INTEROPERABILITY TRACK
Chair: Gene Hudgins

- 1:00 p.m. – 1:30 p.m. Introduction to Interoperability and Remarks
- 1:30 p.m. – 2:00 p.m.

Interoperability and Persistent Connectivity: Keys for Successful Distributed Testing and Training

Mr. Gene Hudgins, TENA / JMETC, BAE Systems

- 2:00 p.m. – 2:30 p.m.

"TENA in Resource Constrained Environments" (TRCE): Technologies to Support Wireless Instrumentation Interoperability

Mr. Tom Treakle, TRCE, SAIC

- 2:30 p.m. – 3:00 p.m.

The Extension of CIAV from the Central Command to the Other U.S. Area Commands

Mr. Michael Leite, PE, TASC-N/DigiFlight Inc., JITC

- 3:00 p.m. – 3:30 p.m. Break with Exhibitors
- 3:30 p.m. – 4:00 p.m.

System Architecture Declarative Semantic Formal Versions to Debug Knowledge Bases

Ms. Lidia Zamarrón and Eric Smith, University of Texas at El Paso, and J. Carlos Acosta, UAEM

- 4:00 p.m. – 4:30 p.m.

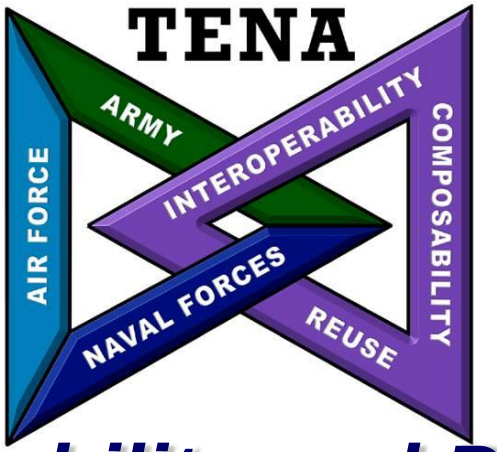
Historical Snapshot and Future Direction for the Coalition Interoperability Assurance and Validation (CIAV)

Mr. Michael Leite, PE, TASC-/DigiFlight Inc., JITC

- 4:30 p.m. – 5:00 p.m.

Defending the Realm: "What is Working and What is Not"

Srinivas Mukkamala Ph.D., Institute for Complex Additive Systems Analysis (ICASA), Computational Analysis and Network Enterprise Solutions (CAaNES), New Mexico Tech



Interoperability and Persistent Connectivity: Keys for Successful Distributed Testing and Training

Gene Hudgins

TENA and JMETC User Support Team Lead

Test Resource Management Center

TENA Mission

- **Historically, range systems tend to be developed in isolation, focused on narrow requirements, and constrained by aging techniques/technologies**
- **Range infrastructures have grown organically with minimal coordination or sharing, resulting in duplicated effort and many "stove-pipe" systems**

The purpose of TENA is to provide the necessary enterprise-wide architecture and the common software infrastructure to:

- Enable interoperability among range, C4ISR, and simulation systems used across ranges, HWIL facilities, and development laboratories
- Leverage range infrastructure investments across the DoD to keep pace with test and training range requirements
- Foster reuse of range assets and reduce cost of future developments

Working with the Range Community to
Build the Foundation for Future
Test and Training Range Infrastructure

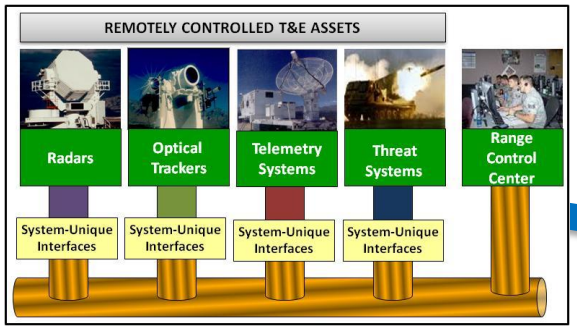
TENA is…

- An architecture that many government organizations & vendors use to build interoperable systems
- A highly robust, GOTS network data transport architecture
- A series of common applications applicable across the community
- Built for "performance, performance, and performance"
- Fully sustained by the DoD for the test and training communities
- Fully controlled by the community of its users
- Revised based on user feedback and lessons learned from working software implementations
- Designed to be hard to use wrong
- Backwards Compatible (from Release 6 onwards)
- A solution, not a requirement

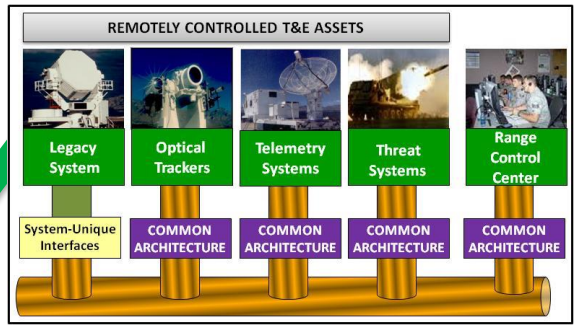
Where TENA is Used

- **<u>Any</u> situation where data needs to be passed over Internet Protocol (IP) networks to include:**
  - Interfacing two or more systems for information exchange
  - Across programming languages and computing platforms
  - Receiving system health & status information
  - Remote command & control of one or more systems
  - Real-time dissemination of instrumentation data
  - Communicating with web applications & browsers
  - Injecting virtual and/or constructive data with live assets and instrumentation

Notional "Current State" of Range Operations



Result: Inefficient, Non-interoperable "stove pipes"



Limited commonality within and between ranges

Range-Unique Architecture

Range-Unique Architecture

Range-Unique Architecture

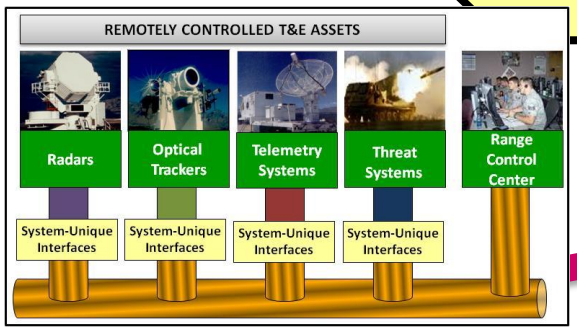
Range-Unique Architecture

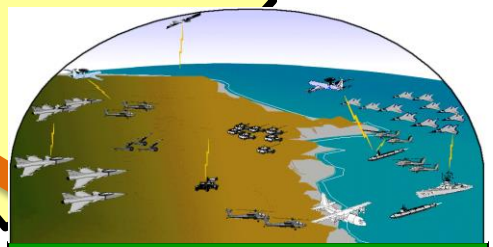
DoD-wide Limitations:

- Limited Resource Sharing
- Unique Interfaces for the same assets located at different ranges
- "Single-point" solutions each with their own sustainment tail
- No Guarantee of Inter-Range Interoperability

Range Limitations:

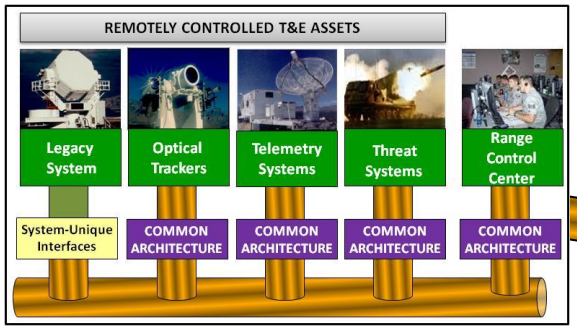
- Single-point solutions each with their own sustainment tail
- Increased integration time
- No Guarantee of Intra-Range Interoperability

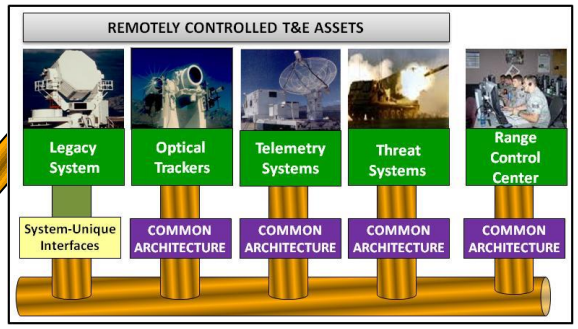




Remotely Operated LVC Range

Notional "Efficient State" of Range Operations



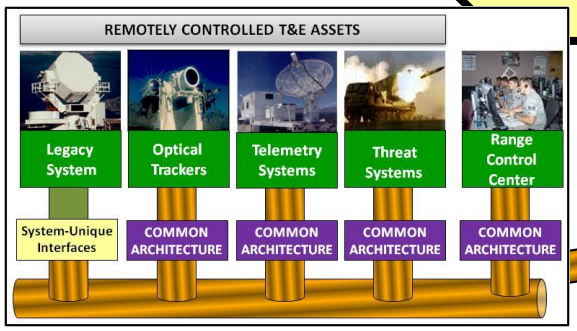


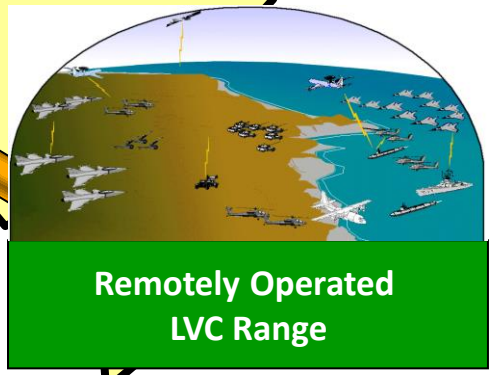
DoD-wide Common Architecture Benefits:

- "Plug and Play" instrumentation across test ranges
- Common solutions shared and reused between ranges
- Shared sustainment burden
- Facilities sharing of range operators

Range Benefits:

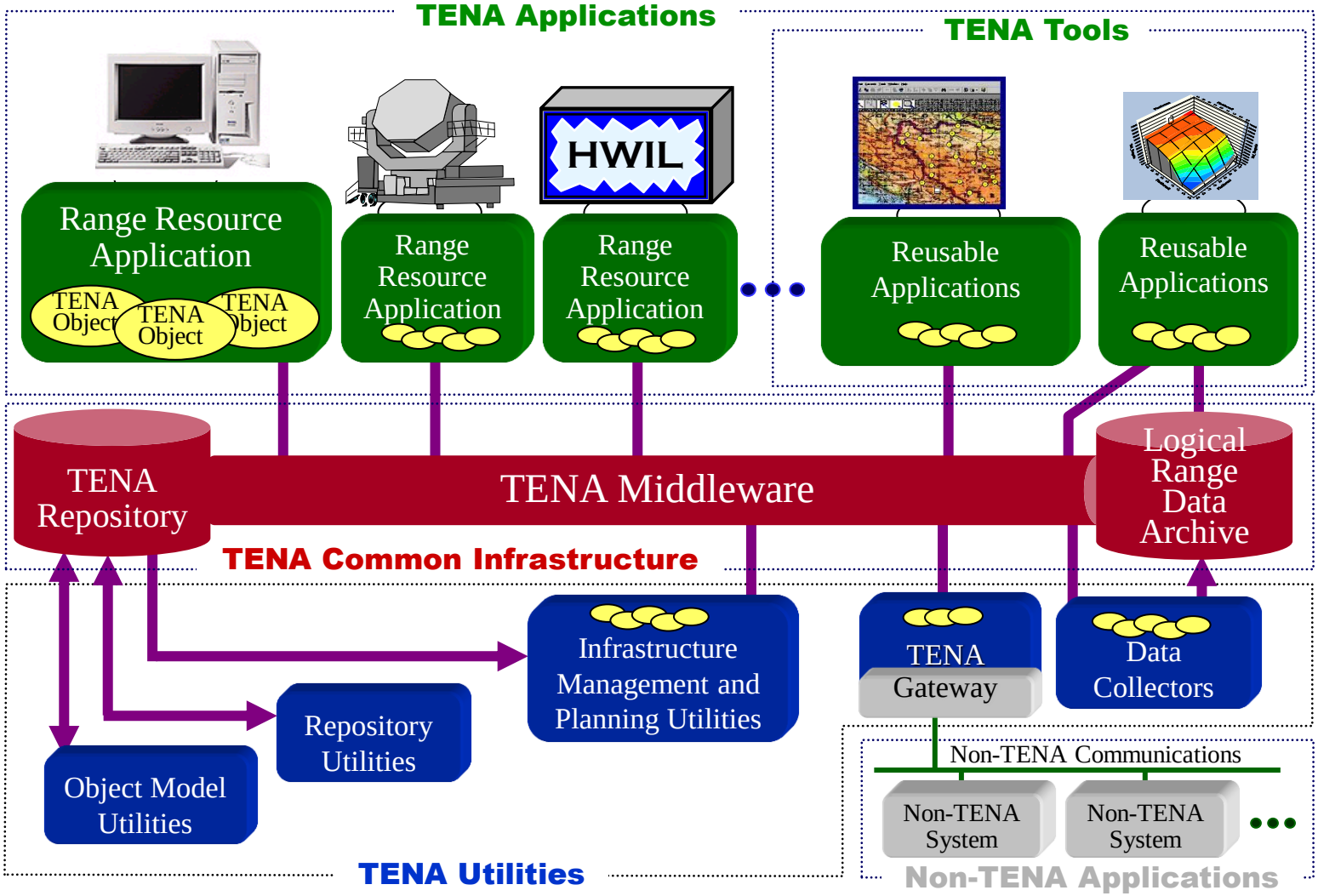
- Reduced Range O&M costs
- Reduced test setup & re-configuration time
- "Data Contract" that assures Intra-Range Interoperability





Remotely Operated LVC Range

TENA Architecture Overview



Benefits of TENA

- **All TENA software and support is free to users**
- **TENA is a very capable and sophisticated interoperability solution**
- **TENA software is thoroughly tested and very reliable**
- **TENA Auto-Code Generation makes creating a TENA application as simple as possible**
  - Auto-generated example / test programs streamline integration
  - TIDE Tool manages installation and configuration, upgrading and maintenance
  - Auto-generated starting points mean you never start with a blank page
  - Rapid development of real-time, distributed, Live-Virtual-Constructive applications
- **TENA's technical approach emphasizes cost savings and reliability**
  - The TENA software is hard to use wrong
  - TENA catches many user errors at compile time rather than run time
  - TENA Tools provide extensive understanding of an event
- **TENA has a standard object model enhancing interoperability**
- **The TENA web site/repository has extensive documentation, training, and collaboration capabilities**
- **TENA has a plan for evolution and funding to execute this plan!**

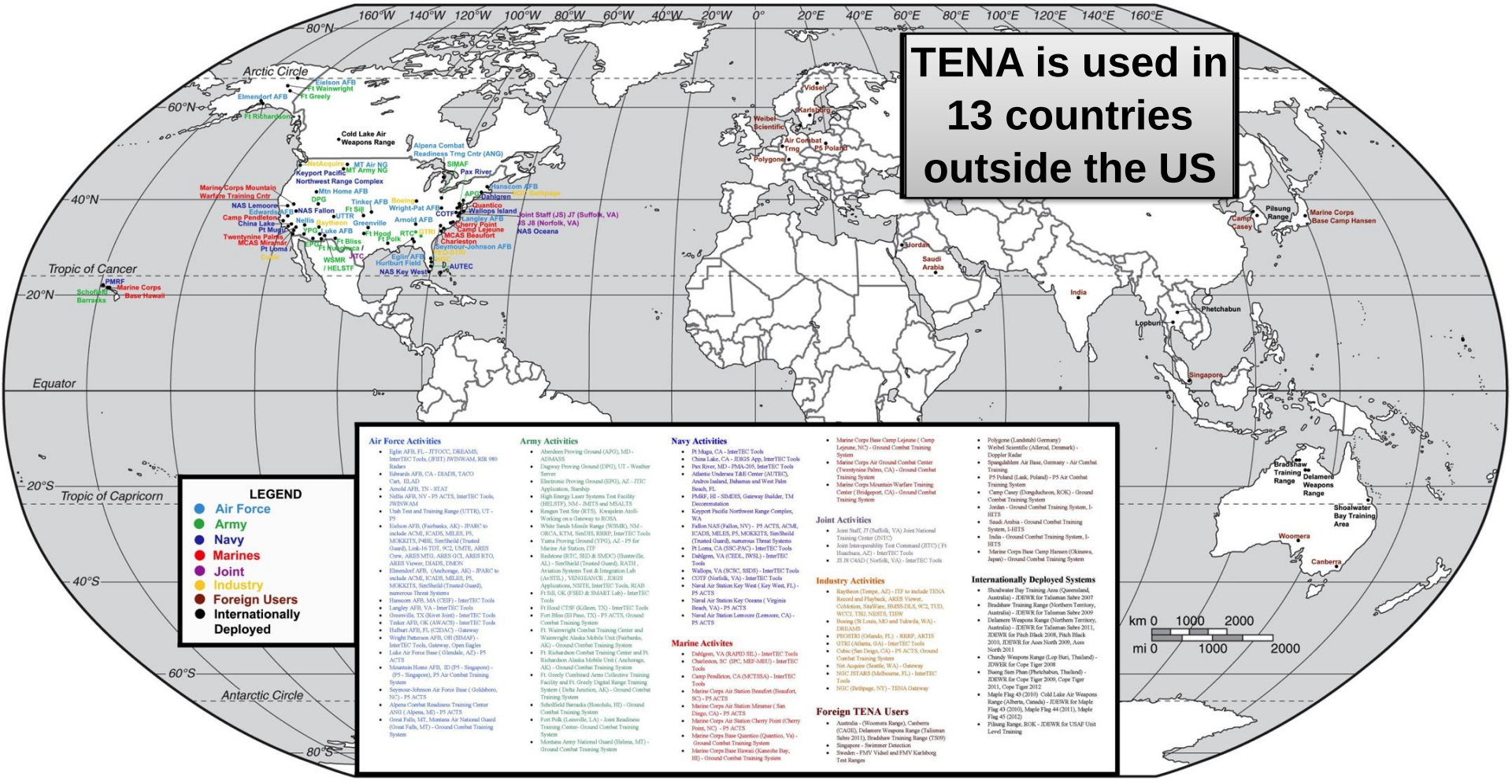
TENA is an Open Architecture

- **The Software Engineering Institute defines an Open System as:**

  "A collection of interacting software, hardware, and human components designed to satisfy stated needs with interface specifications of its components that are fully defined, available to the public, maintained according to group consensus, in which the implementations of the components conform to the interface specifications."

