Solving the Instance Model View-Update Problem in AADL-OSATE

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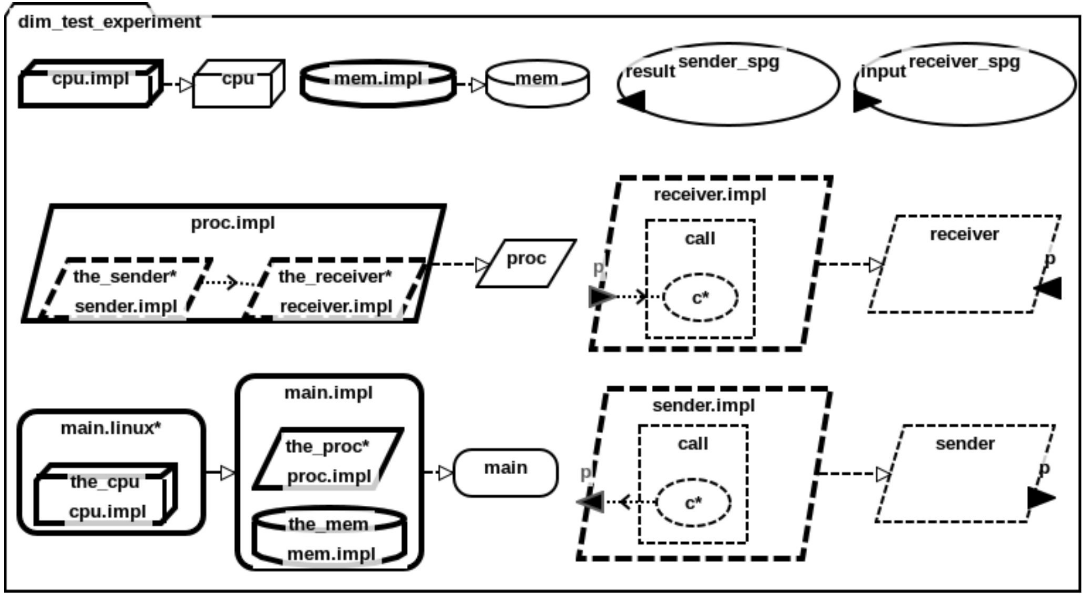
AADL

- Architecture Analysis and Design Language
- SAE Standard AS5506D
- to model real-time embedded systems composed of software and physical execution platform components tightly coupled with actuators and sensors to interact with their environments (Cyber-Physical Systems!)
- scheduling/flow-control analyses
- code generation for embedded platforms

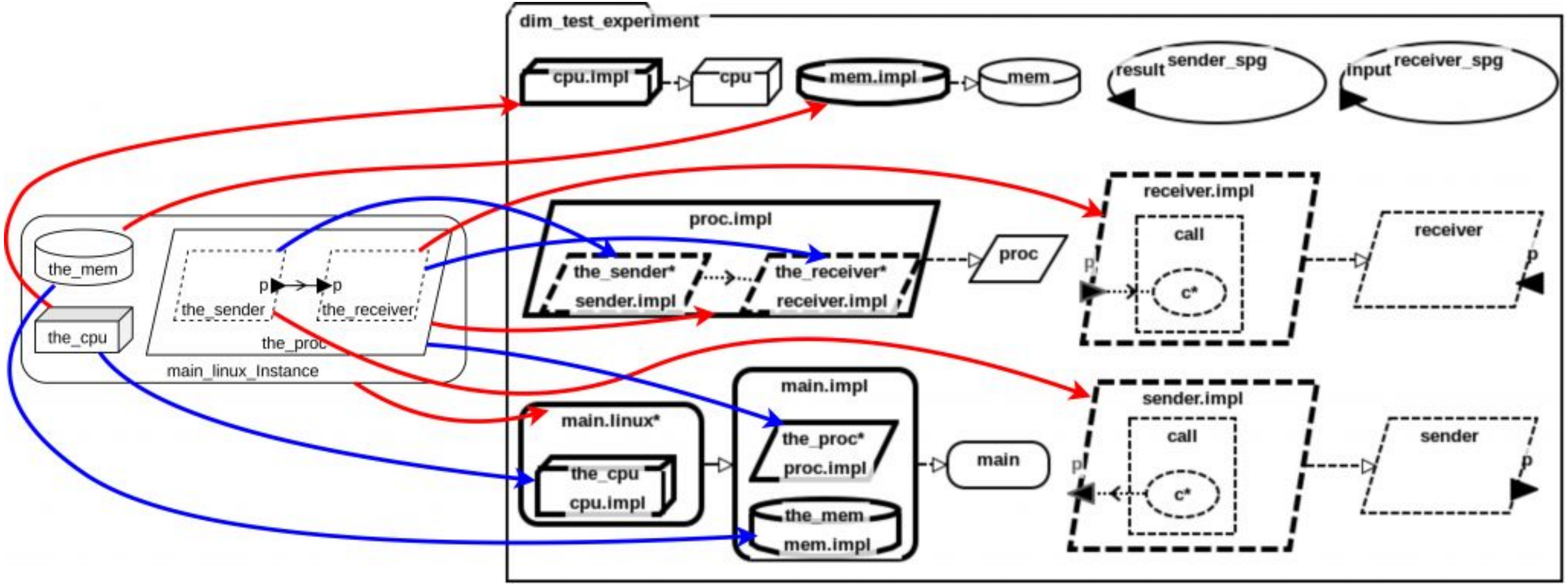
- Open-Source AADL Tool Environment (OSATE)
- Eclipse IDE plugin

