Model-Based Testing Using LSCs and S2A

(a preliminary industrial experience)

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Short presentation at MoDELS 2009, Empirical Results Track

One Slide Abstract

- We report on using high-level visual scenario-based models for test specification, test generation, and aspect-based test execution, in the context of an industrial application
  - To specify scenario-based tests, we used a UML2-compliant variant of live sequence charts (LSC)
  - To automatically generate testing code from the models, we used a modified version of the S2A Compiler, outputting AspectC++ code
  - Finally, to examine the results of the tests, we used the Tracer, a prototype tool for model-based trace visualization and exploration
- Our experience reveals the advantages of model-based test specification and aspect-based execution
  - Generating aspect code from visual models enables exploiting the expressive power of aspects for testing without manual coding and without knowledge of their rather complex syntax and semantics
- We discuss technological and other barriers for the future successful integration of our initial work in industrial context

Live Sequence Charts [DH01]

- LSC is a visual formalism for inter-object scenario-based specifications
- Extends classical sequence diagrams mainly with a universal interpretation, must/may (hot/cold) and monitor/execute modalities
  - Allows to express liveness and safety properties
  - Allows to differentiate between monitoring and execution
- Has formal semantics, translation into TL [KHPLB05], UML2-compliant version using a profile [HM06], execution/synthesis [MH06,HK01]

Scenarios to Aspects [MH06,HKM07]

- S2A: a compiler that translates LSCs into aspects
- Each LSC is translated into a monitoring scenario aspect, simulating an automaton that follows the scenario's progress
  - aspect pointcuts listen out for relevant events
  - aspect advice advances the automaton to the next cut
- The generated aspect code reports the scenarios' activation, progress, completions, and violations
- Original implementation uses AspectJ as the target language
  - we created and used a modified version, outputting AspectC++ code

Trace Visualization and Exploration [MKH07]

- The Tracer is a tool for scenario-based trace analysis, visualization and interactive exploration
- Basic view: hierarchical Gantt chart, use-cases and scenarios in the model, following the scenarios progress
- Identifying completions and violations
- Computing trace metrics
- Interactive exploration: navigation, filters, comparisons

