USING TTCN-3 IN AVIONICS TO TEST SAFETY-CRITICAL SOFTWARE

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Agenda

- The SUT: Flight Management System (FMS)
- Testing FMS with legacy system (Multitest)
- Migrating legacy test scripts to TTCN-3
- Testing FMS with TTCN-3
- Benefit of migrating to TTCN-3
- Summary

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Flight Management System (FMS)

The FMS is a flight management computer embedded with Control Display Unit (CDU) and it provides several functions such as:

- Flight management

- Optimize navigation

- Calculate course to follow
    - ✓ Lateral Navigation (LNAV)
    - ✓ Vertical Navigation (VNAV)

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FMS reads data from different sources (keyboard, navigation sensors, radio, etc.) This data is combined in aircraft navigation

3

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Flight Management System (FMS)

Figure Esterline CMC Electronics

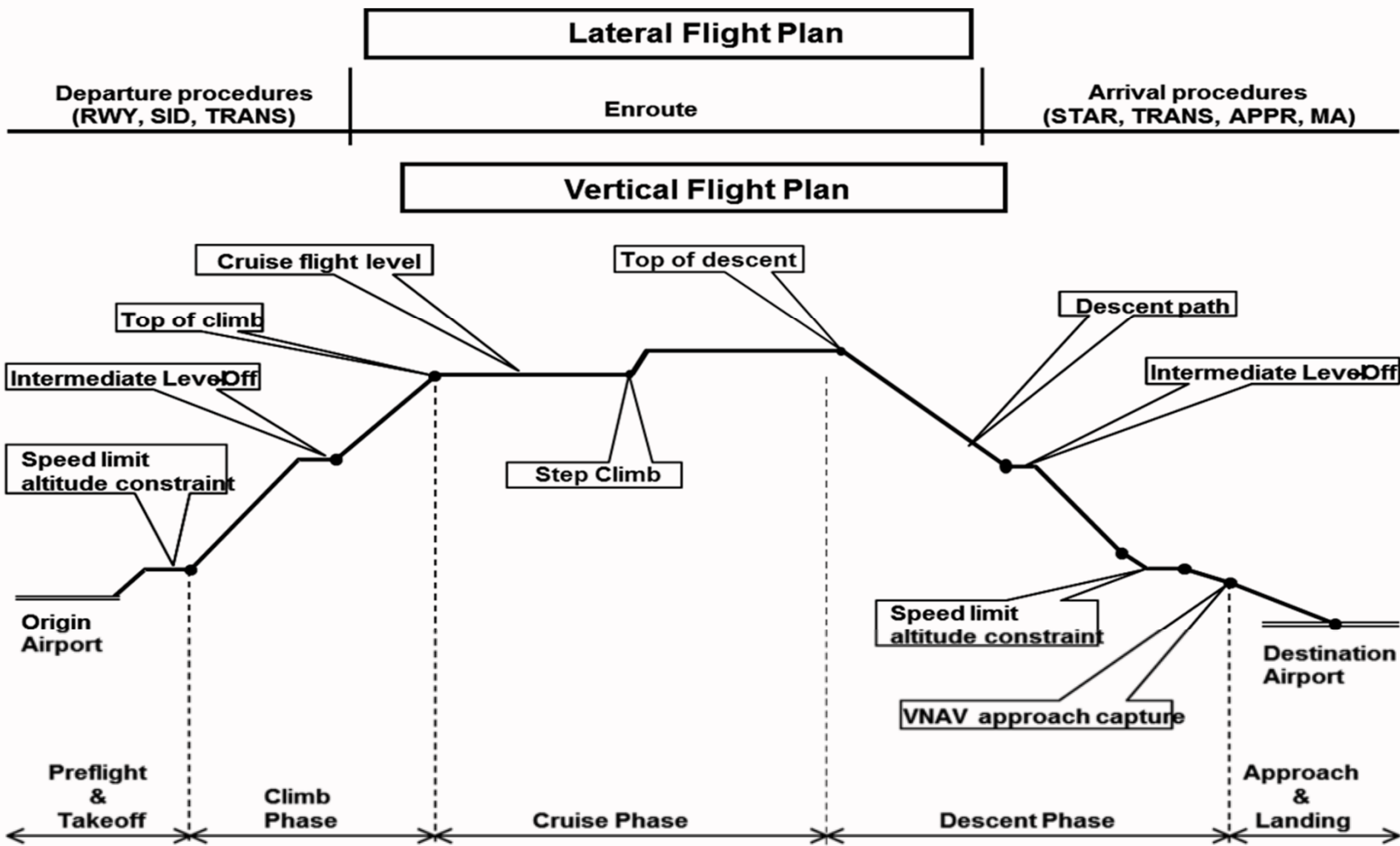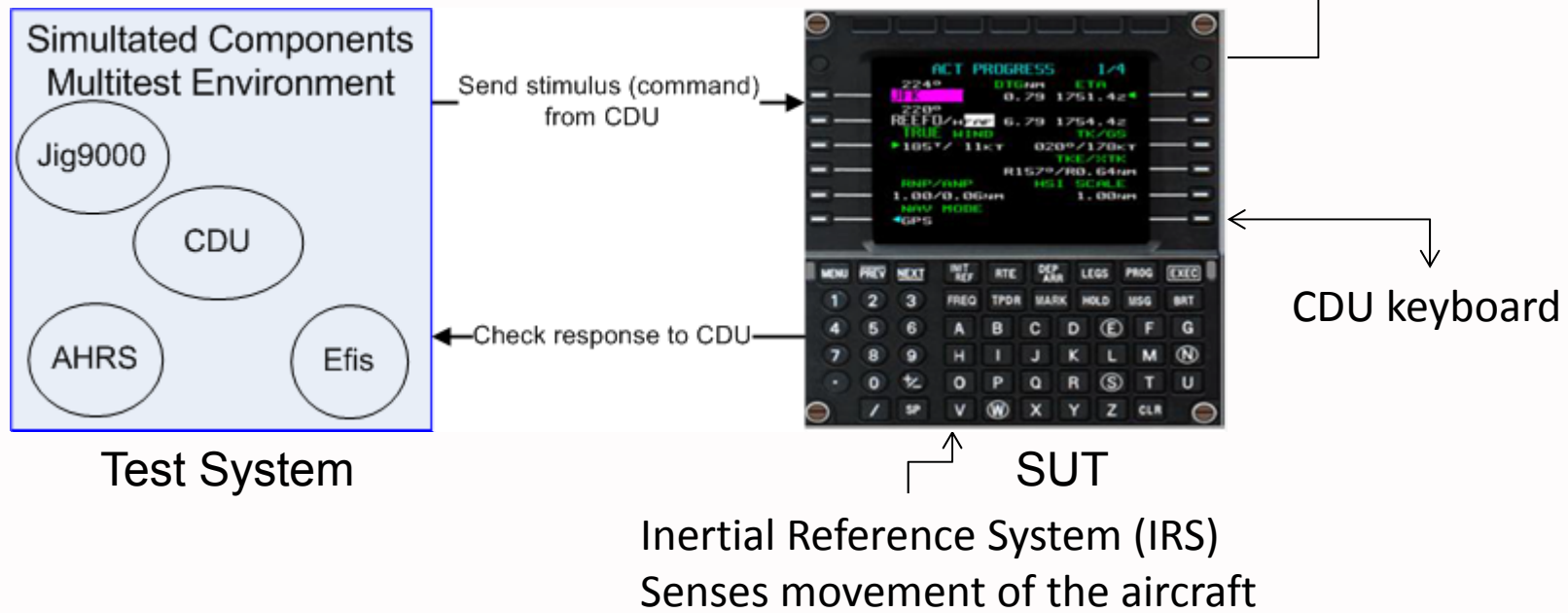20-22/10/2015

