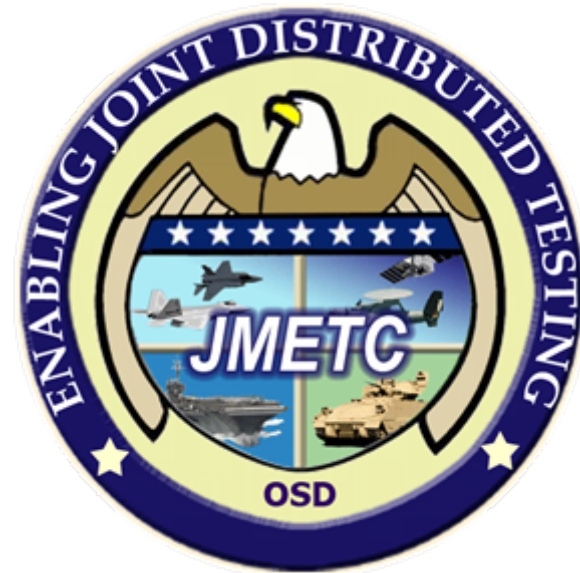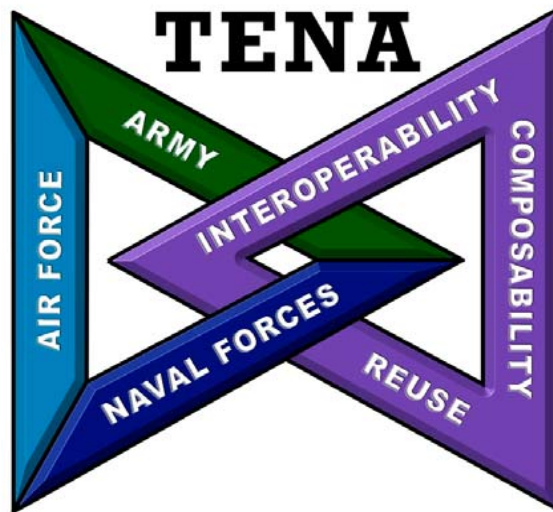# Test and Training Enabling Architecture (TENA), An Important Component in Joint Mission Environment Test Capability (JMETC)

Briefing for:
25th Annual NDIA T&E National Conference

March 4, 2009

Gene Hudgins, TENA SDA User Support Lead

What is JMETC?

- **A corporate approach for linking distributed facilities**
  - Enables customers to efficiently evaluate their warfighting capabilities in a Joint context
  - Provides compatibility between test and training

- **A core, reusable, and easily reconfigurable infrastructure**
  - Consists of the following products:
    - Persistent connectivity
    - Middleware
    - Standard interface definitions and software algorithms
    - Distributed test support tools
    - Data management solutions
    - Reuse repository

- **Provides customer support team for JMETC products and distributed testing**
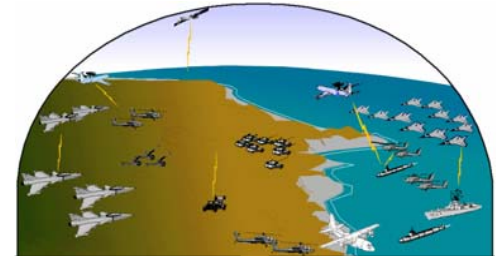
JMETC Enables Distributed Testing

Joint Operational Scenarios

Systems Under Test

Integrated Test Resources

Virtual Prototype	Hardware in the Loop Lab	Installed Systems Test Facility	Range	Environment Generator	Threat Systems
TENA Standard Interface Definitions	TENA Standard Interface Definitions	TENA Standard Interface Definitions	TENA Standard Interface Definitions	TENA Standard Interface Definitions	TENA Standard Interface Definitions
TENA Common Middleware	TENA Common Middleware	TENA Common Middleware	TENA Common Middleware	TENA Common Middleware	TENA Common Middleware

JMETC VPN on SDREN
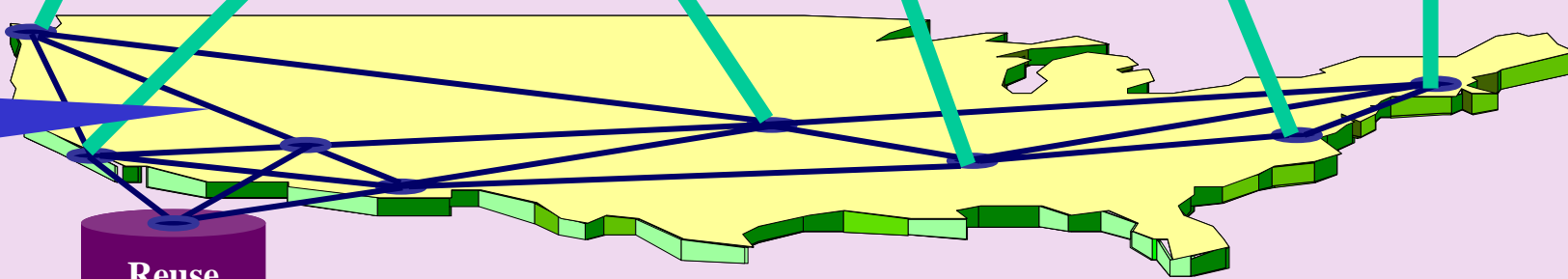
Reuse Repository

JMETC Infrastructure

Distributed Test Support Tools

Data Management Solutions

Customer Support

JMETC: Here and Now

- **Uses the Secure Defense Research & Engineering Network (SDREN) for connectivity**
  - 35 sites currently on-line

