Modeling & Simulation for Enterprise Test and Evaluation

Shala Malone
Combat Systems Performance Manager
PEO IWS 7D
202-781-2133
Shala.Malone@navy.mil

13 March 2008

Distribution Statement A: approved for public release.
# Modeling & Simulation for Enterprise Test and Evaluation

## Abstract

Operational Context: Ship Self Defense

Ship Defense MOE
Probability of Raid Annihilation ($P_{RA}$)
is the ability of a particular stand-alone ship as a system to detect, control, engage, and defeat a specified raid of threats within a specified level of probability in an operational environment.

Operational Context:
Ship Self Defense

Radars: SPS-49, SPS-48, SPQ-9B, MFR...

CIWS/SEARAM sensor
ES, IRST
SLQ-32, advanced ES
DEW

COC, OATM
SSDS

Open Architecture

TSCE

CIWS gun

Signature control

NATO Seasparrow, ESSM

Onboard EA

MK 214 Chaff

MK 216 Chaff

Multi-threat raid
- Subsonic, supersonic, high diver
- Hi-G maneuvers
- Multi-mode seekers

Battle Timeline $\approx 30$ seconds

Battle Space $\approx 0-12$ nmi
Enterprise Test & Evaluation Master Plan

The purpose of the Capstone Enterprise Air Warfare Ship Self Defense (AW SSD) Enterprise Test and Evaluation Master Plan (TEMP) is to consolidate all AW SSD at-sea testing and P_RA Testbed testing.

The AW SSD T&E Enterprise Strategy is founded on a two-tiered process to assess AW SSD warfare systems performance:

1) Validate models with live testing
   • Operational Ship testing
   • Self Defense Test Ship (SDTS) testing

2) Assess performance with models

Test Events DT/OT-ET15 thru ET19 are formal P_RA Testbed events

Includes DDG 1000, LHA 6, LCS and CVN 21 ship classes
• Systems performance for $P_{RA}$ assessment spans different technical communities and multiple managing program offices

• $P_{RA}$ will be assessed using a federation of interoperable simulations; it will not (cannot) be tested empirically
  – Complex, multi-spectral, integrated HK/EW problem space

• Many specific parameters, assumptions, and limitations are negotiated between the testing and acquisition communities

• The testing community is intent on consistent $P_{RA}$ assessment across ship classes and warfare system configurations
  – Different hulls, different configurations…same threat models, same virtual range conditions
Enterprise Test Planning & Execution

• Non-traditional factors
  – M&S events as formal test events
    • “Virtual Range” requirement
  – Expectation for formal, planned data flow from empirical testing to model validation

• Organization and planning are combat-system-centric vice platform-centric
  – Single Enterprise Test Team
  – Centralized management and resourcing of P_{RA} Testbed
  – Multiple ship classes provide testing data supporting P_{RA} Testbed component development and validation
Navy Ship Self Defense
T&E Enterprise IPT Structure

SSD T&E Enterprise IPT
Chair: PEO IWS
Representatives:
- DOT&E
- COTF
- OSD (AT&L)
- SEA 06
- IWS WSEs
- Ship Class Reps
- IWS MPM Reps
- N7
- N43
- N091

Chair NAVSEA PH
SDTS Configuration Working Group

Chair IWS 1TE
Test Planning & Execution Working Group

Testbed Ship Class Baseline

Chair N091
Threat Representation Working Group

Co-chairs: IWS 7D
Ship Class rep

Sub-group chairs: N43 for targets, IWS 7D for models

Effective date: 13 March 2008
• Engineering one Enterprise Testbed, which is instantiated in several unique configuration baselines
  – Formally accredited Baselines are correlated to Enterprise test events and ship class OPEVALs
  – Element Project Offices are vendors to Enterprise not individual ship classes

• One master set of requirements for the Testbed
  – Fed by both Enterprise SE and Baseline IPTs
  – Allocated and adjudicated according to Enterprise deliveries