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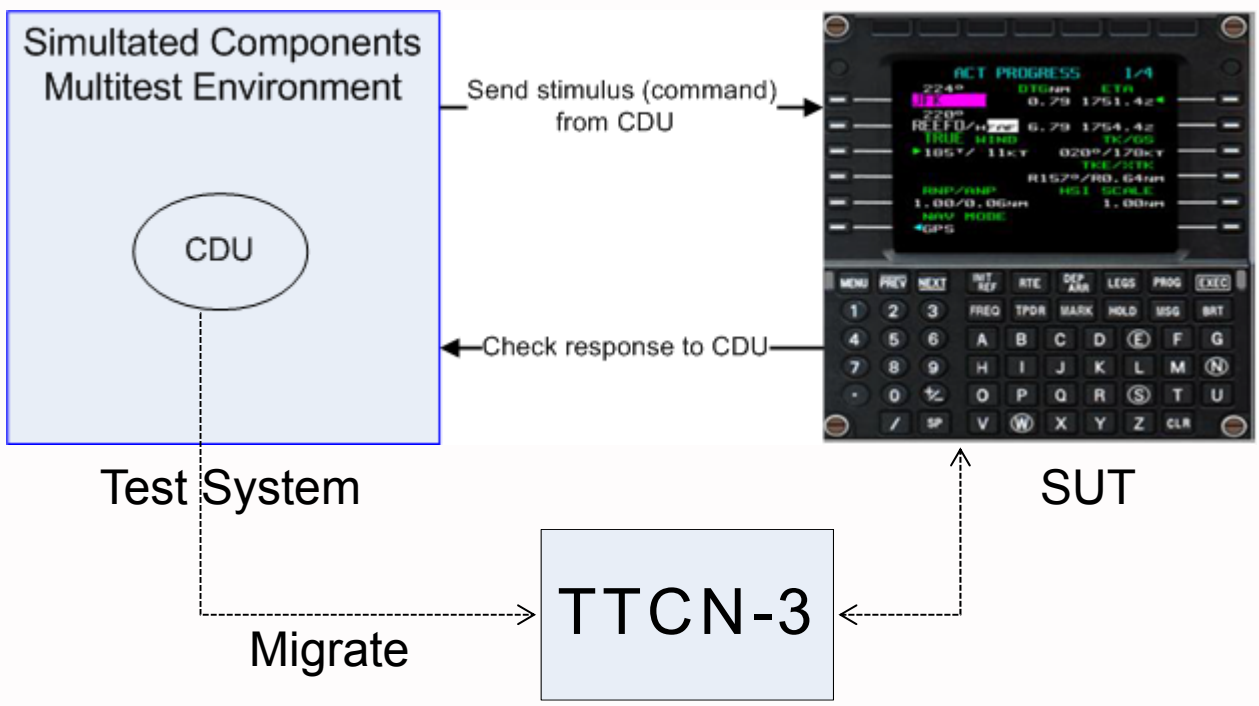
Testing FMS with legacy system (Multitest)

