

MATLAB EXPO 2018

DiSTERaP

Distributed Simulation Test Environment for
Rapid Prototyping

Nazario Tancredi



Distributed Simulation Test Environment for Rapid Prototyping



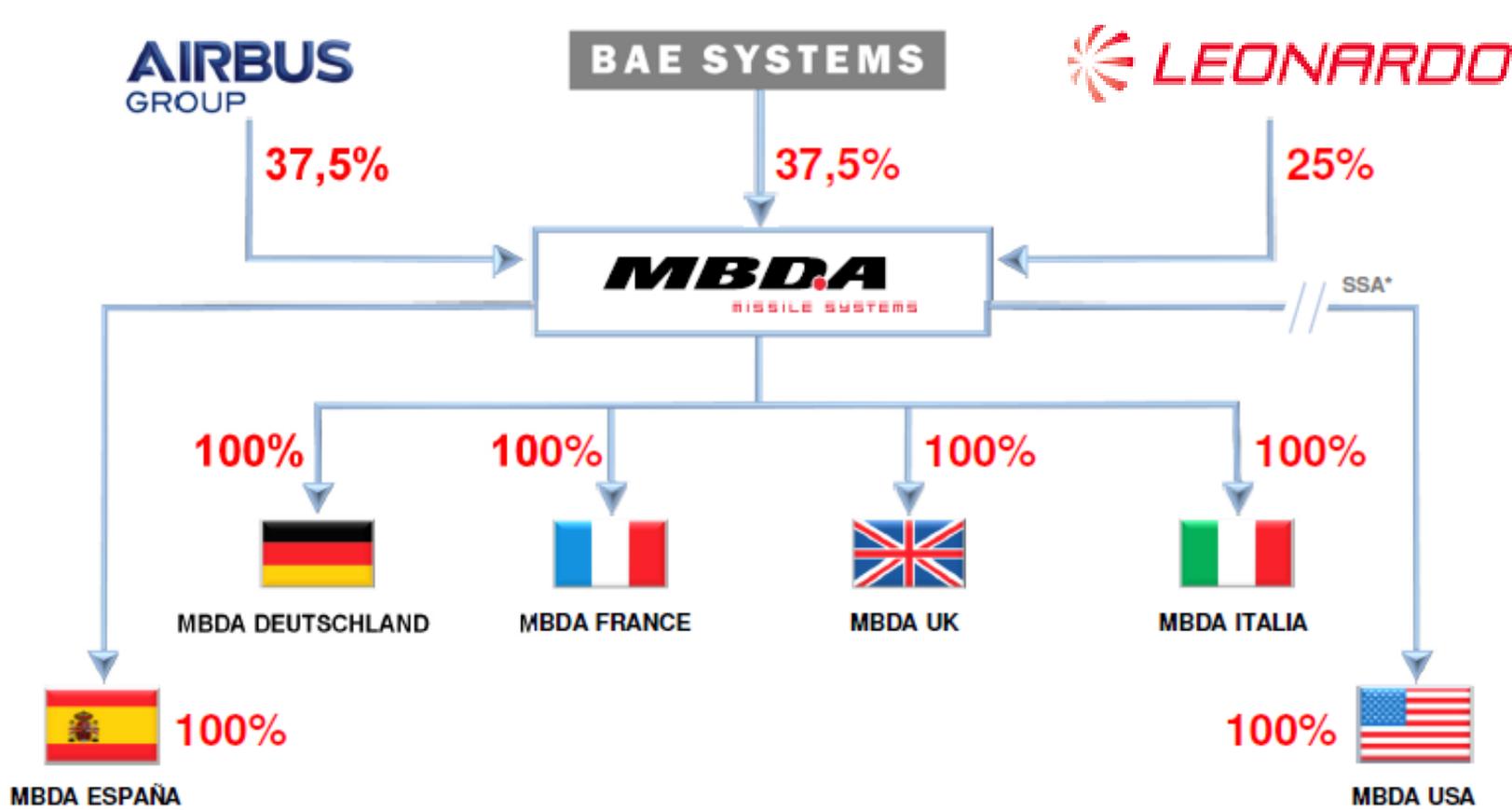
Nazario Tancredi

System Engineer. Simulation & Modelling Practitioner

Missile Dynamics Italy. Simulation & Modelling

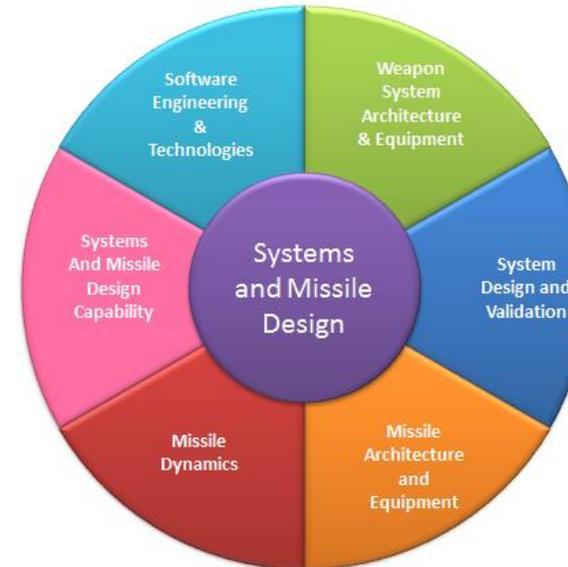
MBDA Italy

31/05/2018



Development and production of Full Missile System

ENGINEERING DEPARTMENT



SIMULATION AND MODELLING

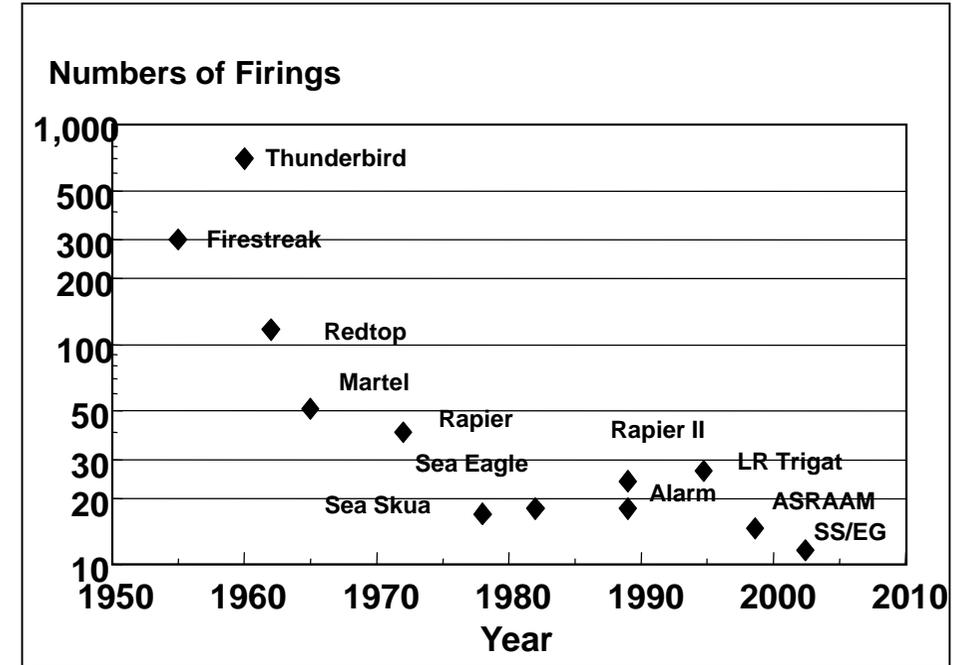
To create and analyze a Missile and Missile System physical model to

