

MATLAB and Simulink
integrated in the DO-178c software
certification workflow
for a new Helicopter
MATLAB Expo 2021

HELICOPTERS

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AIRBUS

Introduction

OBJECTIVE

- The aim of the presentation is to describe how the **MATLAB and Simulink** capabilities can be used in the validation and verification process to satisfy the DO-178c criteria for the software certification of a new Helicopter

CONTEXT

- Efficiency improvement of High Level Requirements (HLR) Test Cases / Test Procedures definition has been identified
 - Use of a Model Based approach
 - Improve convergence on test case maturity and coverage
 - Improve the way to apply the formal verification method

Contents

- Improvement expected
- Solution
- Tools
- Results
- Advantages
- Takeaways/Conclusion

Improvement expected

Test Case elaboration

→ Current Process

Test Cases inputs are manually defined
 Test Cases outputs are computed via C code

RTRT tool is used to:

- Define Test Cases execution conditions
- Develop Test Procedures
- Compute expected outputs of test cases
- Execute tests on VMS EOC & compare outputs
- Compute code structural coverage

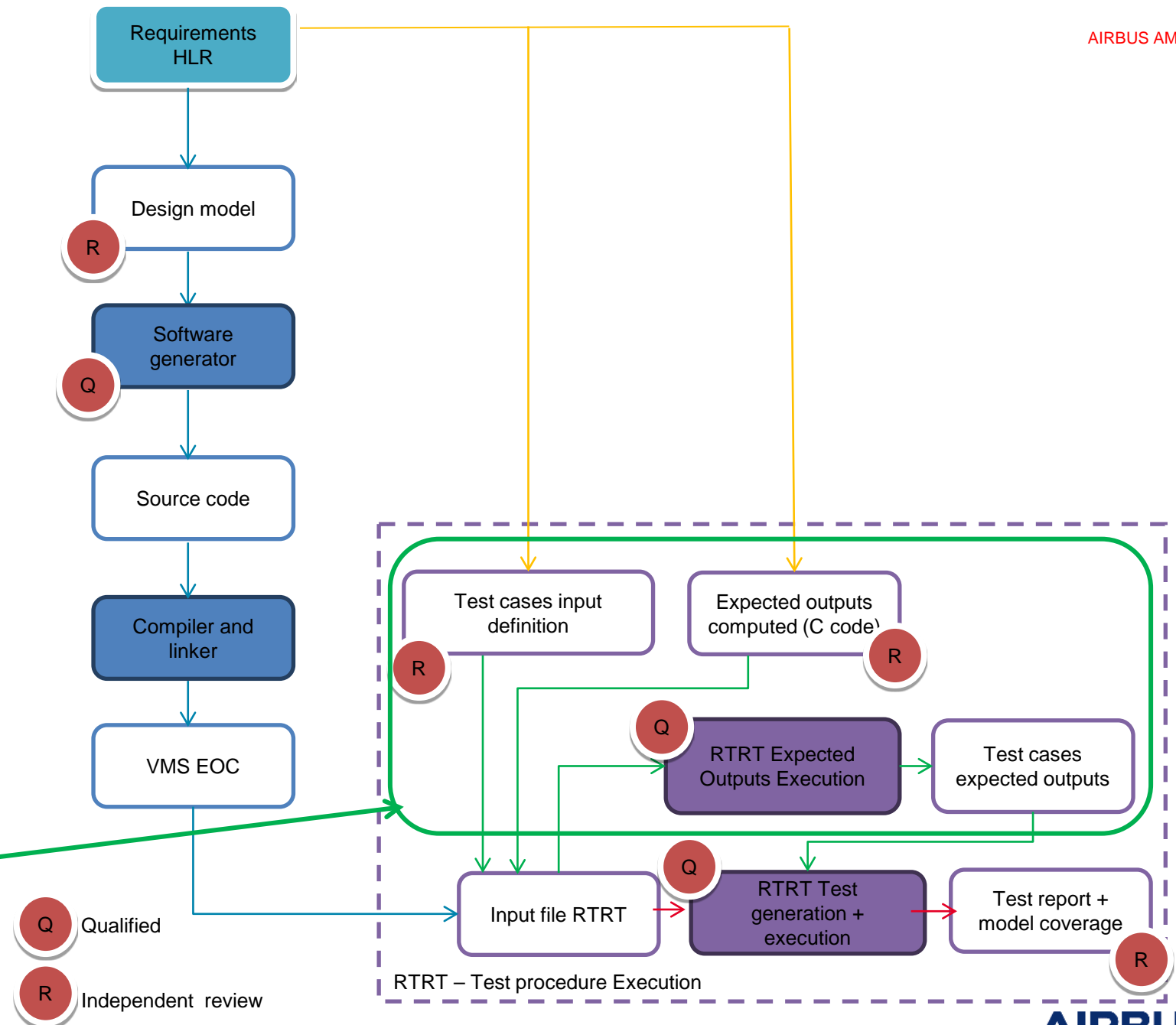
Drawbacks

High Level Test (HLT) C code like definition:

- Requires specific software skills for testing team
- No more adapted to system team way of working

Improvement:

The expected improvement is to automate the inputs definition and the expected outputs generation



Solution

MATLAB & Simulink solution (1/3)

- The MATLAB & Simulink environment contains features for verification method improvement :
 - The requirements (behaviour and data) were developed in a model-based design using Simulink.
 - The test cases creation and execution conditions were developed with a “Test sequence” Simulink tool.
 - Saving of the test cases inputs and expected outputs is automated with MATLAB scripts.

MATLAB & Simulink solution (2/3)

The MathWorks tool suite is introduced to

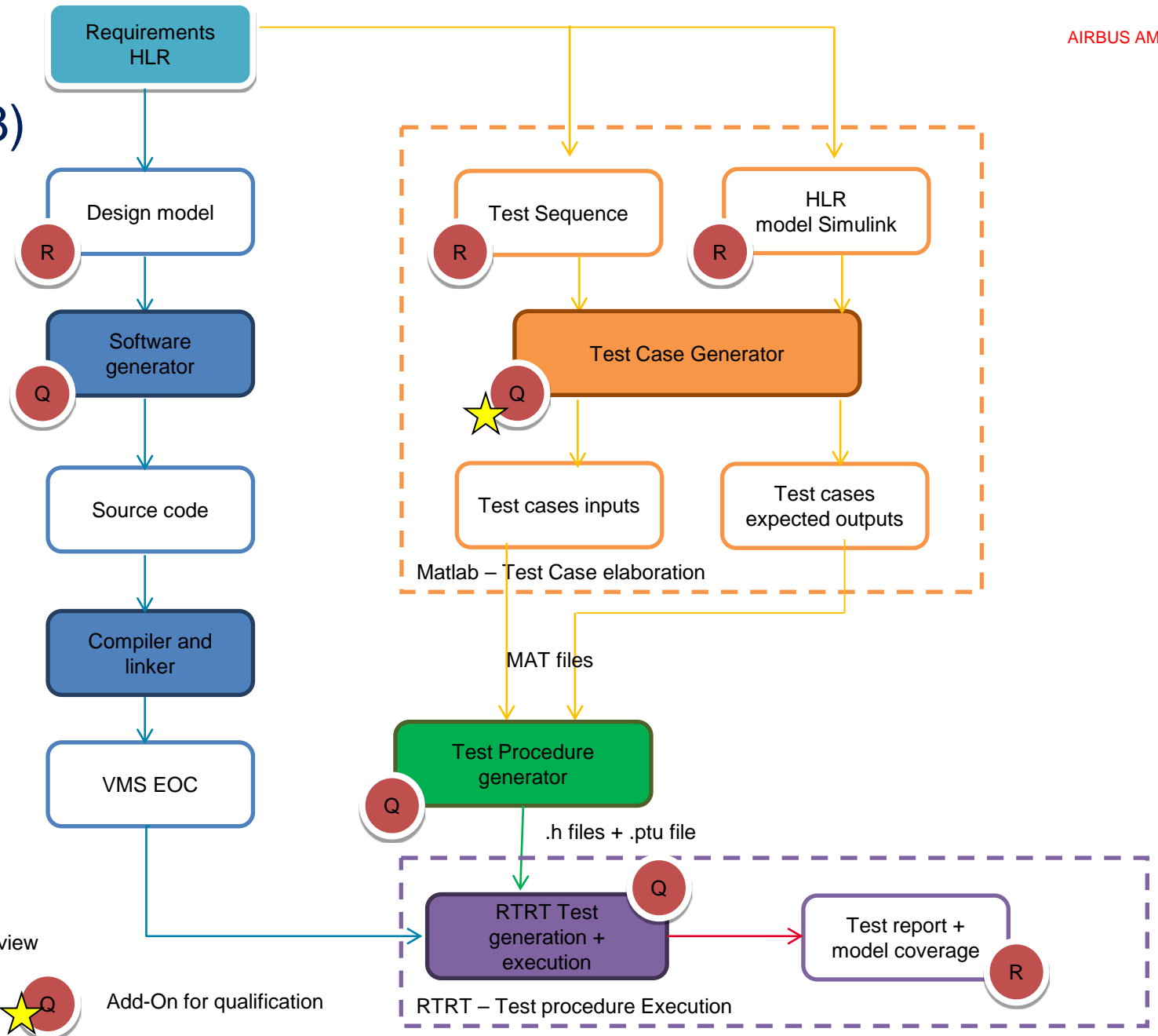
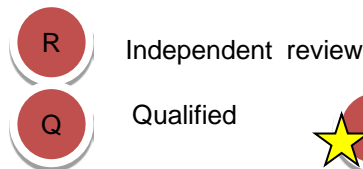
- Model HLR Requirement
- Model Test Cases execution conditions
- Mature and generate Test Cases inputs
- Generate Test Cases expected outputs

