Joint Simulation Environment (JSE): V&V Lessons Learned and Converging Opportunities

Joint Simulation Environment Overview

JSE Defined

JSE presents a multi-Service opportunity to revolutionize high end, complex test and training

- **The JSE is a simulation environment comprised of six major building blocks**
  - A software battlespace environment that is highly extensible, modular, and builds on a solid foundation of existing DoD modeling & simulation technologies
  - A physical computing infrastructure that implements the battlespace
  - One or more ownship simulations that constitute the system under test (SUT)
  - Cockpits and visual display systems that provide the pilot interface
  - Planning/control/briefing rooms that facilitate mission execution
  - An overarching facility that securely contains all of the above and the manpower to operate it
- **The first two elements – the battlespace environment and the physical computing infrastructure to implement the battlespace are referred to as JSE-in-a-box**
- **JSE threat environment and infrastructure is Government-owned and available to support DoD test and training needs**

Why JSE?

PLATFORM MISSION EFFECTIVENESS

- Full Fifth Gen+ assessments not possible on open air ranges. Requires realistic, high density threat environment and high fidelity platform representation

INTEGRATED WARFIGHTING CAPABILITY

- Impossible to scale few vs few live tests to accurately assess theater-wide, multi-platform capabilities

AFFORDABILITY

- Modern system-of-systems capability complexity makes open air testing prohibitively expensive

READINESS

- Realistic environments for high end, multi-platform tactics training are severely limited

JSE ENABLES FIFTH GEN+ OPERATIONAL TEST AND HIGH END TACTICS TRAINING IN THE WORLD'S HIGHEST FIDELITY, HIGHEST DENSITY THREAT ENVIRONMENT

Benefits of JSE

- Government designed, owned, and executed architecture
- Infrastructure designed to scale and support future high fidelity ownship integration
- Leverages best available models from authoritative Intelligence Community partners
- Integrates existing Government products with long established pedigree (DIADS, EAAGLES, NGTS, etc.)
- Benefits from other user investments into existing Government products

JSE Vision

To provide the DoD's premier simulation environment for Fifth Generation+ test and training.