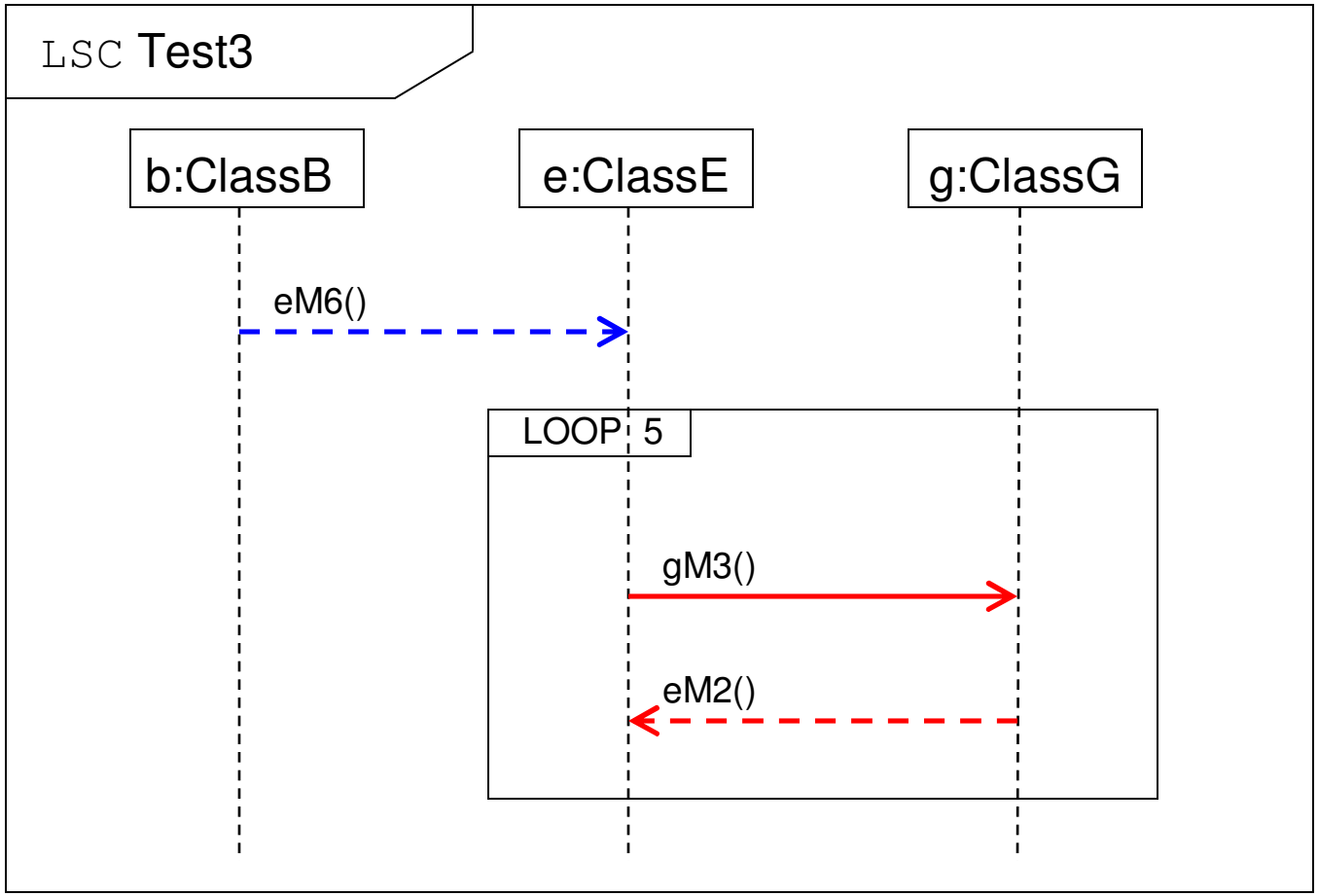
Case Study Setup

- Conducted by the second listed author Jani Metsä while he was working for Nokia Corp., Devices R&D
- Testing a C++ application written by Nokia, running on Symbian OS inside a Nokia N96 smartphone
- Due to confidentiality restrictions, some details of the case study cannot be made public

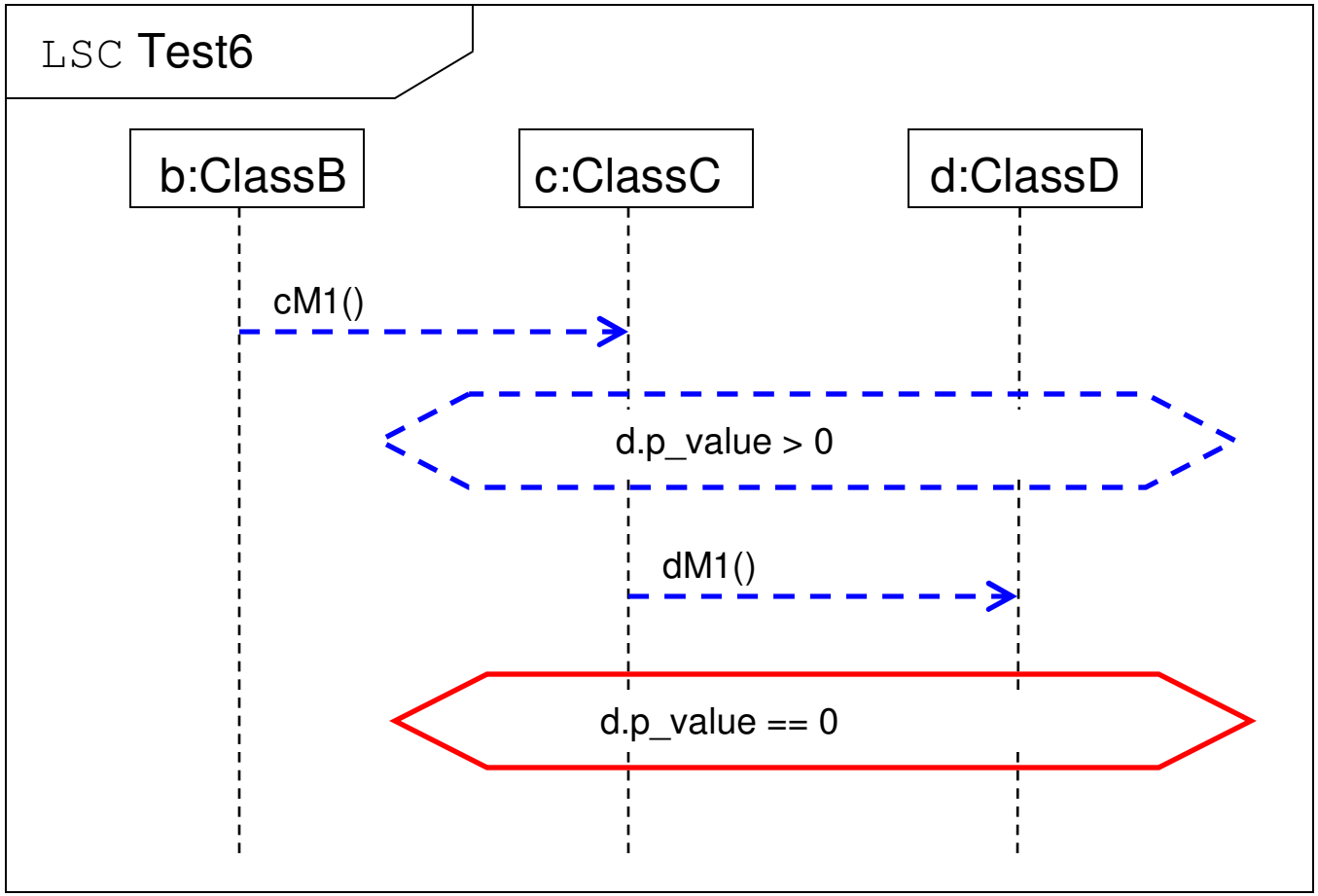
Case Study

- Specified 32 scenarios
  - some represented existing textual test documents
  - drawn using IBM Rational Software Architect
- Scenarios translated into AspectC++ aspects
  - using S2A
- Generated testing code weaved into application code, executed on the Nokia smartphone
- Exploring test results
  - using the Tracer