- **TENA is maintained according to a consensus of its users assembled as the Architecture Management Team (AMT)**
- **TENA Middleware is U.S. Government owned**
  - No proprietary software
- **TENA is freely releasable (Distribution Statement A)**
- **We have many non-U.S. users**

Worldwide Use of TENA



Architecture Management Team (TENA AMT)

AMT Members:

- 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
- Naval Air Warfare Center – Weapons Division
- Yuma Proving Ground (YPG)
- P5 Combat Training System (P5CTS)
- Joint National Training Capability (JNTC)
- 329 Armament Systems Group (329 ARSG)
- 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 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)
- Joint Mission Environment Test Capability (JMETC)
- Common Range Integrated Instrumentation System (CRIIS)

Advising Members:

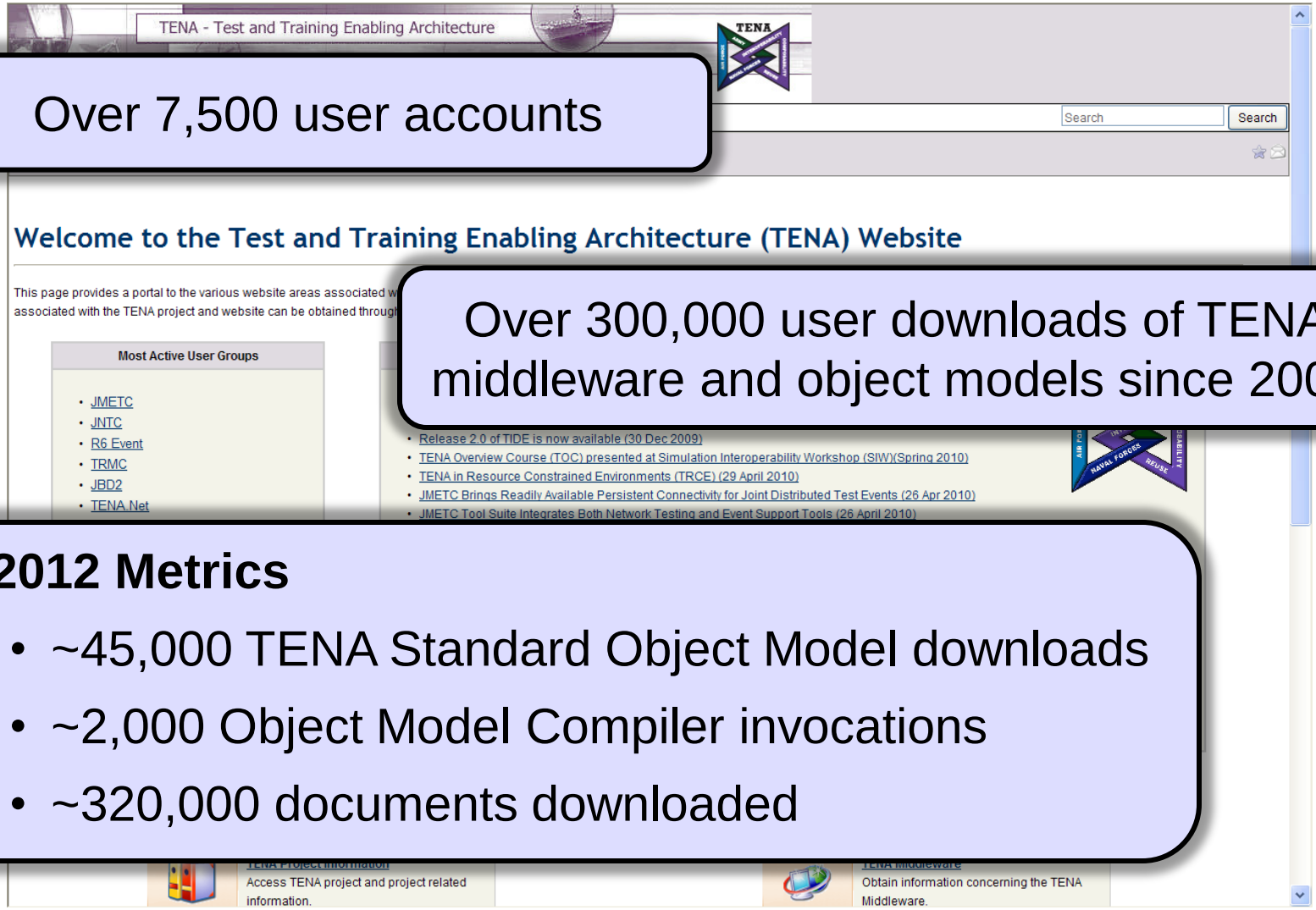
- Boeing
- Cubic Defense
- DRS
- Embedded Planet
- EMC
- General Dynamics – C4 Systems
- KEnetics Incorporated
- MAK Technologies
- NetAcquire
- Raytheon Missile Systems
- Raytheon Trusted Computer Solutions
- Science Applications International Corporation (SAIC)
- Scientific Research Corporation (SRC)
- Scientific Solutions, Inc. (SSI)
- Ultra Electronics ProLogic

International Members:

- FMV, Swedish Defense Material Administration

- **Design Decisions / Trade-offs / Status / Technical Exchanges of Lessons Learned / Use Cases / Testing / Issues & Concerns Identification, Investigation & Resolution**

TENA Web Portal
http://www.tena-sda.org/



Over 7,500 user accounts

Over 300,000 user downloads of TENA middleware and object models since 2006

2012 Metrics

- ~45,000 TENA Standard Object Model downloads
- ~2,000 Object Model Compiler invocations
- ~320,000 documents downloaded

TENA Information Assurance (IA) Activities

- **Air Force Evaluated/Approved Product List (E/APL)**
  - Approved 11/18/2010, currently preparing test results for TENA Console
- **Navy Application & Database Management System (DADMS)**
  - Approved 6/27/2011
- **Army Certificate of Networthiness (CoN)**
  - Approved 5/22/2012 with RTC ATO, and covers middleware, EM, TENA Console and TENA-enabled applications
- **S/DREN (Secret/Defense Research and Engineering Network)**
  - TENA protocol and TENA-based applications approved between DREN and SDREN sites
- **NIPRnet**
  - JTTOCC (which uses TENA) obtained ATO 12/27/2012
- **DIACAP**
  - InterTEC tool suite (which uses TENA) currently in DIACAP testing (with AF 46TS)
- **Cross Domain Solutions**
  - TENA used with Radiant Mercury cross domain guard for bridging information associated with certain Common Training Instrumentation Architecture (CTIA) events
  - TENA-enabled Cross Domain trusted guard SimShield v2.2.0.1 on baseline list
  - Currently working with J7 with the GOTS DTNG (Distributed Training Network Guard) product to integrate TENA and is planned to be certified and accredited in the FY2014/15 timeframe

TENA project working with IA organizations to reduce cost and delays with ability to operate TENA applications

Anatomy of a TENA-Compliant Software Application

User Application Code:

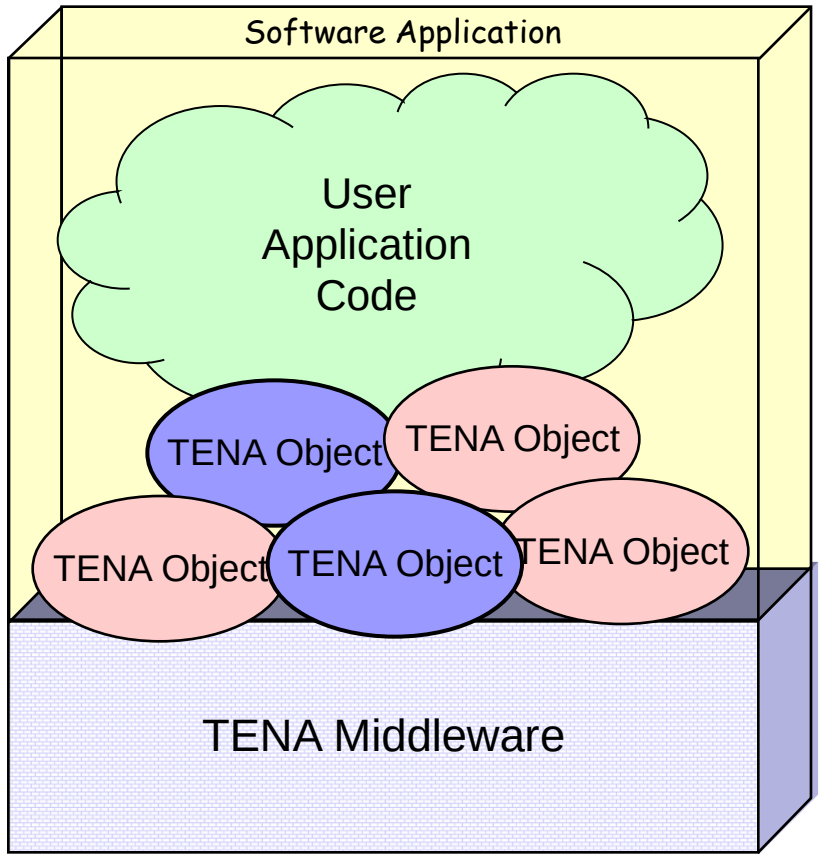
Specific to an individual application (range instrumentation, display system, analysis system, simulation, etc.)

Object Model Code (Auto-Generated):

Standard data definitions and common software algorithms

TENA Middleware Code:

Common across all TENA applications



Will TENA work for my development and operational environment?

- **TENA needs to support diverse development and operational environments**
  - Programming Language
  - Computer Architecture
  - Computer Operating System
  - Network Characteristics
- **TENA Supported Programming Languages**
  - TENA currently supports C++, Java, and Microsoft .NET programming languages
  - Additional languages are supported through a language independent interface generator technology called SWIG
  - Developing a Web-based language binding that permits interaction with a TENA distributed event
  - Python language binding is anticipated to support quick and agile testing support
- **Computer Platforms**
  - TENA software is built and tested across ~50 different computer architectures, operating systems, and configurations (e.g., Windows XP with Visual Studio 2005, Red Hat Enterprise Linux 5.8 with GCC 4.1.2, Mac OS X 10.7 with GCC 4.2.1, Fedora 18 64-bit with GCC 4.7.2)
  - TENA software has been ported to Overo Gumstix embedded device, Apple iOS iPhone/iPad, and Android mobile phones
  - Through separate TRMC S&T investments, currently integrating capabilities to support the operation of TENA across low data rate and high data-loss network links

TENA software is built, tested, and used in many different environments which improves software robustness

TENA is Designed to be Hard to Use Wrong!

