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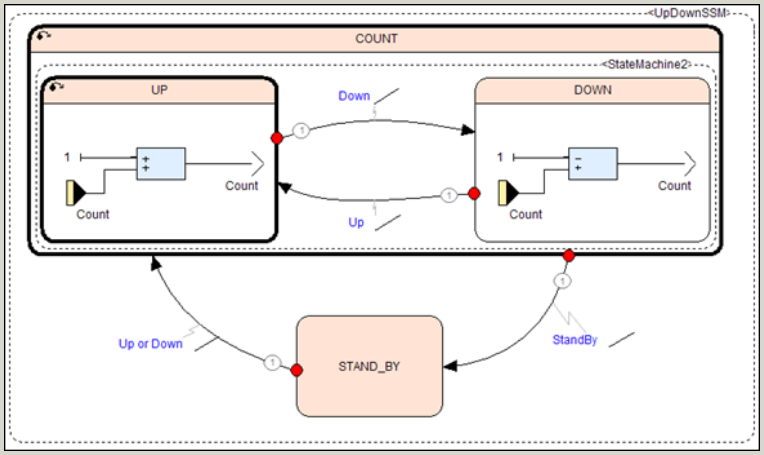

openETCS: WP 7 Model and Tool Evaluation
Subset 26, Sect. 3.5 (Management of Radio Communication)

Modelling „Management of Radio Communication“ with SCADE

Agenda

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- SCADE @ Siemens Rail Automation
- SCADE language & tool suite
- ETCS MoRC model (Management of radio communication) snapshots
  - Modelling
  - Code generation
  - Testing, debugging, simulation
  - Document generation
  - Requirements management and tracing
- ATP sample live demo

SCADE @ Siemens Rail Automation

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- Working with SCADE since 2006

Why SCADE?

- SCADE (by Esterel Technologies) addresses especially
  - Certifiable safety-related software (DO-178B, Level, EN 50128 SIL 4)
  - Embedded control systems
- Covers almost all aspects of a CENELEC compliant development process
- Executables generated from SCADE models:
  - No special target platform required (small footprint)
  - Runs on all platforms for which a C (or ADA) compiler is available

SCADE Suite:
addresses especially
safety-related software (DO-178B, EN 50128 SIL 4)

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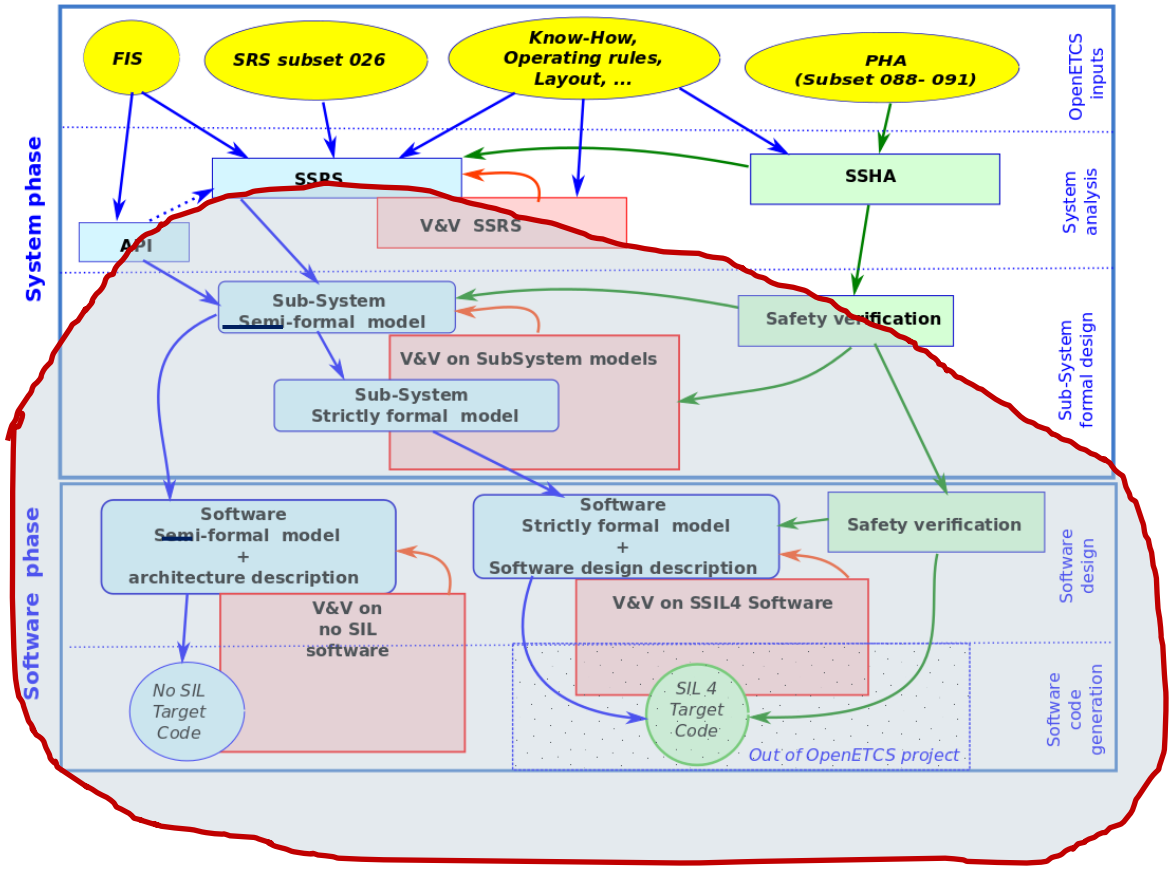