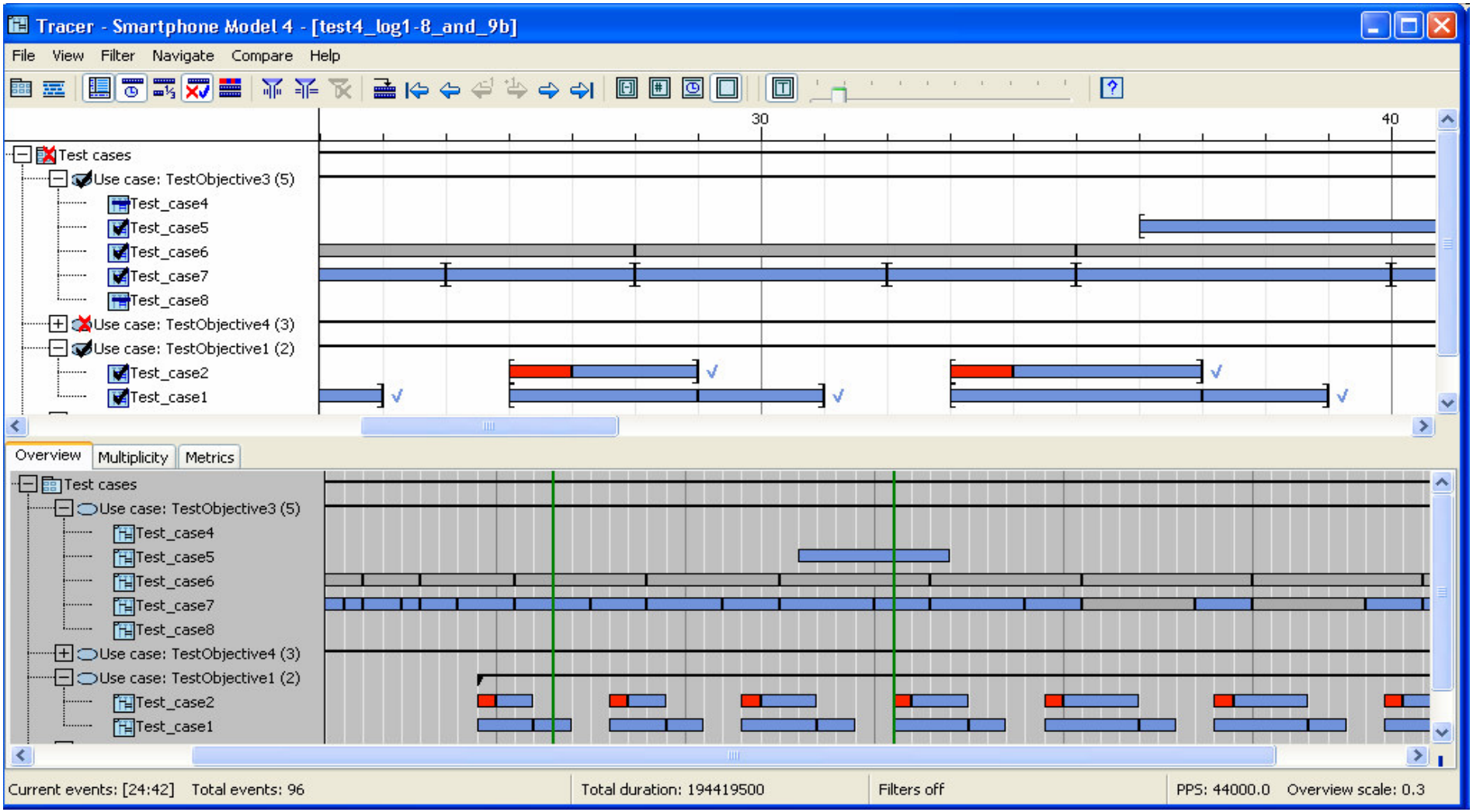
Case Study Example Scenario (1)



Case Study Example Scenario (2)



Case Study Example Trace Output



Case Study Evaluation (1)

- Testing functionality specified at a behavioral level, without implementation details
- No need to know aspects
  - access to SUT internals without requiring the engineer to know aspects
  - automatic generation guarantees certain quality in the code executing the tests
- End-to-end visualization
  - believed to be a positive adaptation factor

Case Study Evaluation (2)

- Access to a model of the SUT is required
- Good command of the modeling language is required
  - suggest the use of test templates

- Modeling language expressive power and semantics; LSC sometimes unable to express the tests we wanted to specify
  - lacking explicit reference to threads
  - not easy to define complex control structures

- Interoperability problems, immature tool implementations
  - mix of academic prototypes and commercial software
  - no single IDE
  - a lot of process overhead, difficulties in identifying source of problems

Conclusion and Future Work

- We presented a new tool chain for model-based testing using aspect code generated from scenario-based models
- Evaluation using an initial case study in an industrial context
- Future work
  - Additional experiments
  - Improving tool implementations

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Thank You!

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