A simulator for each equipment is developed as multitest component to simulate the exchange of data

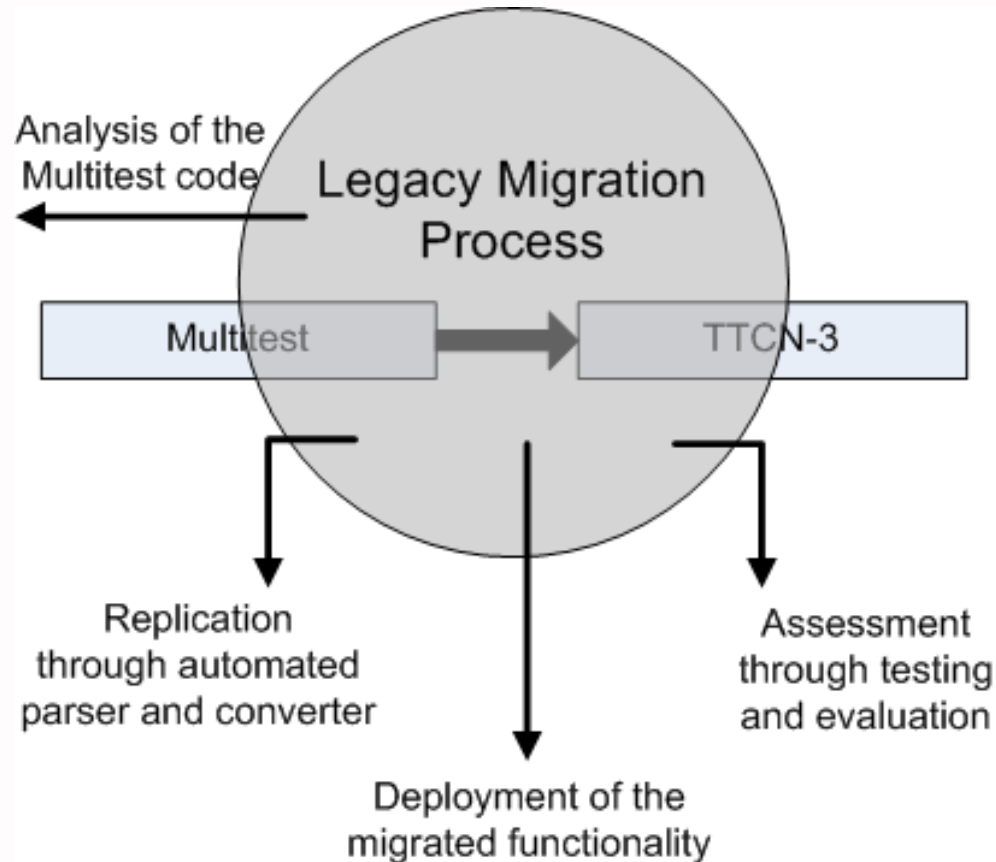Electronic Flight Instrument System (EFIS) flight deck instrument display

Simulated Components Multitest Environment

Jig9000

CDU

AHRS

Efis

Send stimulus (command) from CDU

Check response to CDU

Test System

SUT

CDU keyboard

Inertial Reference System (IRS) Senses movement of the aircraft

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Migrating legacy test scripts to TTCN-3