The SCADE Suite covers ...

... many aspects of the openETCS process

SCADE Suite:
addresses especially
safety-related software (DO-178B, EN 50128 SIL 4)

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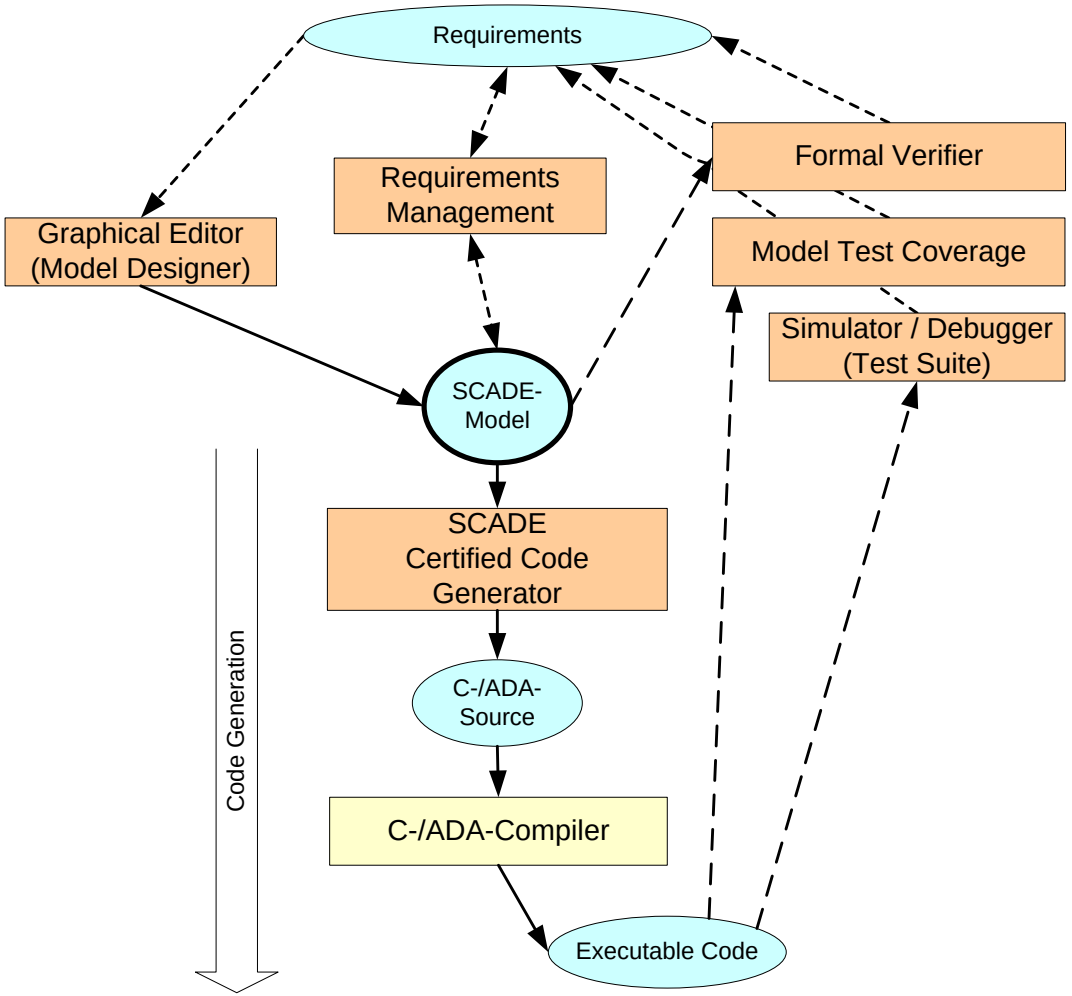