- **Lots of software is supposed to be easy to use … right**
- **But trying to create software that's "easy to use" often results in something that is easy to use … wrong**
- **TENA's software is designed to be "hard to use wrong"**
  - More often than not that implies "easy to use right"
- **TENA's computer-enforced "data contracts" prevent (or detect) errors before they can undermine interoperability**
  - Reduces development time, cost, and risk
- **System interfaces defined using TENA can be automatically translated to actually runnable software in minutes**
  - How much time, money, and risk is involved in translating a "paper" specification into actually runnable software?

How do we use TENA for a particular system?

1. **Determine the "ins and outs" of the Particular System**
   - Any system that needs to interoperate with other systems needs to define the data and services shared with these other systems—TENA defines these "ins and outs" as formal data contracts that are easily understood by humans and enforced by computers
   - Determine if existing interfaces (called object models) already exist—TENA Repository has over 1,200 object models that have already been defined by the user community
2. **Auto-Generate Application Source Code**
   - TENA Repository will automatically generate tested and working source code based on the user's particular object models—developers just need to replace the "dummy" behavior for setting/getting attribute values and implementing methods
3. **Integrate Generated Code into Existing System**
   - Working example code simplifies ability to insert the TENA specific code into an existing system, or the example code can be used as the basis for developing a new system
4. **Connect System to Network to begin Collaborating with Others Systems**
   - Publish-Subscribe paradigm makes it easy (no event specific configuration) for multiple participants to share data and services, as well as providing support for redundancy and evolution to new systems

TENA's auto-code generation capability creates tested and proven user specific example applications in minutes!

TENA Standard Object Models

- **Platform Related OMs**
  - TENA-**Platform**-v4
  - TENA-**PlatformType**-v2
  - TENA-**PlatformDetails**-v4
  - TENA-**UniqueID**-v3
  - TENA-**Munition**-v3
- **Sensor/Navigation OMs**
  - TENA-**EmbeddedSystem**-v3
  - TENA-**GPS**-v3
  - TENA-**Pointing**-v1
  - TENA-**Radar**-v3.1
  - TENA-**SyncController**-v1
- **Time-Space-Position Related OMs**
  - TENA-**Time**-v2
  - TENA-**TSPI**-v5
  - TENA-**SRFserver**-v2
- **Military Related OMs**
  - TENA-**Engagement**-v4
  - TENA-**Exercise**-v1
- **Event Support OMs**
  - TENA-**AMO**-v2

Key Considerations for Using TENA Compared to Range Specific Solutions

There are several important considerations when comparing a common distributed real-time collaboration architecture, such as TENA, to a range specific solution:

1. Performance *(Example: throughput and latency)*
2. Development *(Example: time to write code, time to test)*
3. Lifecycle *(Example: cost / degree of difficulty to change and maintain code)*

1. **Performance: TENA has negligible performance degradation**
   - Latency from using TENA (independently tested at <1ms one-way) does not prohibit intra-range update rates greater than 100 Hz
   - TENA packet header well within tolerance of today's network environment
2. **Development: TENA promotes reusable software building blocks and provides automatically generated code to simplify development**
   - Defining a TENA object model is a simple as defining typical range protocol messages
   - In a multiple developer environment, TENA enables faster software development, integration, and testing due to the ability for the middleware to ensure proper adherence to the common object models
3. **Lifecycle: TENA enables lifecycle cost sharing by leveraging development, testing, and technology advancements from across the user community**
   - Fewer custom software libraries that need to be understood / maintained by the range
   - Removes "single points of failure" and dependencies on contractors to sustain capabilities
   - DoD-wide use of TENA ensures future support of legacy system-system communications
   - TENA-enabled systems can "plug and play" at other DoD ranges

Will TENA meet my performance requirements?

- **Users are encouraged to conduct experiments by customizing the auto-generated example programs to be representative of actual systems**
  - Use actual object models, computers, and networks
- **Primary requirement for TENA is to support high performance, real-time distributed communication**
  - TENA uses compiled code to avoid interpretive marshalling / demarshalling
  - Minimizes data copies, utilize single thread to perform network write, etc.
- **Representative TENA Middleware Performance**
  - TENA Platform updates (Dell laptops from ~2008 running Windows 7 x64)
    - **Update Throughput: 9,700 updates/second**
    - **Update Latency: 0.35 milliseconds**

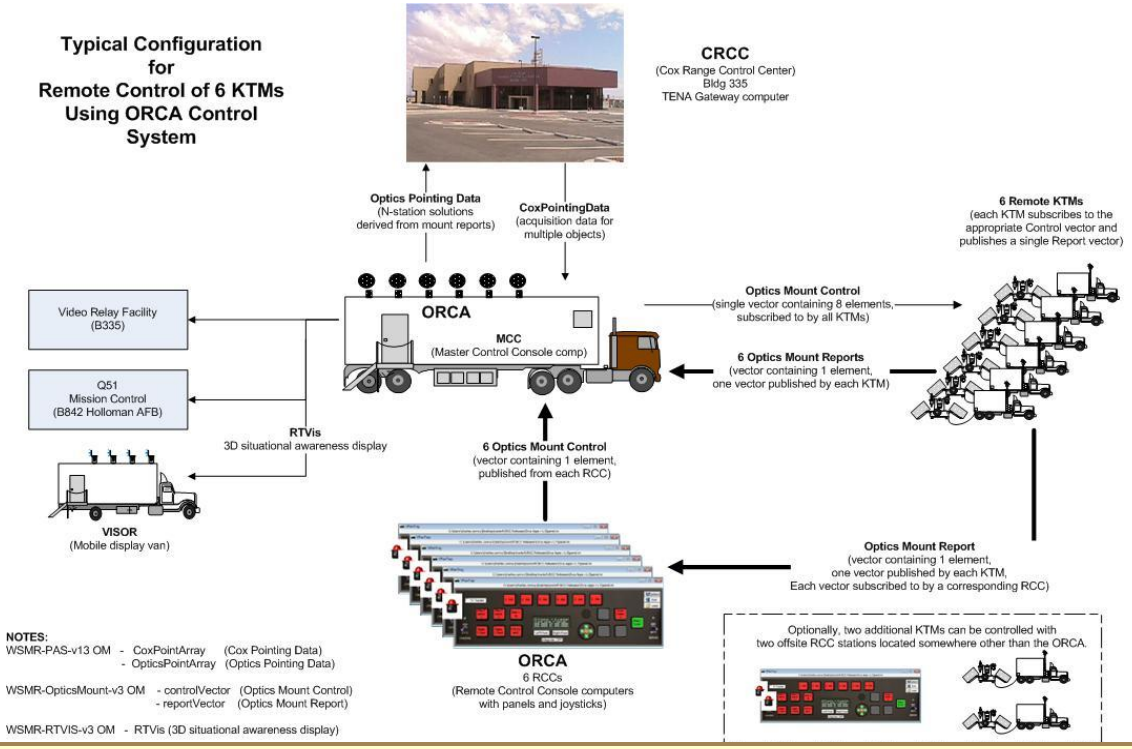
TENA enables test & training solutions
that are cheaper to build, field, maintain, and improve

Some Examples of TENA Usage

- InterTEC (C4ISR stim/sim/collection)
- JDAS (data archive)
- TVDS (video distribution)
- JMITS (live range IR threat emulator)
- MSALTS (live countermeasure emulator)
- SIMDIS (range display)
- Starship (event control)
- Gateways (translators to DIS & HLA)
- CTIA (training instrumentation)
- ARDS (precision TSPI)
- CRIIS (next generation precision TSPI)
- P5 (precision TSPI / ACMI)
- NACTS (precision TSPI / ACMI)
- MMTS (high dynamics optical tracker)
- SimShield (trusted data guard)
- MatLab (data analysis)
- IVT (interface/network verification tools)
- JAAR (after action review)
- JIMM (constructive simulation)
- JSAF (constructive simulation)
- DCIT (distributed monitoring)
- Link-16 translator (Link-16 over WAN)
- RATH (aircraft survivability test control)
- JPARC (LVC force-on-force training)
- PET (air picture data analysis system)
- JWinWAM (test assessment tool)
- Real-time Casualty Assessment System
- ICADS (individual combat aircrew dis. sys.)
- ATREP (training instrumentation)
- iNET (wireless networking)
- CRS-P (constructive simulation)
- AEA HWIL (airborne electronic attack lab)
- OT-TES (tactical engagement sys for OT)
- ADMAS (embedded vehicle instruments)
- HWIL RF threat injection system
- Radars (tracking, surveillance, miss-distance)
- RRRP (Range Radar Replacement Program)
- Range optics (high fidelity remote control)
- Threat systems
- UAV remote control of sensors
- Range safety systems
- Embedded instrumentation
- Weather server (distribution of weather data)
- Player ID server (Unique ID for entities)
- Open air range acoustic sensors
- Undersea hydrophone instrumentation
- Live video – synthetic scene integration
- JTOCC (range operations control center)

TENA at White Sands Missile Range (WSMR)

- **TENA has been supporting the real-time distributed operation of the WSMR optics systems for the past 6 years, including data exchange and remote operation**
  - Based on the success of optics, TENA is being expanded to other range systems



"TENA has functioned extremely well in our network environment and the rigorous requirement of 60 Hz updates to the instrumentation."

