



Air  
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Innovation. In all domains.

# **Modeling and Simulation in Support of T&E**

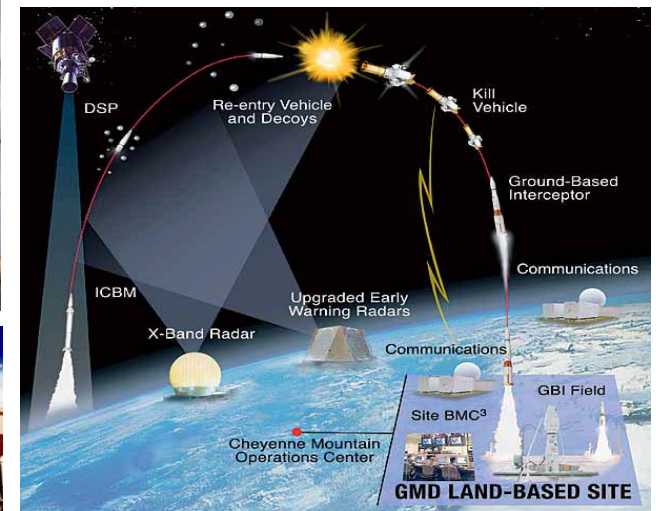
## **Physics-Based Modeling & Simulation in Support of T&E Requirement Panel**

**NDIA National Test & Evaluation  
Conference**

**Gary A. Ross  
15 March 2012**

# Overview

- Models and Simulations (M&S) are essential tools throughout the entire life-cycle of product development
- M&S are essential tools for:
  - Element Engineering
    - Requirements & Algorithm Development
    - Design Prototyping
    - Requirements Verification
  - Operational Planning
  - Flight Test Pre-Test Analysis
  - Post Flight Reconstruction (PFR)
  - Performance Assessment (PA)



**Vital Use Cases Drive Evolving Need For Simulations as Deliverable Products**

# All Programs use Modeling and Simulation

- Digital (All Software), Processor-in-the-Loop, and Hardware-In-The-Loop Experience for all Major Programs

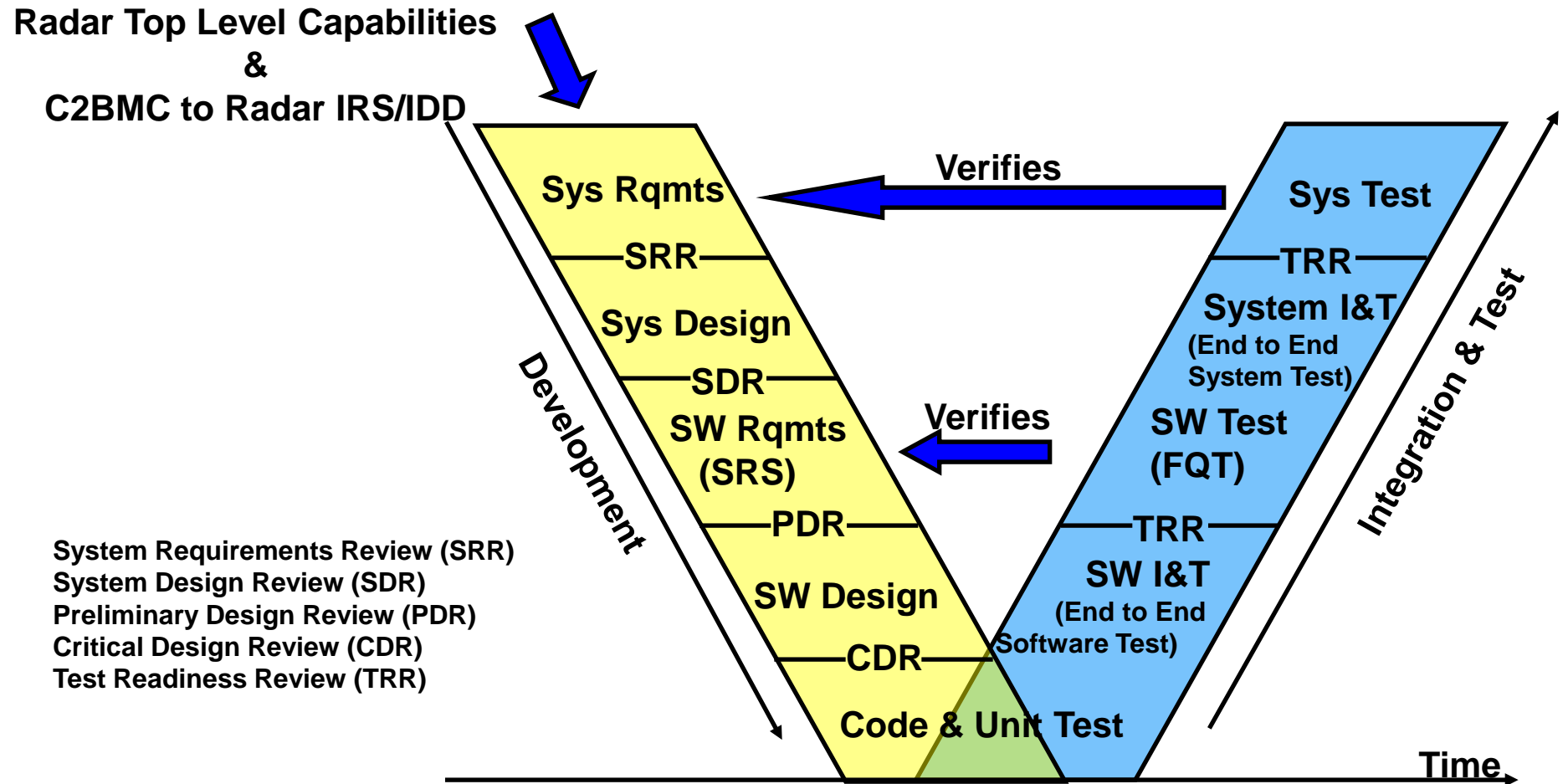
## Sample LEGACY PROGRAMS

AN/TPY-2 (THAAD, Forward Based)