AADL Constructs

- Components
  - Classifiers
    - Type
    - Implementation
  - Extensions
  - Refinements
- Features
  - Refinements
- Connections
  - Refinements



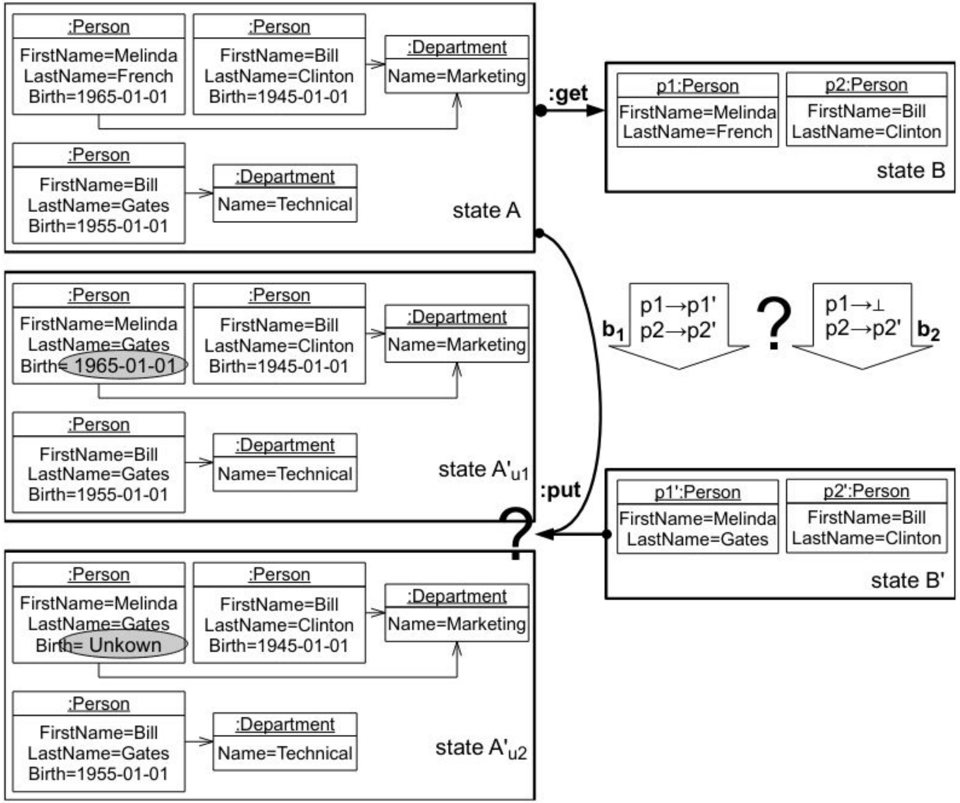
OSATE Instance Model



Instance Model

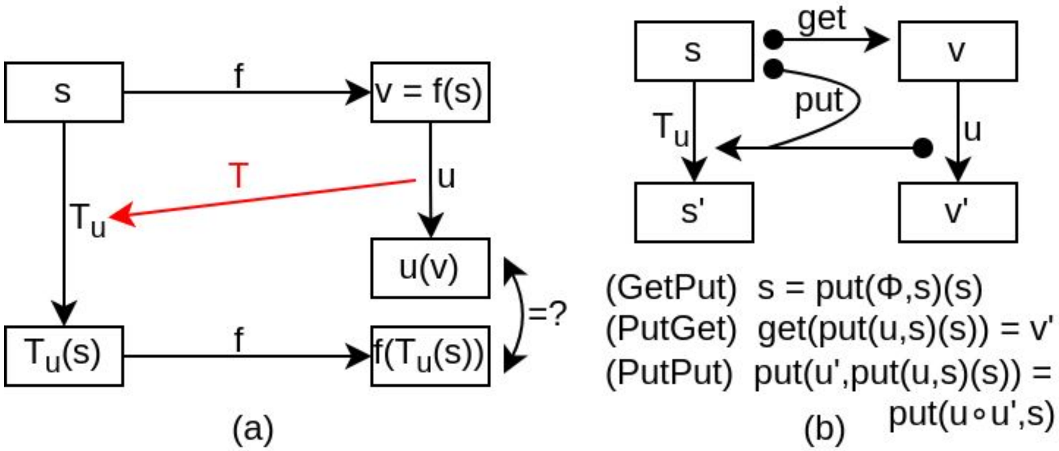
Declarative Model

View-Update Problem



Z. Diskin, et al, “From State- to Delta-Based Bidirectional Model Transformations: the Asymmetric Case”, Journal of Object Technology, 2011

Delta-based Lens



(GetPut) $s = put(\Phi,s)(s)$