Charlie Conroy
WSMR Optics Development Engineering Lead

Mobile Multi-Sensor TSPI System (MMTS) Project

- U.S. Army Program Executive Office (PEO) for Simulation, Training, and Instrumentation (STRI) awarded Photo-Sonics, Inc. a contract to build the Mobile Multi-Sensor Time-Space-Position-Information-System (MMTS)
- The MMTS consists of two high-performance optical tracking pedestals connected via fiber optics to a control van equipped with two remote control consoles, the system was designed to track and provide high accuracy Time-Space-Position-Information (TSPI) of high-speed weapons including hyper-velocity projectiles
- Functional testing and Final Site Acceptance Test completed at White Sands Missile Range (WSMR)
- Final system has been delivered and integrated via TENA Interface into Redstone Arsenal

System Characteristics

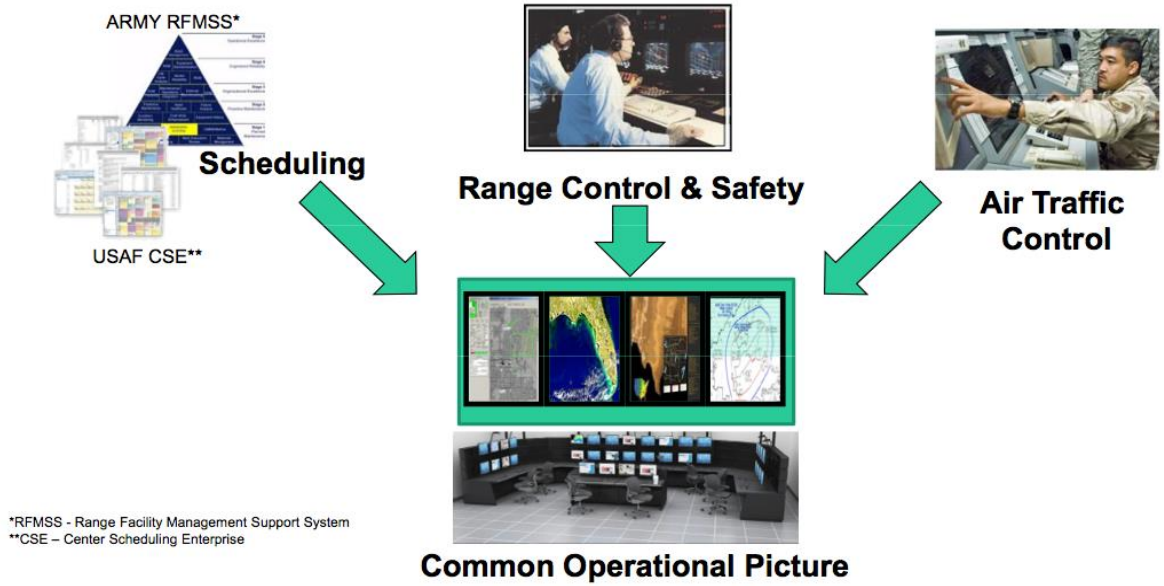
- Fully Integrated Pedestal and Sensor Control Software
- Radar provides a Single Station Solution
- High-Speed Auto Tracker (250 FPS)
- High Accuracy
- High Dynamics
- Automated Stellar and Turn & Dump Calibration
- Simulation System
- Range Interface Computer to calculate real-time 3D data
- Integrated Data-Reduction Software (six degrees of freedom)
- TENA Integration into RTC

"TENA architecture was instrumental in the development of the interoperability between the MMTS and the Integrated Test Range. Implementing the various TENA modules was simple, smooth, and straightforward with no major effort needed."

Philip Kiel
President, Photo-Sonics

TENA at Eglin Air Force Base

- **TENA supports Eglin's Joint Test and Training Operations Control Center (JTTOCC) in providing efficient, flexible real-time control of all resources required for safe air, land, and sea test and training 24x7 operations**

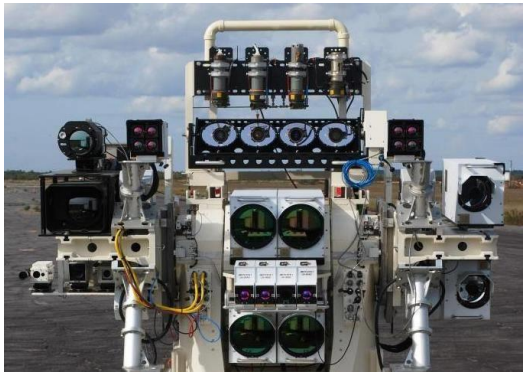


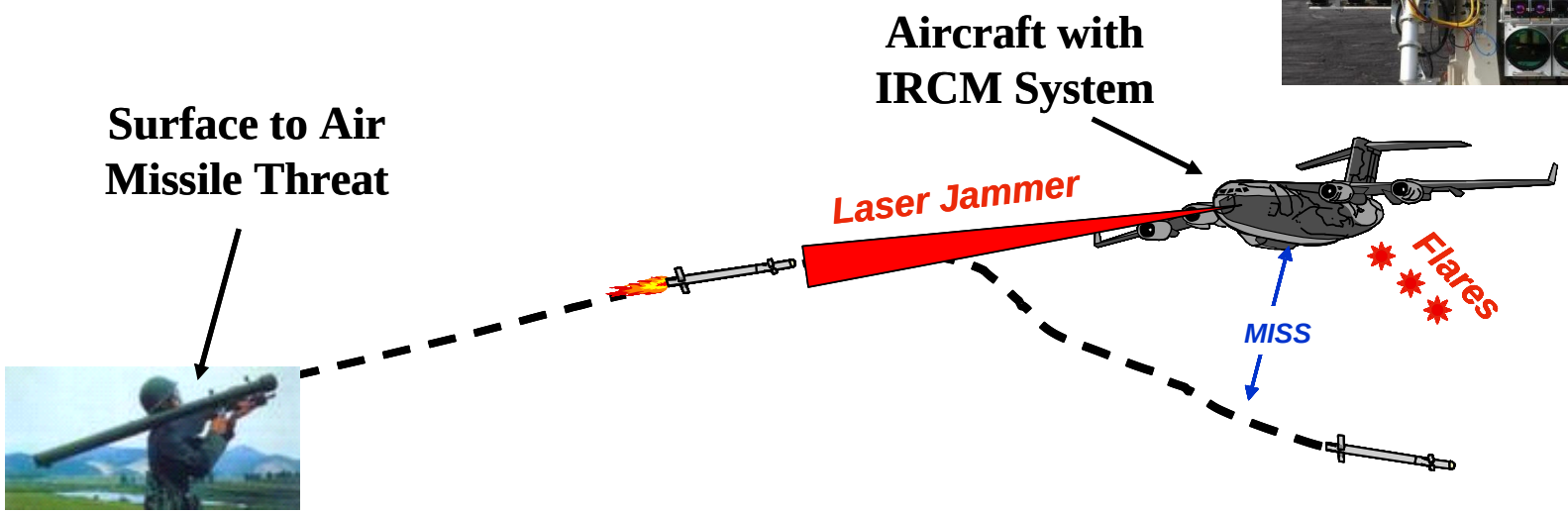
"TENA gave us a common environment that greatly simplified the efforts of our two non-co-located software development contractors. It also significantly aided in our ability to meet information assurance criteria, allowing us to move from requirements to fielding on the NIPRNet in under 18 months. "

Chris Short
JTTOCC Lead Systems Integration Engineer

Joint Mobile IRCM Test System (JMITS) and Multi-Spectral Sea and Land Target Simulator (MSALTS)

- **Illuminates IRCM sensors with UV and IR plume radiation of approaching missiles**
  - Wide variety of threat missile types, engagement geometries, and weather conditions
- **Measures countermeasure response**
  - Flares (captive seekers)
  - Laser jammer (jam beam radiometers)
- **Both Systems have deployed TENA for all Internal and External Communication**



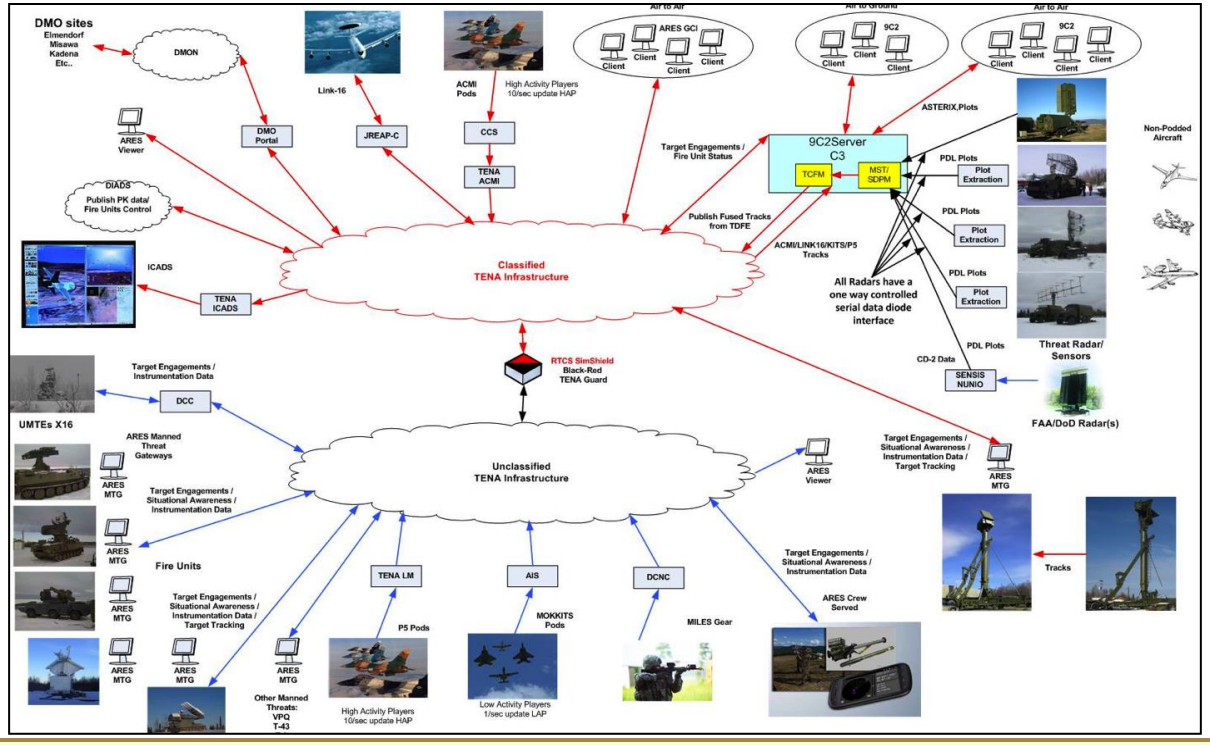


The MSALTS internal architecture attains a high degree of flexibility because of the modularity TENA offers. TENA makes sharing reliable state data between services simple.