What is SCADE?

- Modelling language and engineering platform from Esterel Technologies
- Model design, test and verification
- Requirements management gateway
- Automatic code generation
- Semantic checks during generation
- Certified code generator
- Debugging + simulation
- Formal Verifier
- Model test coverage

The SCADE Paradigm

SCADE Language

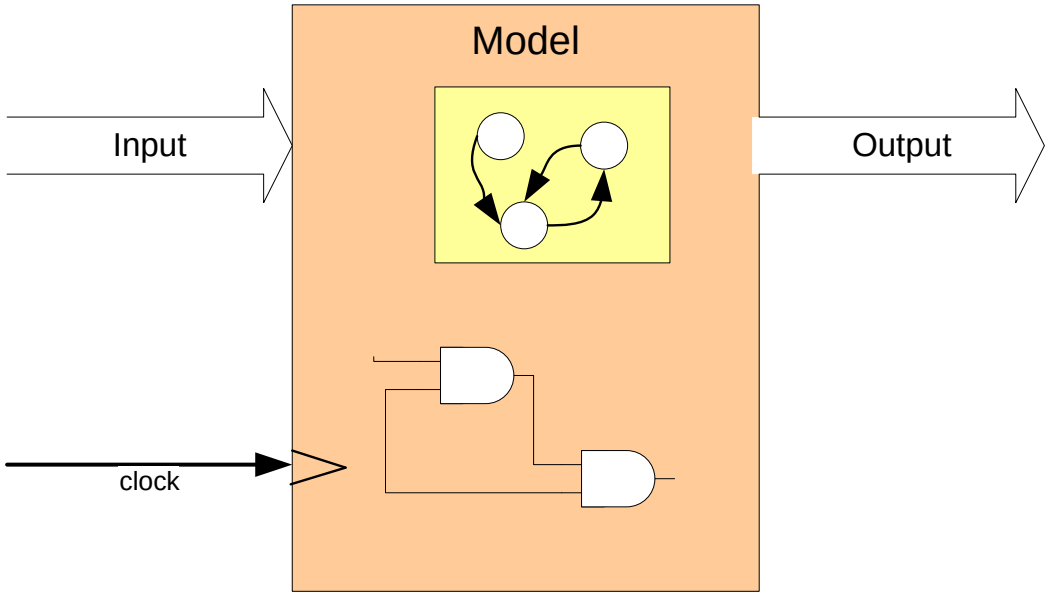
- Strictly formal and deterministic

SCADE-Models are

- synchronously
- clocked
- data flow and state machines
- combinations of these

Timing Behavior

- no signal racing effects
- no transient bug effects



SCADE language

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Data

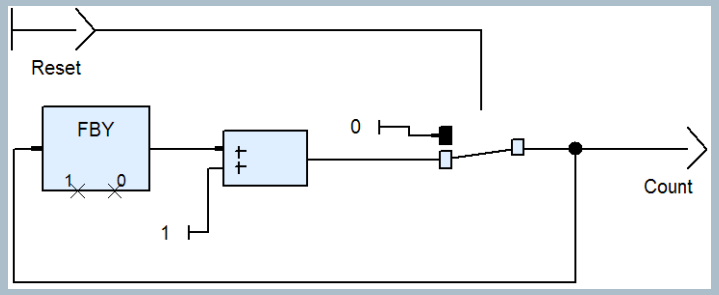
- Strongly typed
  (bool, int, real, arrays, structures)
- **Only static** resource allocation