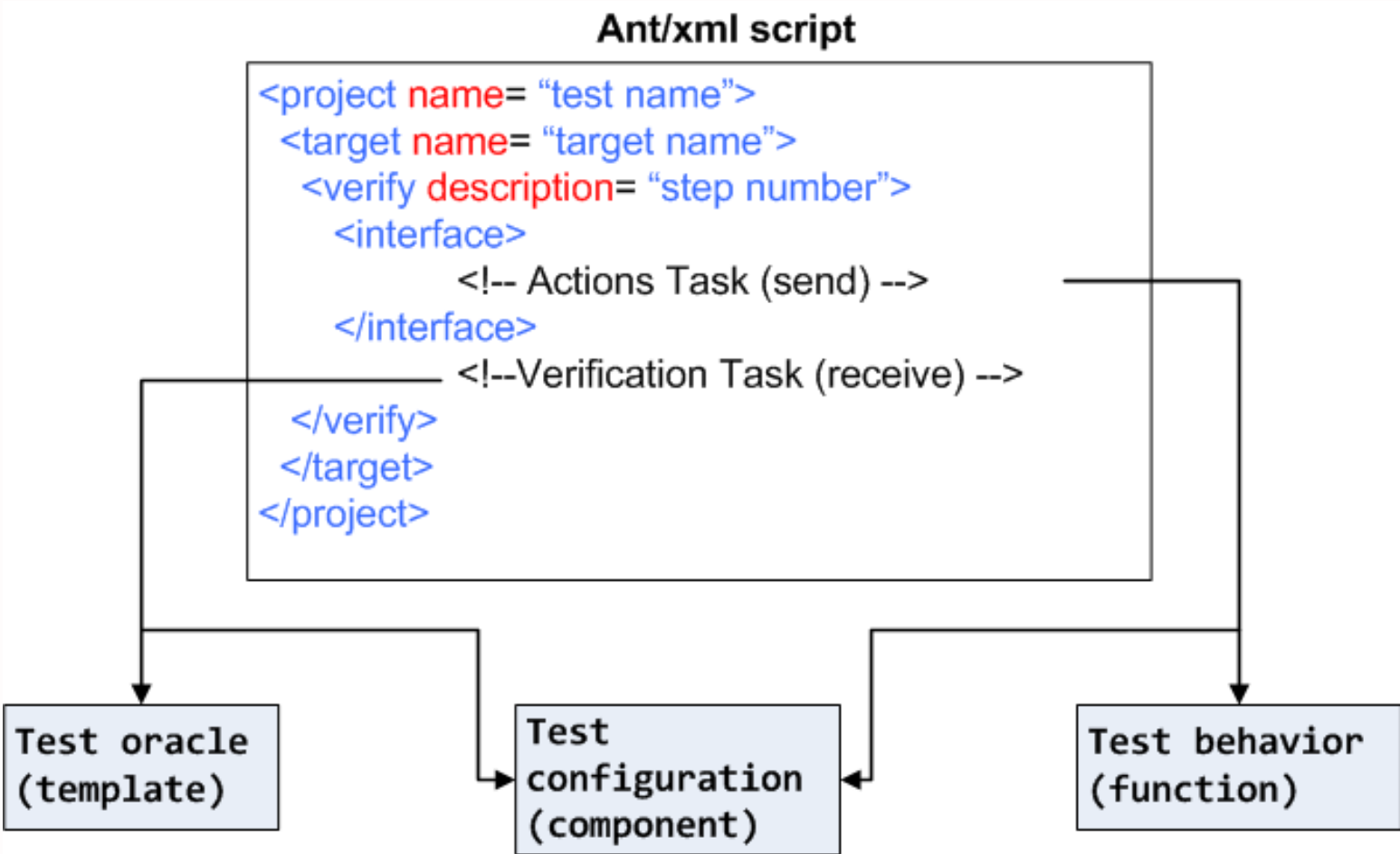20-22/10/2015

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Migrating legacy test scripts to TTCN-3

- Use a mature testing language and benefit from continuing advancement in test scripting tools.

