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SYSTEMS INITIATIVE

Systematic Application of UCIS to Improve the Automation on Verification Closure

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Motivation – Verification, a language feat.?

- Despite SystemC language is one of the main drivers for virtual prototype development its verification features are rather limited:

Language / Feature	IEEE-1800 SystemVerilog	IEEE-1647 *e*	IEEE-1666 SystemC
Coverage Facility	+++	+++	x
Assertions	+++	+++	x
RTPG	+++	+++	+ (SCV)
Verification Methodology	+++	+++	x[1]
TLM	++	+	+++
AOP	x	++	x
C-Software Simulation	simulator dependent	simulator dependent	+++

[1] **not with OSCI simulator**

Motivation – Verification, a language feat.?

- Previous work:
  - Establish a functional coverage and verification methodology for SC

- With this foundation,
  lets improve the automation on verification closure in SC TBs

- Enhance the flow from coverage plan capture to functional coverage implemention within the testbench
  - Basis:
    - recently released
      Unified **C**overage **I**nteroperability **S**tandard (UCIS)

- Target Language/Simulator: SystemC Reference Simulator

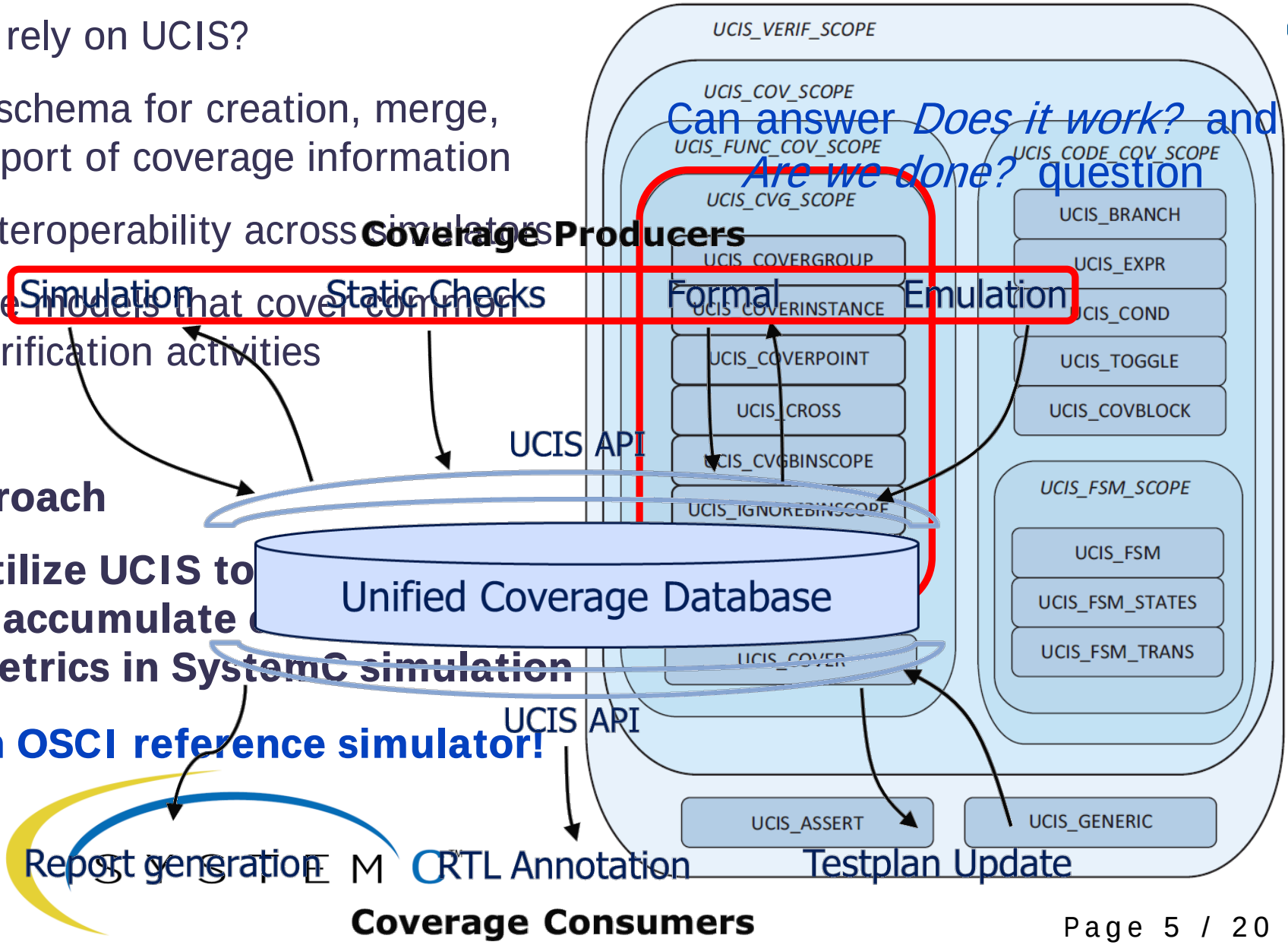
Outline

- Motivation
  - Verification Features of HLDVLs
  - Abstraction and Automation for Verification Closure Productivity
- **UCIS to Improve the Automation on Verification Closure in SC**
  - UCIS and Verification Process
  - Steps in Detail
- Case Study
  - Tooling for UCIS with OSCI SystemC
- Lessons Learned
- Final Remarks

Unified Coverage Interoperability Standard

- Why rely on UCIS?
  - A schema for creation, merge, export of coverage information
  - Interoperability across simulators
  - use models that cover common verification activities
- **Approach**
  - **Utilize UCIS to & accumulate metrics in SystemC simulation**

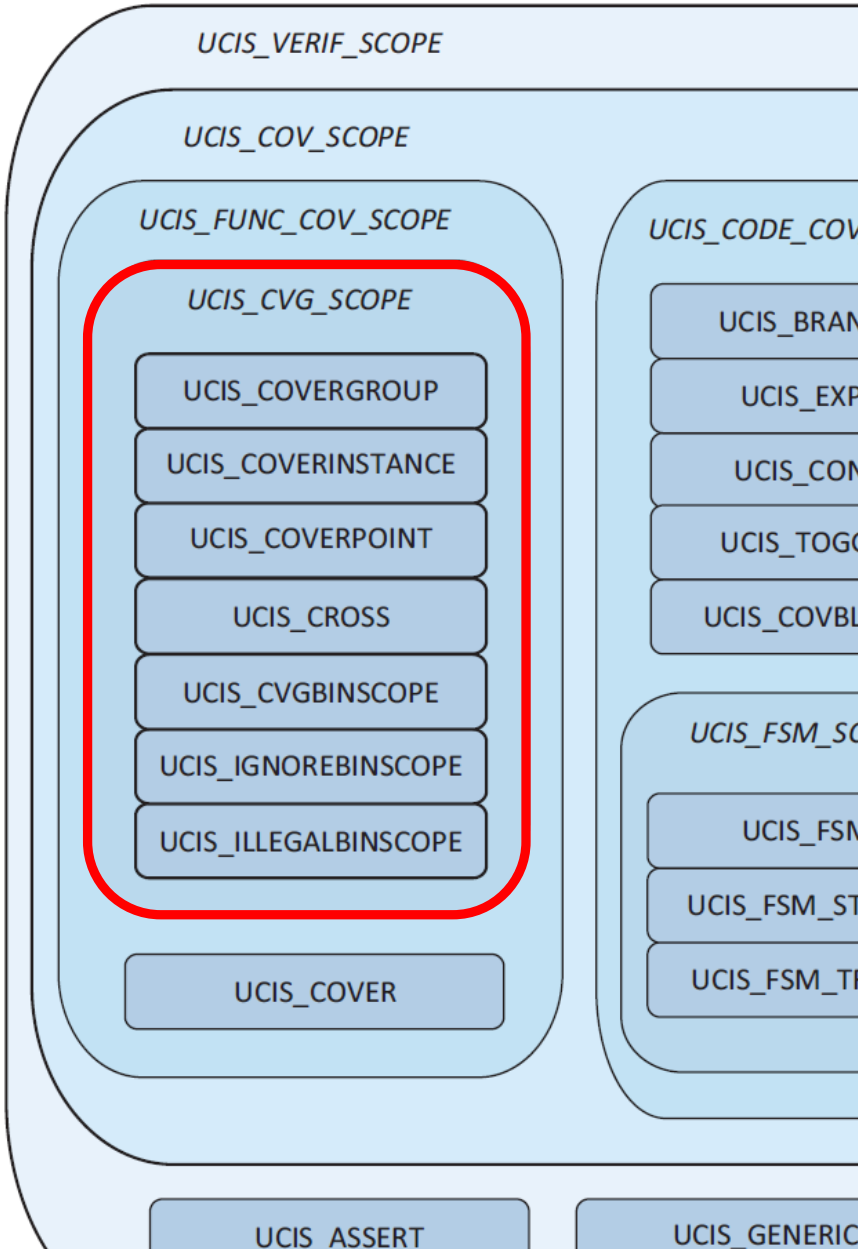
with OSCI reference simulator!