- **Uses Test & Training Enabling Architecture (TENA)**
  - Gateways to link to existing DIS and HLA simulations

- **Incorporates InterTEC test tools**

- **Uses the JNTC-sponsored Network Aggregator to link together other networks**

- **Being expanded based on customer requirements**

- **Holding JMETC Users Group meetings to discuss emerging requirements and technical solutions**
  - Seeking the "best of breed" solutions across the community

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JMETC Uses TENA to Integrate Sites
(Can gateway to existing DIS and HLA simulations)

- TENA is:
  - Developed, upgraded, and sustained by CTEIP and JNTC
  - Middleware that provides a single, universal data exchange solution
  - Common for test and for training (core standard in JMETC and JNTC)
  - Available for download at www.tena-sda.org for free

- TENA provides:
  - Interoperability among range systems, hardware-in-the-loop laboratories, and simulations in a quick, cost-efficient manner
  - A capability to rapidly and reliably develop LVC integrations
  - A set of community-agreed object models that define the data elements used in LVC integrations – maximizes reuse from event to event
 - An auto-code generator to drastically reduce TENA incorporation time

- Next version of TENA (version 6.0) will:
  - Provide advanced data filtering (only data of interest sent over the wire)
  - Improve fault tolerance and embedded diagnostics
  - Currently being beta-tested for a formal release later this year

Gateway Builder

- **GWB is focused on integration of distributed live, virtual, and constructive (LVC) systems into a common synthetic battle space that comprises various simulation protocols, training ranges, live systems and platforms**

- **Gateway Builder streamlines integration process and reduces time and effort of creating gateways**

- **Gateway Builder is a flexible, extensible, graphically driven tool that automatically generates gateways to bridge simulation and live protocols**

- **Gateway Builder supports mappings between TENA, DIS, and HLA and message-based protocols using any object model**
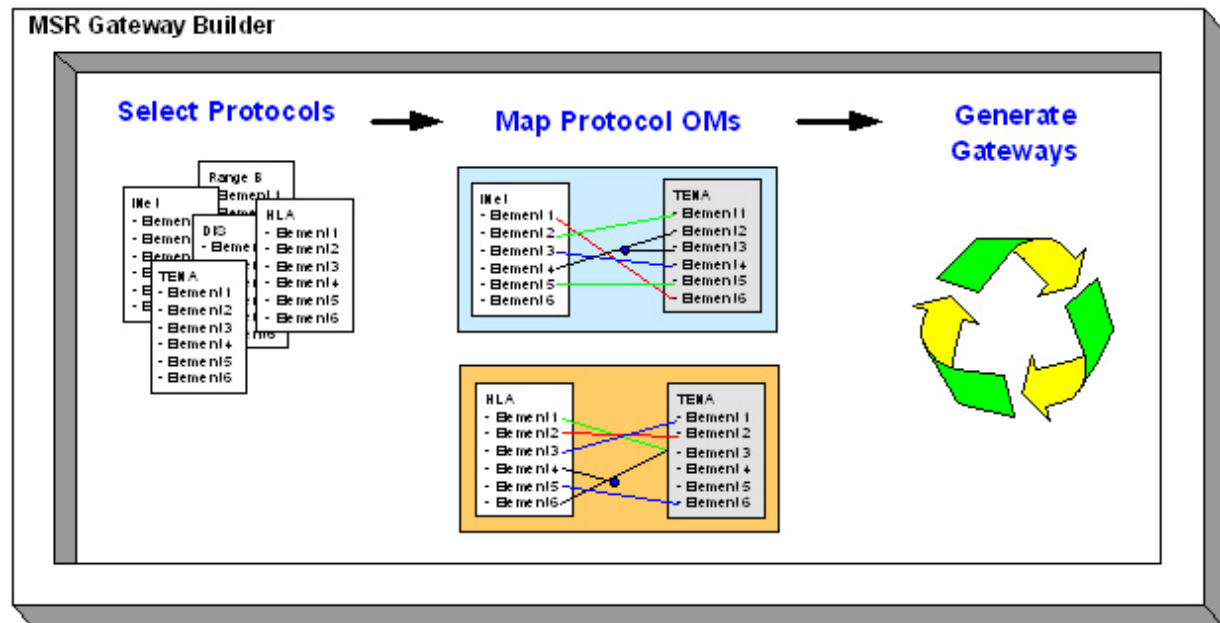
Gateway Builder Simplified Block Diagram
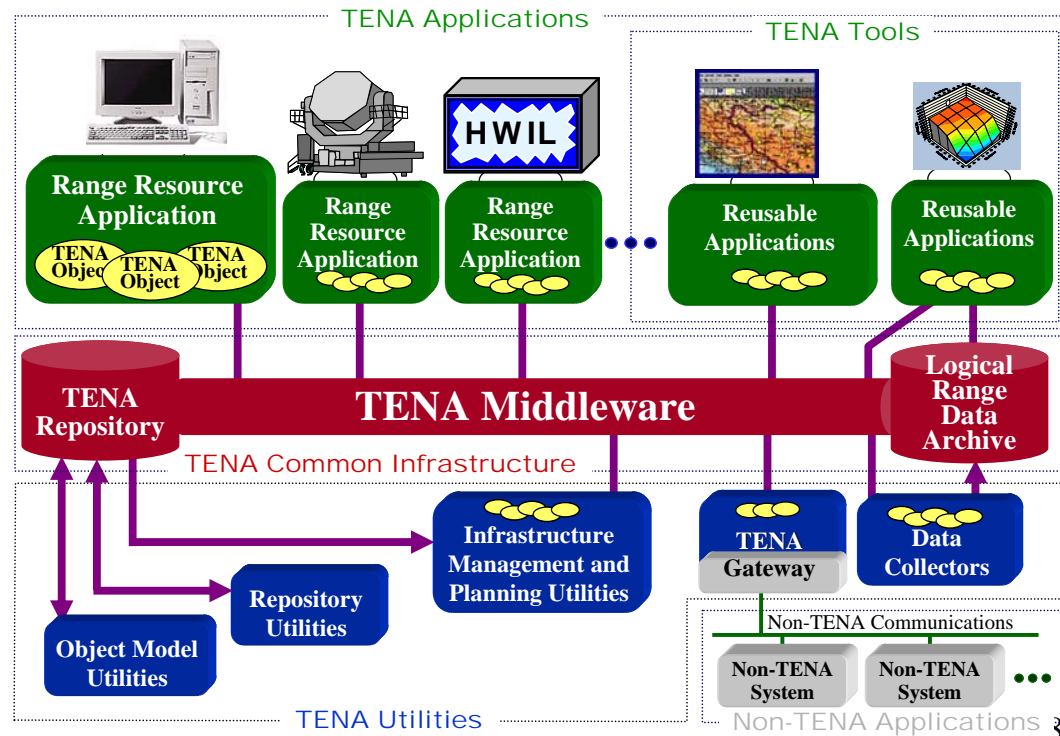
TENA Overview