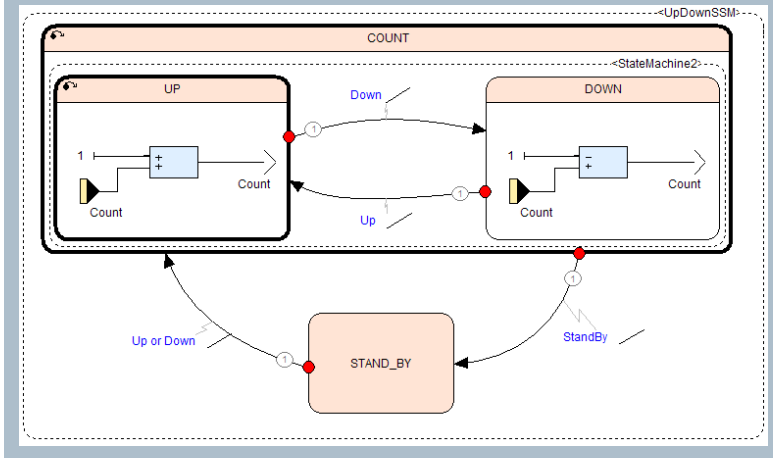
Dataflow description

- Boolean logic + arithmetic operations
- Choice (if … then … else …; switch case)
- **No non-terminating loops**
  - but iterations over data and functions
- Temporal operators:
  access to previous values of data flows

State machines

- Synchronous automata
- Hierarchy
- Parallelism
- Freely mixed with dataflows





Sample: UNISIG Subset 026, Ch. 3.5: Management of Radio Communication

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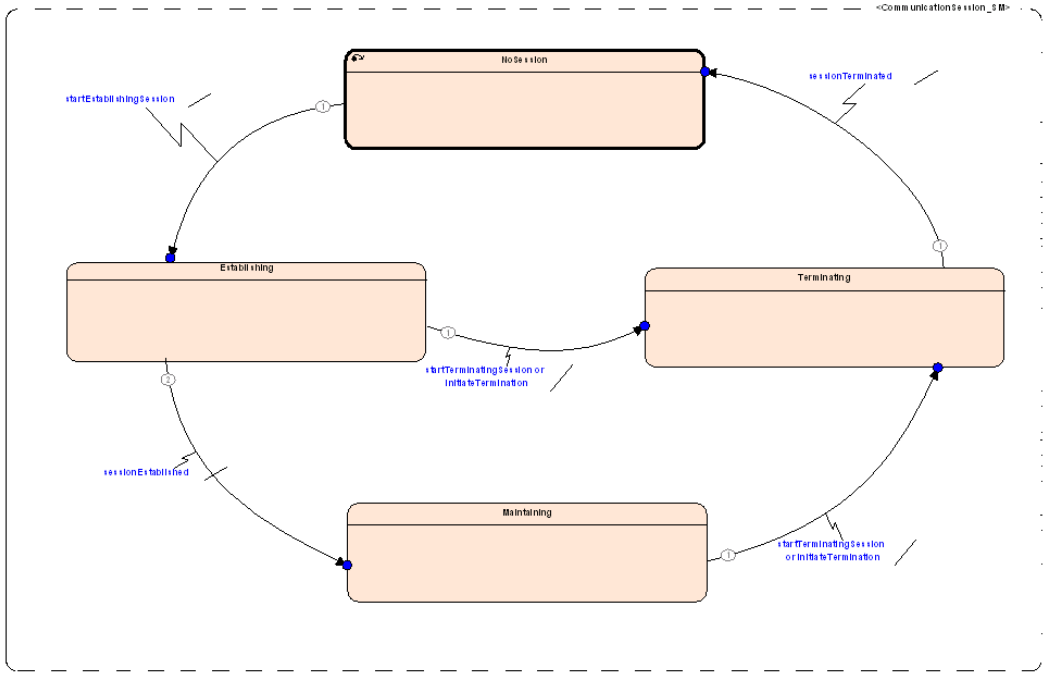
- Subset 026, 3.5:
  - ≈ 60 textual requirements on 10 text pages
  - 4 sequence charts
  - 3 tables
- Function:
  - Session Management