UCIS with OSCI SystemC

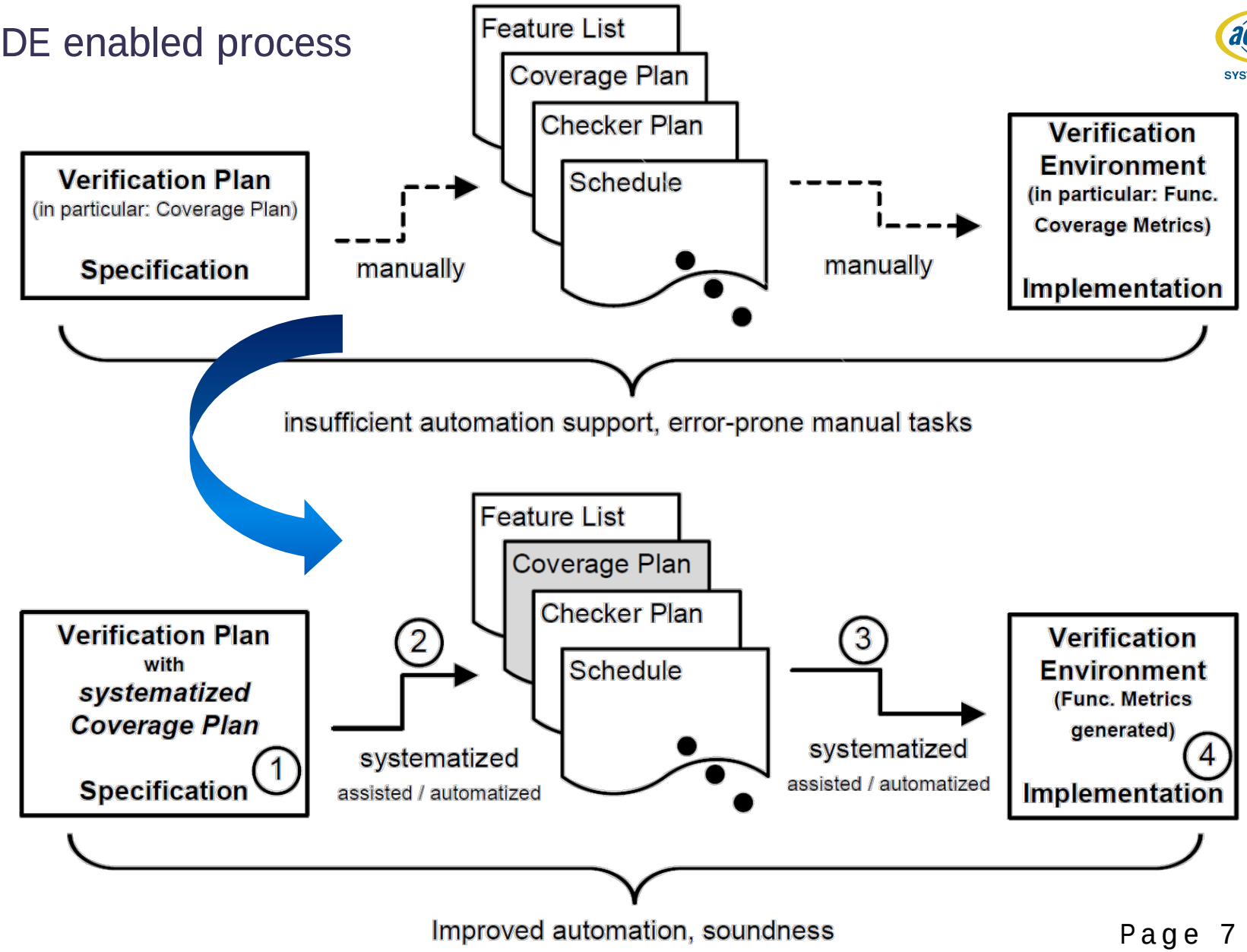
- **Challenges**
  - Accelera UCIS v1.0 Std.
    - API functions description
    - API header file
    - XML schema
  - Consequently,
    own API implementation needed!
  - API = Setter / Getter / Advanced
  - In this work, we focus on the functional coverage scope