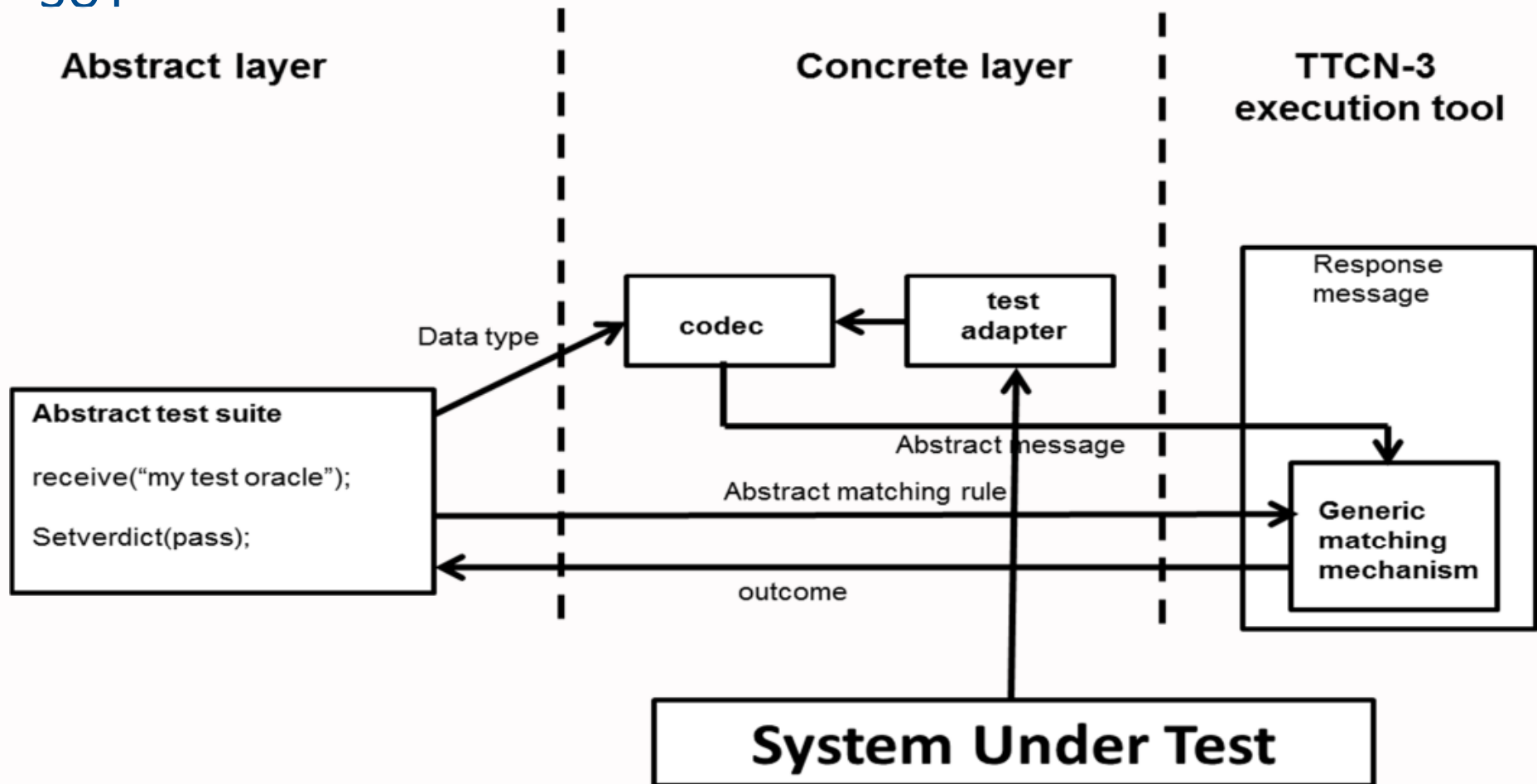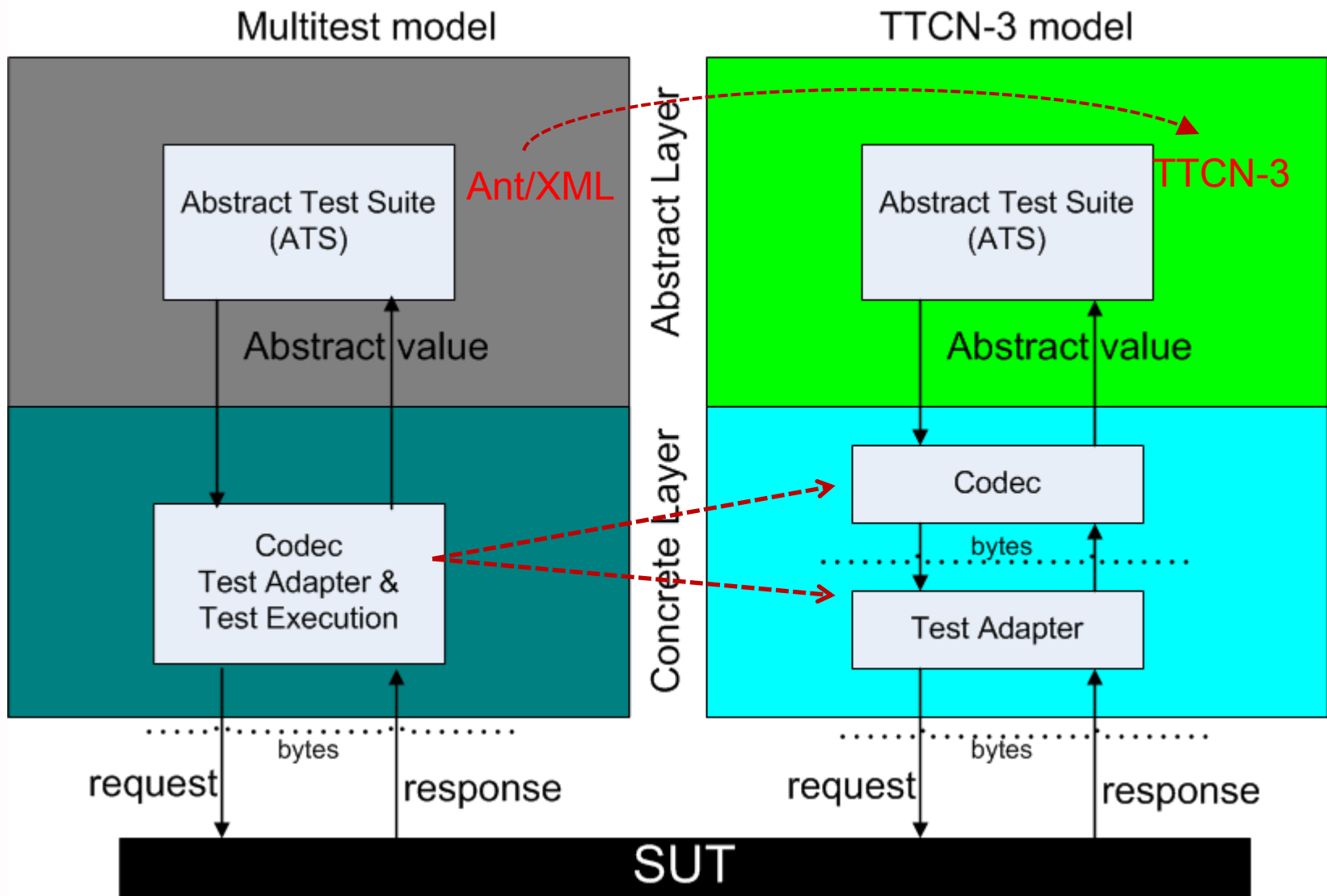**User Conference
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Migrating legacy test scripts to TTCN-3

Ant/xml script

```
<project name= "test name">
 <target name= "target name">
  <verify description= "step number">
   <interface>
        <!-- Actions Task (send) -->
   </interface>
        <!--Verification Task (receive) -->
  </verify>
 </target>
</project>
```

Test oracle
(template)