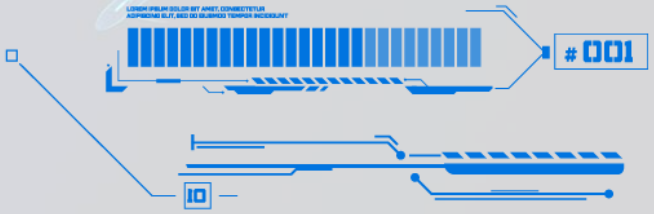
PLATFORM OPERATIONAL TEST AND MISSION EFFECTIVENESS ASSESSMENTS

TACTICS DEVELOPMENT IN HIGH DENSITY THREAT ENVIRONMENT

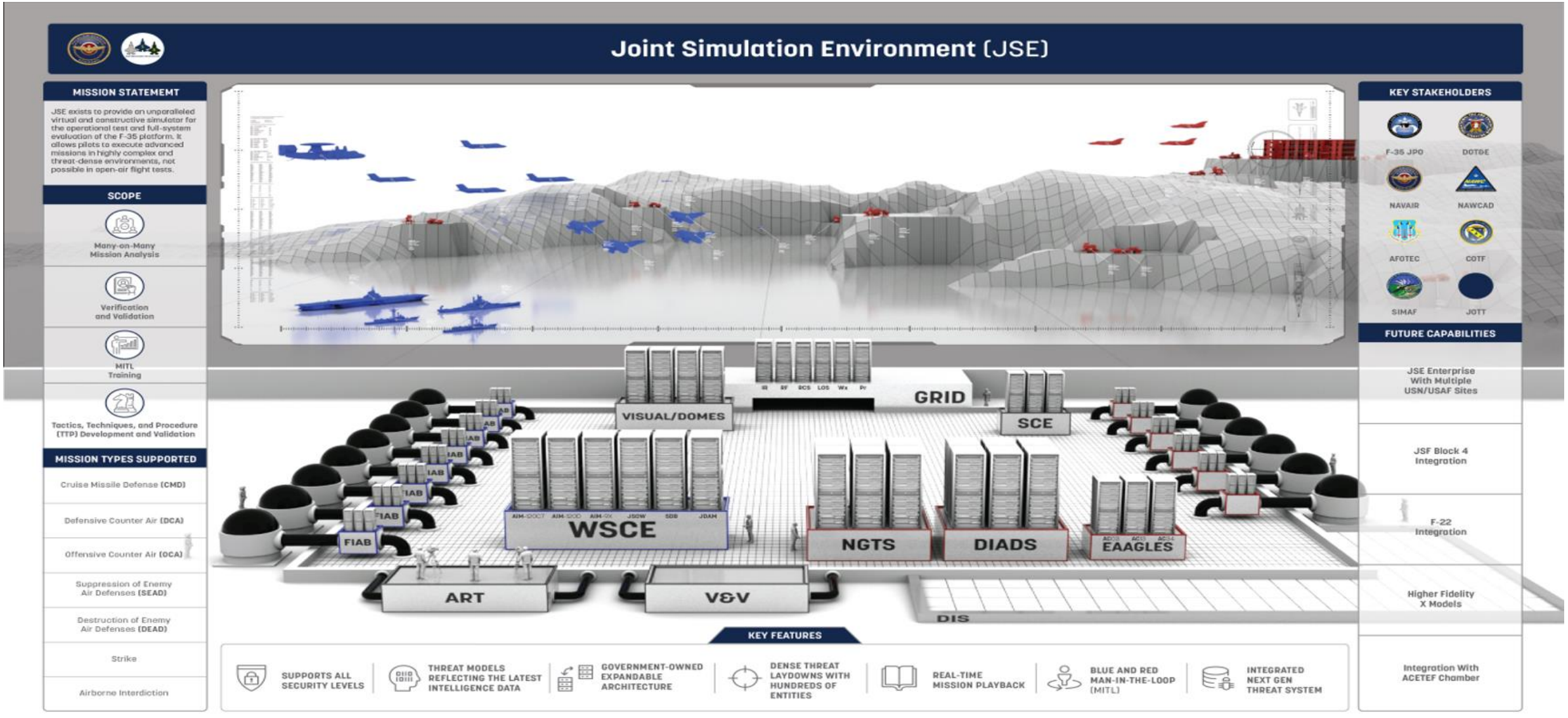
LARGE FORCE TRAINING

HIGH-FIDELITY, MULTI-PLATFORM WARFIGHTING CAPABILITY ASSESSMENTS

NEW CAPABILITY RESEARCH & DESIGN



JSE Overview



JSE V&V

JSE V&V - Overview

- **Intended Use** – Operational Test at the mission level
  - Mission: Defensive Counter Air
    - Metric: Proportion of red strikers that do not reach their weapon release point
- V&V at the Component/Sensor-Level and at the Integrated System-Level driven to enable assessment of risk at the mission level

System Level	**Interaction**	**Air-Air Kill Chain**
	Capability	**Track**
	Metric	**System Track Accuracy**
Component Level	**Component**	**Radar**
	Mode	**Track**
	Metric	**Track Accuracy**

Mission Interactions

Level	Task	Metric	Questions
Mission-Level	DCA	Proportion of Red Strikers that do not reach their Weapons Release Point	• How sensitive is this mission metric to a performance delta in this system metric? • How often will this mission metric include this system metric?
System-Level	A/A Kill Chain, System Track	System Track Accuracy	• How sensitive is this system metric to a performance difference in this component metric? • How often will this system metric include this component metric?
Component-Level	Radar, Track	Track Accuracy	

Value of Validation Test Design

- Structured engineering approach to VV&A
  - Accreditation Plan and V&V Plan interlinked
- Individual component, system, and mission test designs
  - Measures (detection range, false alarm rate, …)
  - Conditions (altitude, RCS, …)
  - Levels (high/low, large/small, …)
- VTDs provided reference matrix for ‘data miners’ to fill
  - Levels purposefully vague to maximize chances of finding suitable reference data
  - Gaps in reference data availability easily identified

Statistical Approach

- Primarily at Component Level
- Perform a 2-sample non-parametric statistical test to identify if real-world (reference) and sim data could be from the same statistical distribution; minimum data size required
- Null Hypothesis: H_0 = reference data and sim data come from same distribution
- 'Pass' = failed to reject H_0, and minimum data requirements met; no additional action required (unless users demand further data)
- 'Fail' = rejected H_0
  - There is a performance difference between reference and sim performance, or failed to meet minimum data requirements
  - Assess potential tactical impact, and mitigation options

V&V Issues

- Scarcity of available expertise
  - V&V skills with SME knowledge is rare combination
  - Many projects require similar expertise
- Typical issues encountered
  - User expectations
  - Sim instrumentation
  - Data tools
  - Model tuning
- Network connectivity and robustness
- Data
  - Discovery, validity for OT, and usability
- Contracting language and specifications
- Syncing with program schedules
- V&V timeline compression

Value of a Government-led V&V

- Developers not validating their own product
  - Ensures separation even for Government-developed models
- Better understanding of intended simulation employment/mission use
- The Government generally has fewer barriers to information access
  - Security
  - Proprietary safeguarding
- Lessons learned can directly benefit future V&V efforts
  - Tools and processes
  - Robust team of subject matter experts
  - Complex organizational connections

JSE Conceptual Roadmap