- *Flow down requirement*
- *Code Generation*
- *Missile and Missile System Performance Evaluation*
- *Rapid and Robust prototyping*

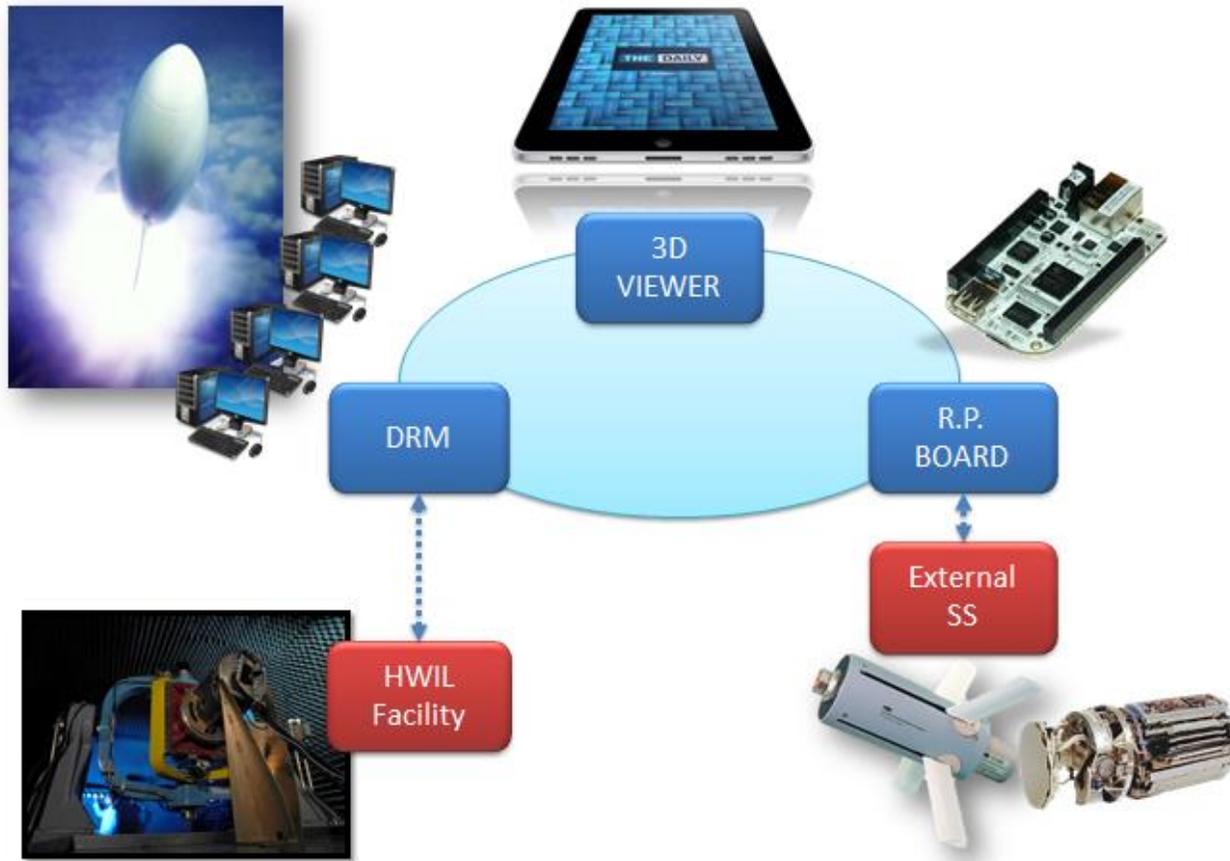
- To help in understanding the structure and behaviour of the system
 - To help in designing the system before we commit to building it
 - To understand product behaviour (both desirable and undesirable)
 - To help in trade-off studies
 - To help in developing specifications
 - To help in product integration and testing
 - To help in planning trials
 - To help in training in the use of the system
 - To help quantify system performance
 - To help in demonstrating that we have met the customer requirements

– To help quantify system performance
 – To help in demonstrating that we have met the customer requirements

- To help in specifying, developing and proving software to be developed for the system
- To understand the performance of the system in scenarios where we cannot do trials, for example:
 - What is the probability of survival of a ship?
 - Will a faulty missile hit the launch aircraft?
 - What is the system performance in heavy countermeasures?



Distributed Simulation Test Environment for Rapid Prototyping



To have
a *distributed simulation* architecture
to support
the *rapid development*
and the *testing*
of *future missile systems*