• A single Enterprise delivery may provide capability to more than one Testbed Baseline
  – A single set of SE artifacts is maintained at the Enterprise level

• Testbed-based Enterprise test events will be treated as empirical events
  – E.g., test readiness reviews, test objectives
**Enterprise P_RA Testbed Components**

**“Virtual Range”**

- **Testbed Component Providers:**
  - IWS 7D
  - Ship Class PM
  - IWS Project Offices

- **Testbed Architecture:**
  - Network interface layer, interface standards, functional allocation standards

- **Common Threat Models:**
  - Seeker, airframe/autopilot, signatures, vulnerability

- **Common Environment Models:**
  - Tailored authoritative databases, runtime environment data services

**Navy P_RA Testbed Ship Class Baseline**

**“Virtual Test Ship” (specific to ship class)**

- **Ship Characteristics**
  - Signature, motion, launcher placements, etc.

- **Combat System Representation**
  - Authoritative, “T&E quality” models of combat system elements

---

"Virtual Range" (Infrastructure)

- Testbed Architecture: network interface layer, interface standards, functional allocation standards
- Common Threat Models: seeker, airframe/autopilot, signatures, vulnerability
- Common Environment Models: tailored authoritative databases, runtime environment data services
Current Simulation Framework Characteristics

• HLA federation implementation
  – All system representations execute simultaneously for each ship defense engagement

• Geographically distributed

• Constructive simulation, conservative time management

• System representations are a mix of digital models and tactical software
  – Most representations are a hybrid of tactical SWIL and digital model
  – Most tactical SW re-hosted to general purpose computers
P_{RA} Testbed Deployment
LPD 17 Baseline

NAWC Weapons Division
China Lake

Naval Research Lab
Washington, DC

JHU Applied Physics Lab
Laurel, MD

Key:
Physics-based Model
Tactical SWIL/HWIL

Network Interface Layer

Scenario & Environment Federate (SEF)
Virtual Range Instrumentation: SIMDIS, RePLAYS, HLA_Results
Background Targets/Emitters

SLQ-32
SPS-48E
SPQ-9B

SSDS
CEP

Deployed over a series of
4 spiral Builds

RAM Launcher
Common Lethality Server

ASCM Seeker, Airframe, Autopilot

reactive multi-threat raid

5 Threat Types

Ship Motion & Signatures
Decoys

Threat/Ship Federate
Enterprise $P_{RA}$ Testbed Status

- $P_{RA}$ Testbed Configuration Working Group established under Ship Self Defense T&E Enterprise
  - Testbed baseline IPTs established for current Enterprise ship classes: LHA 6, DDG 1000, CVN 21, and LCS
  - Enterprise Testbed Master Requirements initiated

- LPD 17 Testbed Baseline nearing completion support of Ship Class OT&E
  - CSSQT validation runs completed Dec 07; further V&V ongoing, leading to COTF accreditation
  - LPD 17 assessment planned for completion Dec 08
Consistent Testbed development across ship classes and CS configurations

Enterprise $P_{RA}$ Testbed Evolution

Common Virtual Range
Process Standards & Architecture
Testbed Configuration Management

Enterprise $P_{RA}$ Testbed Baselines

LPD 17 Testbed Baseline
DDG 1000 Testbed Baseline
LHA 6 Testbed Baseline
LCS Testbed Baseline
CVN 78 Testbed Baseline

Consistent Testbed development across ship classes and CS configurations

Common architecture, common threats & environment, model re-use
Validated models, lessons learned, arch. advances

PEO IWS 7D Leadership
PEO IWS Project Offices

Element System Representations

Significant cost avoidance through re-use of models, virtual range, & architecture

Effective date: 13 March 2008
Challenges Ahead

• Feedback of knowledge and capabilities to early phase acquisition systems engineering
• Improved mechanisms for injecting data needs into planning of empirical tests
• Relationship of $P_{RA}$ Testbed simulations to other M&S supporting system development and T&E
• M&S capabilities development to support Family-of-Systems development
Questions?