- **Requirements**
  - **Interoperability**
  - **Reuse**
  - **Composability**
  - Support Rapid Integration
  - Gradual Deployment

- Guiding Principles
  - Provide middleware
  - Use real software objects
  - Maximize code generation
  - Management by users (AMT)
  - No license fee (GOTS)

- **Supports**
  - Testers & Trainers
  - Joint, Army, Navy, Air Force, Agencies
  - Live, Virtual, Constructive
  - Range, Laboratories, Simulations
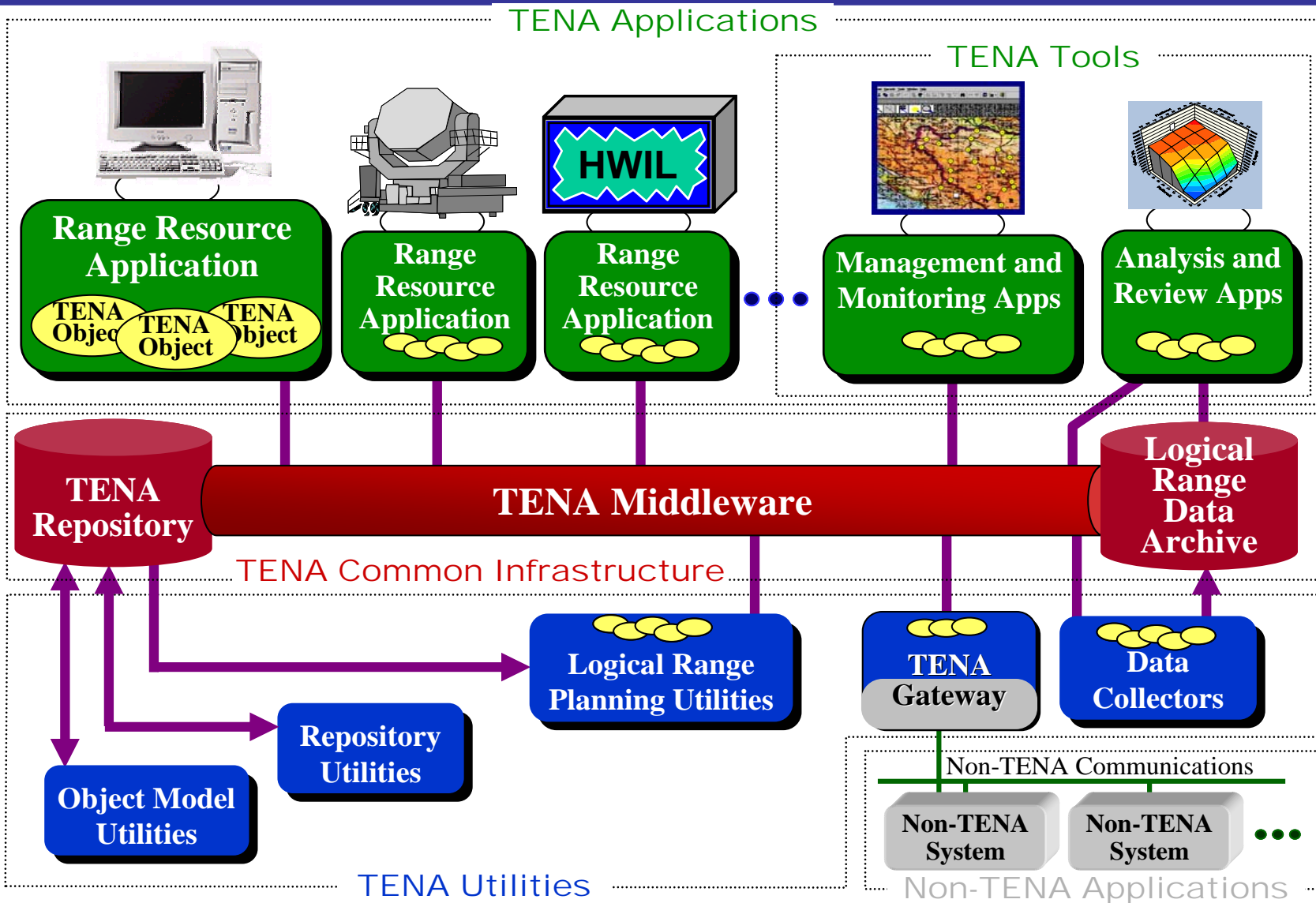 - Real-Time & Non-Real-Time