Test
configuration
(component)

Test behavior
(function)

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Migrating legacy test scripts to TTCN-3

- TTCN-3 separation of concerns processing a response from the SUT

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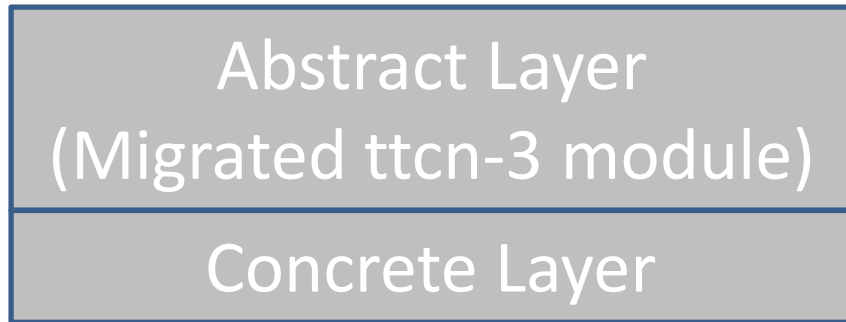**on Advanced Automated Testing**

Migrating legacy test scripts to TTCN-3

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Migrating legacy test scripts to TTCN-3

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Testing FMS using TTCN-3
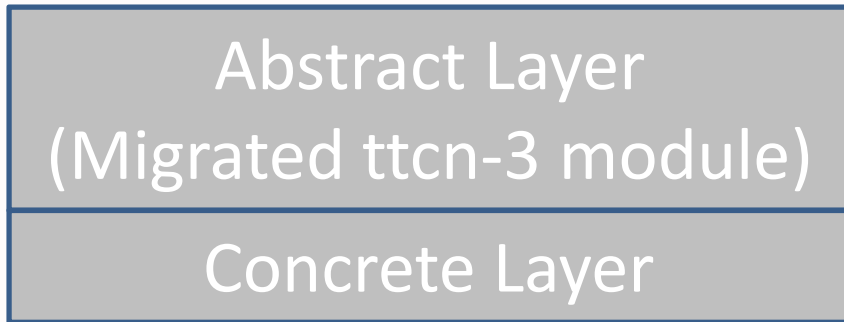
Abstract Layer
(Migrated ttcn-3 module)

