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Naval Undersea Warfare Center (NUWC) Division Keyport

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

Reid Johnson
reidj@kpt.nuwc.navy.mil

Briefing for:
NDIA UMV T&E Conference
Naval Undersea Museum
June 13th-16th, 2005

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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

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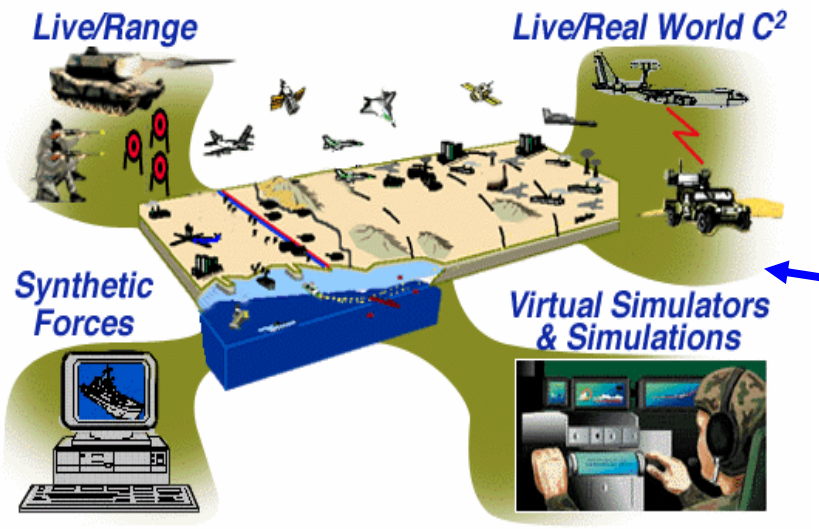
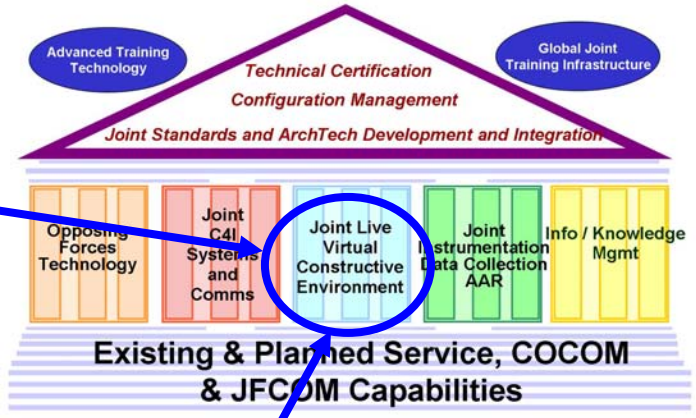
Vector: Integrated, Distributed, Joint L-V-C Environment

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

Asset Realization	People	Systems	Environment
Live	Real	Real	Real
Virtual	Real	Simulated	Simulated
Constructive	Simulated	Simulated	Simulated

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"*

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Strategy: T2E2 Transformation

Testing and Training a New Way – Distributed L-V-C Assets at Multiple Locations

Planning

Execution

CTEC

Analysis

De-brief

Local Operational Network

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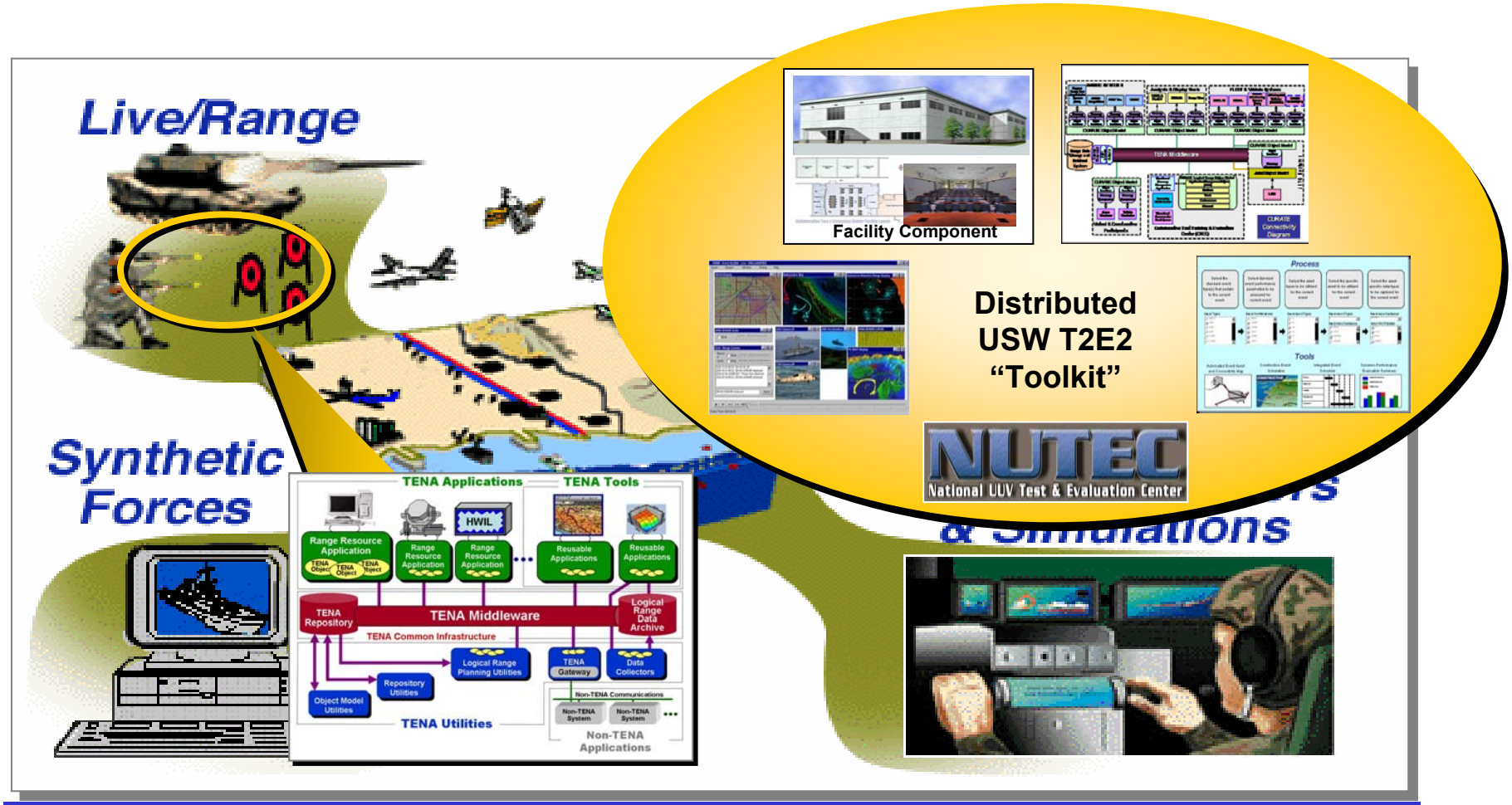
Strategy: USW T2E2 "Tool Kit"

Focus Area: The Undersea / Littoral Warfare Component

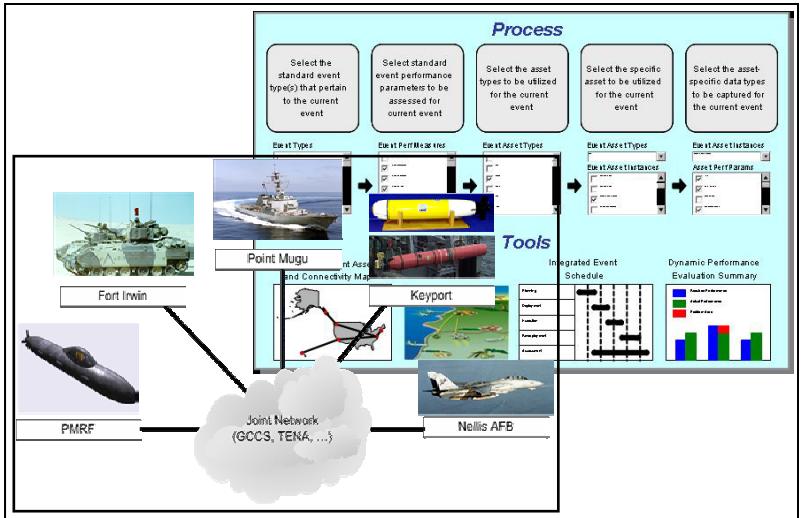


The NUWC Keyport/SAIC IPT is working toward the JNTC capability requirement of distributed and integrated test, training & experimentation for the undersea warfare dimension through specific implementations of TENA and complementary tools.