(PutGet) $get(put(u,s)(s)) = v'$
(PutPut) $put(u',put(u,s)(s)) = put(u \circ u',s)$

(a)

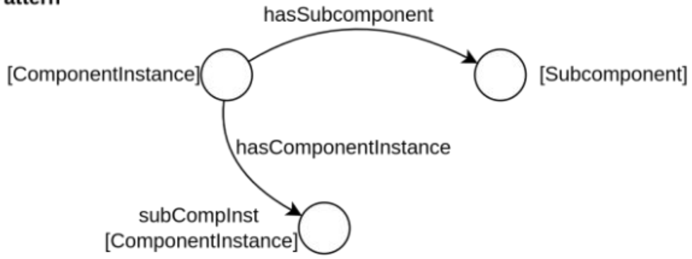
(b)

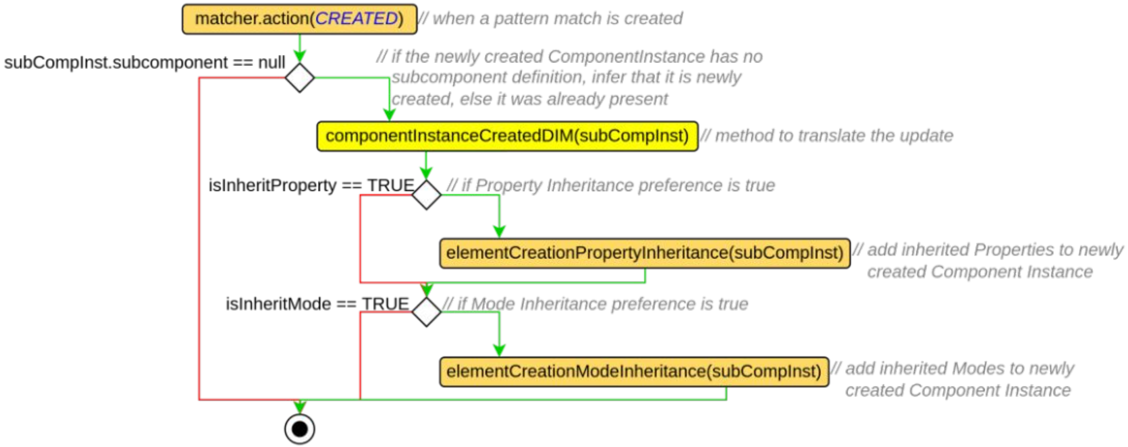
s : Model State	=> Declarative Model
f : View-Generating Function	=> Instantiation
v : View-State	=> Instance Model
u : View-Update	=> Refinement
T : Translation	=> Deinstantiation

OSATE-DIM

- OSATE Declarative-Instance Mapping
- Eclipse/OSATE-based plugin
- Graph Transformations
  - VIATRA
    - Graphical Queries
    - Model Transformation Rules

