means of AADL connection binding
- Initial startup of Generic System Manager (GSM)
- Dynamic creation of processes, threads, and VCs
- Synchronised start of overall system
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**ASAAC System Reconfiguration**

- Error detection by GSM on a resource element (RE)
- Decision on reconfiguration action at integration area (IA)
- Synchronised reconfiguration across effected REs
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Refinement Approach >> Introduction

Application.RW

Reader <-> Virtual Channel <-> Writer

Platform.Abstract

DPM_APOS (Abstract Processor) <-> APOS Services <-> DPM_APOS (Abstract Processor)

Transfer Connections (Logical Bus)
Refinement Approach >> Platform

- Abstract processor refined to HW/SW system
- Interface subprograms assigned to SW comps
- Refined communications

DPM_APOS (Abstract Processor)

Refined

DPM_APOS::Comms
DPM_APOS::Timing
SMOS::Comms
SMOS::Timing

Comm Mgmt
Timers
Config Mgmt

Module to Operating System Interface (MOS)

Network Connections (e.g. ATM Channel)
Refinement Approach >> Application & Comms

Application.RW

Reader

APOS::Comms

DPM_MOS

DPM_APOS.Refinde

Transfer Connection

Writer

APOS::Comms

DPM_MOS

DPM_APOS.Refinde

Network Connections (e.g. ATM Channel)
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Summary

- ASAAC configuration and reconfiguration behaviour modelled in terms of AADL events and moding
- ASAAC application modelling based on AADL processes, threads, data ports, and connections
  - Formalisation of translation scheme
  - Provision of templates for ASAAC modelling
- Platform modelling based on hierarchical refinement (as suggested by Peter Feiler)
  - Formalise refinement approach for incorporation into tools
- Application and communication refinement according to OSI reference model
  - Covers data flow – control flow transformation
  - Applicable for 2 adjacent protocol layers only
- Synchronisation with ARINC modelling required