Net-Enabled Weapon Distributed Test M&S Risk Reduction Capability

U.S. AIR FORCE

ITEA Test Instrumentation Workshop
Distributed Test & Training Session

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10 May 2011

Agenda

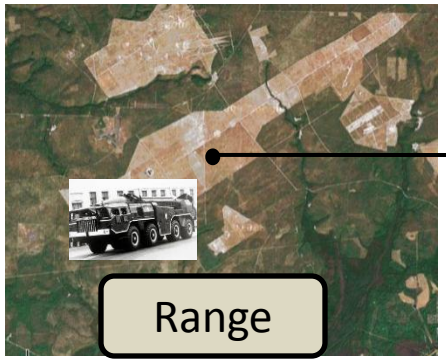
- Net-Enabled Weapon (NEW) Environment
- Real Time Targeting Tool
- Incorporation of Hardware-in-the-Loop (HITL) into NEW Environment
- Verification, Validation, & Accreditation
- Summary

NEW Environment

- Key Components
- Weapon
  - Small Diameter Bomb II
- Aircraft
  - F-15E upgrades
  - F-35 Joint Strike Fighter
- Third party targeting
  - JTAC Systems

All in Concurrent Development

GWEF/SDB II Net-Enabled Test Ops Current Capability



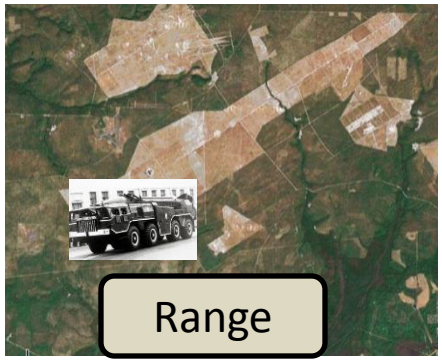
GWEF F-15E (Sim)

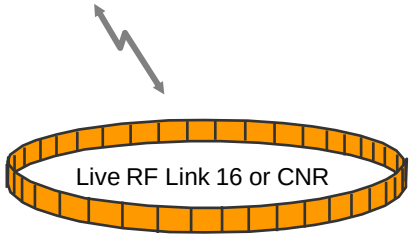
- Live Targets
- Sim Weapons
- Multiple Targeting Sources
  - Sim GWEF F-15E (w/IFTUs)
  - Live JTAC (TACP CASS)
  - Real Time Targeting Tool

Environment currently supports control of simulated weapons by JTACs in the field using real systems and RF Combat Net Radio

GWEF/SDB II Net-Enabled Test Ops Planned Capability

- Live Targets
- Sim Weapons
- Multiple Targeting Sources
  - Live F-15E (Ste 7/8 with IFTUs)
  - Live JTAC Systems
  - Real Time Targeting Tool

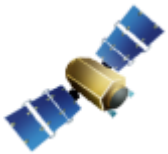




46TW F-15E

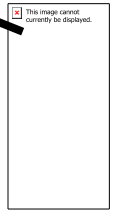
Developing capability to control simulated weapons by aircraft operating on RF Link 16 networks

Real Time Targeting Tool



Link-16

or UHF



Target TSPI

Real Time Targeting Tool (RTTT)

Requirement: Transmit Real-Time Target TSPI to NEW via Combat Net Radio or Link-16 network J11 Message

RTTT Uses Range Instrumentation with GPS

Real Time Targeting Tool

- RTTT was Developed as a DT Test Tool
- Designed to Eliminate / Control Uncertainty
  - Target Location Error
  - JTAC Delays Between Target Acquisition and Relay of Target Coordinates to Weapon
- Eliminates the requirement for JTAC personnel inside weapon footprint during testing
  - AFOTEC is planning to use this
- Can Also Inject Real Target TSPI into Live-Virtual-Constructive Domain

Current Integration Opportunities

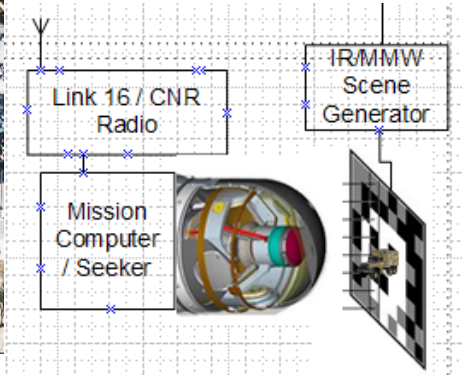
- F-15E Combined Test Force
  - Discussing using our generic NEW model for Suite 7/8 testing
- JFCOM's Digitally-aided Close Air Support Coordination Implementation
  - Using generic NEW model for testing with JTAC Systems during BOLD QUEST 11
  - Joint Mission Environment Test Capability (JMETC) / Joint Training and Experimentation Network (JTEN)