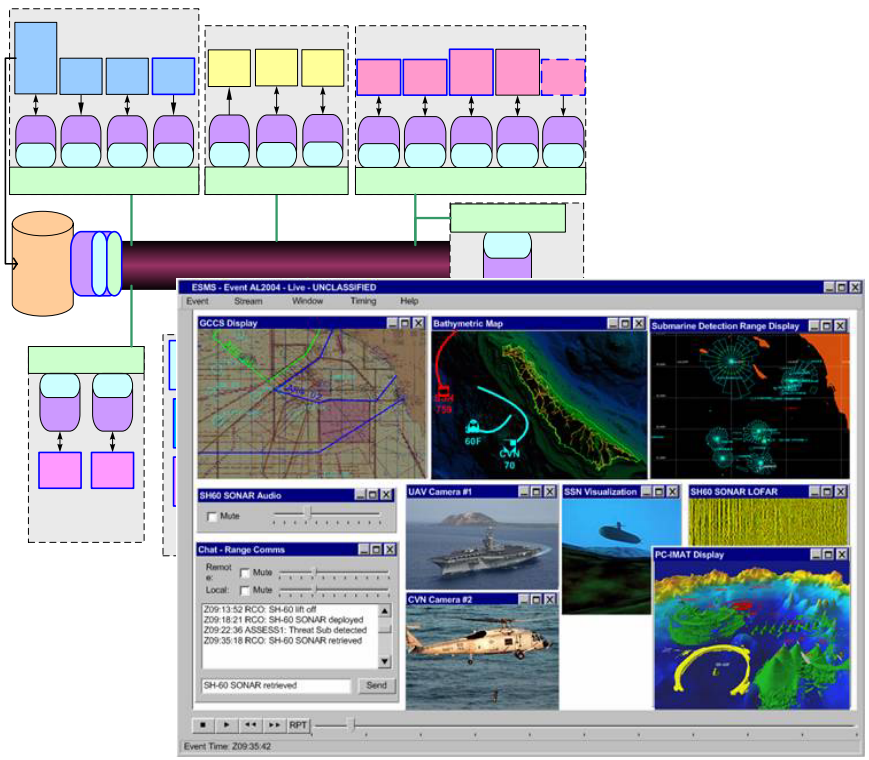
Strategy: CTEC Components

Facility Component

- **CTEC, the *Capability*, is comprised of 3 complementary components:**
  - *Facility*
  - *Organizations & Processes*
  - *Tool Kit*



Organization/Process Components



Tools Component

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

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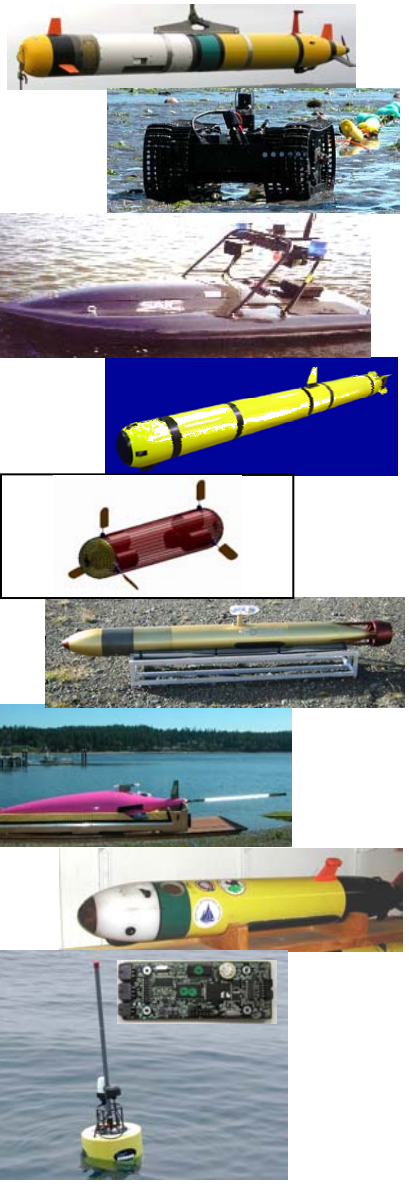
AUV Fest '05 PARTICIPANTS

- **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



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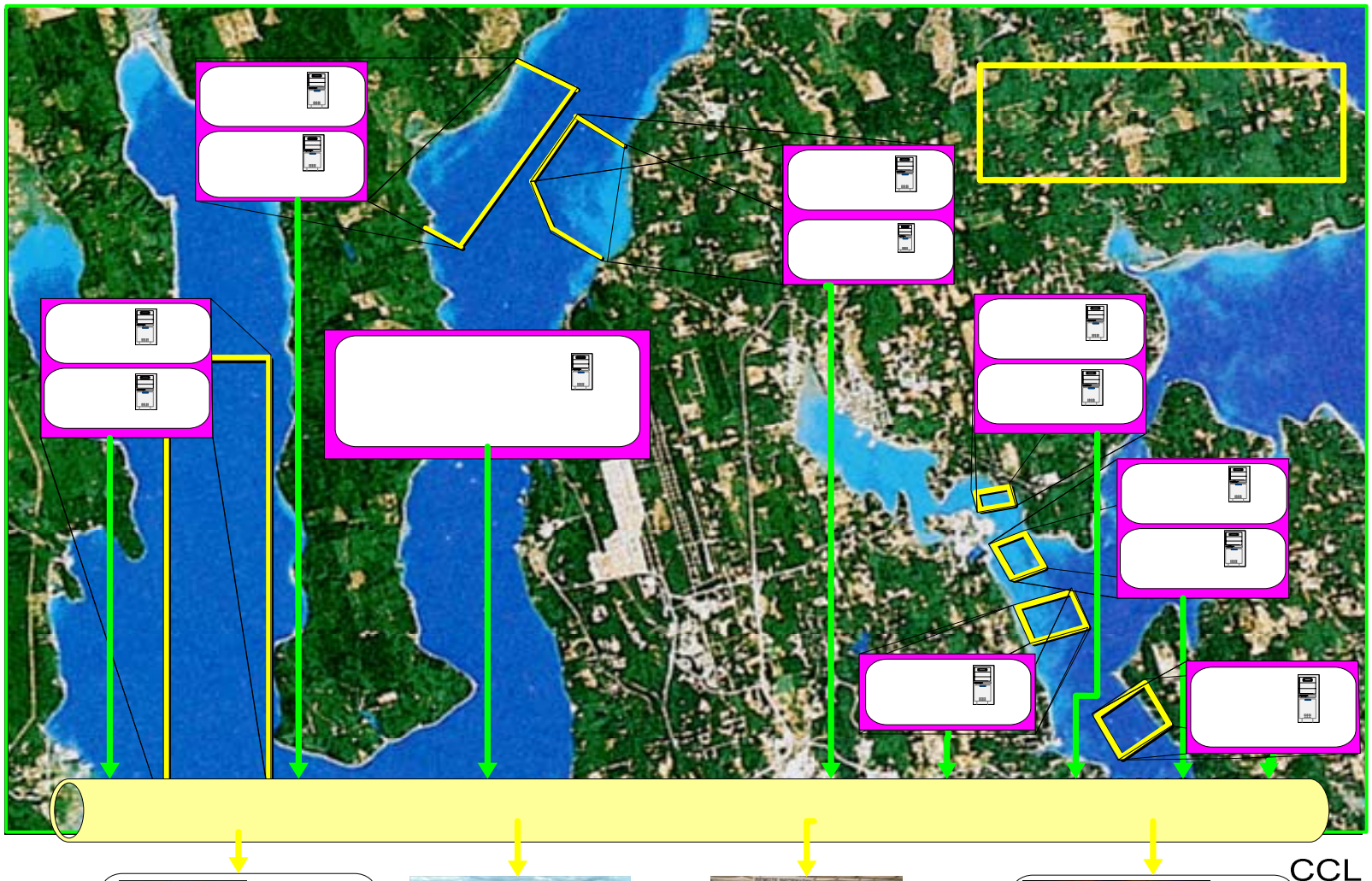
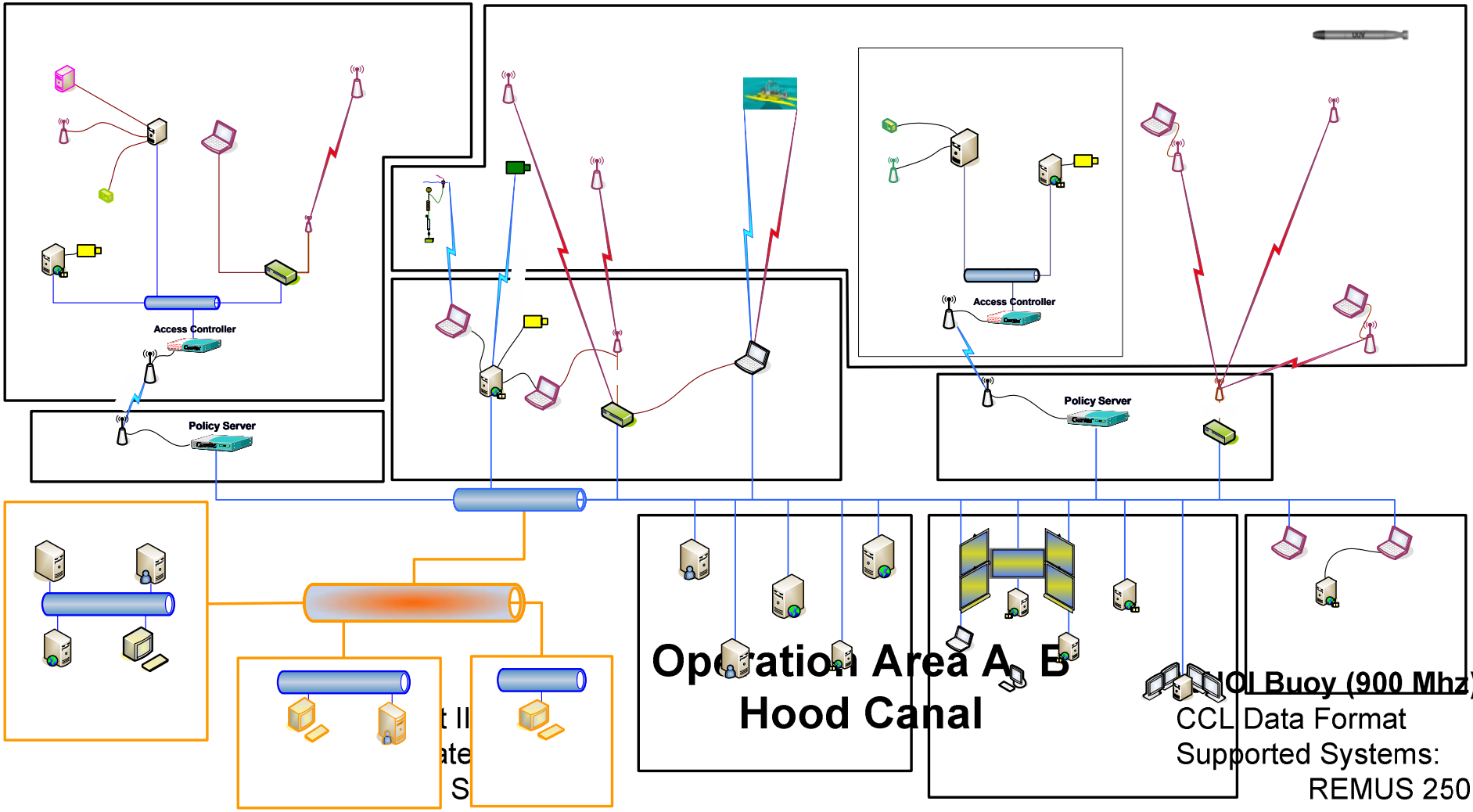
AUV Fest '05 PARTICIPANTS

