Collaborative Test/Training, Experimentation/Evaluation Capability (CTEC) – The NUTEC Engine for USW Live, Virtual, & Constructive Joint Exercises

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CTEC Overview

- Strategy
- Technology & Facility Description
- Contribution to AUV Fest 2005
  - COUP (Collaborative Operating USW Picture) using CURATE and Tools
  - Variety of Vehicles and Technologies to Support
  - Complex Data Communications Scenarios
  - Distance Support (ISR Scenario)
- Summary
Vector: Integrated, Distributed, Joint L-V-C Environment

Development of Joint synthetic environment (L-V-C*) in support of training and experimentation capability - a persistent network that seamlessly links select ranges and simulation centers throughout the world

JNTC Technical Focus Areas

* Live, Virtual and Constructive (“L-V-C”) Training

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<td>Constructive</td>
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JNTC – “The future of T&E is intertwined with training & experimentation …”
DOT&E – “.. Test & Training partnership is essential to transformation”
Sea Trial – “Integrate war-gaming, experimentation, and exercises to speed development of new concepts and technologies… embrace spiral development… through rapid prototyping and Fleet experimentation”
Strategy: T2E2 Transformation

Testing and Training a New Way – Distributed L-V-C Assets at Multiple Locations
Strategy: USW T2E2 “Tool Kit”

Focus Area: The Undersea / Littoral Warfare Component

The NUWC Keyport/SAIC IPT is working toward the JNTC capability requirement of distributed and integrated test, training & experimentation for the undersea warfare dimension through specific implementations of TENA and complementary tools.
Strategy: CTEC Components

CTEC, the **Capability**, is comprised of 3 complementary components:

- **Facility**
- **Organizations & Processes**
- **Tool Kit**
AUV Fest ’05 PARTICIPANTS

- MIT
  - Kayak ASC (Autonomous Surface Craft)
    - Cooperative Navigational Behaviors
- Nekton Research
  - Ranger & TransPhibian UUV
    - Re-Acquire & Neutralize Volume Mines
- NAVOCEANO
  - HUSCy USV
    - Shallow Water Hydrography / Oceanography
- Naval Postgraduate School
  - ARIES UUV
    - Obstacle Avoidance using “Blazed Array” Forward Looking Sonar
- Naval Research Lab
  - ACOMMS & Data Storage Buoy
    - Monitor and Record AUV Fest ACOMMS
    - Characterize the Acoustic Sound Channel
- Naval Special Clearance Team One (NSCT-1)
  - Sea Lion (Bluefin 9) UUV
    - Transponderless Navigation During MCM
  - REMUS UUV
    - UUV OPS & TACHMEMO Demonstration
AUV Fest ’05 PARTICIPANTS

- **NSWC Panama City**
  - REMUS 600 12-3/4 Inch UUV
    - Small Synthetic Aperture Mine Hunting Sonar
  - TAR & Sea Talon Crawler UGV
    - S-C-M VSW-SZ Target Station Keeping & Vectoring
  - Autonomous Search & Hydrographic USV
    - Remote Delivery of a REMUS UUV From a USV

- **NUWC Newport**
  - MARV 12-3/4 Inch UUV
    - Optical Video Transmission via ACCOMS
    - Chemical (Nitrite) Sensor via ACCOMS
  - Biorobotic AUV
    - Maneuvering Demonstration

- **SPAWAR Systems**
  - Gavia UUV
    - Dual Frequency Side-Scan Sonar for S-C-M / R-I

- **APL, University of Washington**
  - Seaglider
    - Acquire & Relay CTD & Optical Data

- **Woods Hole Oceanographic Institution**
  - REMUS UUV
    - Demonstration of Recent REMUS Upgrades
  - Gateway Buoy
    - Support ACOMMS Demonstrations
    - Conduct MCM Sorties with Bluefin UUVs
AUV Fest ’05 PARTICIPANTS

- Alaska Native Technologies
  - Slocum Glider
    - Measure CTD & Map Ambient Acoustic Noise

- AUSI
  - Solar AUV (SAUV)
    - Cooperative Behavior Between SAUV Vehicles

- Florida Atlantic University
  - Air-Deployed Gateway Buoys
    - Rapid Deployment of Self-Anchor Gateway Buoys

- Hydroid Inc.
  - REMUS UUV
    - Find, Localize, & Image Mines

- Lockheed Martin Perry Technologies
  - CETUS II UUV
    - Interoperability with S-C-M Systems & Crawlers
    - Surface Ship Hull Inspection
    - Close Proximity Maneuvering – Payload Delivery
Collaborative Operating
USW Picture (COUP)
AUV Fest 2005