TENA Architecture Overview

Key Release 6 Improvements and New Capabilities

New Middleware Capabilities

- Advanced Filtering
- OM Subsetting Support
- SDO State Processing Support
- Self-Reflection Option
- Object Reactivation
- Separate Inbound/Outbound ORBs

Metamodel and Model Improvements

- Fundamental Sized Type Aliases
- Const Qualifier
- Optional Attributes
- SDO Initializers
- Middleware Metadata
- Middleware IDs

New Event Management Capabilities

- Object Model Consistency Checking
- Remote Object Termination
- Execution Manager Fault Tolerance
- Embedded Diagnostics
- TENA Console

Usability Improvements

- Observer Pattern
(with Callback Aggregation)
- Local Methods Factory Registration
- Code Installation Layout

Key Release 6 Improvements and New Capabilities

New Middleware Capabilities

- Advanced Filteri...
- OM Sub...
- St... ...port
- ...tion
- ...ctivation
- ...parate Inbound/Outbound ORBs

Enhanced data distribution
Optimized network usage

Metamodel and Model Improvements

- Fundamental Si...
- Const O...
- ...
- ...o Metadata
- ...dleware IDs

Better ways to define data
Remove ambiguity

New Event Management Capabilities

- Object Model ...
- Remo...
- ...t Tolerance
- ...nostics
- ...onsole

Improved reliability
Enhanced troubleshooting

Usability Improvements

- Observer Patt...
(with Co...
- ...
- ...tallation Layout

Easy to use
Harder to use wrong

# Alaska Training Range Evolution Program (ATREP) use of TENA

ATREP's intent is to enhance the existing Pacific Alaska Range Complex air and ground capabilities by providing a force-on-force (FOF) training capability that fully integrates and supports joint and coalition components for both air and ground training in live, virtual, and constructive (LVC) domains.

High Side
- **TENA ICADS**
- **TENA ACMI**
- **TENA 9C2**
- **TENA DIADS**
- **TENA SimShield**

Low Side
- **TENA MOKKITS**
- **TENA MILES 2000**
- **TENA I-HITS**
- **TENA UMTE**
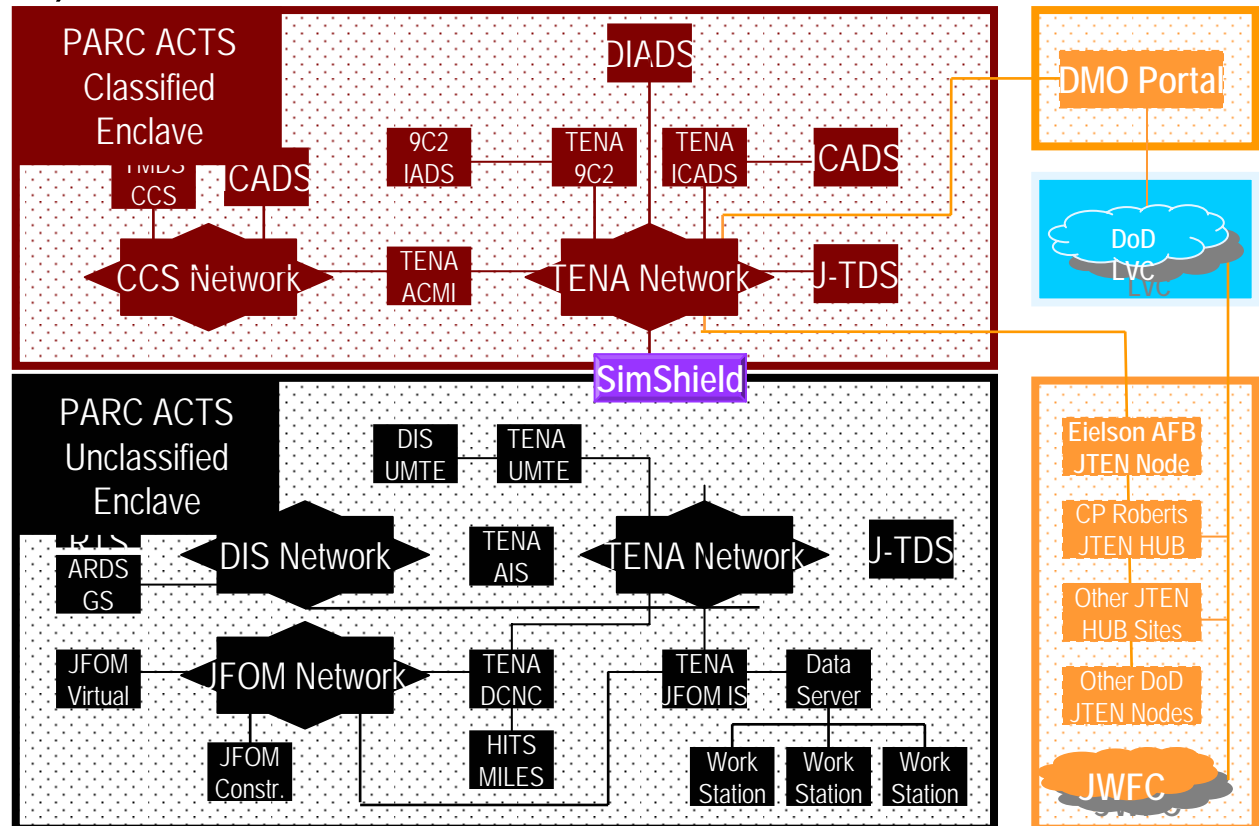
JMETC: Here and Now