- **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-Anchoring 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)



COUP Communication & Data Flow Diagram



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

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Undersea Warfare Center Division

NUTEC
National UUV Test & Evaluation Center

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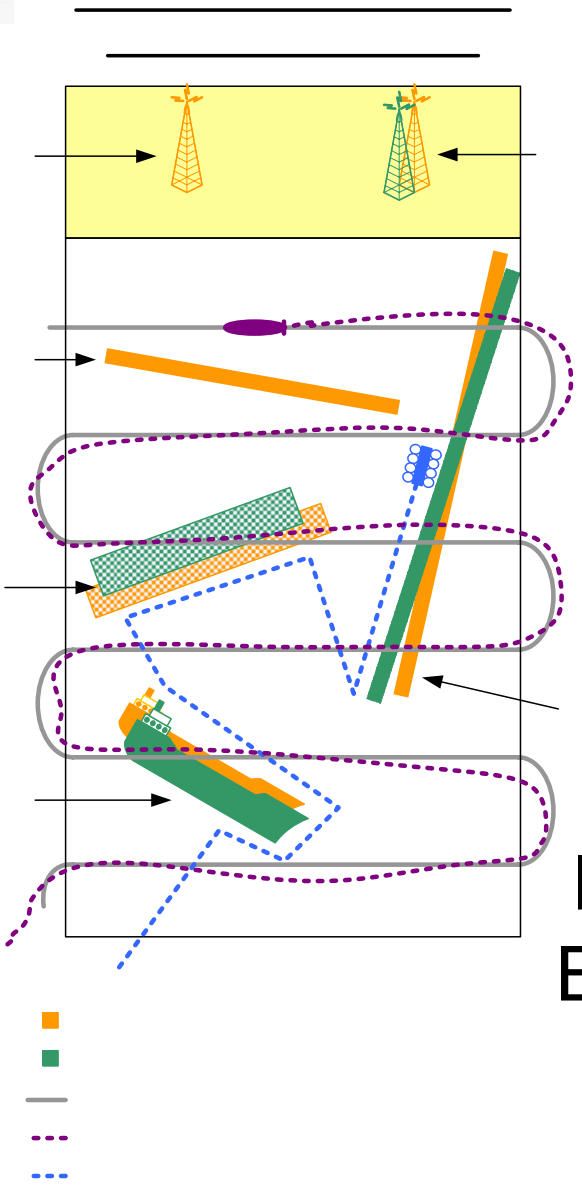
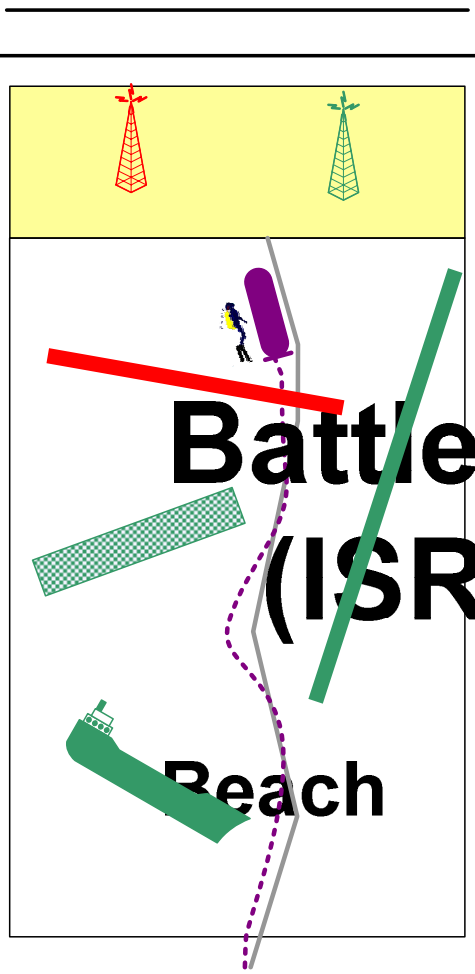
ISR Scenario Objectives

- 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





Battlespace
(ISR) at Ke

Beach

Radar
Emitter

Surveyed

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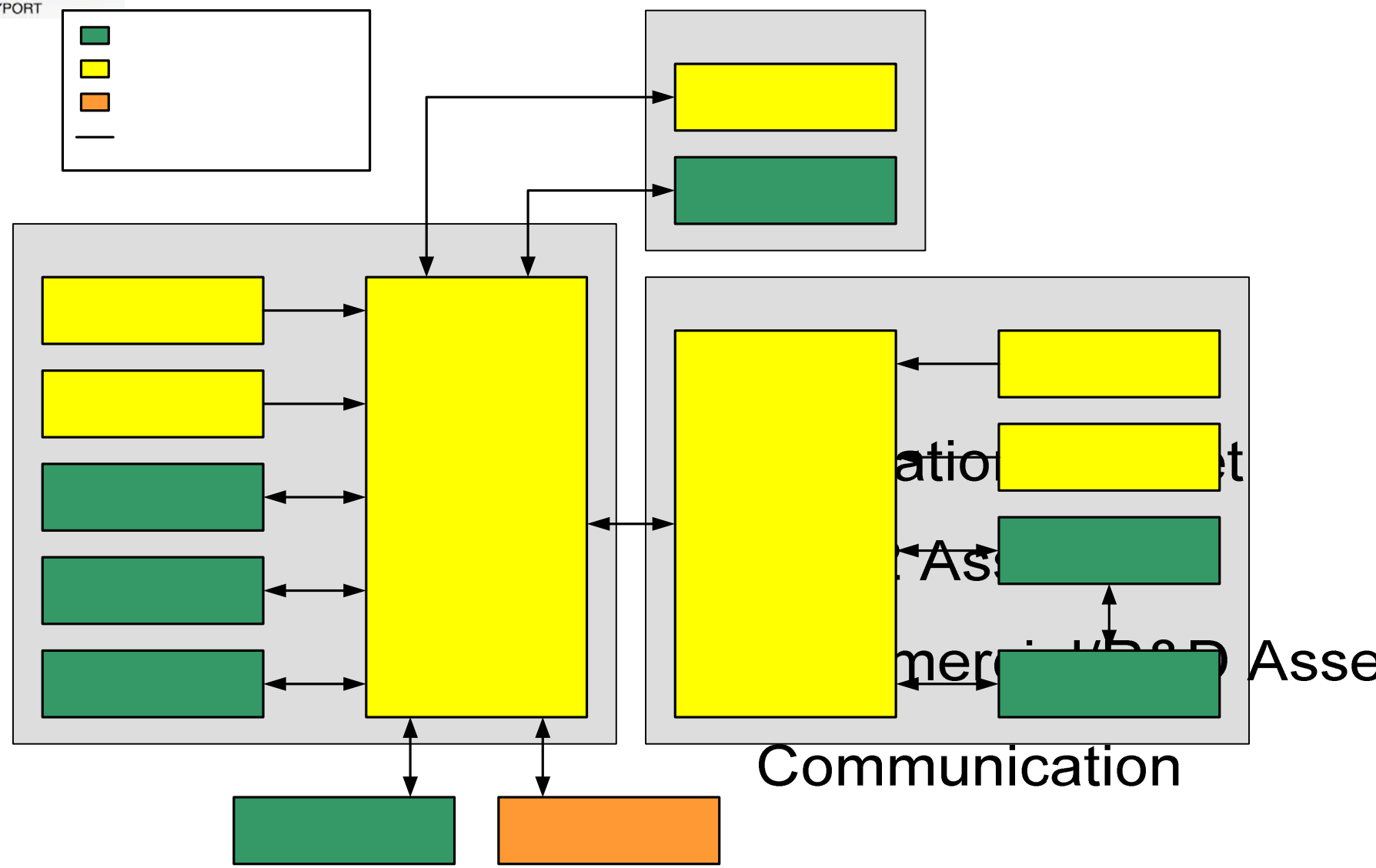
Event Systems & Connectivity