    UCIS_CVG_SCOPE



UCIS and Verification Process

- MDE enabled process



UCIS and Verification Process cont'

- 1) Capture cover plan data in spreadsheet style data model (language independent)
- 2) Transform cover plan data to UCIS metric model (in fact a template of the metric to generate)
- 3) Generate func. coverage metric skeletons from the UCIS metric model
- 4) Assisted completion of the verification environment skeletons

OMG ReqIF

Verification Plan
with
systematized
Coverage Plan

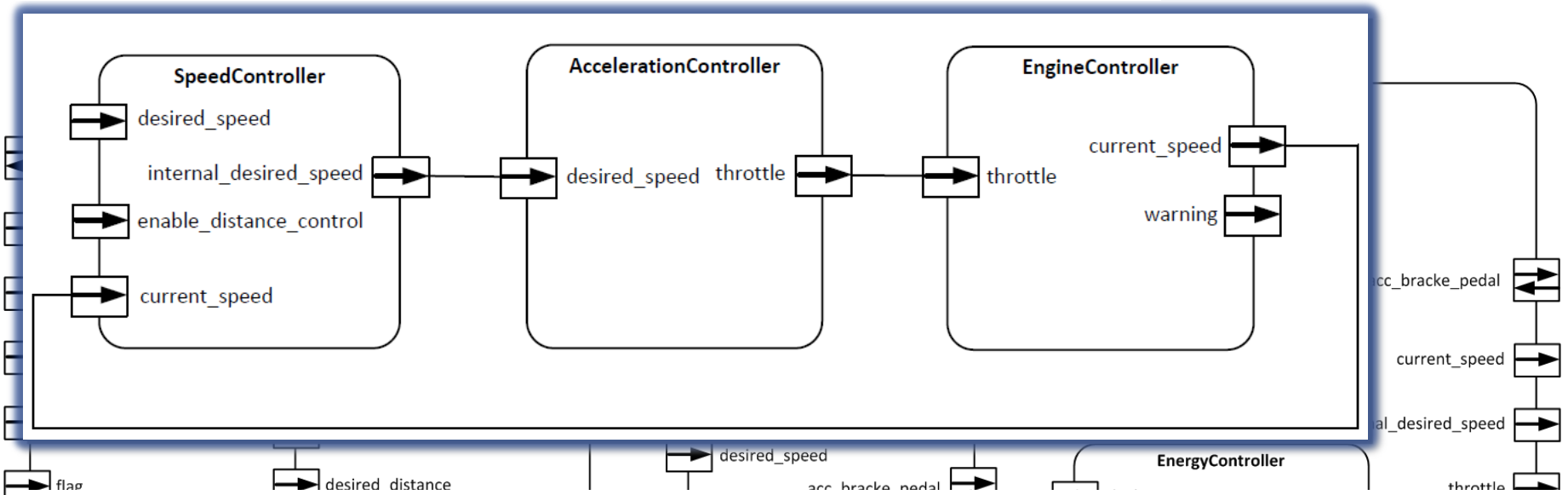
Specification 1

SYSTEMC™

concrete tooling