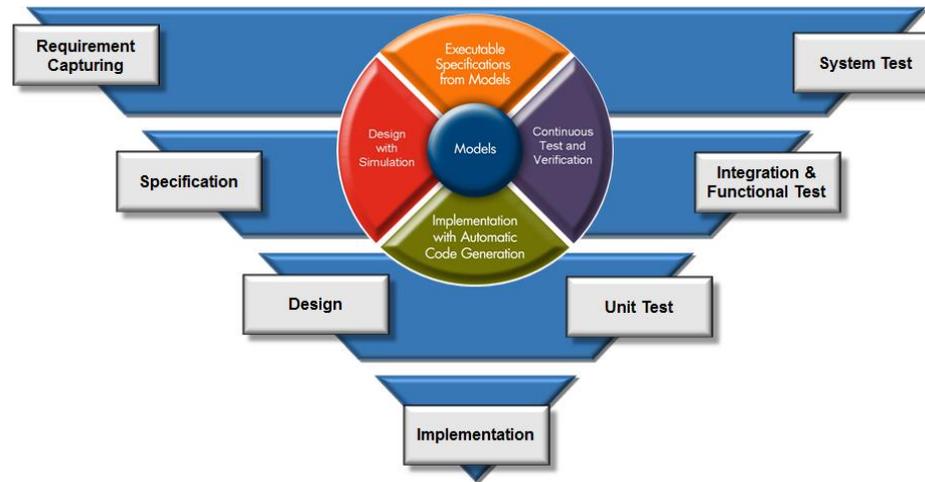
MBD-A Model-Based Design Approach

All in one Simulation

GOLDEN MODEL

Trade Off Analysis

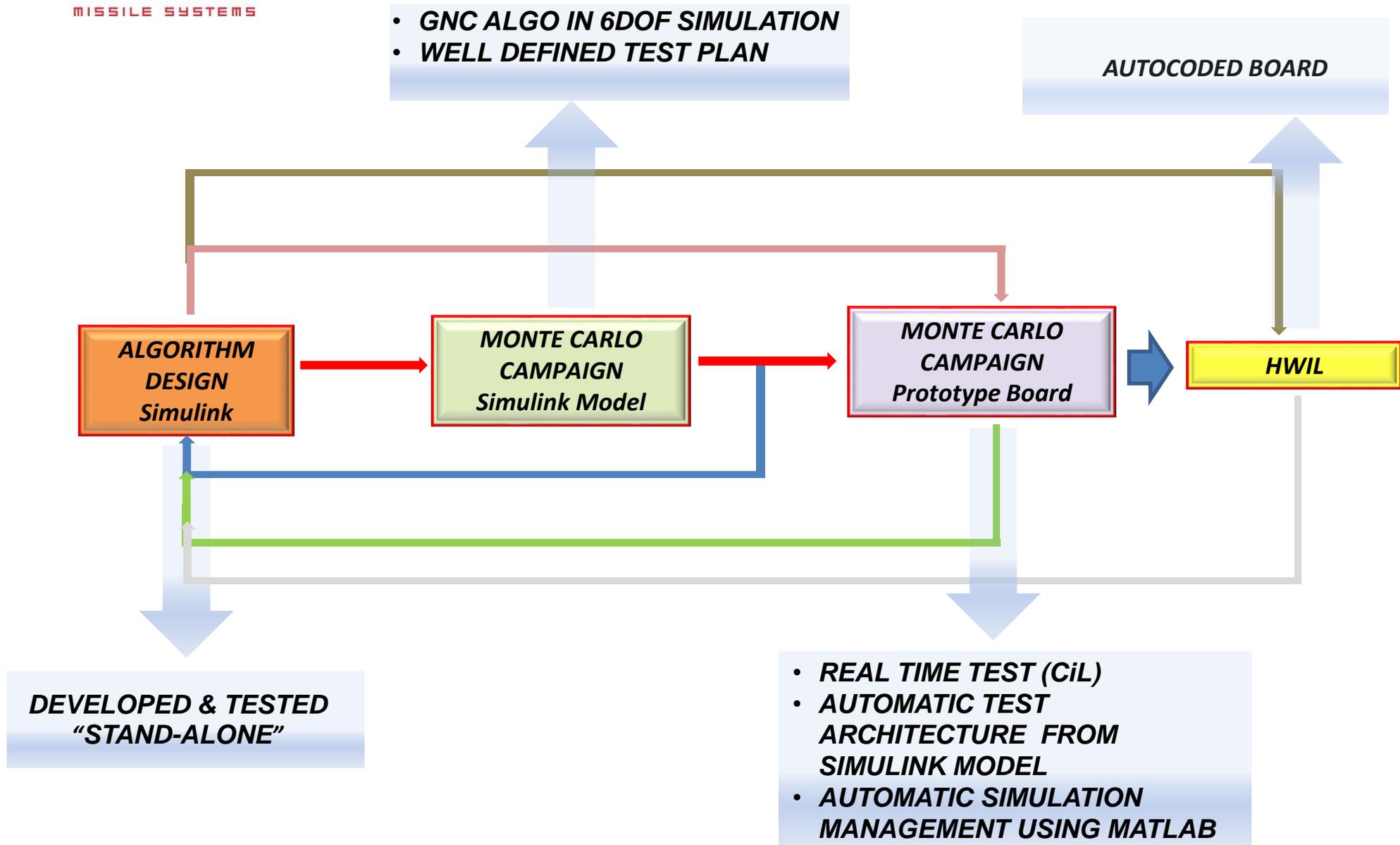
Performance Evaluation

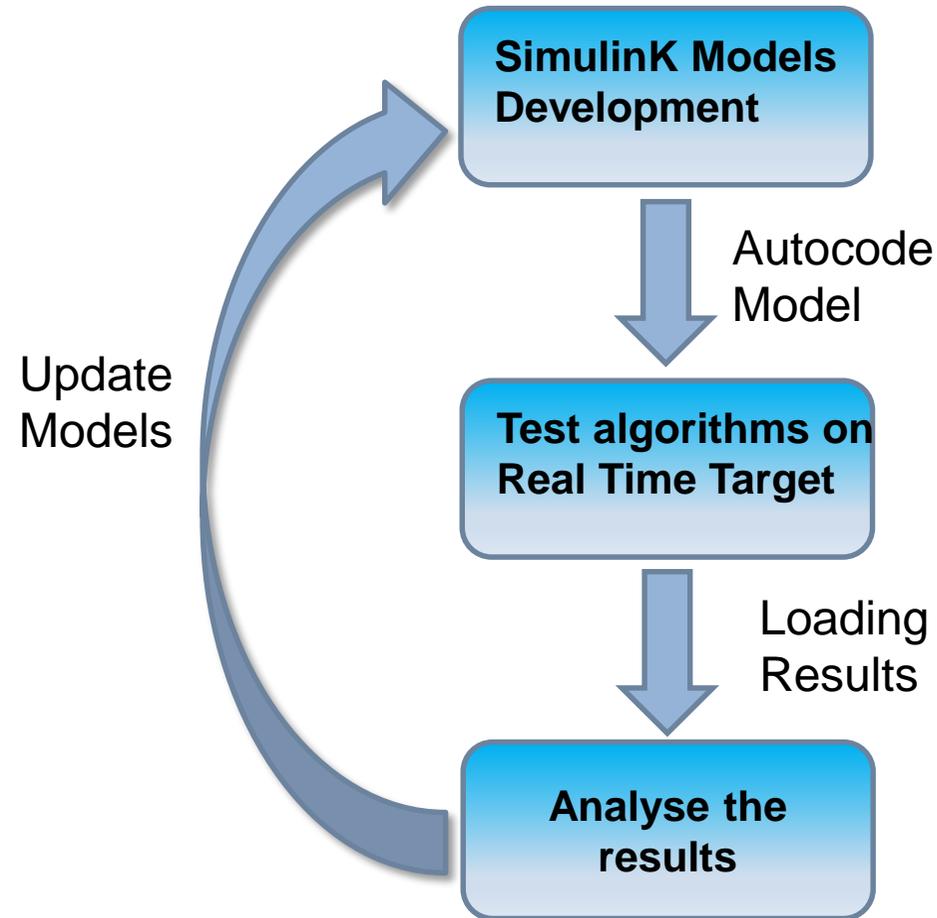


Real-Time MC Analysis

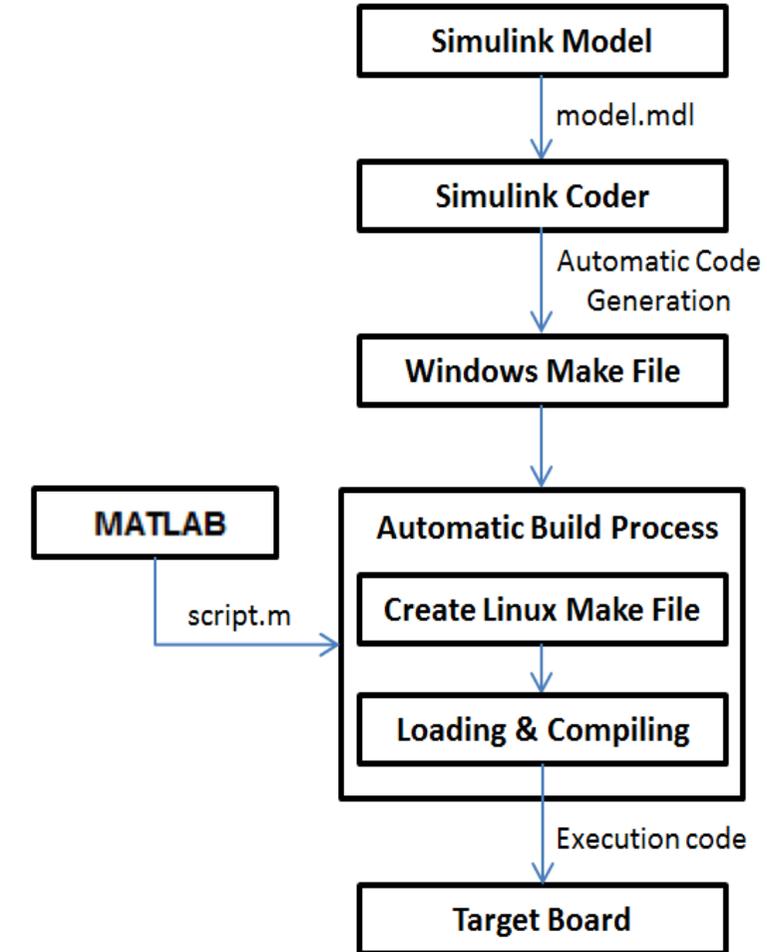
Code Generation

WCU
Prototyping





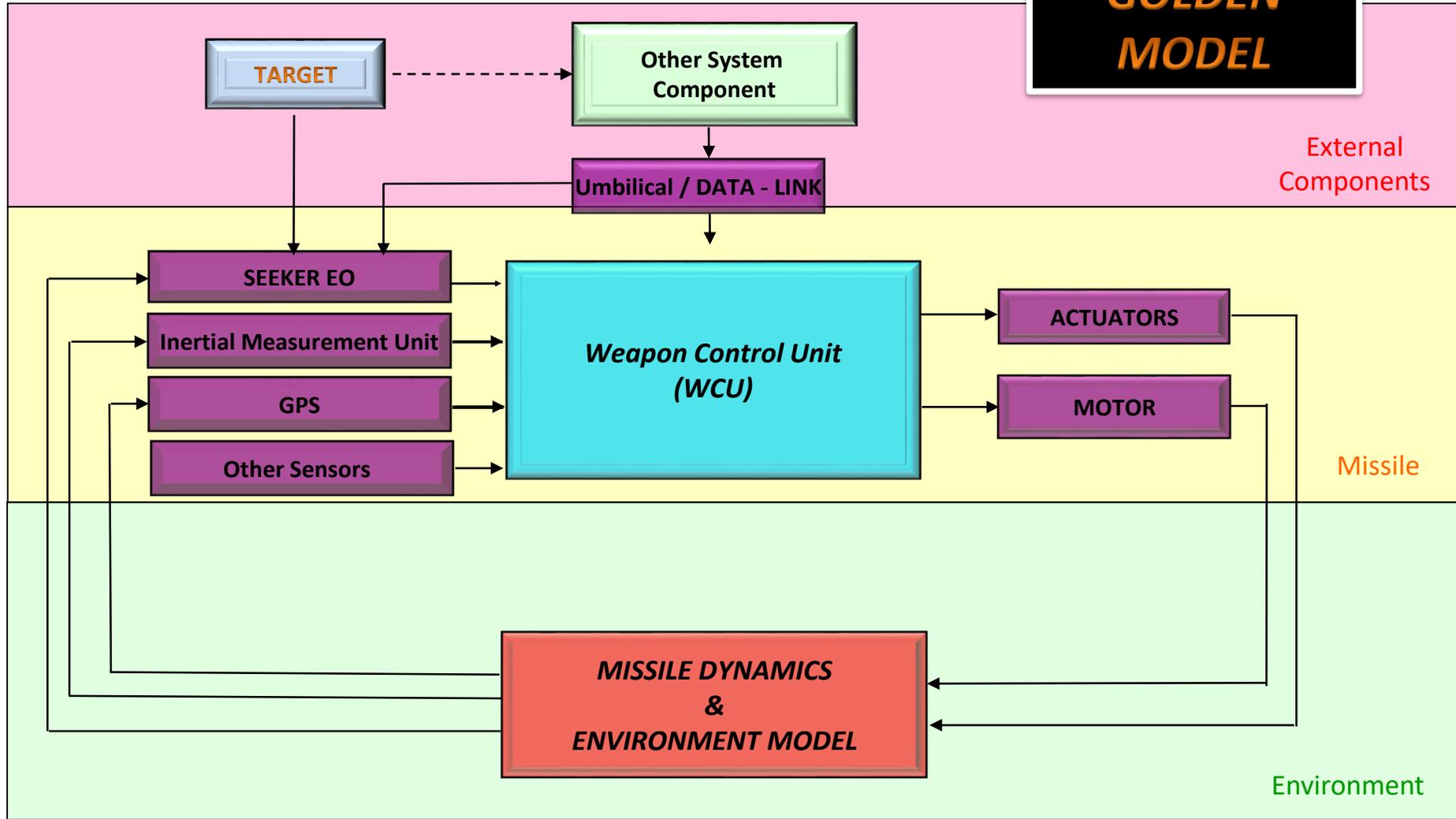