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InterTEC Operational View-1
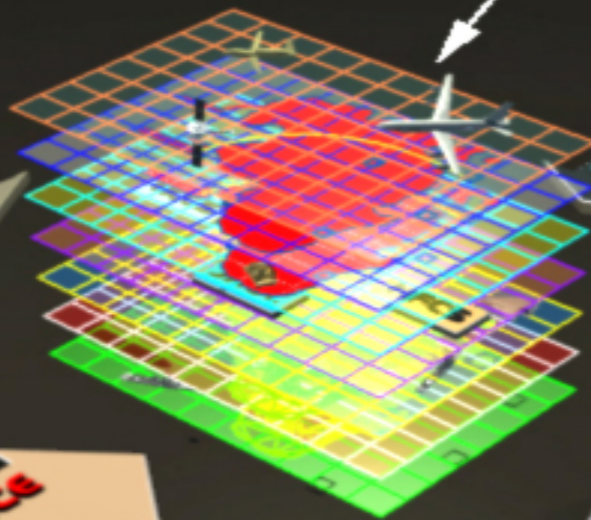## TENA-Based Integrated Test Tool Applications

20 Integrated Apps in Spiral 2

C4ISR Instrumentation & Analysis

Joint C4ISR Test Environment

Test Control
- Planning
- Rehearsal
- Control
- Monitoring
- Reporting

Instrumentation

C4ISR Test Control

- Data Capture
- Stimulation
- Analysis
- Display

Virtual Components
- HWIL Interfaces
- Message Generation

Synthetic Battlespace Environment

Distributed Test Suites

Live Components

Constructive Components
- Simulation Interfaces