Case Study: Adaptive Cruise Controller

- Architecture of ACC model



- DUV has various I/O, functional coverage is a valuable metric to determine end of testing

- Proceed the individual methodolgy steps
  - Build coverage plan
  - Use UCIS to automatize metric skeleton generation

Case Study: Verification Planning

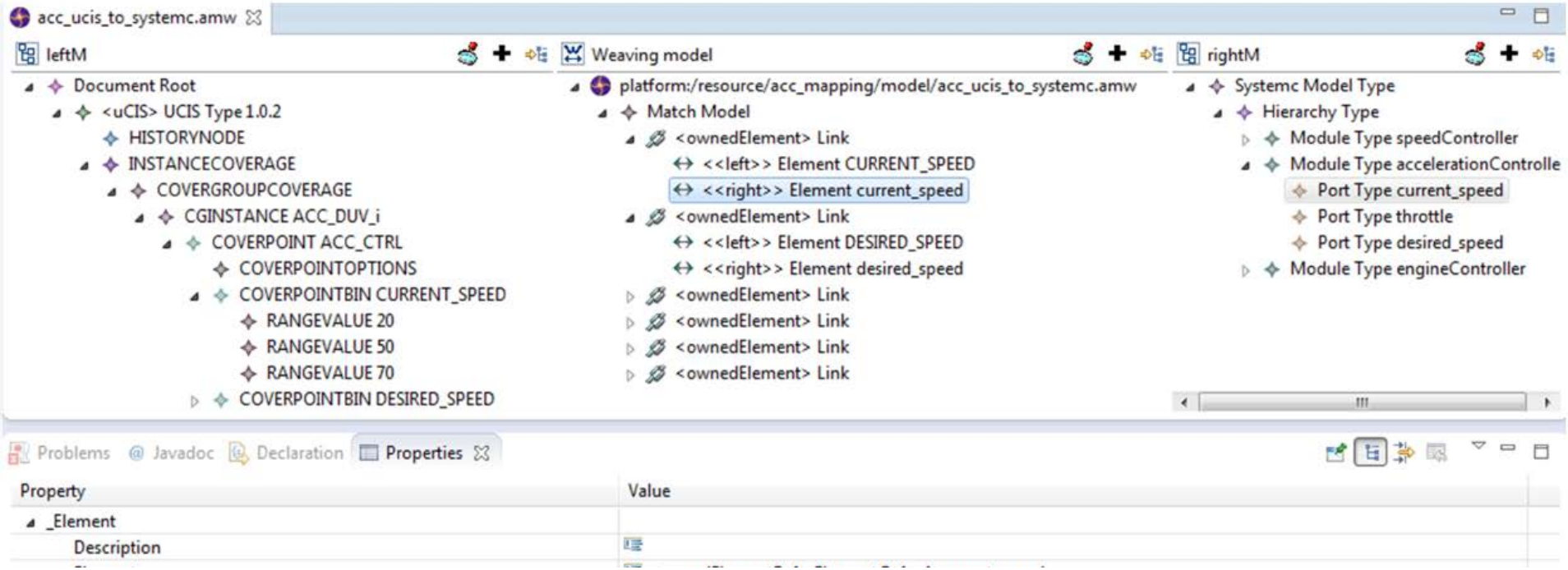
- Coverage Plan Spreadsheet structure
  - ~~Excel table~~ vs. custom coverage plan format
  - Usage of OMG Requirement Interchange Format (ReqIF)
    - Allows to define a custom „coverage plan spreadsheet“
    - MDE/Eclipse tooling compatible