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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

Contact:

Brian Williams
SAIC
360.396.2915

or

Reid Johnson
NUWC Keyport
360.396.6658

williamsbj@kpt.nuwc.navy.mil

reidj@kpt.nuwc.navy.mil

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END

CTEC

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Drill-Down Slides

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COLLABORATIVE T2E2 CENTER (CTEC)

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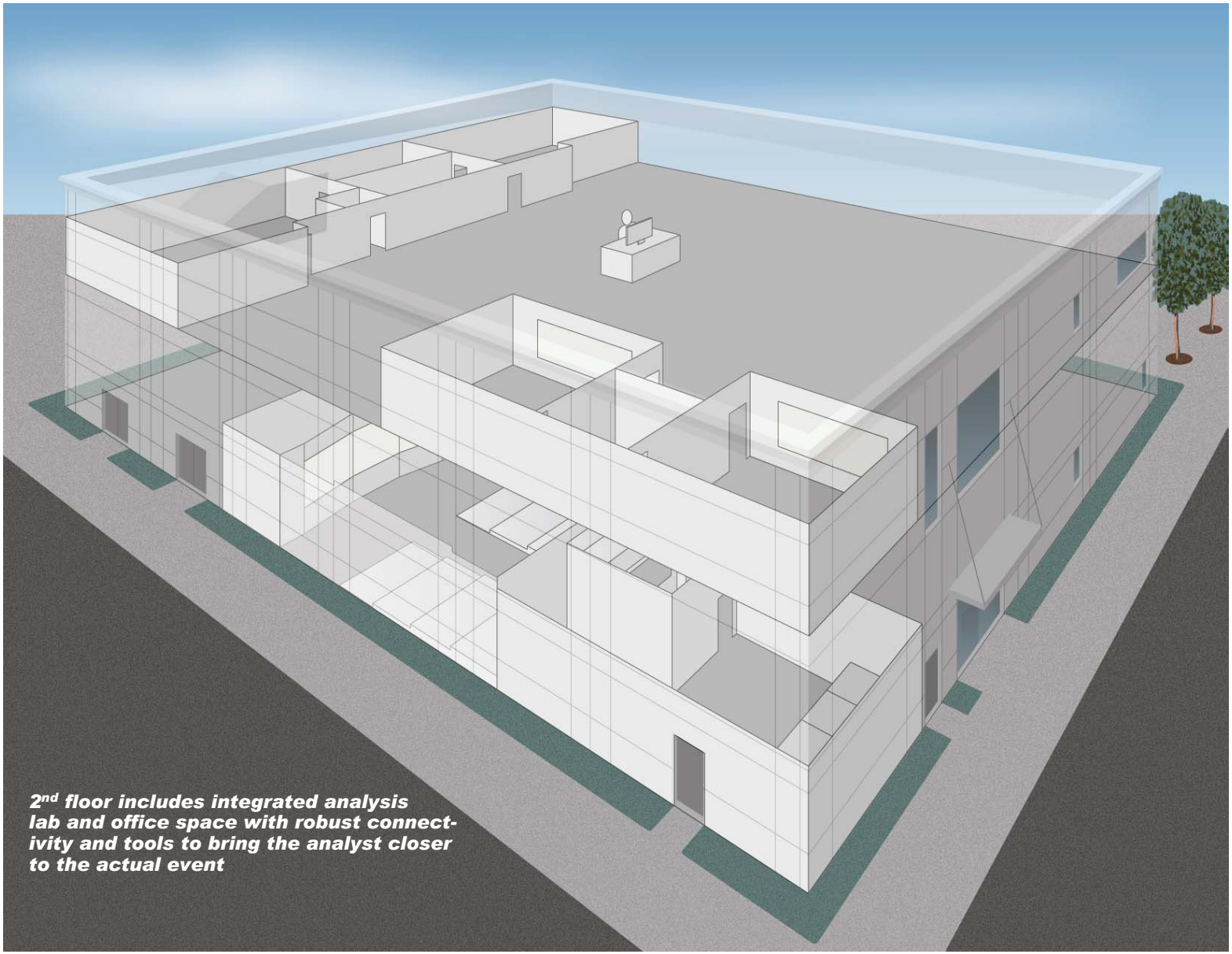
COLLABORATIVE T2E2 CENTER (CTEC)



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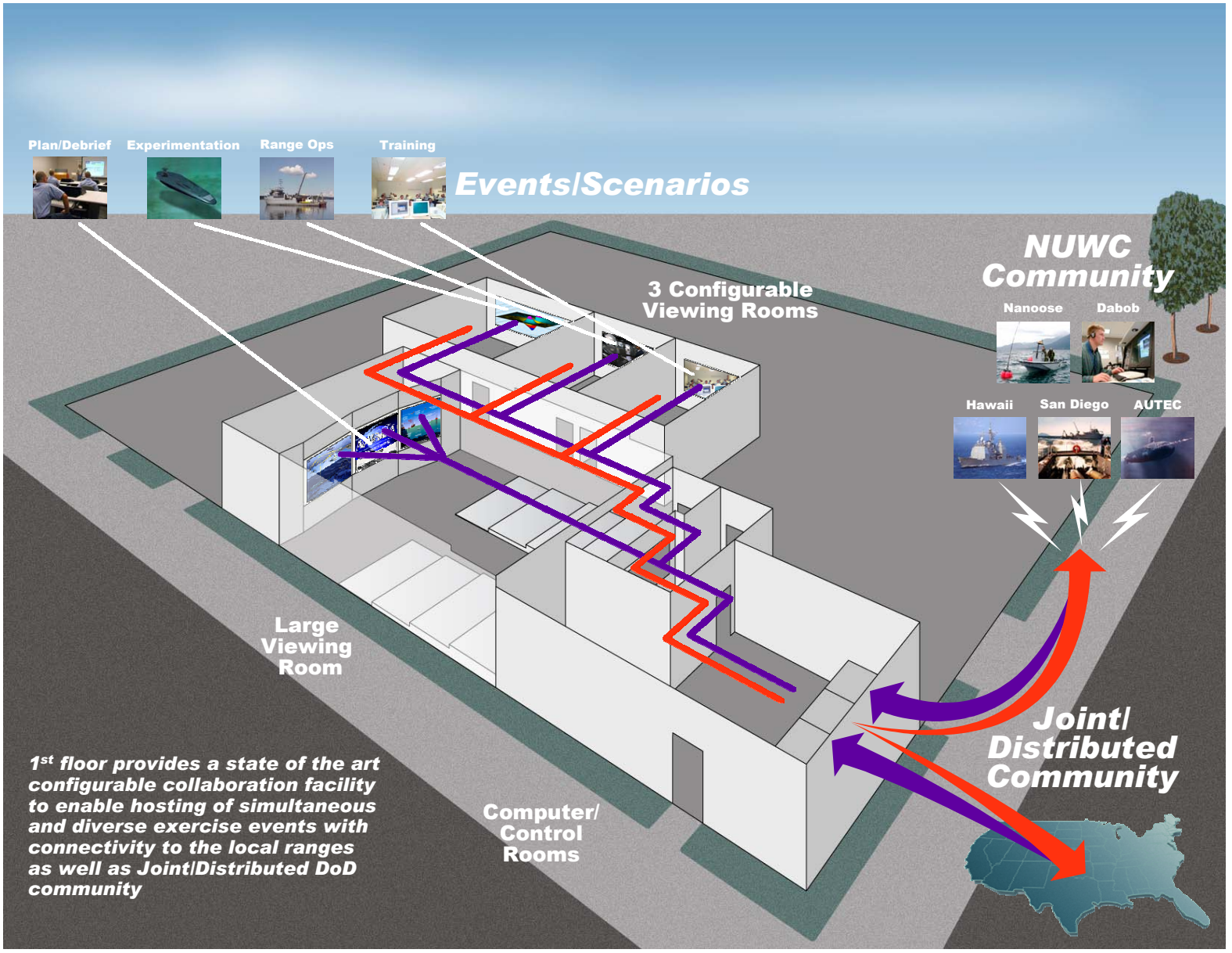
COLLABORATIVE T2E2 CENTER (CTEC)