Benefits

- Reduces Data Link Integration Risk
- Aircraft and Third Party Targeting Systems gain exposure to SDB II J11 Implementation before testing with real SDB II
- Warfighters gain exposure to SDB II for CONOPS Validation
- Potential for End-to-End Testing for AFOTEC
- Flight Profile Validation / Generation

Incorporation of NEW Hardware into NEW Environment

GWEF Net-Enabled Test Ops Planned Capability

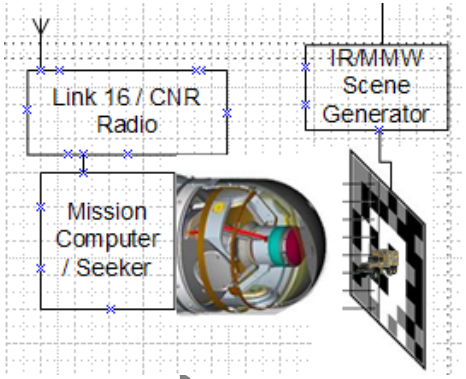


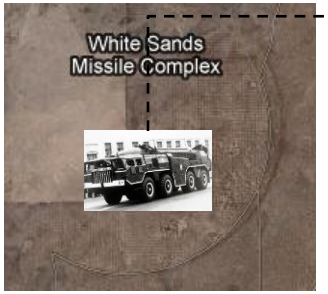
- Live Targets
- HITL Weapon
- Multiple Targeting Sources
  - Live F-15E (with IFTUs)
  - Live JTAC Systems
  - Real Time Targeting Tool

Incorporation of Hardware-in-the-Loop can support end-to-end flight test risk reduction at Eglin

GWEF Distributed Test Ops (Flight Test Risk Reduction & JMETC)

GWEF





Live RF Link 16

JMETC

Live RF Link 16

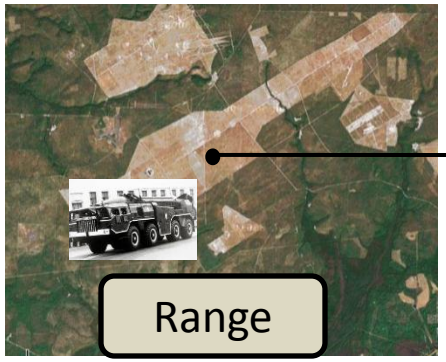
46TW F-15E

- System Development
- Live Targets at WSMR
  - Stream TSPI to GWEF (JMETC)
- Link Live RF Links via JREs (JMETC)

- 46TW F-15E (at WSMR) tracks targets and sends IFTUs
- GWEF receives target TSPI & IFTUs
  - Use WSMR Environment in GWEF
- Weapon communicates with F-15E

Incorporation JMETC for distributed testing and Hardware-in-the-Loop can support end-to-end flight test risk reduction at other ranges such as WSMR

GWEF/SDB II Net-Enabled Test Ops
AGILE Fire 4



Live RF CNR & Link 16

- Live Targets
- Sim Weapons
- Multiple Targeting Sources
  - Sim GWEF F-15E (w/IFTUs)
  - Live JTAC Systems
  - Real Time Targeting Tool
- JMETC Backbone
- Latency / NDL Parameters

AGILE Fire 4 is being used to support RTTT Verification, Validation, & Accreditation efforts and other efforts for SDB II

Benefits

- Test Configuration using Link 16
  - Validates SDB II Net Design Load with single/multiple NEW
- Collect JTAC Accuracy Data against Moving Targets
- BOLD QUEST 11 Risk Reduction using Combat Net Radio (CNR)
  - Supports Voice / J / K Messages over Single Channel
  - Tests Integration of JTAC Systems with GWEF Generic NEW
  - Currently TBD
- Conduct Verification, Validation, and Accreditation Activities
  - Real Time Targeting Tool and GWEF Generic NEW
  - Supporting both Developmental and Operational Test
  - Using a Risk Based Assessment Methodology
  - Generating MIL-STD 3022 reports and plans
  - Supporting AFOTECMAN 99-101 processes

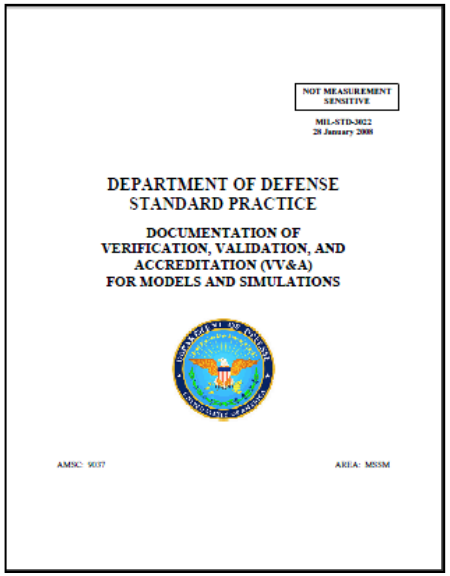
Verification, Validation, & Accreditation