Virtual ISR Mission Linking
Keyport to Hawaii for SDVT-1
Insertion Mission Planning

Demonstration of the Collaborative Test, Training, Experimentation and Evaluation Capability (CTEC) and NUTEC UUV T&E Center (NUTEC) Assets
ISR Scenario Objectives

- Demonstrate integration of remote & distributed USW assets (vehicles, range instruments, targets, etc.) during testing, training, and experimental events
- Demonstrate network-enabled dissemination of UUV ISR information for operational benefit
- Demonstrate ability to use Live-Virtual-Constructive (L-V-C)* assets to train, test and evaluate mission planning and execution
- Monitor and assess undersea asset performance during all phases of the event
- Capture all event assessment information for live presentation and for archive and playback
- Assess the overall usefulness of some emerging UUV/ISR capabilities for SDVT-1 mission planning

* L-V-C - see definition on next chart
Event Systems & Connectivity

Communication

Keyport WA
CTEC Summary

- **DoD transformation** is integrating and distributing Testing & Training
- **CTEC is a capability** based on best practices of the Joint DoD community in support of L-V-C (Live-Virtual-Constructive) Testing & Training events
- **CTEC, the center, is a facility** designed to enable and refine the capability
- **CURATE (TENA), ESMS, and EPAS** are CTEC **tools** being developed to integrate the COUP (Common Operating USW Picture) into a consistent L-V-C Test & Training battle space in support of USW assessment and readiness
- **Test & Training organizations** can leverage CTEC to achieve their objectives for Joint and Fleet forces (Fill the USW “Gap”)

Distributed USW T2E2 for Undersea and Littoral Warfare is viable and available through CTEC
For further information regarding CTEC & Distributed USW T2E2

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END

CTEC
Drill-Down Slides
COLLABORATIVE T2E2 CENTER (CTEC)

2-story office and lab facility focused on improved coupling of T&E functions internally and with the larger Joint Distributed environment that is required to prepare and support today's war fighter.
COLLABORATIVE T2E2 CENTER (CTEC)

2nd floor includes integrated analysis lab and office space with robust connectivity and tools to bring the analyst closer to the actual event.
1st floor provides a state of the art configurable collaboration facility to enable hosting of simultaneous and diverse exercise events with connectivity to the local ranges as well as Joint/Distributed DoD community.
Expert analysts on the 2nd floor will apply complex tool sets and engage in live event collaboration, providing valuable and timely insight to exercise participants on range and as required throughout the exercise community.
COLLABORATIVE T2E2 CENTER (CTEC)

Capabilities/Tools
- Filtering/Formatting
- Analysis
- Reporting
- Archiving

Events/Scenarios
- Plan/Debrief
- Experimentation
- Range Ops
- Training

NUWC Community
- Nanoose
- Dabob

Joint/Distributed Community
- Hawaii
- San Diego
- AUTEC

3 Configurable Viewing Rooms

Large Viewing Room

Computer/Control Rooms

Secure real time data distribution coupled with collaborative analysis enhances operational efficiency for both local and remote Fleet and Warfare customers.
Common Undersea Range Architecture for Distributed T2E2 (CURATE)

- CURATE -

"Tool Kit" -

Common Architecture
   Standards
   Common Data
   Common Tools
   AAR Tools
   Aggregate Models
   Entity Models
   Virtual Sims
   Specialty Models
   Range Gateways
   C4I Interfaces

Joint USW T2E2 Capability--Link to Services, JNTC LROM

Live/Range

Virtual Simulators & Simulations

Live/Real World C2

Synthetic Forces

TENA Middleware

CURATE Connectivity Diagram
CURATE is the USW TENA implementation:

- Developed as member of OSD sponsored TENA Architecture Management Team. TENA is a funded program (OSD & JNTC).
- Supports the “Joint Training Toolkit” goal of JNTC
- Supports remote & distributed T2E2 vision, using gateway components for legacy data
- Provides a common ASW/USW/MCM data Logical Range Object Model (LROM)
Event Streaming Media System (ESMS)

Components

Publish/Present Graphical User Interface
Event Streaming Media System (ESMS)