Tyson Horrocks
MSALTS Lead Software Engineer

TENA at Joint Pacific Alaska Range Complex (JPARC)

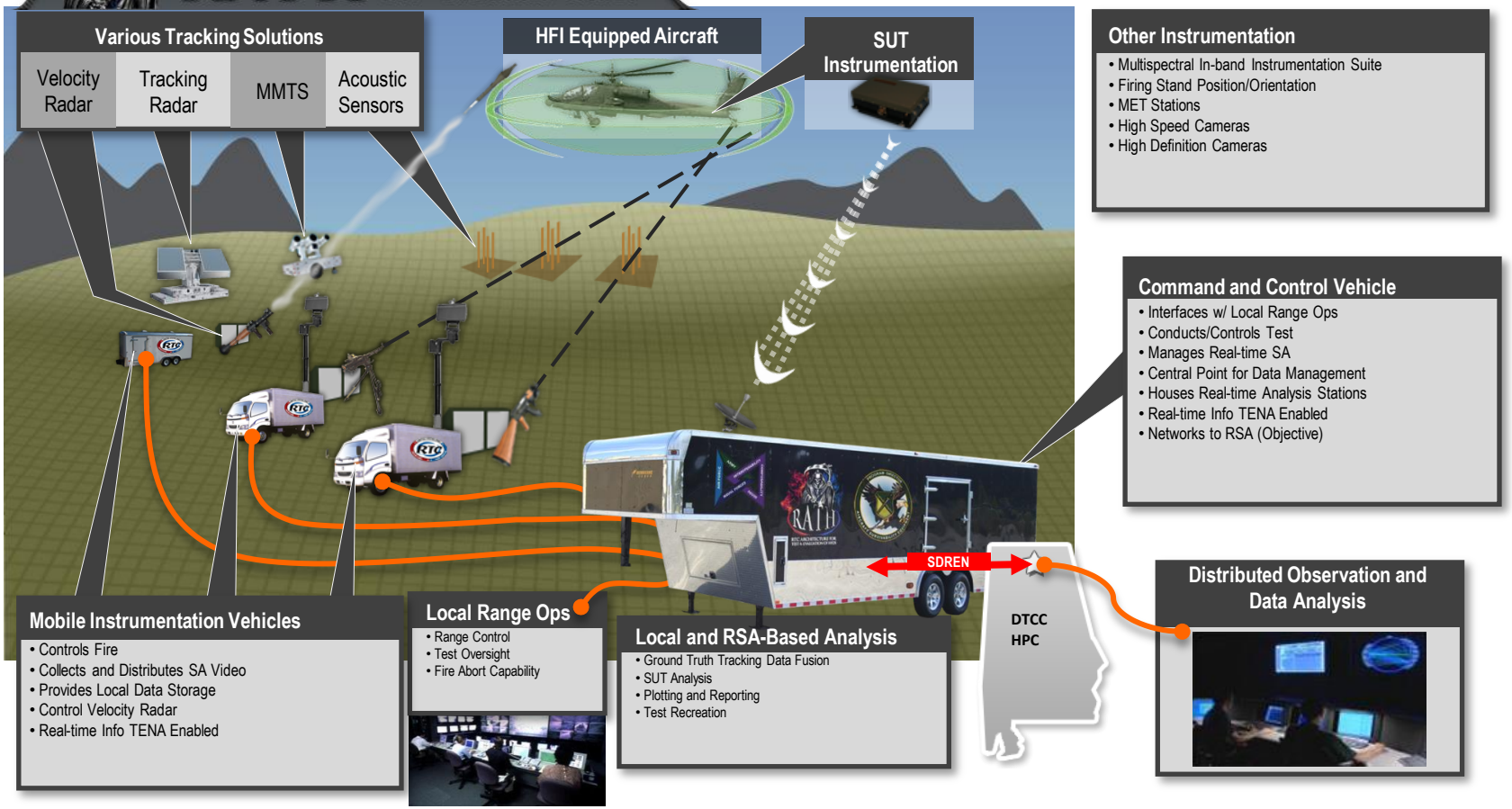
- **TENA enables JPARC to provide force-on-force (FOF) training capability that fully integrates and supports joint and coalition components for both air and ground training in live, virtual, and constructive (LVC) domains**



"TENA is the greatest thing that ever happened to us. We couldn't be doing today with all these systems–and we couldn't have all the participants that we do–if it weren't for TENA"

Billy D. Smith
Chief of electronic combat training requirements for Red Flag at JPARC

RTC/ASE Architecture for Test & Evaluation of Hostile Fire (RATH)

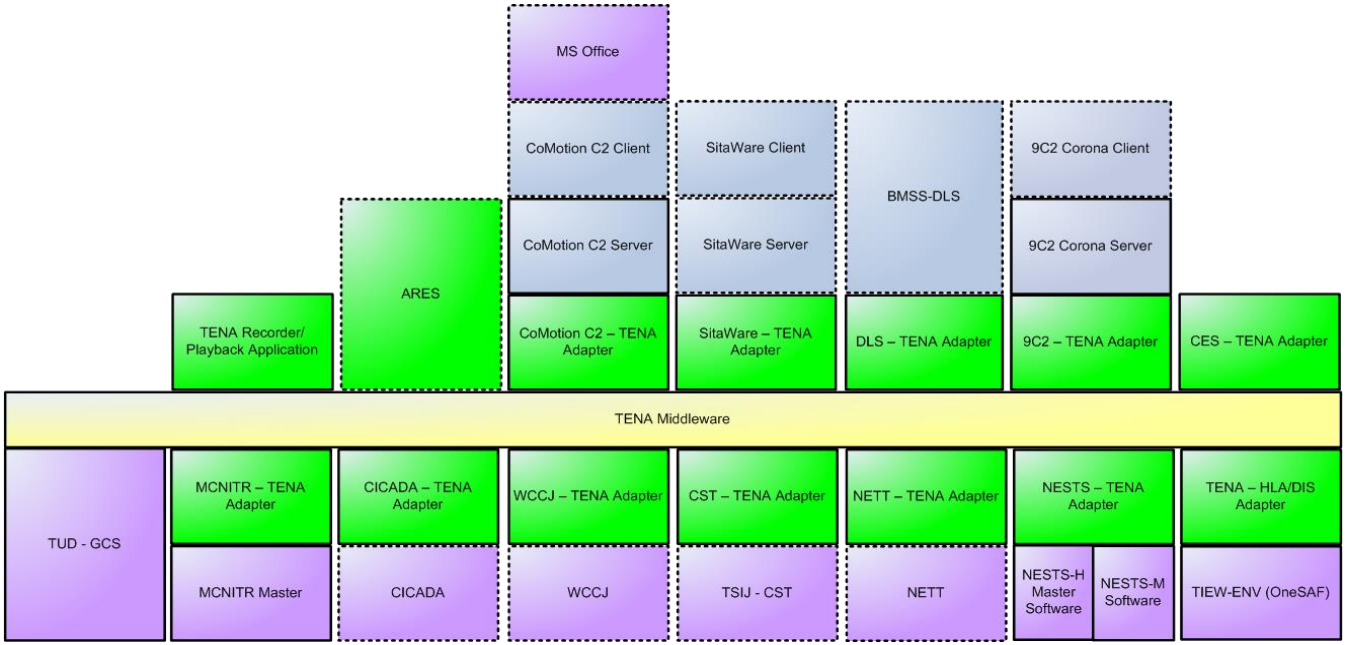


"Applying TENA has been a leading contributor to making disparate efforts (M&S, Lab, Hangar, Range) leverage duplicate capabilities to form an overall better test capability"

Mac Lowry
Advanced Technology Office Chief, Redstone Test Center

Integrated Threat Force (ITF)

- **The Integrated Threat Force (ITF) provides the Army Test and Evaluation Command (ATEC) a scaled threat force against which BLUEFOR (Blue Force) systems, and systems of systems, are tested during their Operational Evaluation Events**