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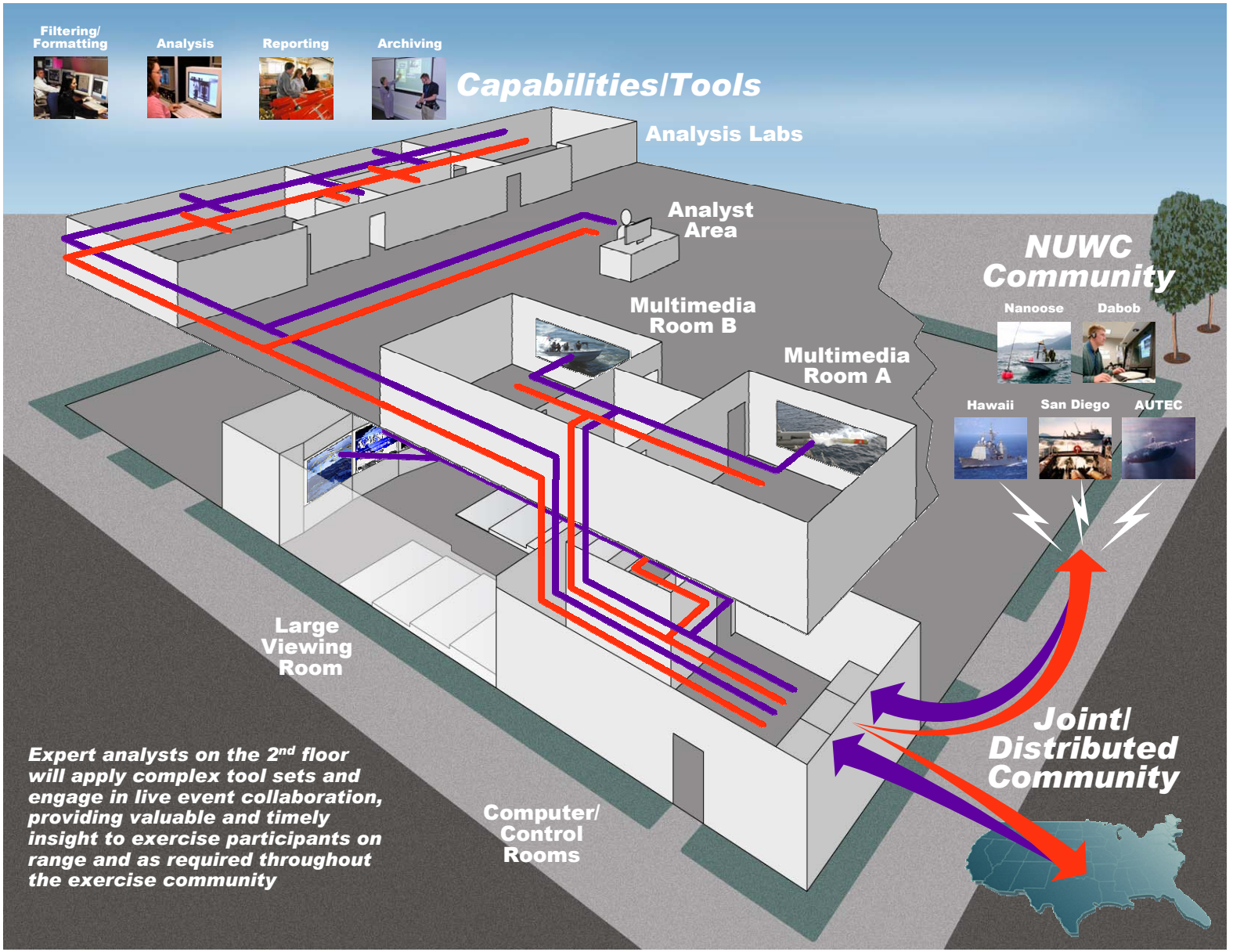
COLLABORATIVE T2E2 CENTER (CTEC)