- Case Study Example

Name	Range	Type	Weight	Goal
desired_speed	[10:100]	BIN	1	100
current_speed	[0:100]	BIN	1	100
desired_distance	[10:30]	BIN	1	100
current_distance	[0:150]	BIN	1	100
enable_acc	[0:1]	BIN	1	100
enable_dist	[0:1]	BIN	1	100

Case Study: Model Mapping

- Multi Pane Editor View
  - Mapped model contain references to both UCIS metric template and design model



  - A model of UCIS can be generated using MDE tooling, moreover API Setter/Getter functions can be generated

Case Study: Generated Metrics


```
1   // Init the factory
2   svm_pFac = svm_Factory::init();
3
4   // Set UCIS data model format
5   svm_pFac->setCoverageDb("acc_sim_cov.xml");
6
7   // Specify metric, covergroups
8   cv_pCG = svm_
          "ACC_DUV
9
10  cv_pCP = svm_
11  cv_pCP->set_v
12  cv_pCP->set_a
13  cv_pCP->set_c
14
15  (...)
```

```
17  // Specify metric, bin types
18  cv_pBa = svm_pFac->newBins(cov_pCP, "CURRENT_SPEED",
          AUTOBINS);
19  cv_pBa << range(20, 49) << range(50, 69) << range(70,
          100);
20  cv_pBa->connect(current_speed);
21
22  cv_pBb = svm_pFac->newBins(cov_pCP, "DESIRED_SPEED",
          AUTOBINS);
23  cv_pBb << range(10, 49) << range(50, 69) << range(70,
          100);
24  cv_pBb->connect(desired_speed);
25
26  (...)
```

Case Study: Simulation

- Stimuli = Computation Tree Method + Random
  - Tree-oriented decomposition of test scenarios into individual variable ranges
  - RTPG for the selected ranges
- Coverage
  - Usage of our functional coverage protoype for SystemC
  - Accumulation of hits w.r.t. metric

```
1    BIN: ACC_SPEED_CTRL:desired_speed::: 2014 Hits
2    BIN: ACC_SPEED_CTRL:current_speed::: 2189 Hits
3    BIN: ACC_SPEED_CTRL:desired_distance::: 2077 Hits
4    BIN: ACC_SPEED_CTRL:current_distance:: 2338 Hits
5    BIN: ACC_SPEED_CTRL:enable_ac::: 41 Hits
6    ...
```