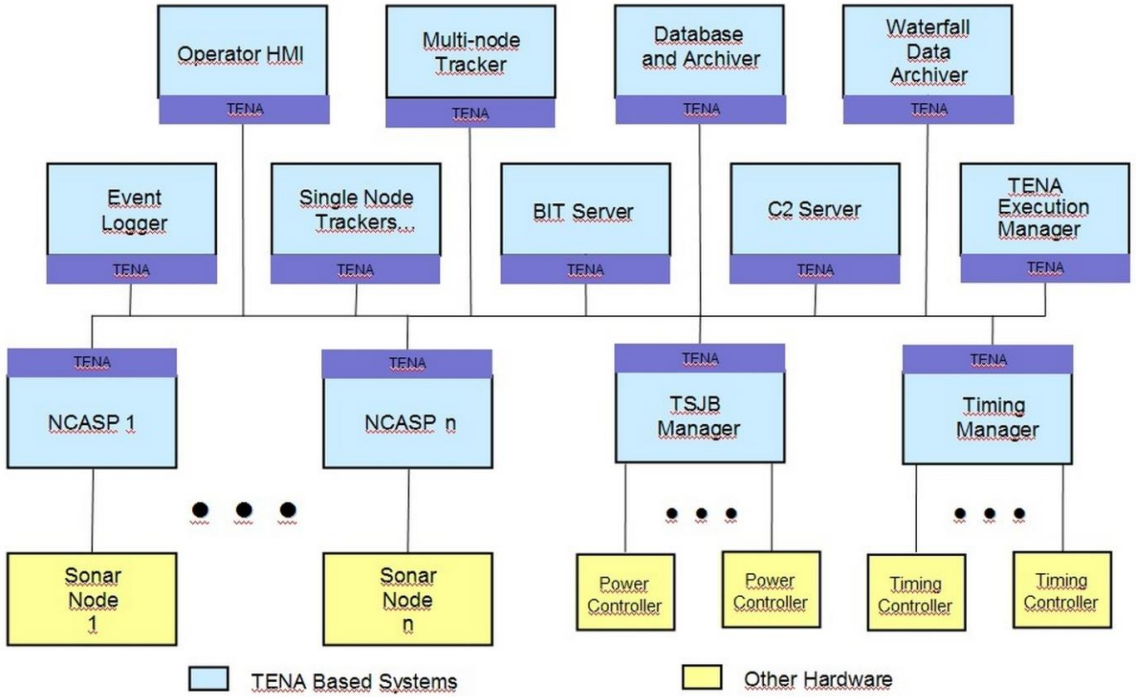


"TENA has enabled us to bring together many systems which don't typically work together. The object oriented design of the object models and middleware … allow for the quick production of adapters to legacy systems. Without TENA, this would be a much more complicated and expensive program."

Brett Kaylor
ITF Lead Software Architect

Swimmer Detection System

- **Highly scalable, distributed, real-time underwater intruder detection system utilizing active sonar – operational system is integrated end to end using only TENA**
  - Installed and operational "24x7" since 2010

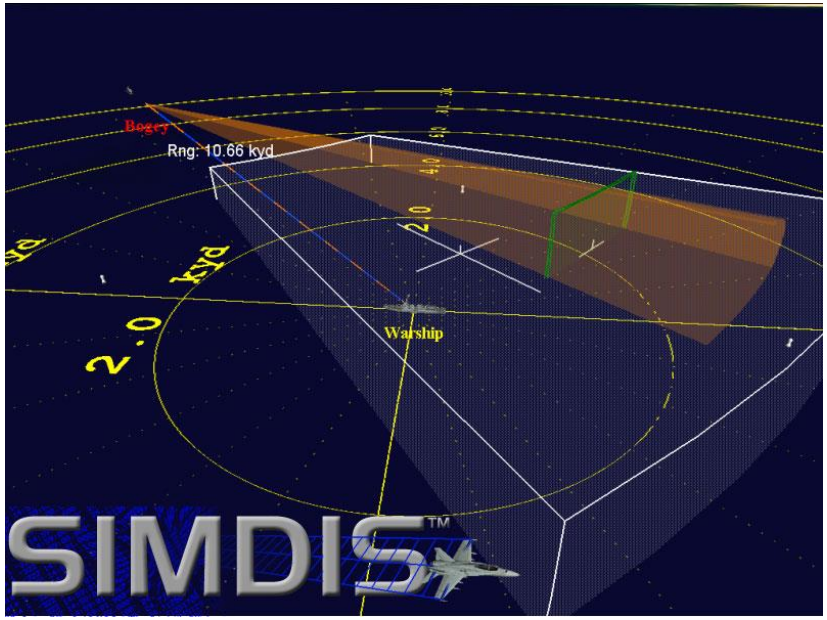


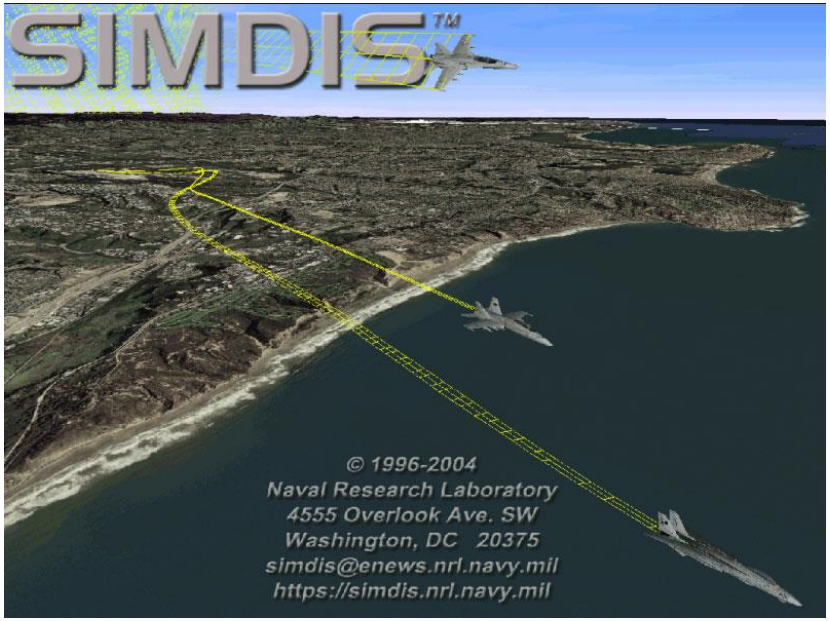
"Using TENA makes the almost-impossible almost easy. TENA flexibility and platform independence was essential."

C. Nylander
Senior Software Manager, Scientific Solutions

SIMDIS Analysis and Display Tool

- **SIMDIS™ is a set of software tools that provide two and three-dimensional interactive graphical and video display of live and post processed simulation, test, and operational data.**
  - In collaboration with TENA SDA, SIMDIS supports a binary and source code version of a TENA plugin which enables SIMDIS to display and support analysis of data from TENA events

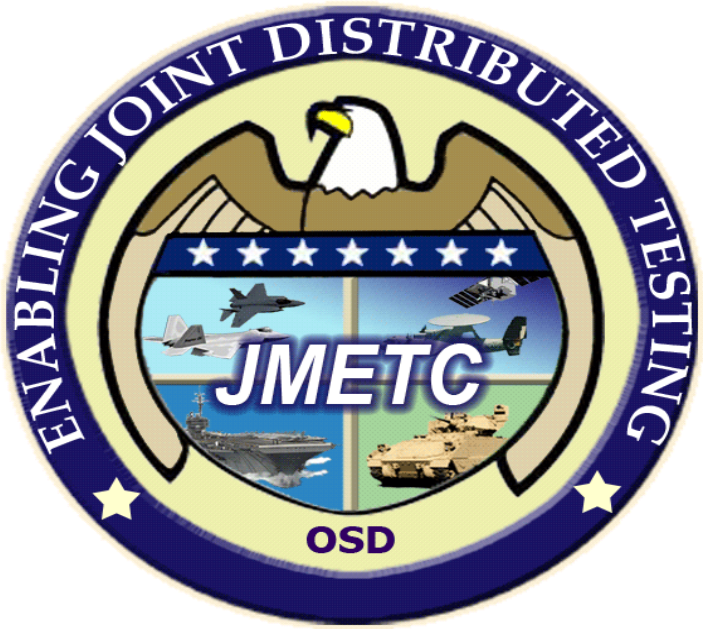




"TENA offers extensibility to add new data sources and protocols as they become available without impacting the existing SIMDIS software."

William Doughty
Naval Research Laboratory, SIMDIS Developer

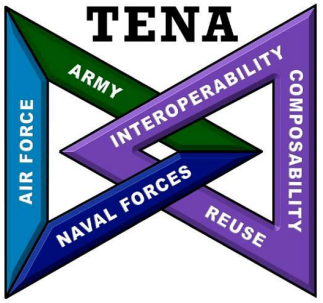
Joint Mission Environment Test Capability (JMETC)



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

JMETC Network using SDREN



TENA Software, Object Models, Tools, Repository

- Provides customer support team for JMETC products and distributed testing

JMETC Connectivity

- Functional Sites: 71
- New Sites Planned: 10
- Connection Points to Other Networks: 7

- Dedicated, trusted connectivity on SDREN (part of the GIG)
- Encrypted for Secret – System High
- DISA-registered IP address space
- Active monitoring of network performance
- Capable of supporting multiple simultaneous test events

Boeing LabNet: Tukwila
Keyport: NUWC
Ft Lewis: EPG

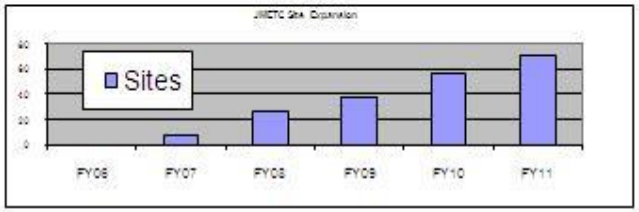
Site in Alaska
Ft. Greely: CRTC

Edwards (2): Ridley
412th EWG IFAST
China Lake (3): F/A-18, IBAR, TSPIL
Point Mugu (2): ITEC, EA-6B
Camp Pendleton: MCTSSA
Corona: NSWC
Palmdale, BAMS
Point Loma :
SSC-PAC 59140
SSC-PAC HAIPE
West Agg Rtr.
Rancho Bernardo, NGC BAMS