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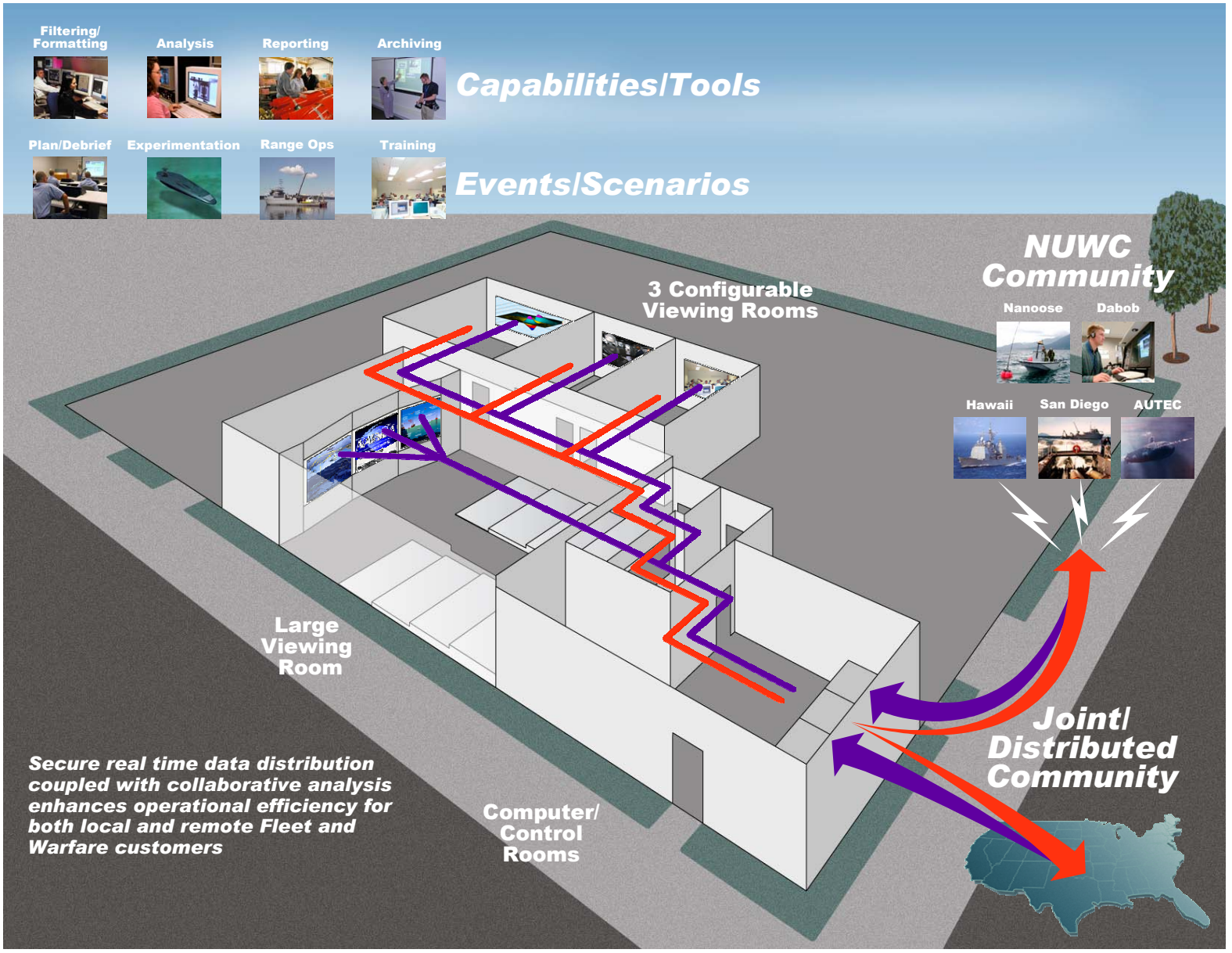
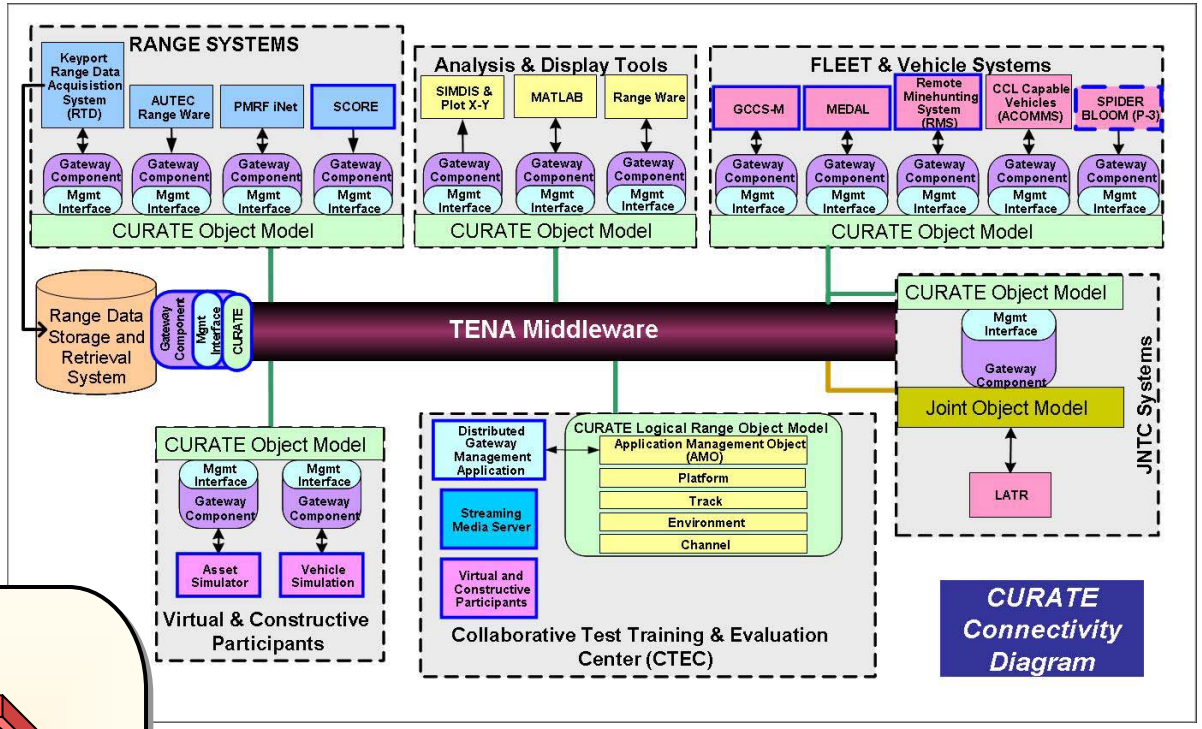
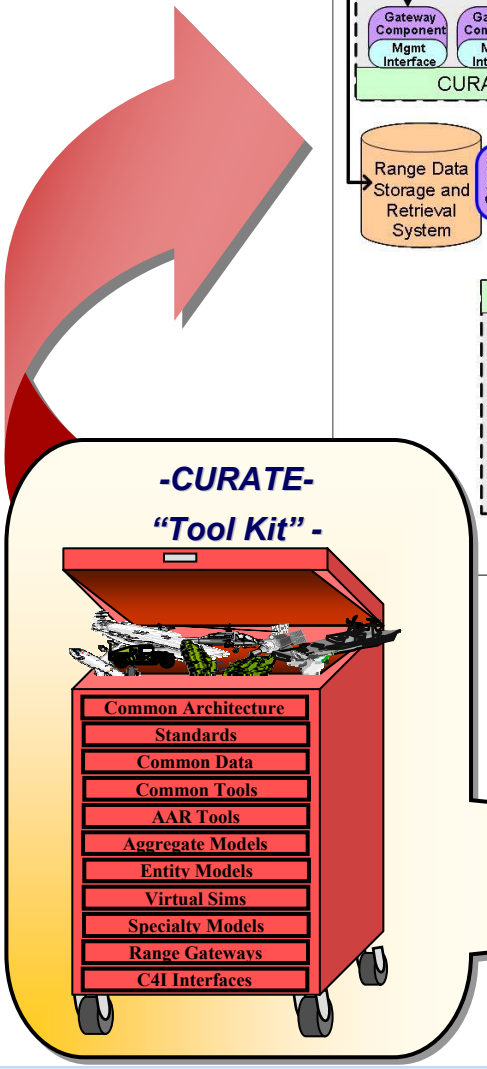
COLLABORATIVE T2E2 CENTER (CTEC)

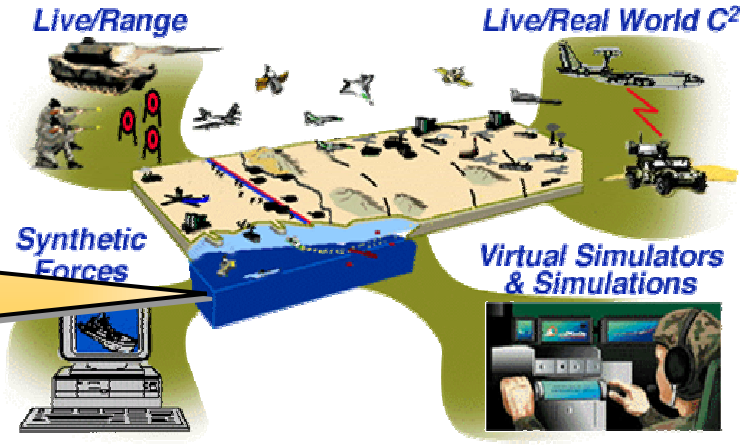


Common Undersea Range Architecture for Distributed T2E2 (CURATE)





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



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Common Undersea Range Architecture for Test/Training & Evaluation/Experimentation (CURATE)

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)

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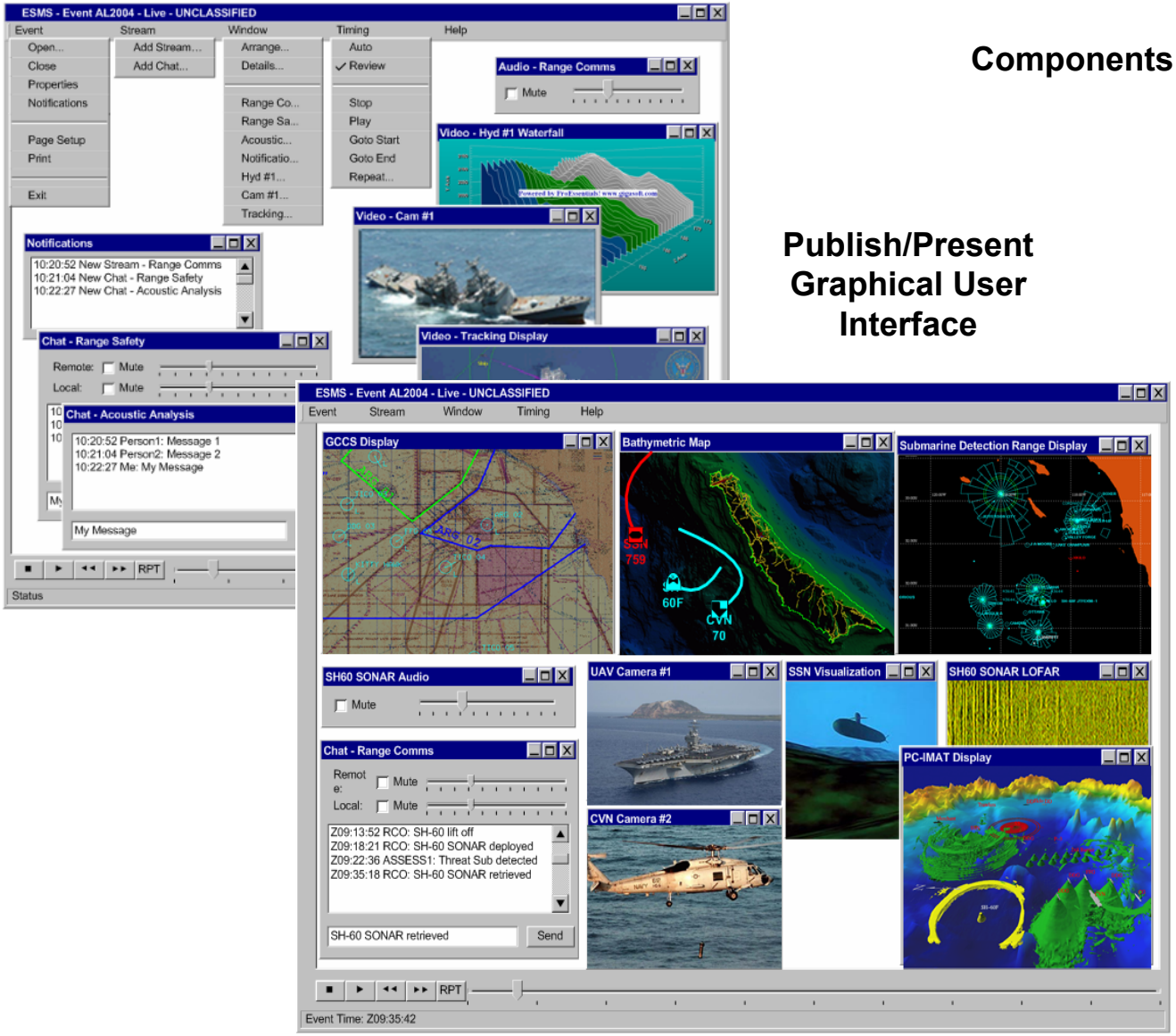
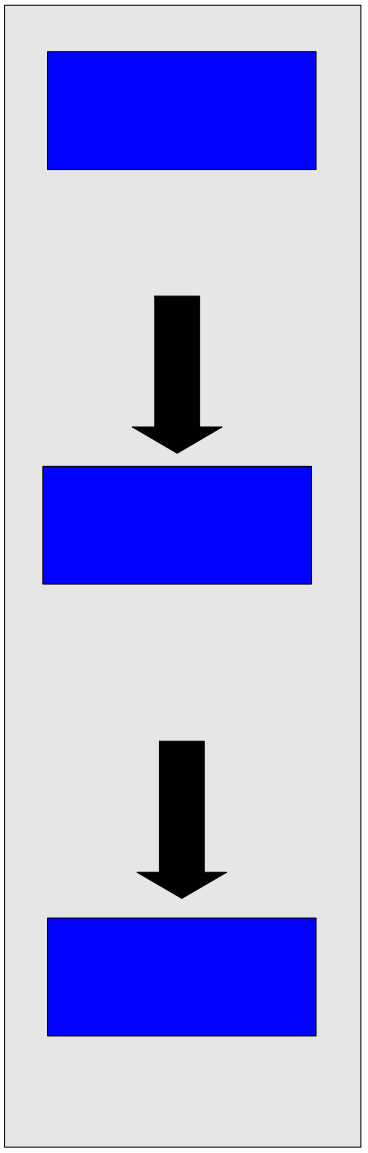
Event Streaming Media System (ESMS)