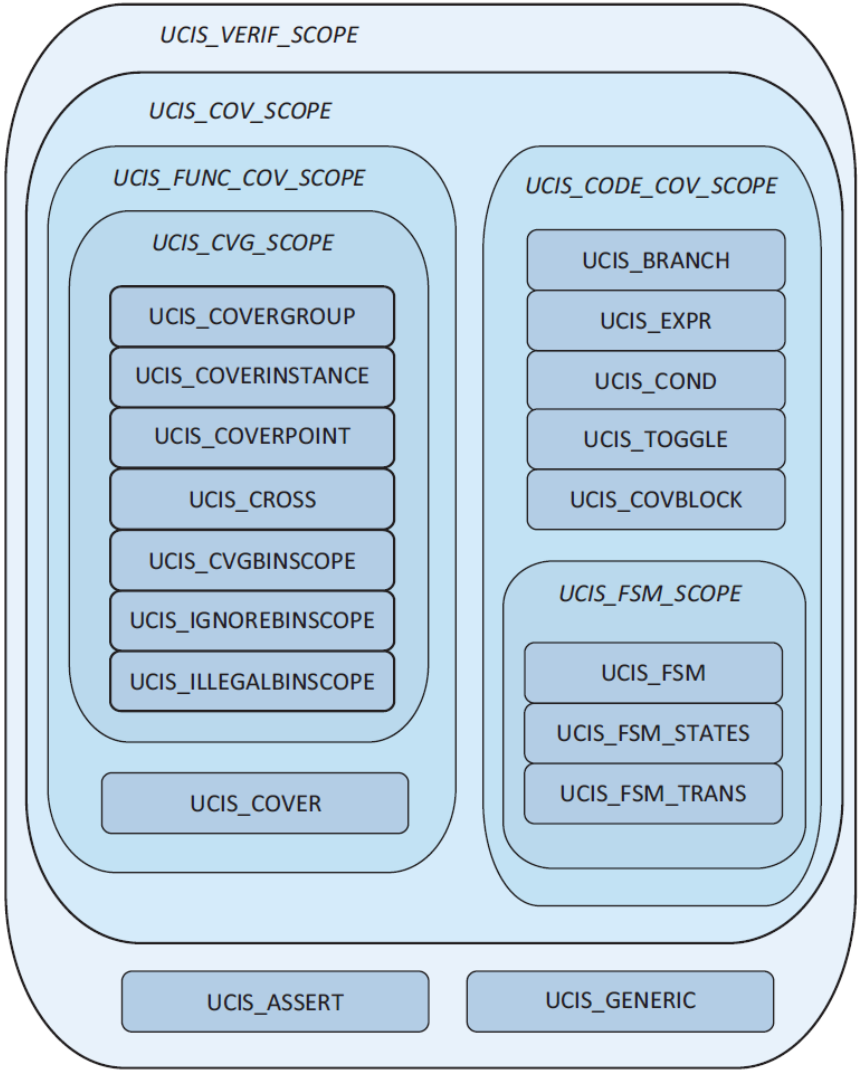
Case Study: Simulation cont‘

- Output to UCIS format
  - Usage of generated Setter/Getter functions (w.r.t. schema)

Example will be inserted asap

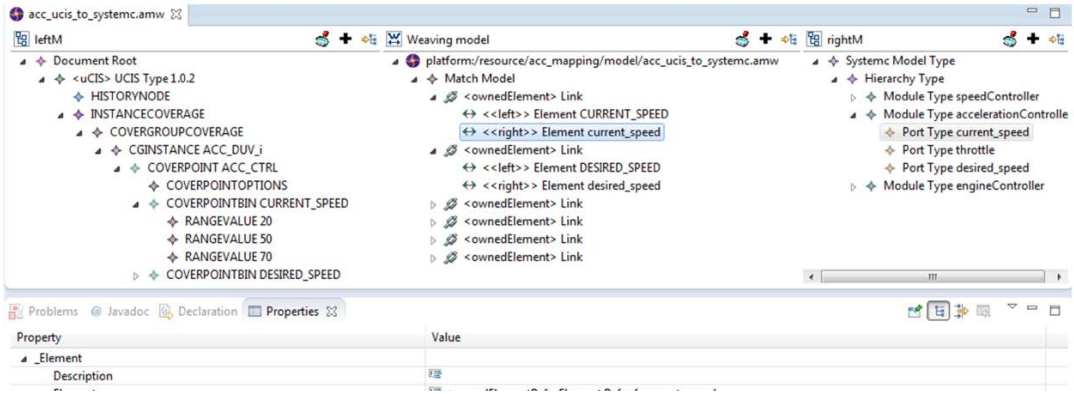
Lessons learned: UCIS

- „Missing“ reference API Writer
  - Effort to build Setter/Getter API for C/C#/... w.r.t. XML schema is low
  - Advanced API commands implementation requires in-depth expertise in UCIS and it‘s use models
- Slight inconsistencies of API and XML
  - Donation and glue residue
- A common standard format for *Does it work?* and *Are we done?*
  - A great thing ;-)