Sites in Hawaii
PMRF: Bldg 105
MHPCC

Dugway Proving Ground
Nellis AFB: CAOC-N
Yuma PG
WSMR: IRCC
Ft Huachuca: (4)
JITC, JTDL, CMIS, JTRS
EPG
Ft. Sill (2): FSED, SMART Lab
Tinker AFB: AWACS
Ft Hood (2): CTSF, TTEC
Greenville: Rivet Joint
Boeing LabNet: Berkeley
WPAFB: SIMAF
Crane: NWSC RDT&E
Redstone (10): SMDC
RTC: DTCC, GMAN
SED:
Patriot, THAAD, FAAD, GSIL,
(2) SED-PSEM, AMRDEC
GTRI
Charleston (2): IPC, MEF-MEU
Hurlburt Field: C2DAC
Eglin AFB (5): AOC, DTF, GWEF, KHILS, JDAT
Melbourne: NGC JSTARS

Hanscom AFB: CEIF
Newport: NUWC
Bethpage: NGC BAMS
Bethpage: NGC BCN
Moorestown: CSEDS
Aberdeen: ACCN
Pax River:
(8)ESTEL
E2C/D, MCL, ACETEF, SAIL, ATR,
E-2C SIL, UASIL, MFS
JMETC SYSCON
East Agg Rtr.
Dahlgren:
(2) CEDL,IWSL
(1) Rapid SIL
JS J8 DDC4: C4AD
Langley (2): C-GIIF, TDLITC
Norfolk: COMOPTEVFOR
Dam Neck: CDSA
Wallops Island (2): SCSC, SSDS
Newport News: NGC VASCIC
McLean: MITRE NCEL
LMCO Global Vision Network, Arlington, VA

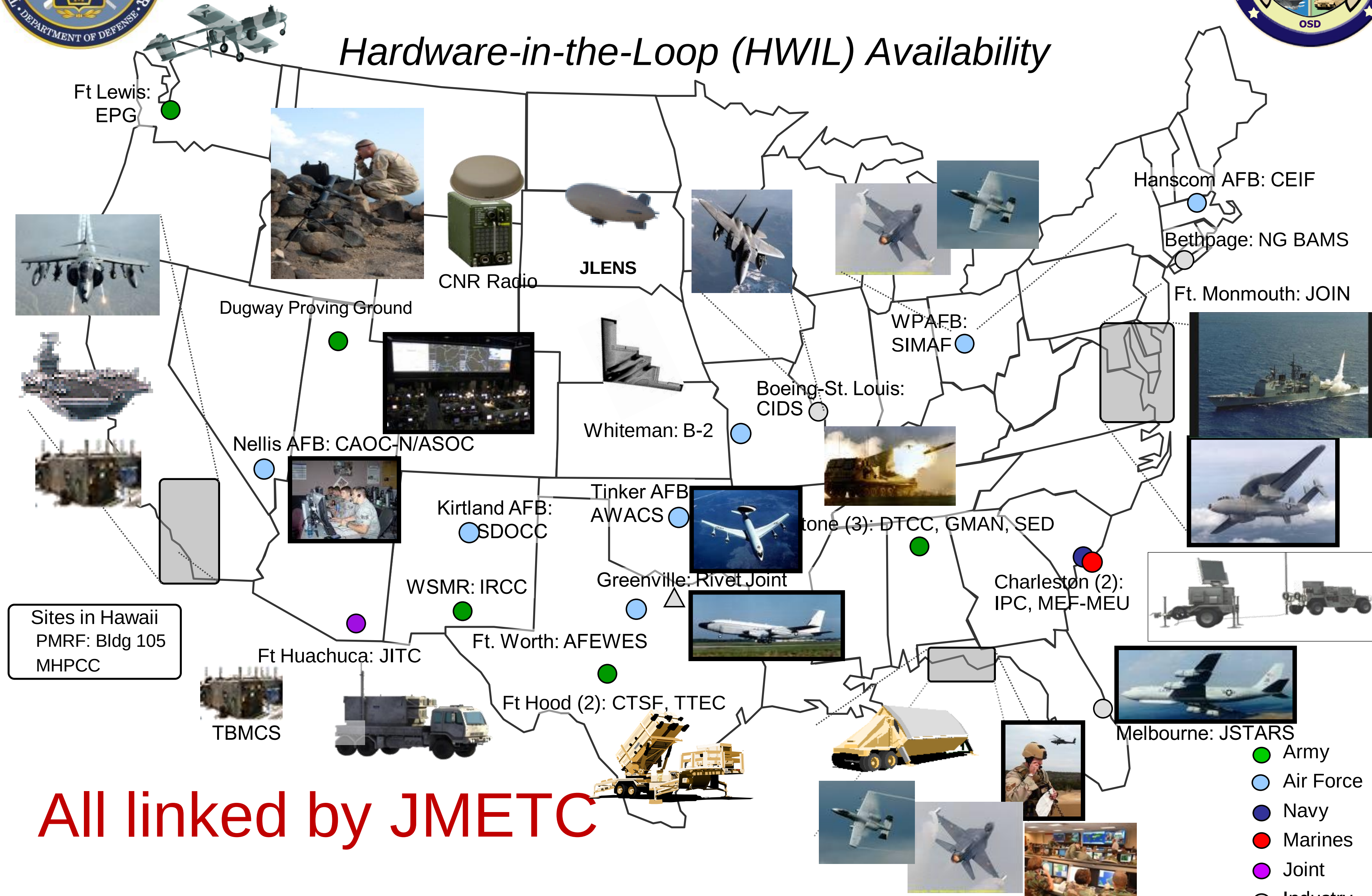


As of 23 Aug 2012

Army
Air Force
Navy
Marines
Joint
Industry
Academia

How a Test Planner Should View JMETC

Hardware-in-the-Loop (HWIL) Availability

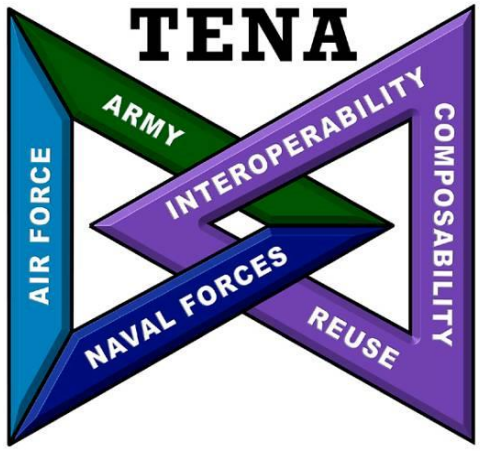


Important Contact Information

- **TENA Website: http://www.tena-sda.org**
  - Download TENA Middleware
  - Submit Helpdesk Case (http://www.tena-sda.org/helpdesk)
    - Use for all questions about the Middleware

- **JMETC Program Office Contact:**
  - E-mail: **jmetc-feedback@jmetc.org**
  - Telephone: (571) 372-2699
  - JMETC Website: **http://www.jmetc.org** – under construction

- **TENA Feedback: feedback@tena-sda.org**
  - Provide technical feedback on TENA Architecture or Middleware
  - Ask technical questions regarding the TENA architecture or project
  - Provide responses to AMT action items
  - Request TENA training



Backup Slides

How hard is it to create a new TENA Object Model?

1. **Name the object model, including the version**
2. **Define the message or object types needed by the application**
3. **Define the attributes that characterize the messages and objects**
4. **Determine if any attributes are constant or optional**
5. **Define any remote or local methods**

```
  file Example-Vehicle-v6.tdl

package Example {

  enum Team {
    Team_Red,
    Team_Blue,
    Team_Green };


  class Vehicle {
    optional   string   name;
    const      Team     team;
               float64  xInMeters;
               float64  yInMeters;


  };

    driveTo (float64 xInMeters,
             float64 yInMeters);


};
```

TENA has a powerful meta-model for defining expressive object models, yet descriptive models are easy to create

INTEROPERABILITY TRACK
Chair: Gene Hudgins

- 1:00 p.m. – 1:30 p.m. Introduction to Interoperability and Remarks
- 1:30 p.m. – 2:00 p.m.

Interoperability and Persistent Connectivity: Keys for Successful Distributed Testing and Training

Mr. Gene Hudgins, TENA / JMETC, BAE Systems

- 2:00 p.m. – 2:30 p.m.

"TENA in Resource Constrained Environments" (TRCE): Technologies to Support Wireless Instrumentation Interoperability

Mr. Tom Treakle, TRCE, SAIC

- 2:30 p.m. – 3:00 p.m.

The Extension of CIAV from the Central Command to the Other U.S. Area Commands

Mr. Michael Leite, PE, TASC-N/DigiFlight Inc., JITC

- 3:00 p.m. – 3:30 p.m. Break with Exhibitors
- 3:30 p.m. – 4:00 p.m.

System Architecture Declarative Semantic Formal Versions to Debug Knowledge Bases

Ms. Lidia Zamarrón and Eric Smith, University of Texas at El Paso, and J. Carlos Acosta, UAEM

- 4:00 p.m. – 4:30 p.m.

Historical Snapshot and Future Direction for the Coalition Interoperability Assurance and Validation (CIAV)

Mr. Michael Leite, PE, TASC-/DigiFlight Inc., JITC

- 4:30 p.m. – 5:00 p.m.

Defending the Realm: "What is Working and What is Not"

Srinivas Mukkamala Ph.D., Institute for Complex Additive Systems Analysis (ICASA), Computational Analysis and Network Enterprise Solutions (CAaNES), New Mexico Tech

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