- Synchronized event audio, video, & screen capture streams
  - Provides event insight to local and remote participants
  - Supports live and post-event collaboration capabilities
  - Readily scales to support small or large events
- Integrates with established DoD and Navy initiatives and architectures (FORCEnet, GIG-ES, TENA, DCTS, NMCI)
- Easy-to-use tool for non-technical users
  - Familiar web browser based implementation
  - Intuitive graphical user interface via Macromedia Flash Player
  - Simple capture of stream content
  - Automatic deployment/versioning using web server approach
- Employs existing, proven, approved technologies
  - Adapts COTS (Macromedia Flash) streaming technology
  - No specialized hardware needed to capture or present
**Event Planning and Assessment System (EPAS)**

### Process

1. **Select the standard event type(s) that pertain to the current event**
   - Amphibious Landing
   - ASW Event
   - MCM Event
   - NEO Event
   - SOF ISR Event
   - SOF Recon Event

2. **Select standard event performance parameters to be assessed for current event**
   - Deployment Time
   - Threat Classification
   - Threat ID Success
   - Threat ID Time
   - Threat Kill Success
   - Threat Kill Time

3. **Select the asset types to be utilized for the current event**
   - CVN
   - DDG
   - SH-60
   - SSGN
   - SSN
   - P-3C

4. **Select the specific asset to be utilized for the current event**
   - SSN

5. **Select the specific data types to be captured for the current event**
   - Newport VSSN (Virt)
   - TDPI
   - BSY-1 SONAR
   - WAA SONAR
   - Hydrophone Signals

### Tools

- **Automated Event Asset and Connectivity Map**
- **Constructive Event Simulation**
- **Integrated Event Schedule**
- **Dynamic Performance Evaluation Summary**
  - Required Performance
  - Actual Performance
  - Problem Area
Event Planning and Assessment System (EPAS)

- Provides integrated planning and assessment capability for joint Test, Training, Evaluation, and Experimentation (T2E2) events - event definition and asset selection and performance measurement
- Utilizes existing (e.g. TENA, HLA) and emergent (FORCEnet, GIG-ES) interoperability mechanisms to provide discovery of specific asset capability and schedule information for planning
- Integrates the event planning and assessment process with the data collected during events
- Set up event measures of success and to objectively evaluate event and asset performance
- Tailor events to meet specific cost and technical objectives through asset selection and simulation
Back-Up Slides
Recent CTEC USW T2E2 Efforts

AUV Fest – 2003
- Initial Demo Of Collaboration Capability At Keyport
- Integration Of Disparate Live UUV Systems Into COP During Mocked Events At Keyport
- Distribution Of Real-time Test & Training Data To Remote Facilities

CJTFEX – 2004
- Remote Use Of Distributed USW T2E2 Infrastructure At Large Scale Training Event
- Integration Of Disparate Live UUV Systems Into COP During Training Events At Camp Lejeune, NC
- Distribution Of Real-time Test & Training Data And Control Capability To Remote Facilities
• **Common Undersea Range Architecture for Distributed T2E2 (CURATE)**
  - Provides a Common ASW/USW/MCM Data Logical Range Object Model (LROM)
  - TENA Middleware employed to provide rapid, centralized data storage/archiving/playback, as well as controlled live data distribution throughout LROM domain
  - Enables network-enabled, synchronized, distributed T2E2 data to allow collaborative participation in geographically remote locations

• **Event Streaming Media System (ESMS)**
  - Used for distributing event AV streams – Video, Tactical Displays, etc.
  - Provides test, exercise director overall situational awareness
  - Uses COTS Macromedia server products + web browser interface

• **Event Planning and Assessment System (EPAS)**
  - Provides event definition, asset selection, & performance measurement
  - Integrates event planning and assessment process with data collection requirements
  - Sets up event measures of success to evaluate individual and total system performance
  - Tailors events to meet specific cost and technical objectives through asset selection and simulation

**Systems Engineering and Development for CURATE, ESMS & EPAS is a Joint Government/Contractor Effort**
Test & Training Enabling Architecture (TENA)
TENA - Executive Summary

- TENA supports the implementation of the Joint Vision 2020 by promoting integrated testing and simulation-based acquisition through the use of the concept of a “Logical Range.”
  - A logical range integrates testing, training, simulation, and high-performance computing technologies, distributed across many facilities, and ties them together with a common architecture.
  - In a logical range, real military assets can interact with each other and with simulated weapons and forces, no matter where these forces actually exist throughout the world. TENA is designed to make the logical range vision a reality.

- A common infrastructure through the medium of the TENA object model encodes all of the information that is transferred between systems during a range event. It is the common language with which all TENA applications communicate.