Graphical Query Pattern




matcher.action(CREATED)
subCompInst.subcomponent == null
componentInstanceCreatedDIM(subCompInst)
isInheritProperty == TRUE
elementCreationPropertyInheritance(subCompInst)
isInheritMode == TRUE
elementCreationModeInheritance(subCompInst)

// when a pattern match is created

// if the newly created ComponentInstance has no subcomponent definition, infer that it is newly created, else it was already present

// method to translate the update

// if Property Inheritance preference is true

// add inherited Properties to newly created Component Instance

// if Mode Inheritance preference is true

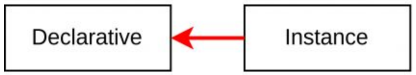
// add inherited Modes to newly created Component Instance

OSATE-DIM Values/Aims

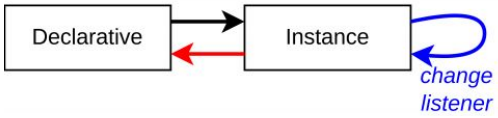
- Maximum Information Preservation
- Least/Minimal Change
- Very-well behaved lens (3 laws)
  - No extraneous model updates.
  - Equality of updated-model state with updated view-state
  - Composability of updates
- Flexibility
  - Scenarios
  - Preferences

Transformation Scenarios

State-based



Delta-based with In-place refinement

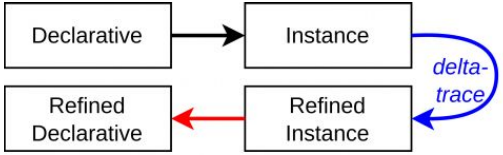


→ instantiation

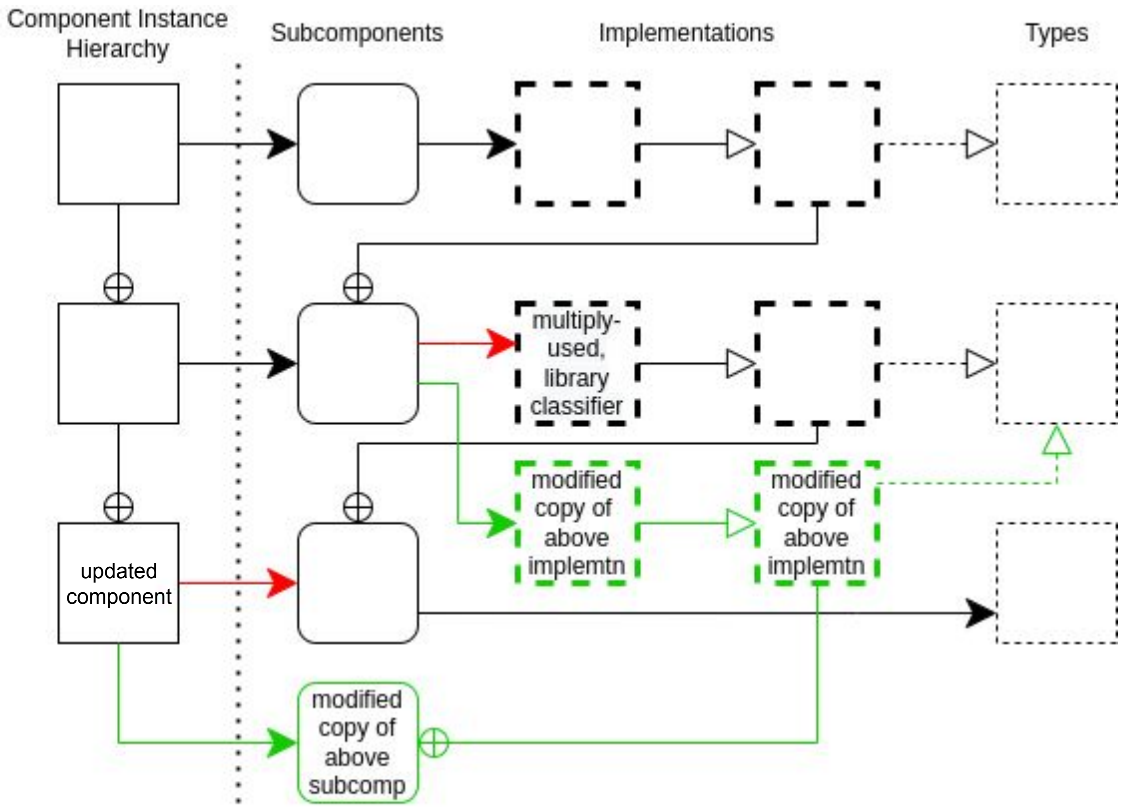