Concrete Layer

Send
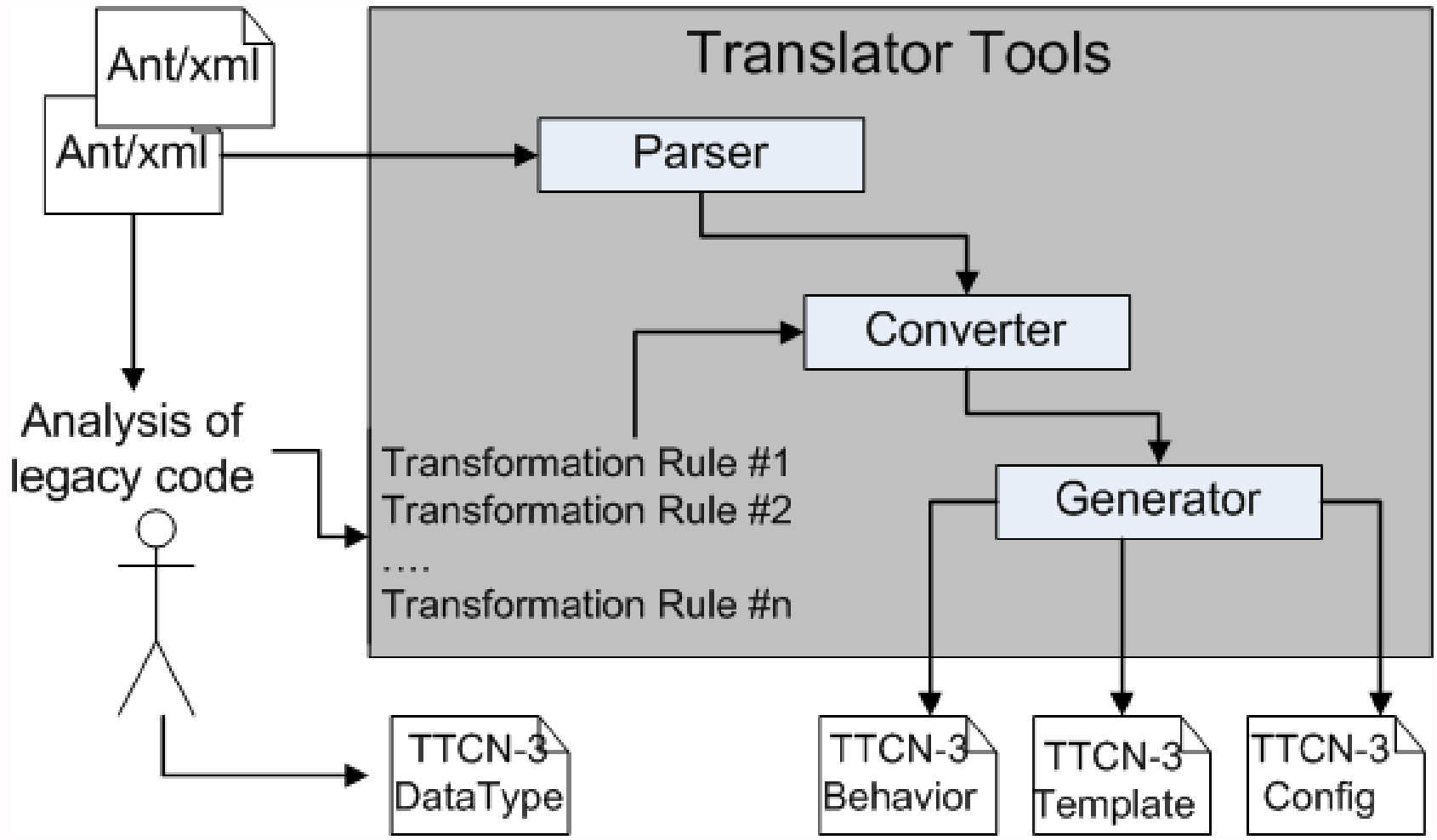
```
function check_Step_5() ... {

pressKey("LEGS");
editKey("YUL/H","1L");
pressKey("LEGS");
editKey("YMX/H","2L");
pressKey("EXEC");
pressKey("LEGS");
grabScreen();
}
```
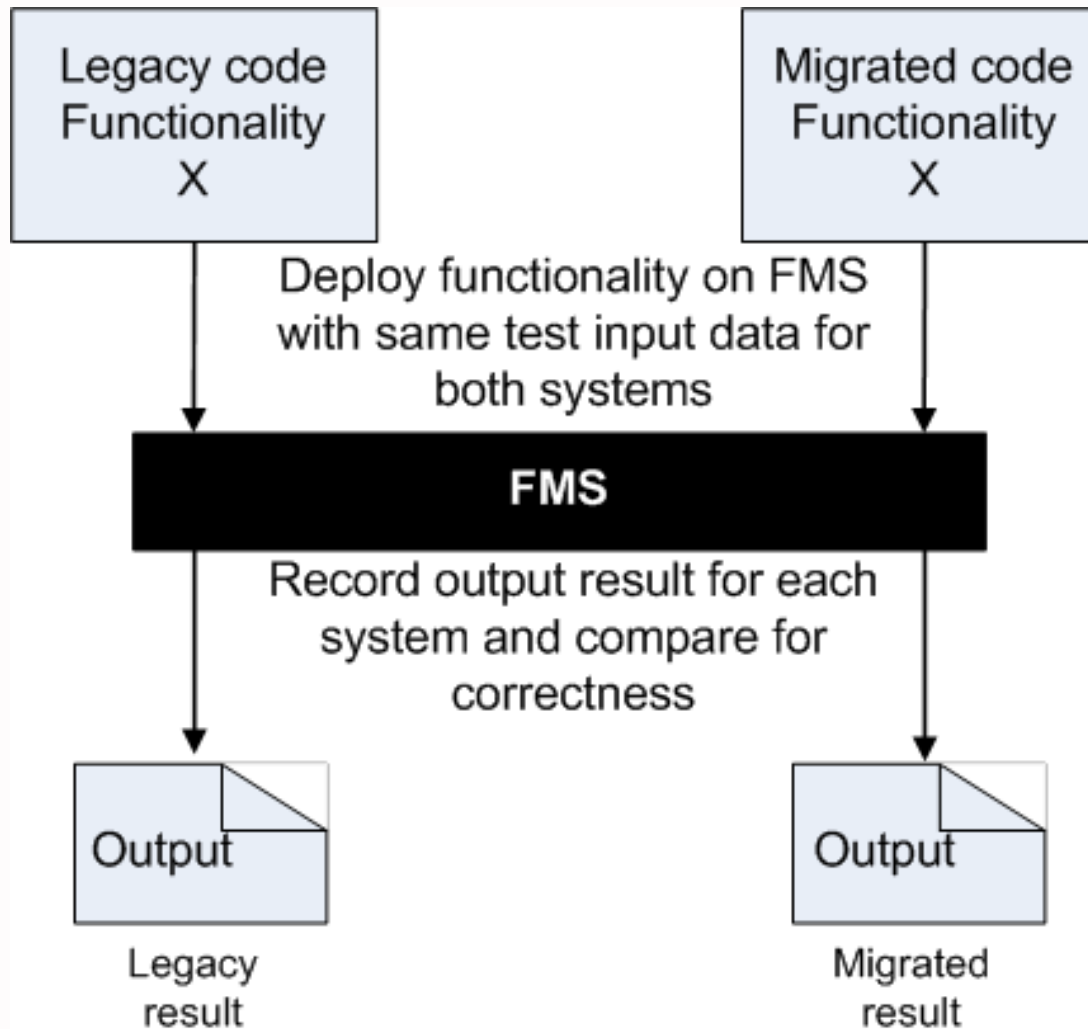
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Testing FMS using TTCN-3

Abstract Layer
(Migrated ttcn-3 module)