- Range Interfaces
- Range Instrumentation
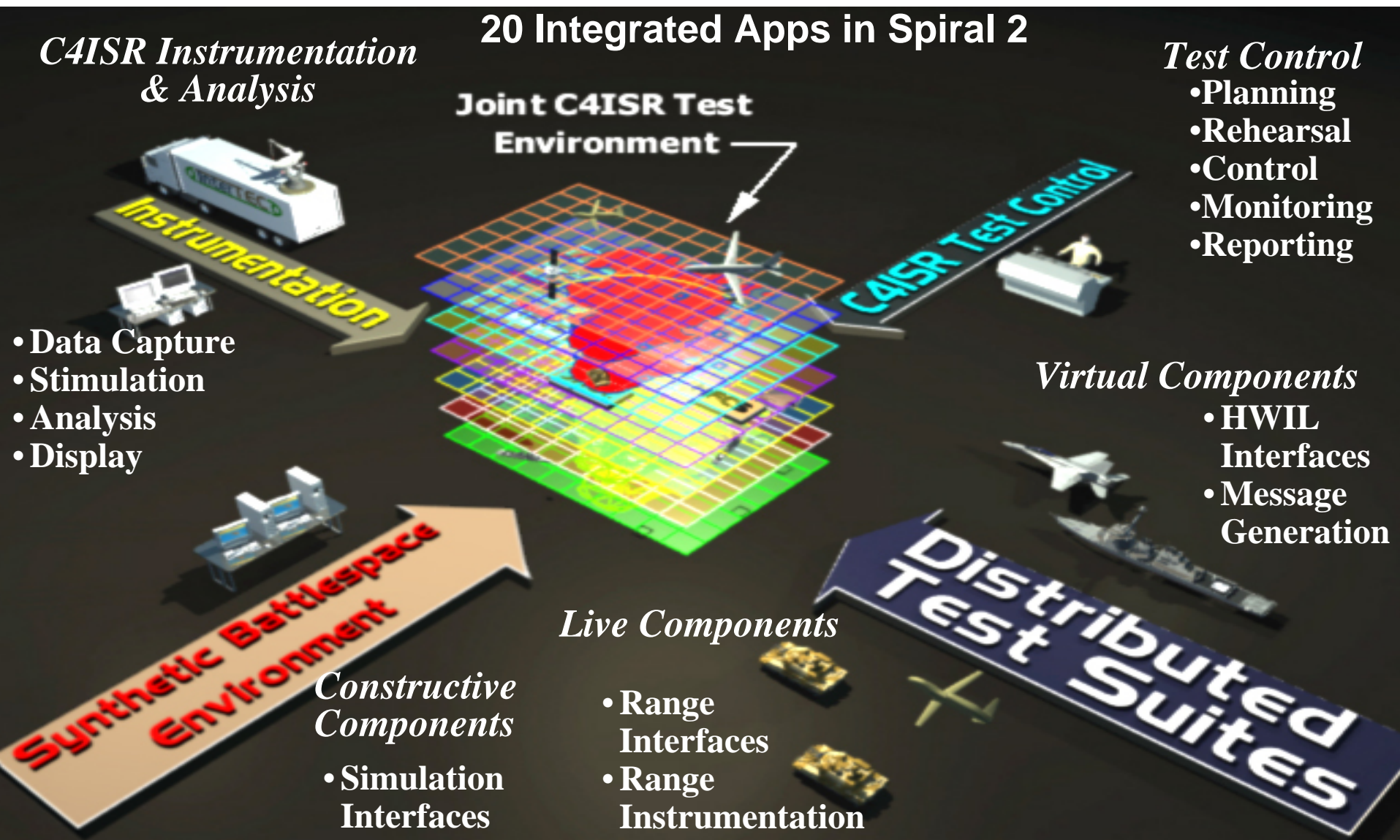
InterTEC Integration with JMETC Inextricably Intertwined

4Q 2010		
InterTEC Spiral 3	*Intel , Net Readiness*	**IBS, UAV, CGS & SOA Test Tools** → *JMETC Toolbox*
4Q 2008		
InterTEC Spiral 2	*Joint Planning Network*	**OTH-G & USMTF Test Tools** → *JMETC Toolbox*
Fielded		
InterTEC Spiral 1	*Joint Data Network*	**Link-16, Link-11, & VMF Test Tools** → *JMETC Toolbox*
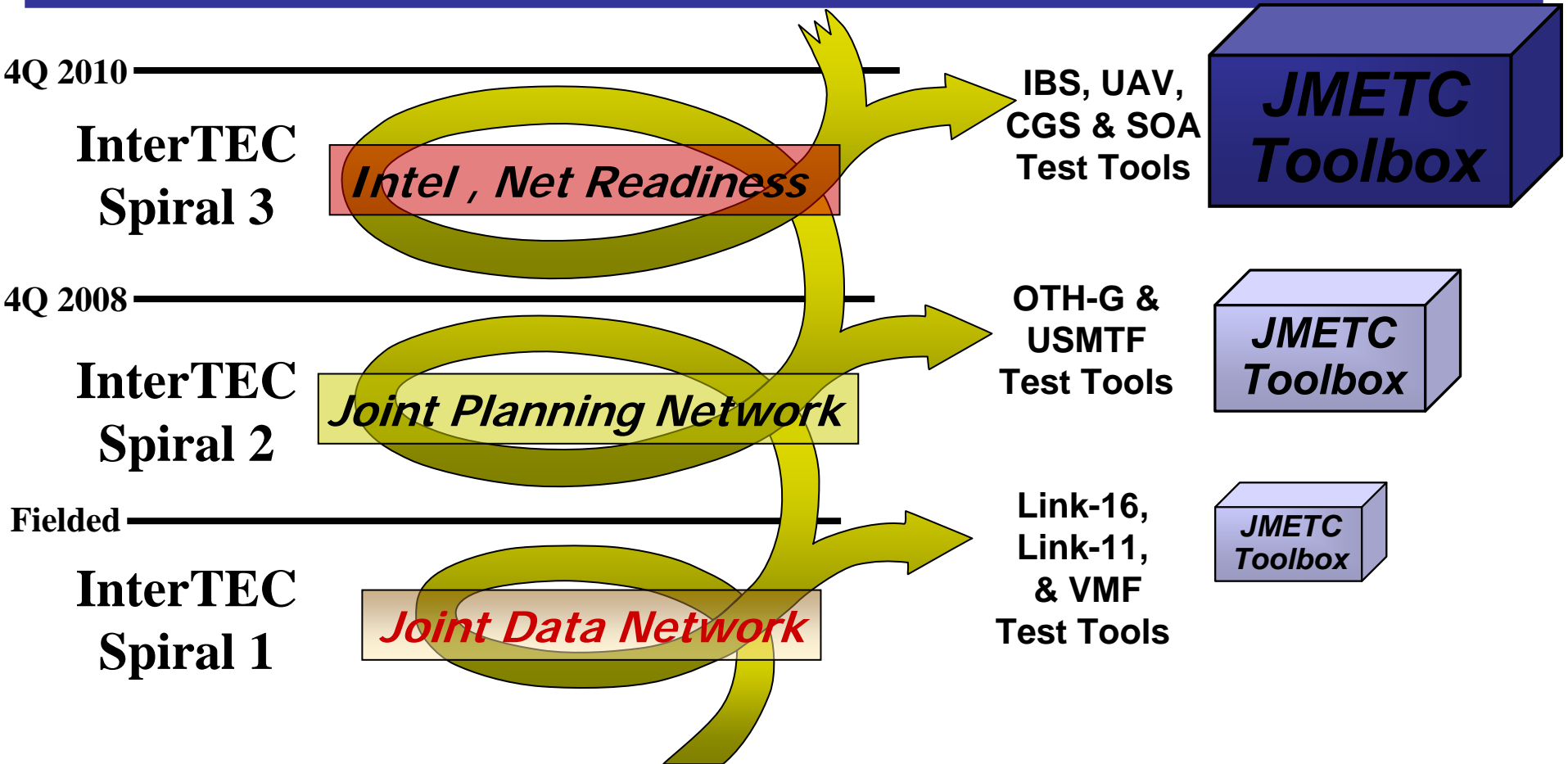
- **JMETC supports InterTEC during their spiral development**
- **InterTEC expands JMETC toolbox with certified C4ISR Test Tools**