- System Engineer develops the Models in *Simulink*
- Generate C code, from the Model, in automatic mode
- Test the algorithms on Real Time Target
- Analyse the results and update the models if it is necessary
- Repeat the process as far as will be obtain satisfactory results



Example of Missile Simulation

MiL

GOLDEN MODEL

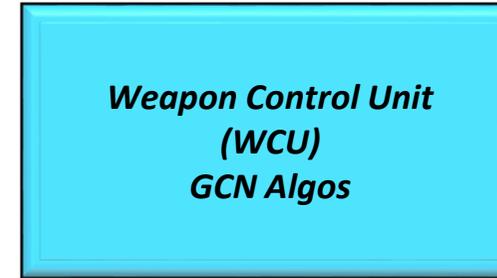
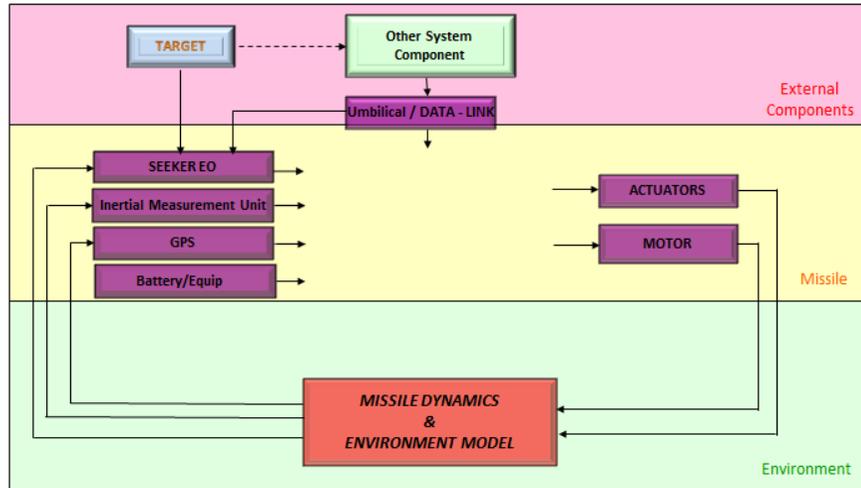