Components

Publish/Present Graphical User Interface



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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

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Event Planning and Assessment System (EPAS)

Process

Select the standard event type(s) that pertain to the current event

Select standard event performance parameters to be assessed for current event

Select the asset types to be utilized for the current event

Select the specific asset to be utilized for the current event

Select the asset-specific data types to be captured for the current event

Event Types
- ☐ Amphibious Landing
- ☑ ASW Event
- ☐ MCM Event
- ☐ NEO Event
- ☐ SOF ISR Event
- ☐ SOF Recon Event

→

Event Perf Measures
- ☐ Deployment Time
- ☑ Threat Classificatio
- ☑ Threat ID Success
- ☑ Threat ID Time
- ☑ Threat Kill Success
- ☑ Threat Kill Time

→

Event Asset Types
- ☐ CVN
- ☐ DDG
- ☑ SH-60
- ☐ SSGN
- ☑ SSN
- ☑ P-3C

→

Event Asset Types: SSN

Event Asset Instances
- ☐ SSN 688 (Live)
- ☐ SSN 724 (Live)
- ☑ Newport VSSN (Vi
- ☐ EB Sim SSN (Consty

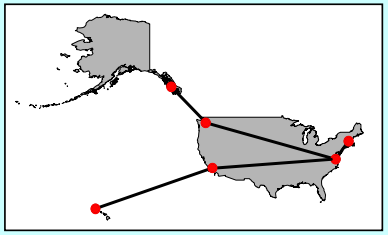
→

Event Asset Instances: Newport VSSN (Virt)

Asset Perf Params
- ☑ TSPI
- ☑ BSY-1 SONAR
- ☐ WAA SONAR
- ☑ Hydrophone Signals

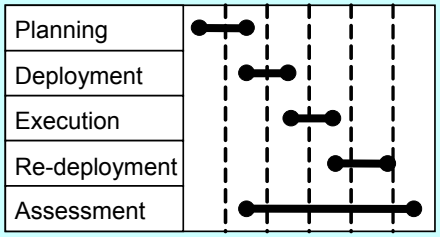
Tools

Automated Event Asset and Connectivity Map

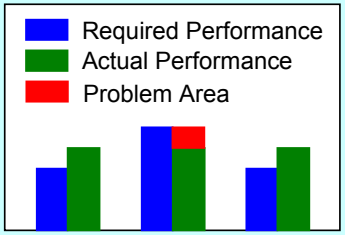


Constructive Event Simulation

Integrated Event Schedule



Dynamic Performance Evaluation Summary



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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

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Back-Up Slides

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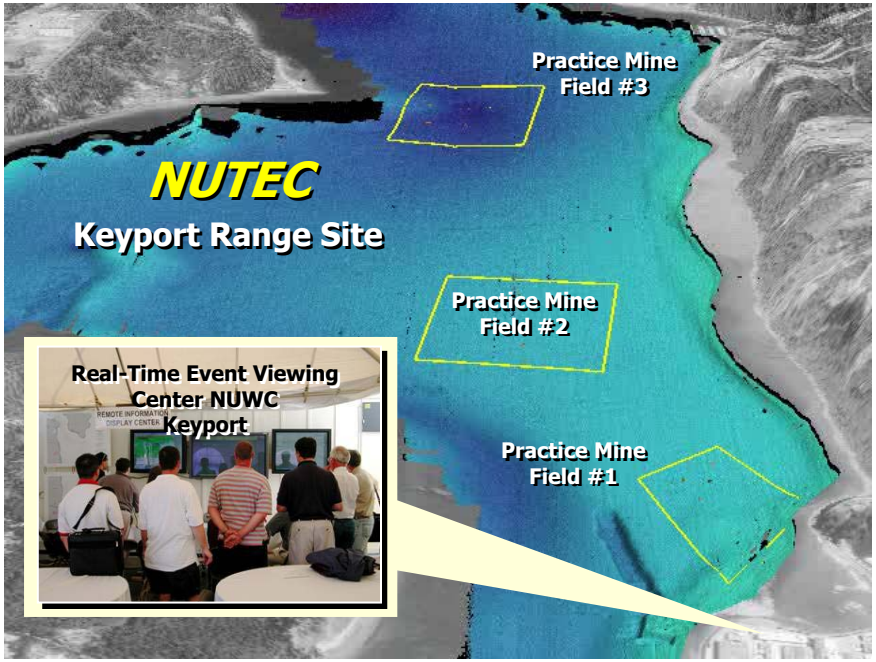
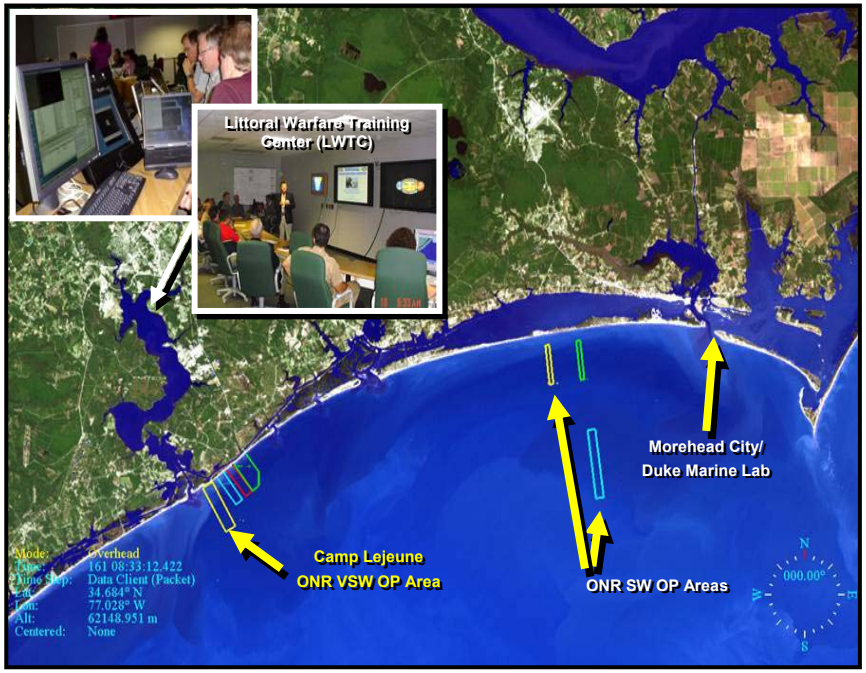
Recent CTEC USW T2E2 Efforts