- The core of TENA is the TENA Common Infrastructure, including the TENA Middleware, the TENA Repository, and the TENA Logical Range Data Archive. TENA also specifies the existence of a number of tools and utilities, including those necessary for the efficient creation of a logical range.

- TENA Gateway applications allow the integration of TENA applications with non-TENA resources. Gateways communicate with both a TENA logical range (via the TENA Middleware) and another set of applications using some other protocol.
## AUV Fest 2005 Demonstrations

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<td>Ranger</td>
<td>Neutralization of Moored Target with Expendable UUV</td>
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<td>CETUS II RIN</td>
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<td>Pictures Along Track Lines / Bathymetric &amp; Environmental Measurements</td>
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<td>Florida Atlantic University</td>
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<td>ARIES</td>
<td>Blazed Array Sonar &amp; Obstacle Avoidance</td>
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<td>Woods Hole Oceanographic Institution</td>
<td>REMUS (VSW)</td>
<td>S-C-M, SVS &amp; SSH &amp; Acoustic-Communications-Only R-I Mission</td>
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<td>Autonomous Undersea Systems Institute</td>
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<td>Hydroid, Inc</td>
<td>REMUS (SW)</td>
<td>SW S-C-M/R-I with Dual Frequency Side Scan Sonar, DIDSON, and Video</td>
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<td>BioRobotic AUV</td>
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<td>Sea glider</td>
<td>Seaglider Operations &amp; Dissolved Oxygen / CTD Profiling</td>
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<td><strong>PMS EOD Programs</strong></td>
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<td>SPAWAR San Diego</td>
<td>GAVIA 8&quot; UUV</td>
<td>Dual Frequency (900/1800 MHz), S-C-M / R-I, Iridium, Obstacle Avoidance</td>
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<td>NSWC Panama City</td>
<td>Bluefin 9 - SEA LION</td>
<td>Bluefin 9 (900 kHz), S-C-M Without Need for LBL Navigation Transponders</td>
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<td>NSCT-1</td>
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<td>UUV Operations and Verification of TACMEMO (Identification)</td>
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<td>ARL:University of Texas</td>
<td>COIN</td>
<td>Demonstrate Interface Between UUV / Diver Tools / Dolphin MCM</td>
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<td>NSWC Panama City</td>
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<td>Remote Delivery of Unmanned System Technology (RDUST)</td>
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<td>Remote Launch of a REMUS UUV from an ASH USV</td>
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<td>Spread-Spectrum, LPI, Underwater Communication Systems</td>
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<td>Accurate Navigation, Color Video, and ACOMMS</td>
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<td>AUV Fest 2005 Common Operational USW Picture (COUP) &amp; Remote Distribution</td>
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<td>NUWC Division Newport</td>
<td>ISR Vehicle Simulation</td>
<td>Simulation of an ISR Vehicle - To Show Up in the COUP Display</td>
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<td><strong>Other</strong></td>
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<td>Naval Oceanographic Office</td>
<td>HUSCy (USV)</td>
<td>Demonstrate Shallow Water Hydrography / Oceanography</td>
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Joint Exercises:
- USW Support Concept

NUWC Newport
- CTEC
- SCORE
- Nanoose
- Pacific (Anywhere)
  - Carrier Strike Group

NUWC Keyport / CTEC

USJFCOM
- Fort Irwin
- Fort Bragg
- Nellis AFB
- China Lake

SCORE
- BPAUV
- REMUS
- MCMRON

CTEC: USW T2E2 Event Broker
- CVTSC
- Planning
- Assessment

Maritime LROM Data
- Research & Development
- Constructive Simulation
- Virtual Simulation

TENA Middleware
- Analysis

CVTSC

Score

LROM Gateway
- Independent Assessment & Evaluation
- Assist Test-Training-Experimentation Scheduling
- Translate Requirements to Test/Training Plans
- Optimize Events for Live-Virtual-Constructive
- Integrator

• Optimize L-V-C Asset Selection
• "Referee" Data Flow For Customer (OTD, EX DIR)
• Rapid Event Reconstruction
• Collaboration Setup (Analysts, DMs, Trainees)
• Event Archival for Post Analysis, Lessons Learned

Other Maritime Ranges, Sites, Facilities, & Assets
- Other Maritime
- Navy Operational Asset
- T&E Asset or Resource
- Portable/Fixed T&E Instrumentation

Other Non-Maritime Ranges, Sites, Facilities, & Assets
- China Lake

Range, Site, Facility, etc.