Patriot, JLENS, ZUMWALT, UEWR, CDU, Standard Missile, Sparrow, AMRAAM, Maverick, EFOGM, Sidewinder, ATACMS, Phoenix, IR&D, etc, etc



# System Development Process



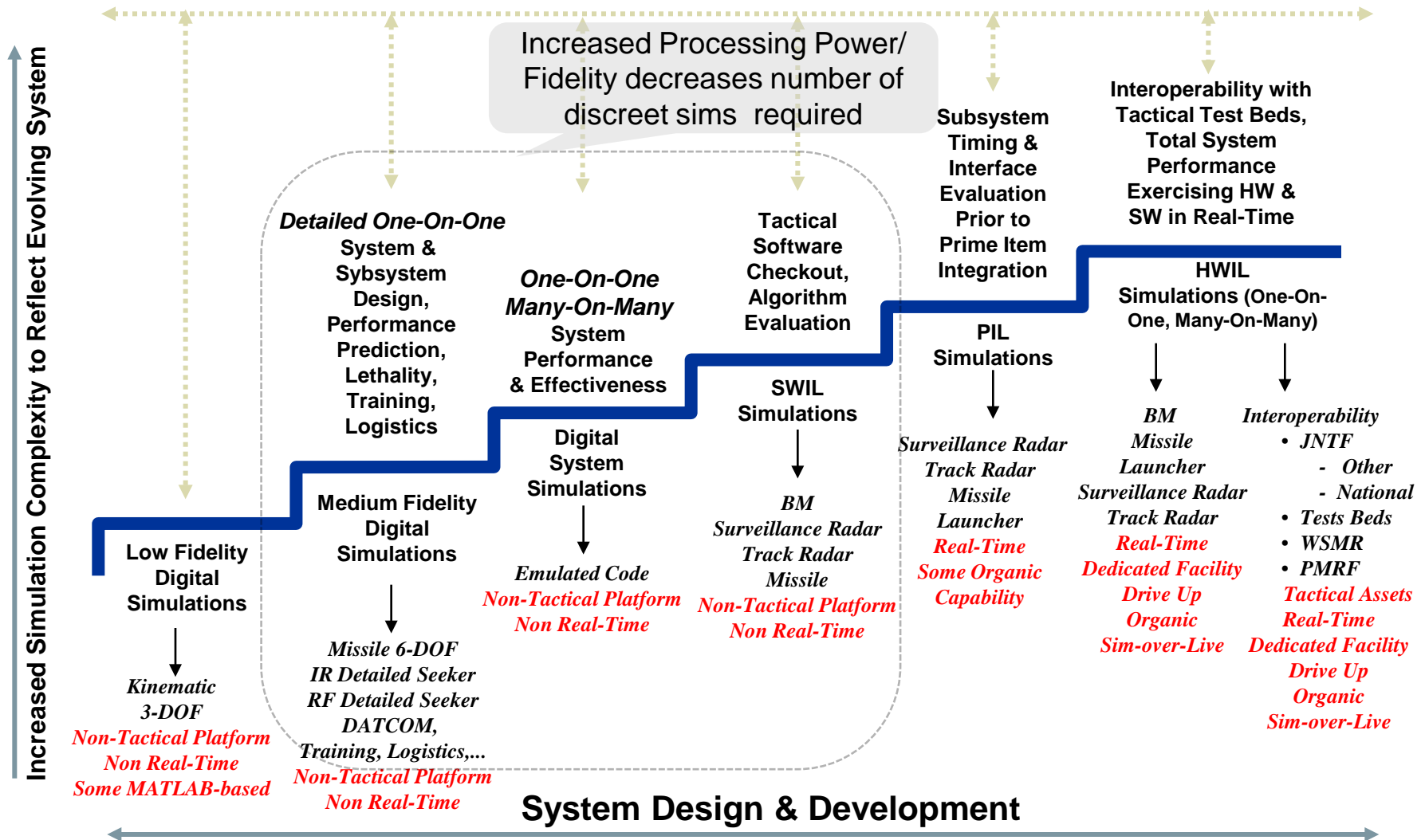
**System Integration & Test Complete, Ready for System Validation**

# M&S Evolving as Computing Capabilities Grow

- M&S problem multi-dimensional
  - M&S requirements range from simple quick and dirty design tool to complex non-realtime models to many-on-many distributed architectures
- Design choices include trades of model complexity vs. run-time
  - Historically, running real-time or near real-time would necessitate limiting model fidelity
  - Increases to computing power have continued to “blur” the trade space allowing greater fidelity while still running realtime
    - Greater fidelity translates directly to more complex models
      - Better target modeling
      - Better environmental modeling
      - Better Airframe models
      - Physics-based modeling has merit here
  - Greater Processing Power / Higher Fidelity reduces number of discreet simulation required

Physics-based Modeling will bring more bang for the buck

# Simulation Plays a Significant Role in all Phases of a Systems Lifecycle



# Summary

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- Models and Simulations (M&S) are essential tools throughout the entire life-cycle of product development
- M & S are recognized as an Integral part of Raytheon's engineering process
  - Virtually every project has a significant M&S component
- Validated and Accredited M&S products can reduce program cost and risk
  - Reduce the number of required live tests
  - Reduce risk associated with scheduled live tests
  - Perform parametric tests that can not be performed in the field due to safety or cost constraints
  - Perform monte carlo analysis to characterize statistical performance
- M&S results are essential to tactical fielding & capability declarations