When Test Cases are mature & complete, Independent review is performed

Test Cases are translated into Test Procedures

RTRT execute the test procedures & compare expected output, & compute structural code coverage

★ Qualification add-on and toolkit was provided by MathWorks Consulting team at start of project



Tools

MathWorks Tools

- The MathWorks tools used for the verification method improvement are :
 - **MATLAB & Simulink R2017a**

With additional toolboxes :

- **Simulink Test**
- **Simulink Requirements**
- **Simulink Coverage**
- **Stateflow**

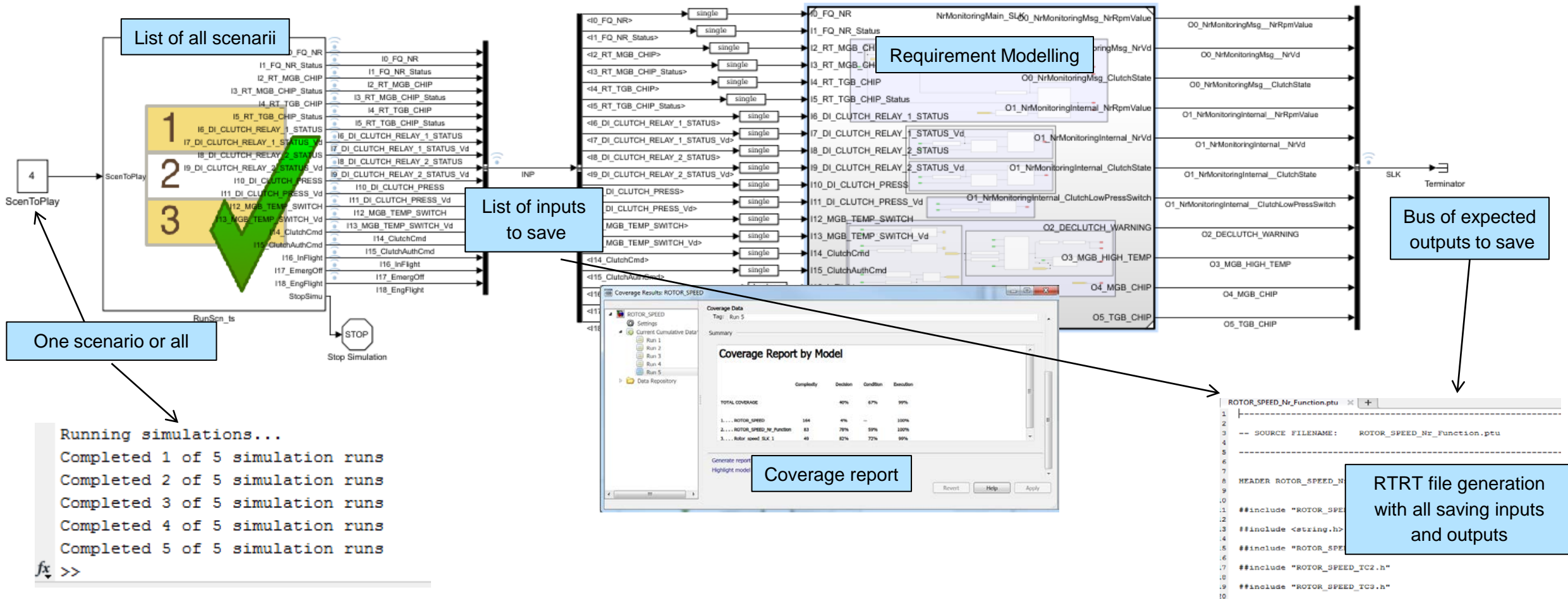
With add-on :