External Components

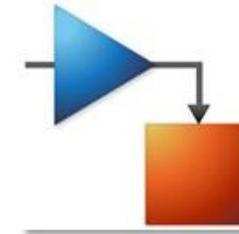
Missile

Environment

Guidance Navigation and Control algorithms performance evaluation in simulation (MiL – Model in the Loop)



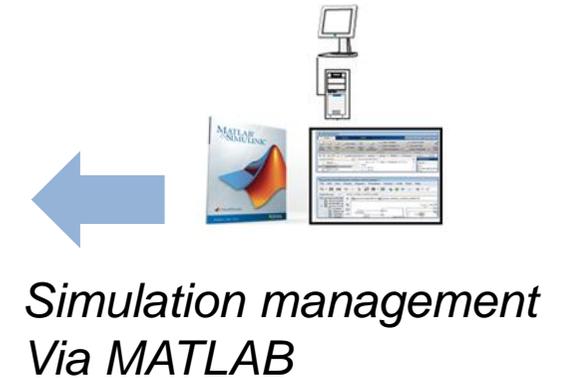
Simulink



Auto-coded using Embedded Coder (DiSTERaP Approach)



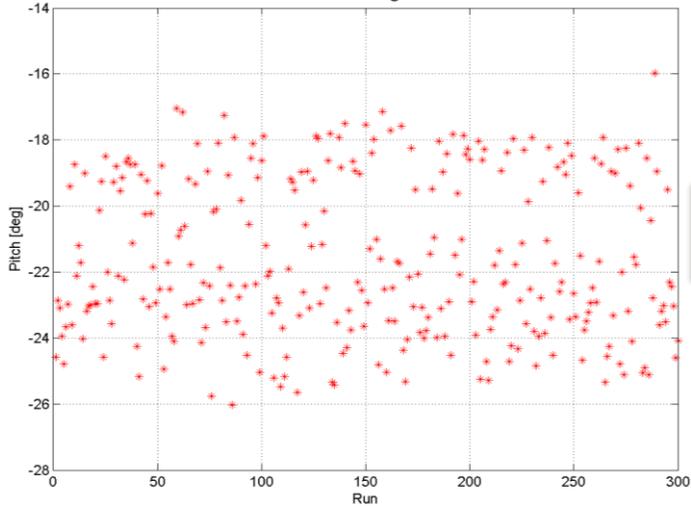
Real Time execution



Guidance Navigation and Control algorithms performance evaluation on WCU prototype (CiL – Computer in the Loop)

Full Simulink

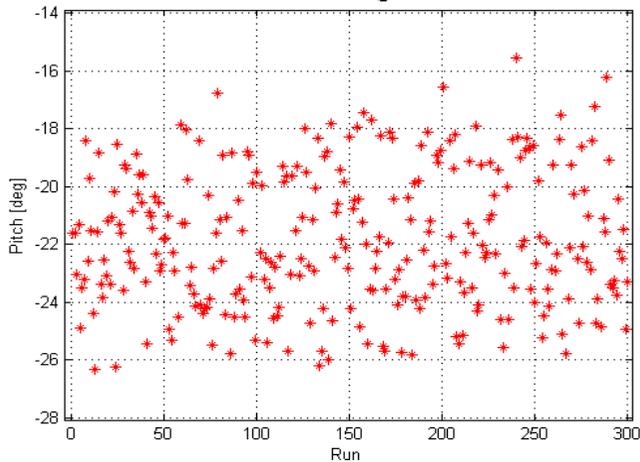
Pitch at Firing Point



MiL

Real-Time CiL

Pitch at Firing Point



CiL

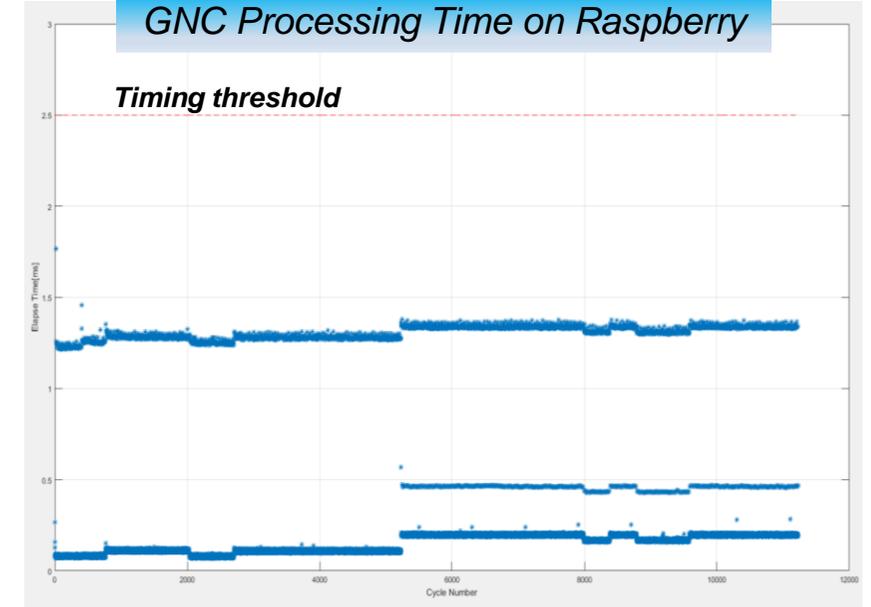
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A. GCN Algorithms performance evaluation directly on prototype of WCU made in the first phase of design