Lessons learned: MDE Tooling Effort

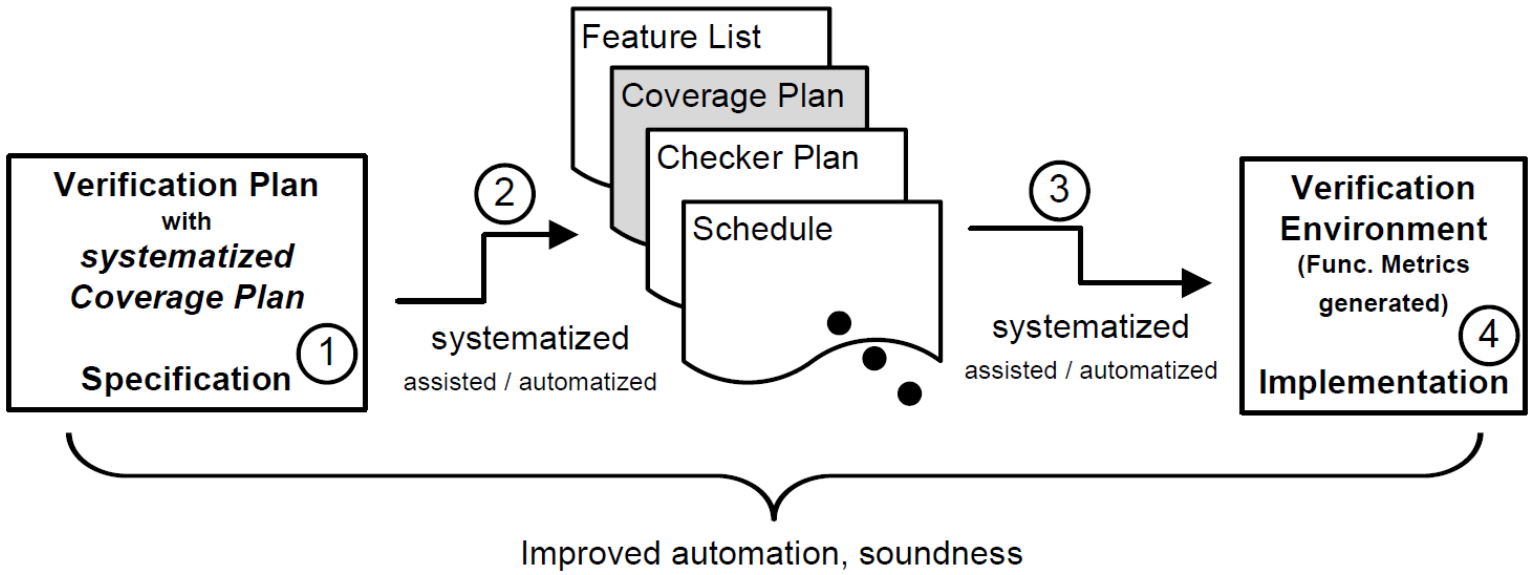
- Eclipse Tooling Construction
  - the devil is in the details...
  - ReqIF, EMF, EMF4CPP, specific Eclipse version requirements and dependencies
  - MDE expertise definitely necessary



- Eclipse Tools Usage
  - Editors for coverage plan, UCIS, model weaving work
  - BUT: domain-specific (EDA) view preferable

Conclusion

- We see potential for usage of UCIS in earlier phases of verification, in particular verification/coverage plan creation
- Building Setter/Getter API for UCIS is easy
- General: FC metric generation can avoid error-prone manual coding



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Acknowledgement

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Thank you for your attention.

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