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

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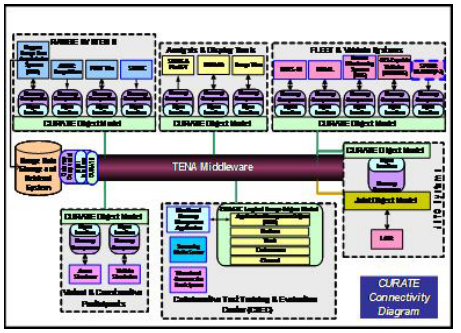
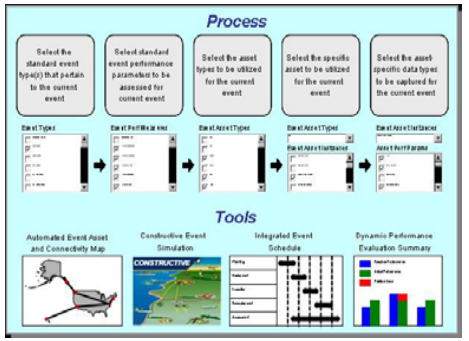
Strategy: Tool & Process Components

- **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

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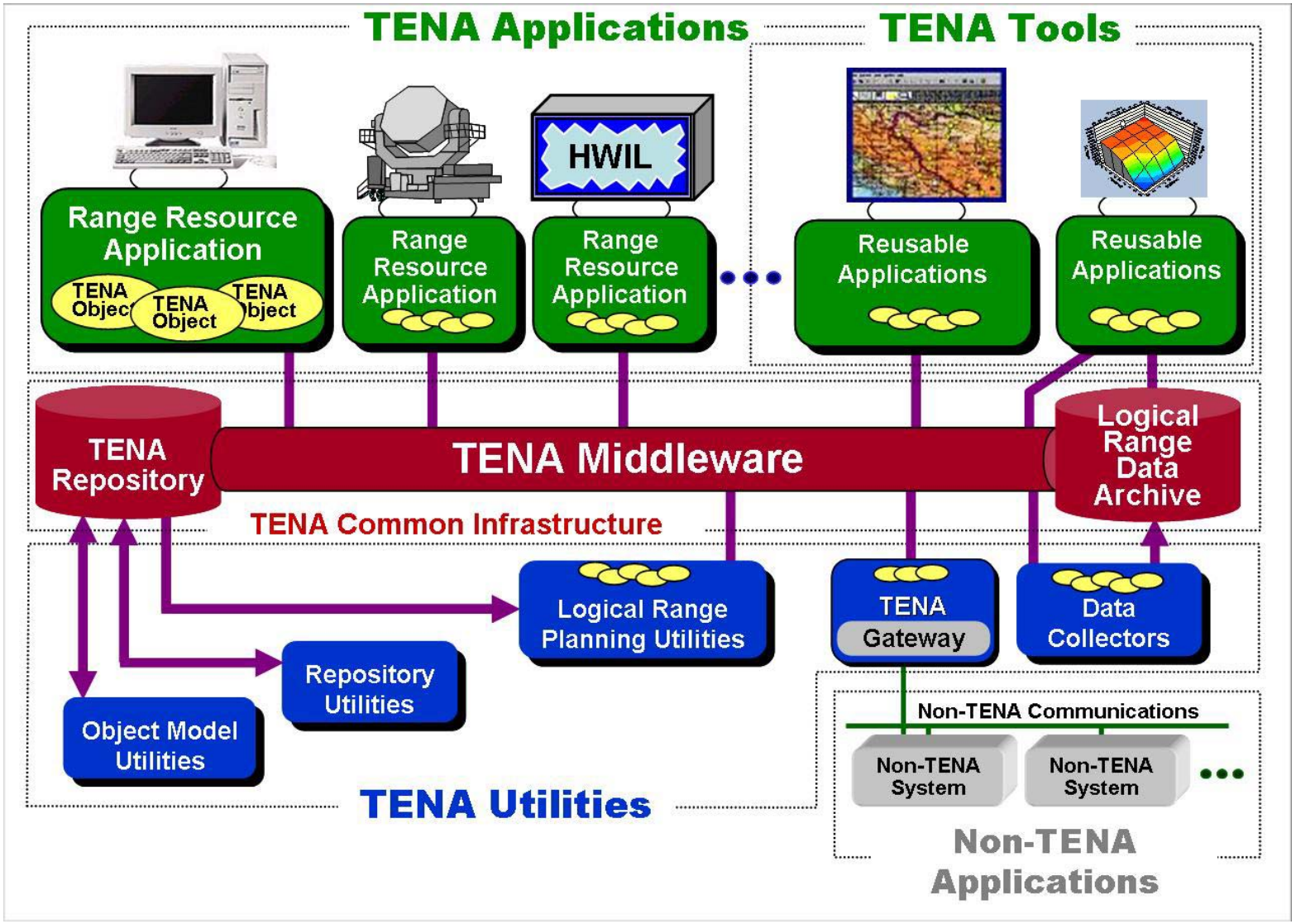
Test & Training Enabling Architecture (TENA)



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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.**

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AUV Fest 2005 Demonstrations

SPONSOR / Demonstrator		VEHICLE / TECHNOLOGY	CAPABILITIES TO BE DEMONSTRATED
ONR - Dr. Tom Swean			
	Nekton Research LLC	Ranger	Neutralization of Moored Target with Expendable UUV
	Nekton Research LLC	TransPhibian	VSW-to-Shore Vehicle Demonstration - Swimmer and Crawler Modes
	Lockheed Martin Perry Technologies	CETUS II RIN	Reacquire & ID
	NSWC Panama City / WHOI	REMUS 600 (12.75" UUV)	MCM Applications with REMUS 12.75 Inch UUV with SSAM
			Pictures Along Track Lines / Bathymetric & Environmental Measurements
	NSWC Panama City	CRAWLERS	S-C-M (VSW & SZ) & Acoustic-Communications-Only R-I Mission
			One-on-Many Neutralization with Vehicle to Crawler Vectoring
	Florida Atlantic University	Gateway Buoy	Gateway Communications, Air Deployable / Self-Mooring Buoy
	Naval Postgraduate School	ARIES	Blazed Array Sonar & Obstacle Avoidance
	Woods Hole Oceanographic Institution	REMUS (VSW)	S-C-M / ID - Cooperative, Multi-Vehicle Operations with CETUS II & Crawlers
	Autonomous Undersea Systems Institute	Solar AUV	Cooperative UUV Operations using "Mother Ship" Navigation Concept
	Hydroid, Inc	REMUS (SW)	SW S-C-M/R-I with Dual Frequency Side Scan Sonar, DIDSON, and Video
	NUWC Division Newport	BioRobotic AUV	Demonstrate Precision Maneuvering Capabilities
ONR - Dr. Tom Curtin			
	MIT	CARP	USV Cooperative Behavior with Kayaks
	Alaska Native Technologies	Slocum Glider	Noise Mapping with Gliders
	NAVAIR	Autonomy Software	Simulation/Display of Autonomy Software (Draper)
	APL / University of Washington	Seaglider	Seaglider Operations & Dissolved Oxygen / CTD Profiling
PMS EOD Programs			
	SPAWAR San Diego	GAVIA 8" UUV	Dual Frequency (900/1800 MHz), S-C-M / R-I, Iridium, Obstacle Avoidance
	NSWC Panama City	Bluefin 9 - SEA LION	Bluefin 9 (900 kHz), S-C-M Without Need for LBL Navigation Transponders
	NSCT-1	UUV Operations	UUV Operations and Verification of TACMEMO (Identification)
	ARL:University of Texas	COIN	Demonstrate Interface Between UUV / Diver Tools / Dolphin MCM
NSWC PC			
	NSWC Panama City	REMUS UUV and ASH USV	Remote Delivery of Unmanned System Technology (RDUST) Remote Launch of a REMUS UUV from an ASH USV
NUWC			
	NUWC Division Keyport	HAIL	Spread-Spectrum, LPI, Underwater Communication Systems
	NUWC Division Newport	MARV 12.75" UUV	Accurate Navigation, Color Video, and ACOMMS
	NUWC Division Keyport	CTEC	AUV Fest 2005 Common Operational USW Picture (COUP) & Remote Distribution
			Live, Remote, Virtual ISR Information Support to SDVT-1
			C^2 Linkage with SEAL Delivery Team ONE and NUWC DET in Hawaii
	NUWC Division Newport	ISR Vehicle Simulation	Simulation of an ISR Vehicle - To Show Up in the COUP Display
Other			
	Naval Oceanographic Office	HUSCy (USV)	Demonstrate Shallow Water Hydrography / Oceanography

- Independent Assessment & Evalution
- 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