# TENA Integrated Development Environment (TIDE)

- **TIDE is a tool designed to assist developers in the creation, development, testing and deployment of TENA applications**

- **Initial Capabilities**
  - Catalog installed object models on a user's machine
  - Migrate user applications between object model versions
  - Migrate user applications between middleware versions
  - Browse and download object models available in the TENA Repository
  - Request object model distributions from the TENA Repository

- **TIDE 2.0 is the current version**
 - Available at http://www.tena-sda.org/tide web site

TENA Tools used by JMETC Interface Verification Tool (IVT)

- **Designed to support the integration testing of TENA applications**
  - TENA Standard OM's
  - JNTC and InterTEC LROM's
- **Provides real-time monitoring, logging and statistics gathering**
- **Operates in three different roles, either stand-alone or in combination:**
  - Data Subscriber Role
  - Data Publisher Role
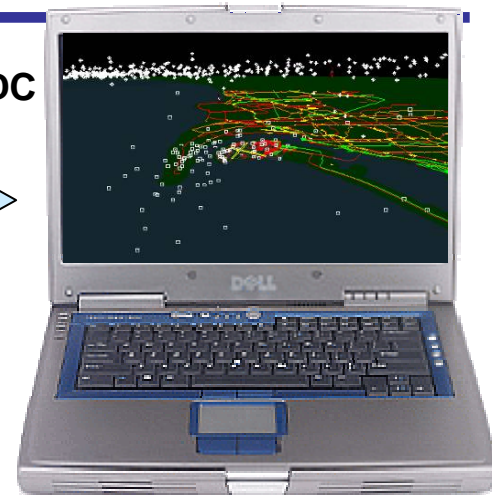 - DIS to TENA Gateway Role
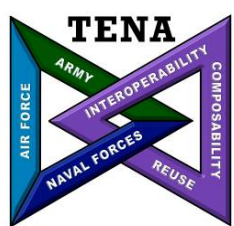
SIMDIS Use of TENA
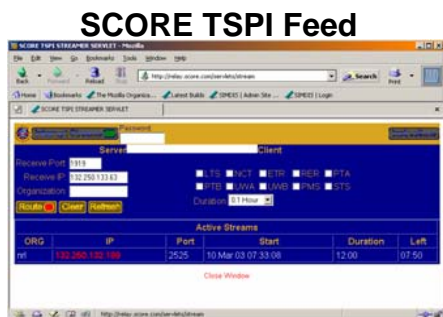
SCORE TSPI Feed

Southern California

NRL Washington, DC

TENA

- **Duration testing using SCORE TSPI data feed**
  - Four consecutive days
    - Win XP, Red Hat 9, Solaris 5.8
    - Processed 180,000+ entities
  - Two consecutive days
    - Win XP, Red Hat 9
    - Processed 53,000+ entities

- **Results and observations**
  - No issues with discovery latency
  - No issues with update latency
  - No issues with CPU usage
  - No issues with memory usage
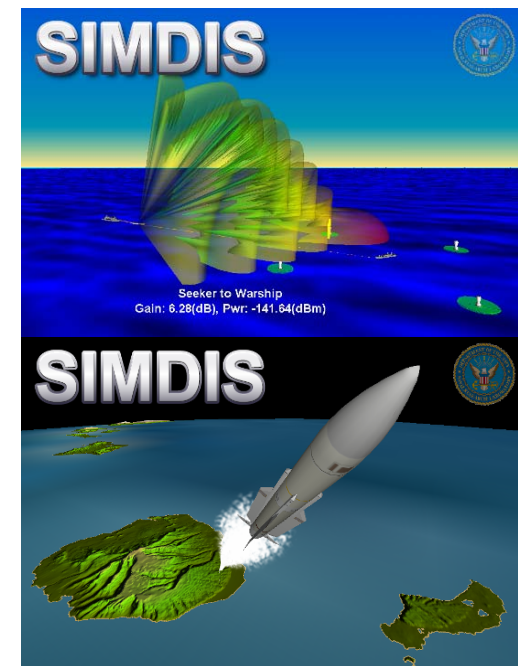
SIMDIS