VV&A and Interoperability

- Three Levels of Interoperability Testing
  - Correlate to the OSI Reference Model
- Application Layer
  - How well do the systems interact at the data message level?
  - Typically uses Deterministic Communication Methods (JREAP-C)
- Transport Layer
  - How robust are the systems when using the operational transport methods – TDMA, etc
- Operational Layer
  - How does the system operate within the constraints of the GIG?
  - Multiple Systems, Multiple Weapons, Contention Access, Limited Bandwidth at the tactical edge
  - Loosely Correlates to Joint Test

Verification, Validation, and Accreditation

- Model and Simulations are VV&A'd for a specific application
- GWEF's Net-Enabled Weapon Model & Real Time Targeting Tool
  - Application Layer (Message)
  - Transport Layer (Protocol)
    - Link 16 Interface
    - Combat Net Radio Interface
  - Operational Layer (Ops Constraints)
- Risk Based Assessment Methodology
- MIL-STD 3022 Provides Guidance
- Multiple venues--AGILE Fire, BOLDQUEST, Etc


NOT MEASUREMENT SENSITIVE

MIL-STD-3022
28 January 2008

DEPARTMENT OF DEFENSE
STANDARD PRACTICE

DOCUMENTATION OF VERIFICATION, VALIDATION, AND ACCREDITATION (VV&A) FOR MODELS AND SIMULATIONS

AMSC: 9037 AREA: MSSM

VV&A Goal 1

- Weapon Model VV&A'd for the purpose of testing systems that interface with NEWs
  - Supports Developmental Test
  - Supports Operational Test

Risk / Focus Area	Application Layer	Transport Layer	Operational Layer
J11 Message Formats	•		
J11 Message Behavior	•		
Performance (Distributed Test)	•	•	
Performance (Live RF)	•	•	•

VV&A Goal 2

- Real Time Targeting Tool VV&A'd for the purpose of providing In-Flight Target Updates to Net-Enabled Weapon
  - Supports Developmental Test
  - Supports Operational Test

Risk / Focus Area	Application Layer	Transport Layer	Operational Layer
J11 Message Formats	•		
System Accuracy	•		
TSPI Accuracy	•		
Target Location Error Implementation	•		
Performance (Distributed Test)	•	•	
Performance (Live RF)	•	•	•

VV&A Goal 3

- Weapon environment VV&A'd for the purpose of testing systems supporting planning data flow
  - Supports Developmental Test
  - Supports Operational Test

Verification, Validation, and Accreditation

- Environment VV&A'd for a specific application
- Planning Data Flow
  - Application Layer (Message)
    - Air Tasking Order Generation
    - Airspace Coordination Order Generation
    - OPTASKLINKCNR
    - Net Design Load
    - Crypto Key Load
    - JMPS
- Actual systems can be used as they are developed

Summary

- Net-Enabled Weapon Environment provides significant risk reduction
- Verification, Validation, and Accreditation Process validates systems and environment to support End-to-End testing

Backups

Open System Interconnection (OSI) Reference Model

Application (Layer 7)	This layer supports application and end-user processes. Communication partners are identified, quality of service is identified, user authentication and privacy are considered, and any constraints on data syntax are identified. Everything at this layer is application-specific. This layer provides application services for file transfers, e-mail, and other network software services. Telnet and FTP are applications that exist entirely in the application level. Tiered application architectures are part of this layer.
Presentation (Layer 6)	This layer provides independence from differences in data representation (e.g., encryption) by translating from application to network format, and vice versa. The presentation layer works to transform data into the form that the application layer can accept. This layer formats and encrypts data to be sent across a network, providing freedom from compatibility problems. It is sometimes called the *syntax layer*.
Session (Layer 5)	This layer establishes, manages and terminates connections between applications. The session layer sets up, coordinates, and terminates conversations, exchanges, and dialogues between the applications at each end. It deals with session and connection coordination.
Transport (Layer 4)	This layer provides transparent transfer of data between end systems, or hosts, and is responsible for end-to-end error recovery and flow control. It ensures complete data transfer.
Network (Layer 3)	This layer provides switching and routing technologies, creating logical paths, known as *virtual circuits*, for transmitting data from node to node. Routing and forwarding are functions of this layer, as well as addressing, internetworking, error handling, congestion control and packet sequencing.
Data Link (Layer 2)	At this layer, data packets are encoded and decoded into bits. It furnishes transmission protocol knowledge and management and handles errors in the physical layer, flow control and frame synchronization. The data link layer is divided into two sub layers: The *Media Access Control* (MAC) layer and the *Logical Link Control* (LLC) layer. The MAC sub layer controls how a computer on the network gains access to the data and permission to transmit it. The LLC layer controls frame synchronization, flow control and error checking.
Physical (Layer 1)	This layer conveys the bit stream - electrical impulse, light or radio signal -- through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier, including defining cables, cards and physical aspects. Fast Ethernet, RS232, and ATM are protocols with physical layer components.

http://www.webopedia.com/quick_ref/OSI_Layers.asp