Sample: UNISIG Subset 026, Ch. 3.5: Management of Radio Communication (MoRC)

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SCADE Suite life impressions from the MoRC model:

- Editor
- Code generation
- Report generation
- Requirements management and tracing
- Debugging, Simulation, Test

MoRC Model + generated C-Code + documentation on github:

- https://github.com/openETCS/model-evaluation/tree/master/model/SCADE_Siemens

SCADE Requirements Management Gateway // Reqtify

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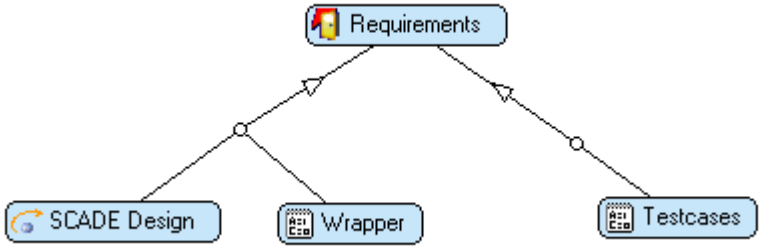


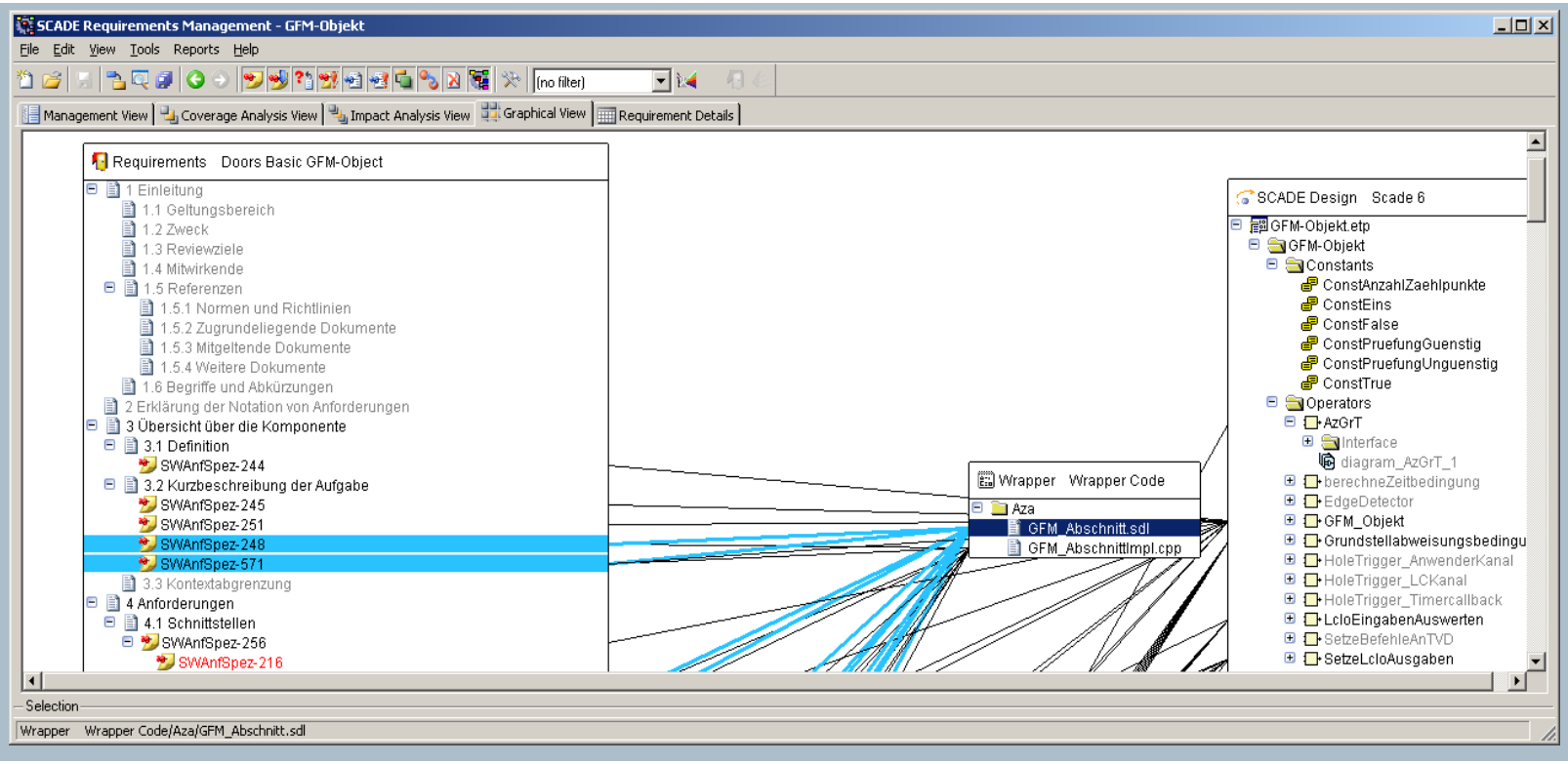
- Model elements are linked to requirements in