Seeker to Warship
Gain: 6.28(dB), Pwr: -141.64(dBm)

SIMDIS

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JMETC Users Group Meetings

- Identify core infrastructure requirements and use cases
- Discuss available solutions, tools, and techniques
- Identify, investigate, & resolve issues
- Identify opportunities to collaborate
- Share lessons learned

Users Group #01
- 19-20 Jun 2007
- Dulles, VA
- ~140 participants
- Plenary session:
  - SIAP
  - JSF
  - FCS CTO
- Tracks:
  - User Requirements
  - Security
  - InterTEC Spiral 2
  - Networking

Users Group #02
- 14-15 Aug 2007
- San Diego, CA
- ~150 participants
- Plenary session:
  - Navy JTEO
- Tracks:
  - User Requirements
  - Distrib. Test Tools
  - InterTEC Spiral 2
  - Networking

Users Group #03
- 29-30 Jan 2008
- Portsmouth, VA
- ~100 participants
- Plenary briefs:
  - InterTEC Spiral 2
  - AF-ICE
  - JFCOM J84
- Tracks:
  - User Requirements
  - Distrib. Test Tools
  - Object Models
  - Networking

Users Group #04
- 20-21 May 2008
- Charleston, SC
- ~135 participants
- Plenary session:
  - InterTEC Spiral 2
  - SPAWAR Systems Center-Charleston
- Tracks:
  - User Requirements
  - Distrib. Test Tools
  - Service-Oriented Architectures (SOAs)
  - Networking

Users Group #05
- 9-10 Sep 2008
- Boston, MA
- ~176 participants
- Plenary session:
  - Dan Roth, AFFTC
  - Rick Cozby, FCS CTO
- Tracks:
  - User Requirements
  - Distrib. Test Tools
  - Service-Oriented Architectures (SOAs)
  - Networking

Users Group #07
24-25 March
AMT 41 on 26 March
Ft Walton Beach, FL

Users Group #08
23-24 June
Portsmouth, VA

Users Group #06
16-17 Dec 2008
AMT 40
18 Dec 2008
Austin, TX

Standard Architecture Management Team Members
(as of AMT-40)

- Air Armament Center (AAC), Eglin AFB, FL
- Naval Undersea Warfare Center (NUWC)
- Redstone Technical Test Center (RTTC)
- Electronic Proving Ground (EPG)
- White Sands Missile Range (WSMR)
- Naval Air Warfare Center – Aircraft Division
- NAWC – Weapons Division
- P5 Combat Training System (P5CTS)
- Joint National Training Capability (JNTC)
- Pacific Missile Range Facility (PMRF)
- T&E/S&T Non-Intrusive Instrumentation
- Integrated Network Enhanced Telemetry (iNET)
- NAVSEA Warfare Center - Keyport
- Dugway Proving Ground (DPG)
- Joint Fires Integration & Interoperability Team (JFIIT)
- Common Range Integration Instrumentation Systems (CRIIS)
- Common Training Instrumentation Architecture (CTIA)
- Army Operational Test Command (OTC), Fort Hood, TX
- Interoperability Test and Evaluation Capability (InterTEC)
- Naval Aviation Training Systems Program Office (PMA-205)
- Air Force Flight Test Center (AFFTC), Edwards AFB, CA
- Aberdeen Test Center (ATC), Aberdeen Proving Ground, MD
- Alaska Training Range Evolution Plan (ATREP)

Advising AMT Members
(as of AMT-40)

- **BMH Associates, Inc.**

- **Boeing**

- **Cubic Defense**

- **DRS**

- **Embedded Planet**

- **EMC**

- **MAK Technologies**

- **NetAcquire**

- **Science Applications International Corporation (SAIC)**

- **Scientific Research Corporation (SRC)**

- **Scientific Solutions, Inc. (SSI)**

Summary

- **JMETC supports the full spectrum of Joint testing, supporting many customers in many different Joint mission threads**
  - **CVN-21, SIAP, FCS, JSF, MMA, NECC, DD1000, WWF**
- **TENA is the CTEIP architecture for future instrumentation, the JNTC architecture for Live integration and an enabling technology for JMETC**
- **TENA and JMETC:**
  - **Being built based on customer requirements**
  - **Partnering with Service activities and leveraging existing capabilities**
  - **Coordinating with JFCOM to bridge test and training capabilities**
  - **Provide a forum for users to develop and expand the architecture**
    - **JMETC User Groups, TENA AMT Meetings**

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Important Contact Information

- **TENA Website: www.tena-sda.org**
  - Download TENA Middleware
- **JMETC Website: www.jmetc.org**

- **TENA Feedback: feedback@tena-sda.org**
  - Provide technical feedback on TENA Architecture or Middleware

- **JMETC Feedback: jmetc-feedback@jmetc.org**

- **JMETC Program Office Contact**
  - E-mail: Telephone: (703) 604-0350 ext. 0