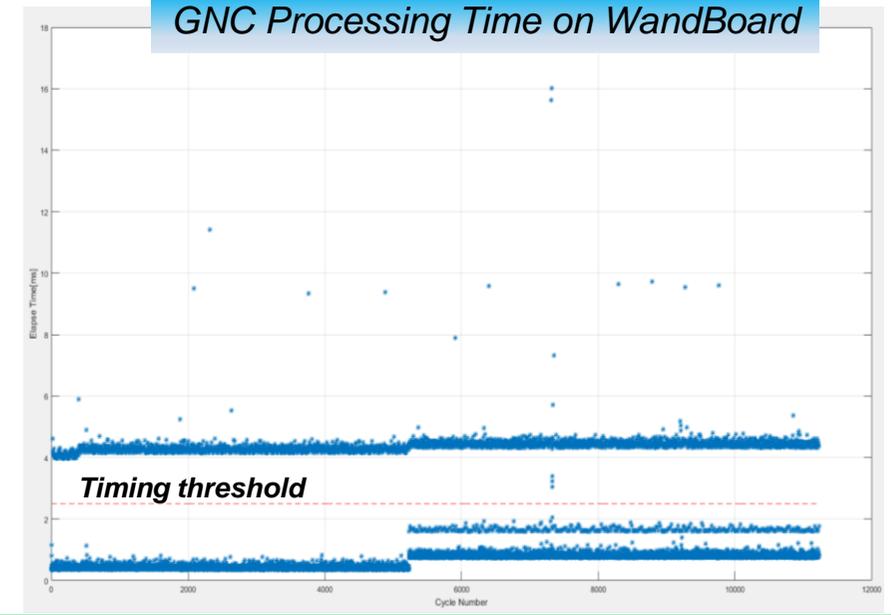
RAPID ON BOARD ALGORITHMS PERFORMANCE EVALUATION

B. GCN Algorithms performance evaluation directly on different HW with comparison purpose

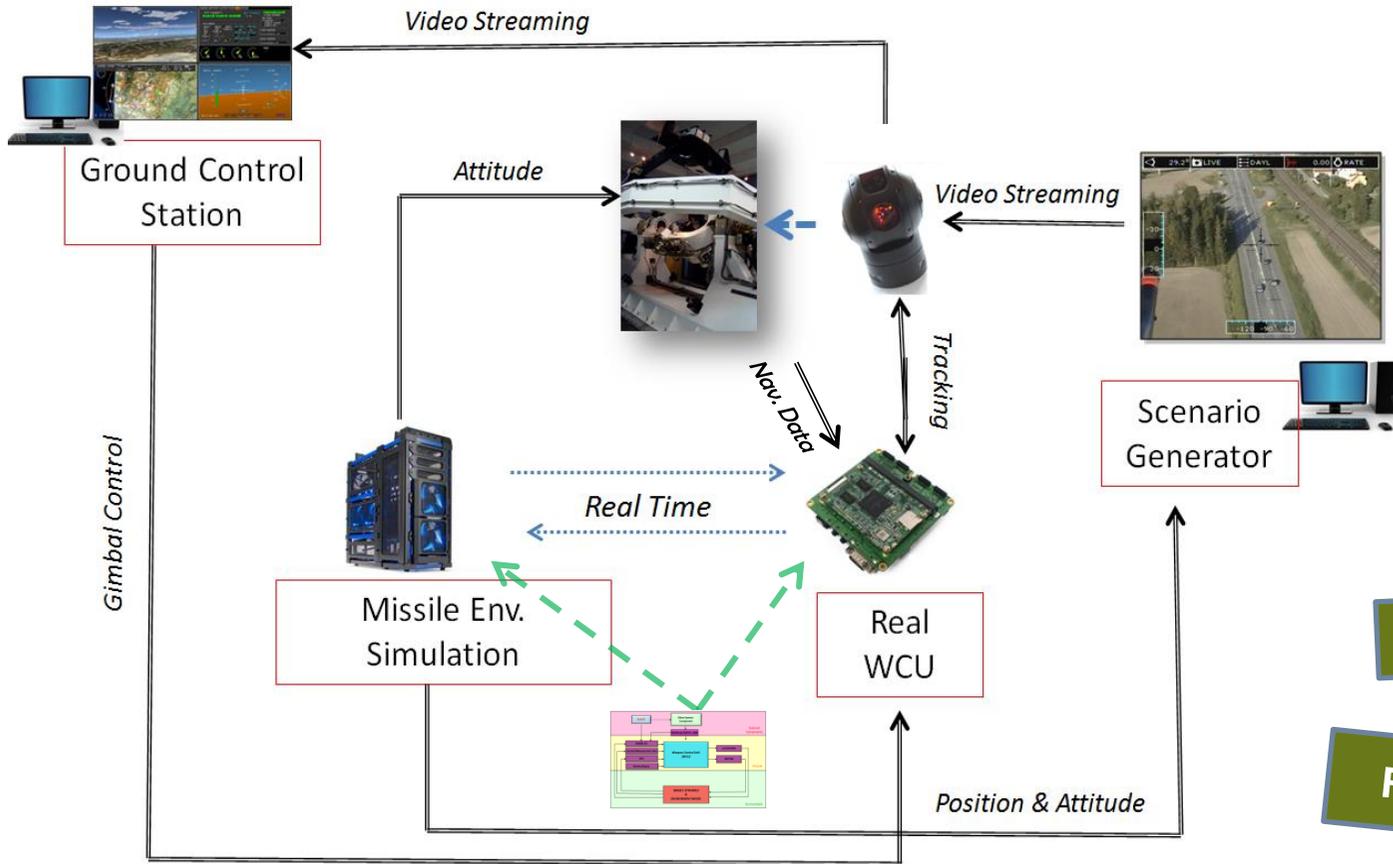
GNC Processing Time on Raspberry



GNC Processing Time on WandBoard



HWIL

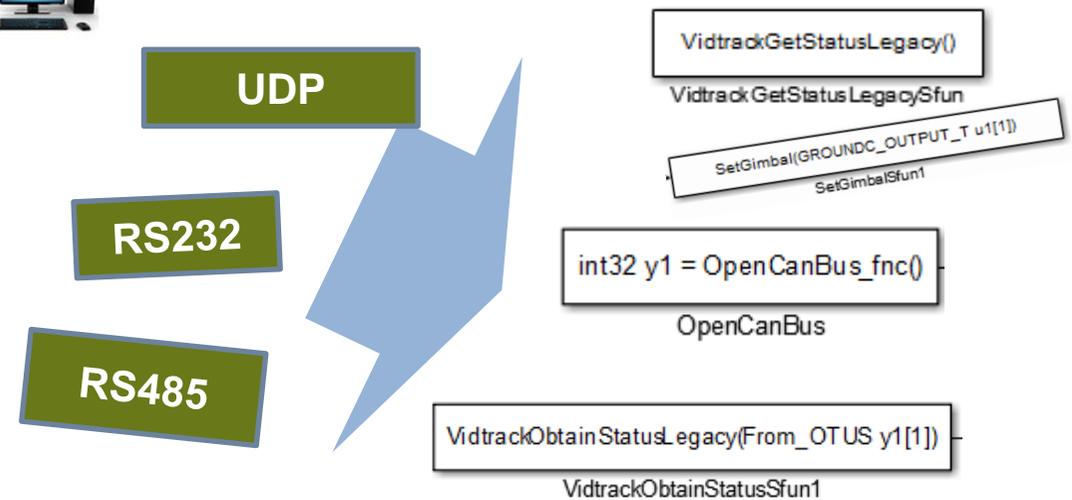


Communication with Real-Time Computer

- Receive
 - ✓ Simulation Equipment Bus (LRF, IMU, GPS)
 - ✓ Simulation Umbilical & Data-Link Messages
- Send
 - ✓ Seeker / Motor on
 - ✓ Wing Deflection