→ refinement

→ de-instantiation by OSATE-DIM

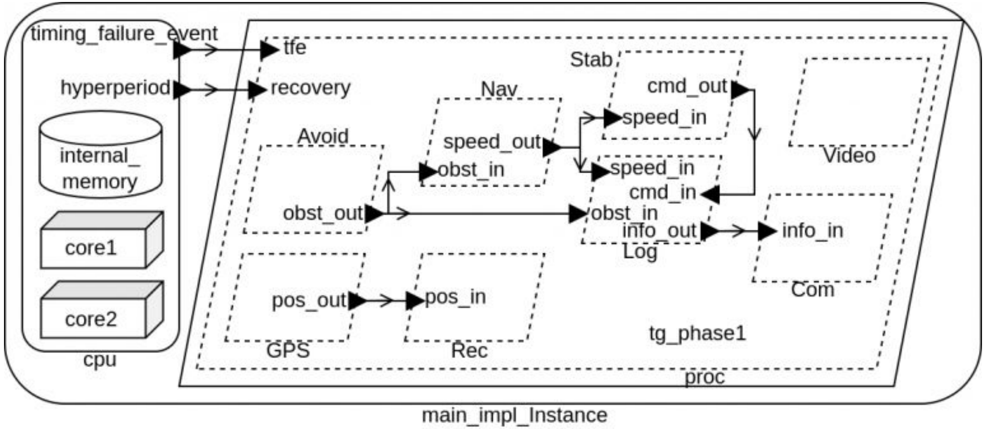
Delta-based with Out-of-place refinement



Update Propagation

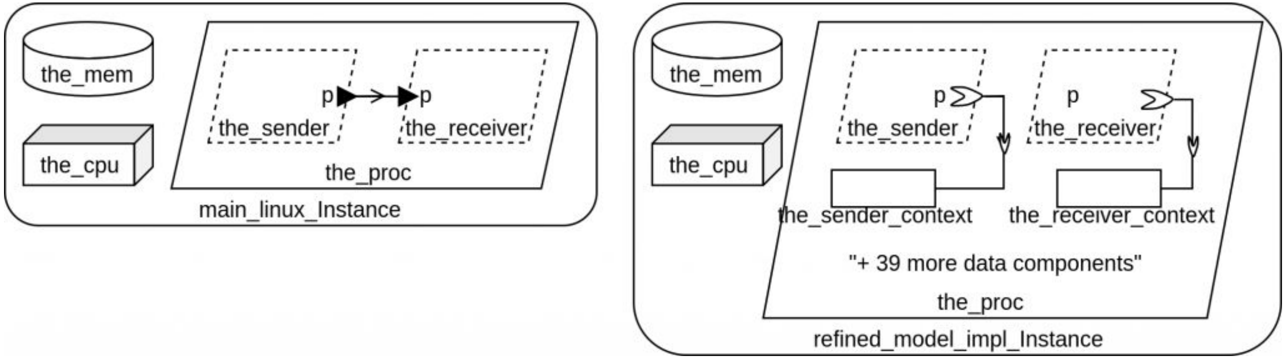

Component Instance Hierarchy
Subcomponents
Implementations
Types
multiply-used, library classifier
modified copy of above implemtn
modified copy of above implemtn
updated component
modified copy of above subcomp

Case Study: MC-DAG



- Addition of *Property Associations* (RAMSES::Execution_Slots) for each *Thread.*
- Contain static scheduling tables for each *Thread* in different *Modes* LO and HI.
- Properties also reference the core and memory binding, not just static data.

Case Study: RAMSES



- Addition of 41 *Data Components* to a *Process Component*, which are shared by two threads.
- The *Port Features* interfacing the two threads with each other are changed to *Data Access* kinds.
- New *Data Access Connections* are also added between the shared *Data Components* and the *Threads*.
- The added *Data Components* have varying numbers of *Properties*, and the total number of newly added properties is 122.
- the name of the top-*System Instance* is changed to “refined_model_impl_Instance”

Demonstration