- « Test Sequence » qualification toolkit developed and delivered by the **MathWorks Consulting** team

Results

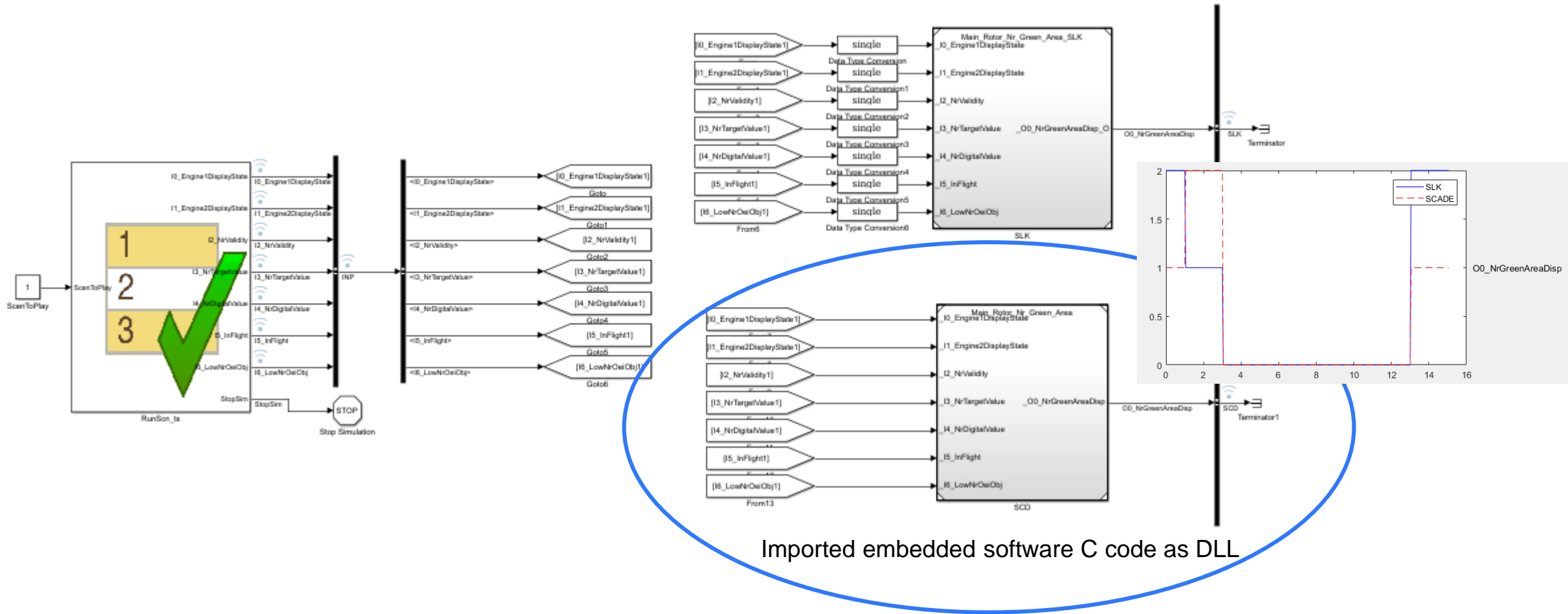
MATLAB & Simulink results (1/2)

- The main Simulink model is made of a Test sequence block and a subsystem containing the design model (Run by script):



MATLAB & Simulink results (2/2)

- Co-simulation (Embedded software Vs Simulink model) can be done and displayed with graphical interfaces to check mismatch :



Advantages

MATLAB & Simulink advantages

Early validation of test cases maturity and coverage can be performed by using the MathWorks tool suite

- HLR Model Simulink can be simulated
- Co-simulation with embedded software:
 - Improve discussion between System Design Responsible and Vehicle System team,
 - Improve early identification of discrepancy between embedded software and HLR

Nota : In classical process, it was difficult to identify if failed result is due to scenario issue or « C code » issue.

HLT Test Case development performed with a **familiar tool** to Vehicle System Engineers allows :

- No specific software coding skill required
- HLR Model is reviewed by System Engineers

Quick update of models and scenarii at each requirement modification or update

All scenarii, coverage and procedure generation **run in one click**

Takeaways/Conclusion

Conclusion

- The **MATLAB and Simulink** capabilities can be used in the validation and verification process to satisfied the DO-178c criteria for the software certification for a new Helicopter
- Proven efficiency for test model validation and therefore HLR maturity
- This new process allows to accept more software changes with low validation and verification impact on the Host

Great thanks to MathWorks team :

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Thank you