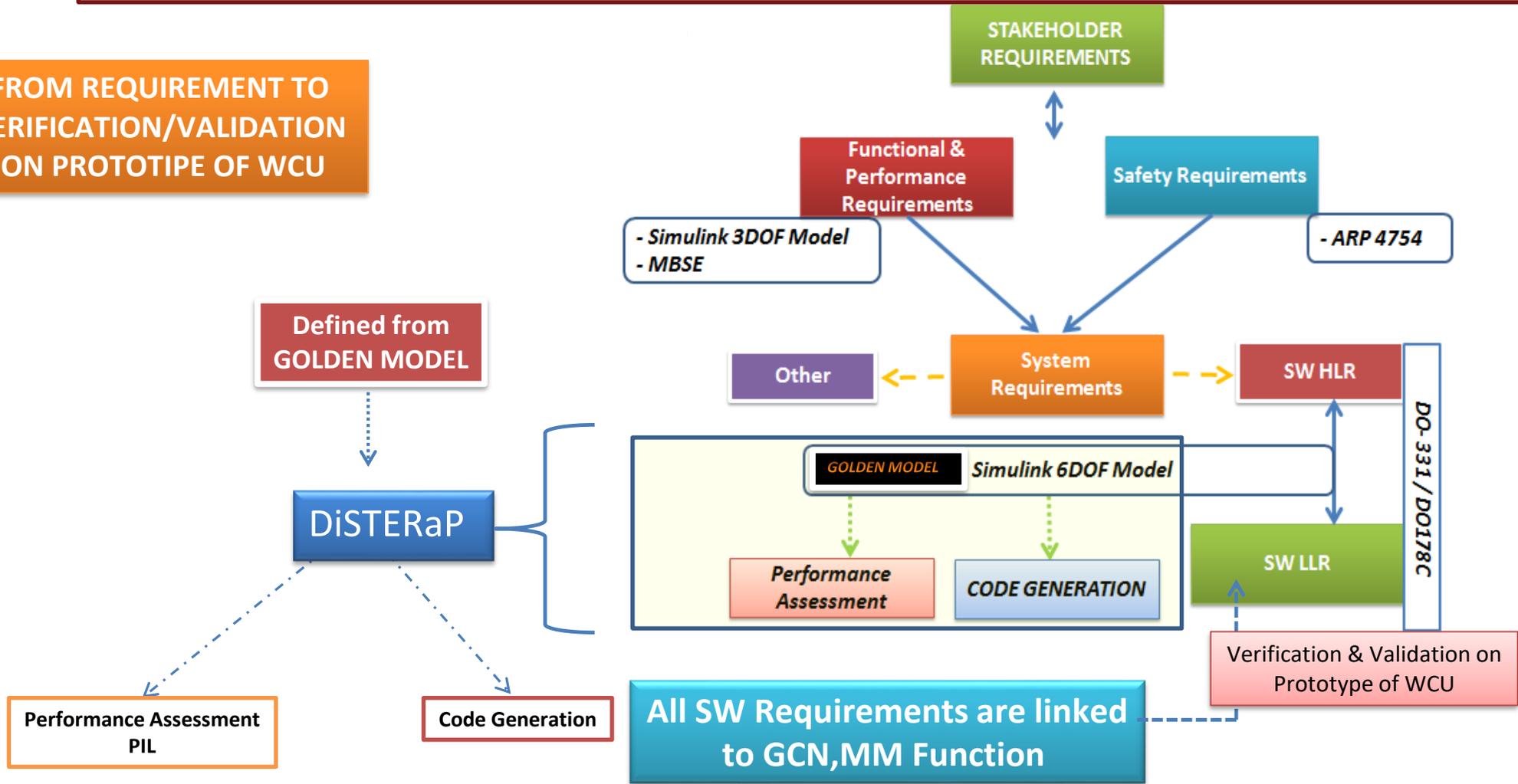
Communication with Gimbal

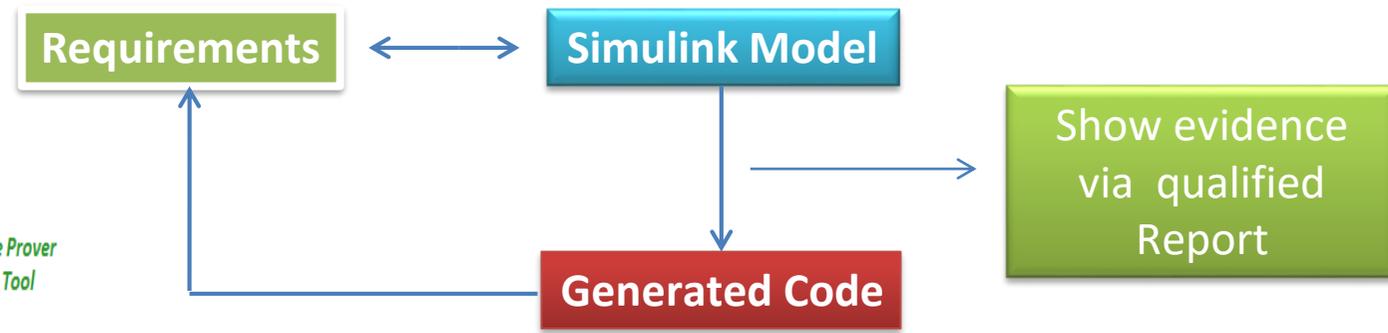
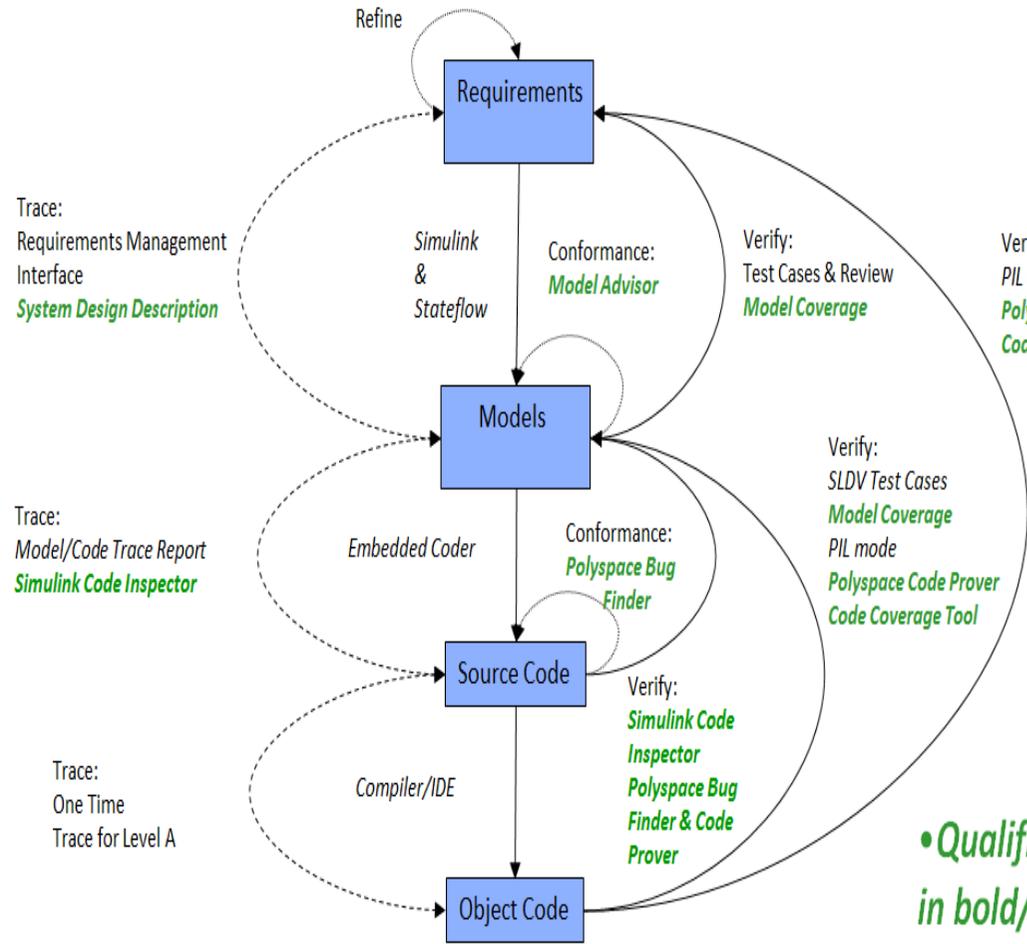
- Receive
 - ✓ Tracking Message (on-call)
 - ✓ Gimbal Status
- Send
 - ✓ Set Mode / Set Position