  DOORS, MS Word, .pdf, .txt, .tex, ….
- SCADE model and … cover the requirements
- Test cases cover requirements
- Impact analysis
- Automated document generation:

  Traceability matrix, coverage values, lists of covered/uncovered requirements

SCADE Requirements Management Gateway // Reqtify

- Example: Graphical View
- Requirements-Links: … ⇔ SCADE Model



Requirements Clarification

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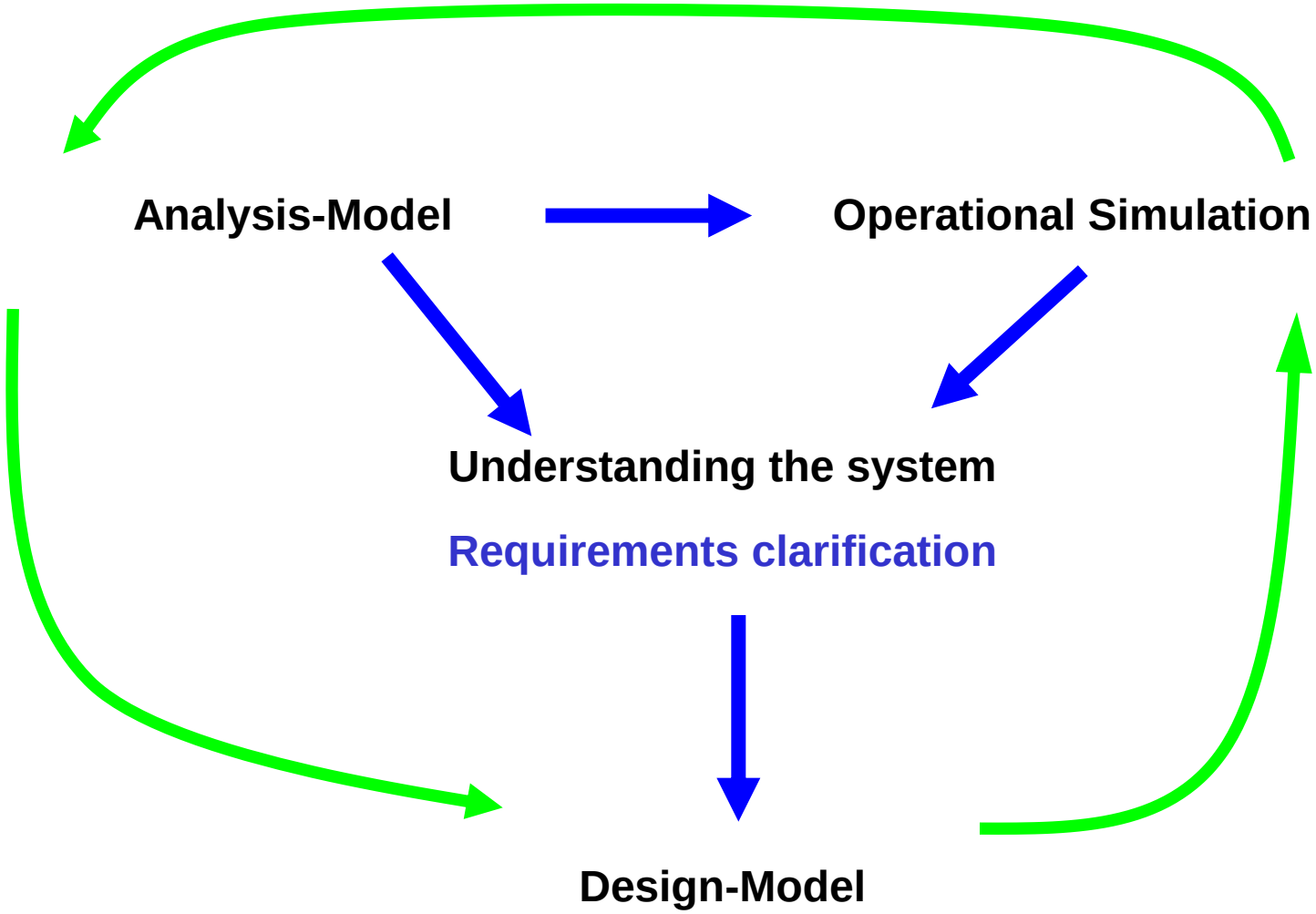
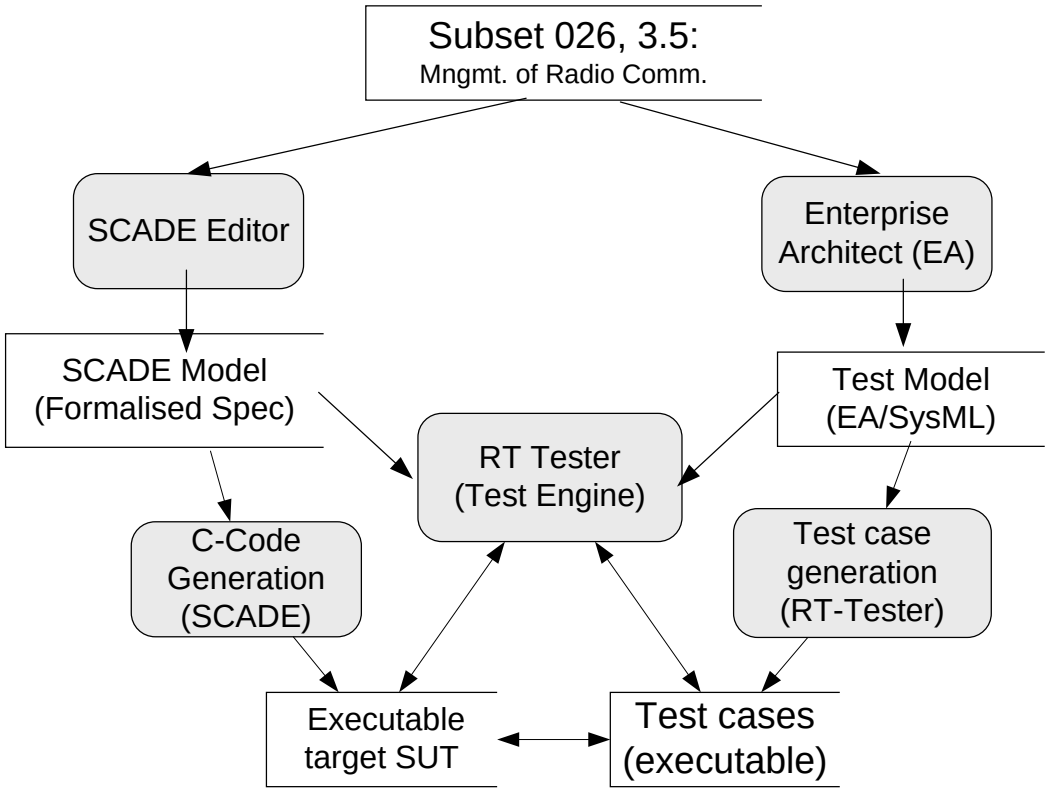


MoRC: Model based testing scenario prospect

- Target (SUT) to be tested:
  = SCADE model
- Test model for test case generation:
  = EA / SysML model
- Test case generator: RT-Tester



SCADE model based ATP live demo: Braking curves on track

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