Concrete Layer

Receive

```
template cduPage a_Fly_LegsPageTemplate:= {
pageTitle:= " ACT RTE LEGS 1/1 ",
line_1:= {" 312$ ","YUL /h ",
" 13.0nm ",blank_field},
line_2:= {" 314$ ","YMX /h ",
" 23.5nm ",blank_field},
line_3:= {" THEN ","~~~~~ ",
blank_field,blank_field},
line_4:= {"-- ROUTE DIS","CYMX ",
"CONTINUITY -",blank_field},
line_5:= {blank_field,"----- ",
blank_field,blank_field},
line_6:= {blank_field,"{STBY RTE ",
blank_field," LEGS ETA}"},
scratchPad:= blank_scratchpad }
```

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Testing FMS using TTCN-3

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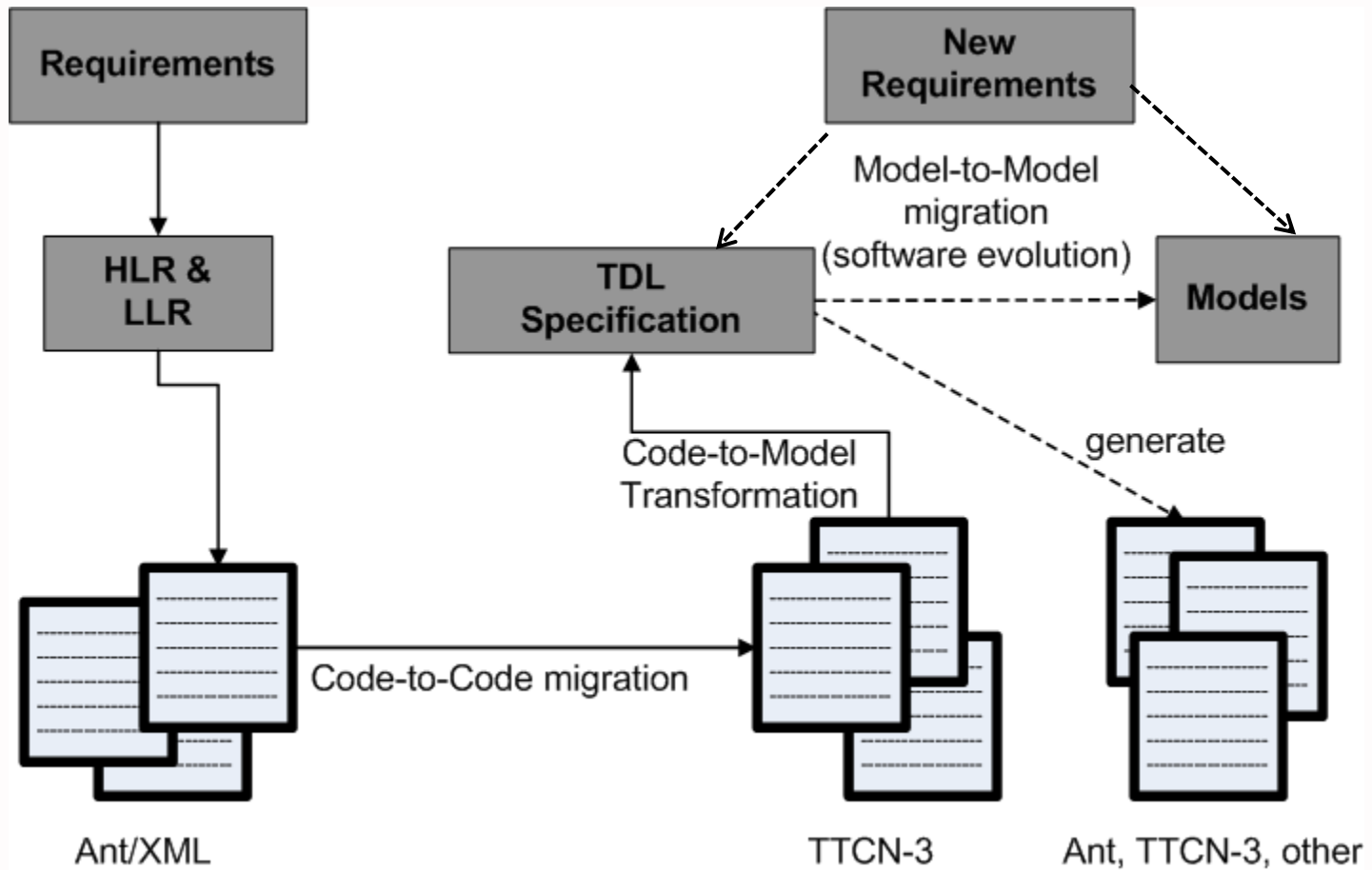on Advanced Automated Testing**

Benefit of migration to TTCN-3

- Duplication of information is reduced
  - ✓ Common Test Oracle is reused via template
  - ✓ Common Test behavior is reused via functions

- Faster execution time comparing to legacy
  - ✓ Unlike legacy, one connection is opened and shared during the execution of test case

- Error detection at compilation time
  - ✓ Strong type checking of TTCN-3

- Fewer reading request to the SUT
  - ✓ Use of templates to specify structured values

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Benefit of migrating to TTCN-3

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Summary

- Initial experiments shown that TTCN-3 has several benefits over Multitest when testing the FMS.

  Testers need to learn TTCN-3 language to prepare test cases.

- Adopt a mature and standard testing language

- Use an industry-based testing methodology to benefit from continuing advancement in modeling and in test scripting tools.

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