DiSTERaP and DO178C Certification Process

FROM REQUIREMENT TO VERIFICATION/VALIDATION ON PROTOTYPE OF WCU





Code Certification:

- Pass through different stages
- Provide evidence of compliance with specification and standards
 - ✓ For each stage a certain number of certified document will be produced



Provide evidence that used SW and HW are certified: Qualification Plan

• Qualified tools are in bold/color

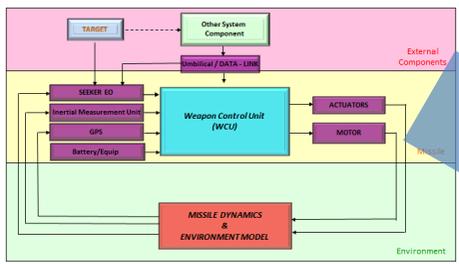


Evidence via generated reports

SUMMARY



SIMULINK 6DOF SIMULATION



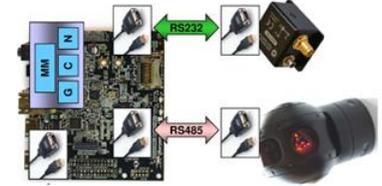
- *Development Algorithm*
- *Performance analysis*

On Board Computer ARM Processor

GCN ALGOS



HWIL TEST

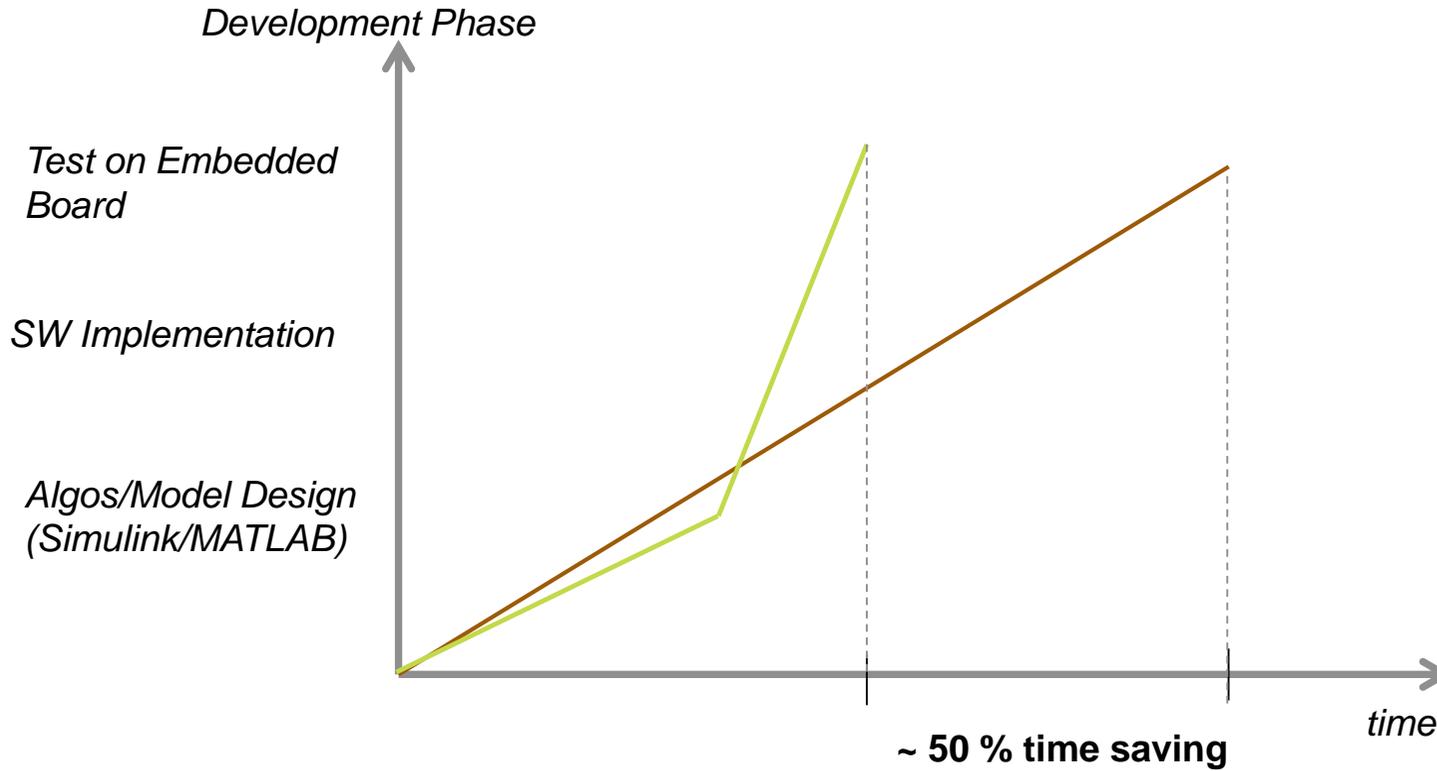


- *Prototype of final WCU*
- *ARM Processor*
- *POSIX Library OS*

- *IMU*
- *Seeker*
- *Actuator*
- *Motor*
- *... Equipment*



Next Step: Validate «on Flight» WCU fully developed using DiSTERaP Approach

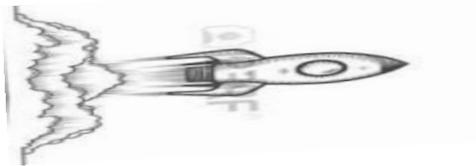
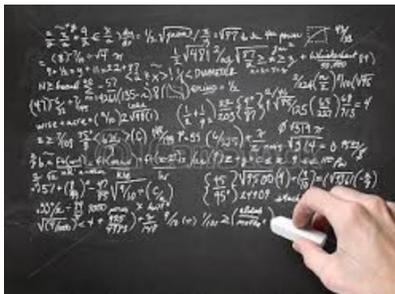


ADD:

- Robustness to design: GCN Algorithms development considering HW performance

REDUCE

- V&V Time
- Time to market



Key Takeaways

1. Models established as golden reference companywide
2. Time-consuming programming tasks eliminated
3. Simulations and analysis accelerated

USE OF «GOLDEN MODEL» AS A KEY DRIVE FACTOR IN YOUR DESIGN,
IN FULL PRODUCT DEVELOPMENT PHASE

Thank
you



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MISSILE SYSTEMS

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