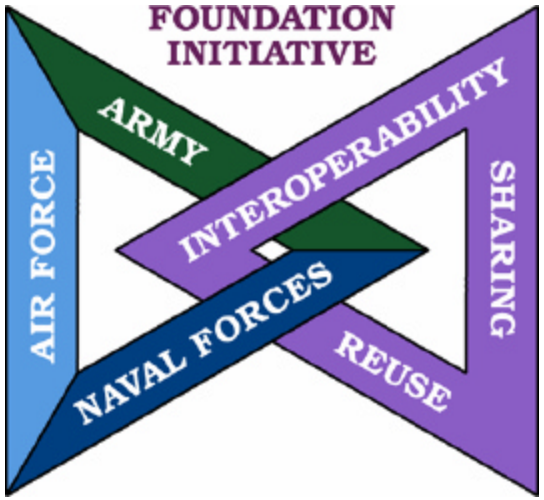
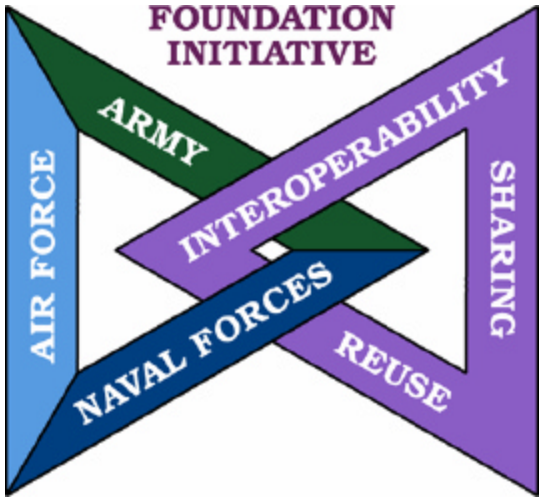


Test & Training Enabling Architecture (TENA) Overview

Keith Poch

Foundation Initiative 2010 Cadre

20 Aug 2002



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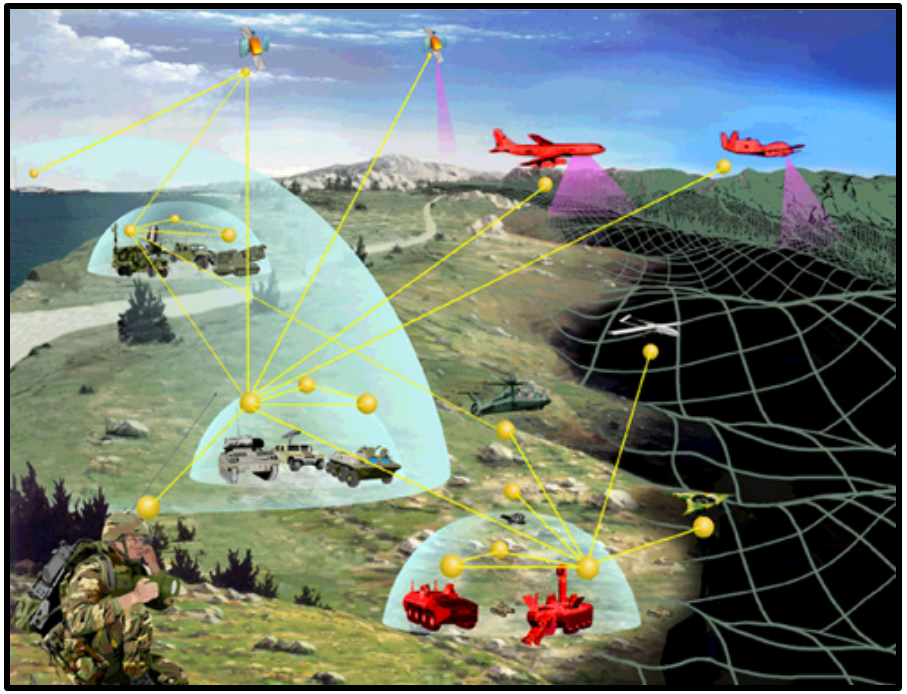
- **Summary**

Foundation Initiative 2010
Overall Vision

- **Design and prototype a technological infrastructure to enable interoperability and reuse within the range community**
  - Seamless environments that integrate test ranges and facilities, training ranges, laboratories, and modeling and simulation (M&S) assets
  - Improve the scope and scale of testing and training the increasingly complex systems and missions in a cost-effective manner
- **Recognize that our solutions need to be more than quality software, we need to:**
  - Elegantly solve key usability issues
  - Satisfy the core operational and performance requirements
  - Work with the range community so the solutions are implemented
- **Lay the groundwork for full lifecycle support for integrated multi-range events**



Foundation Initiative 2010
Mission Summary

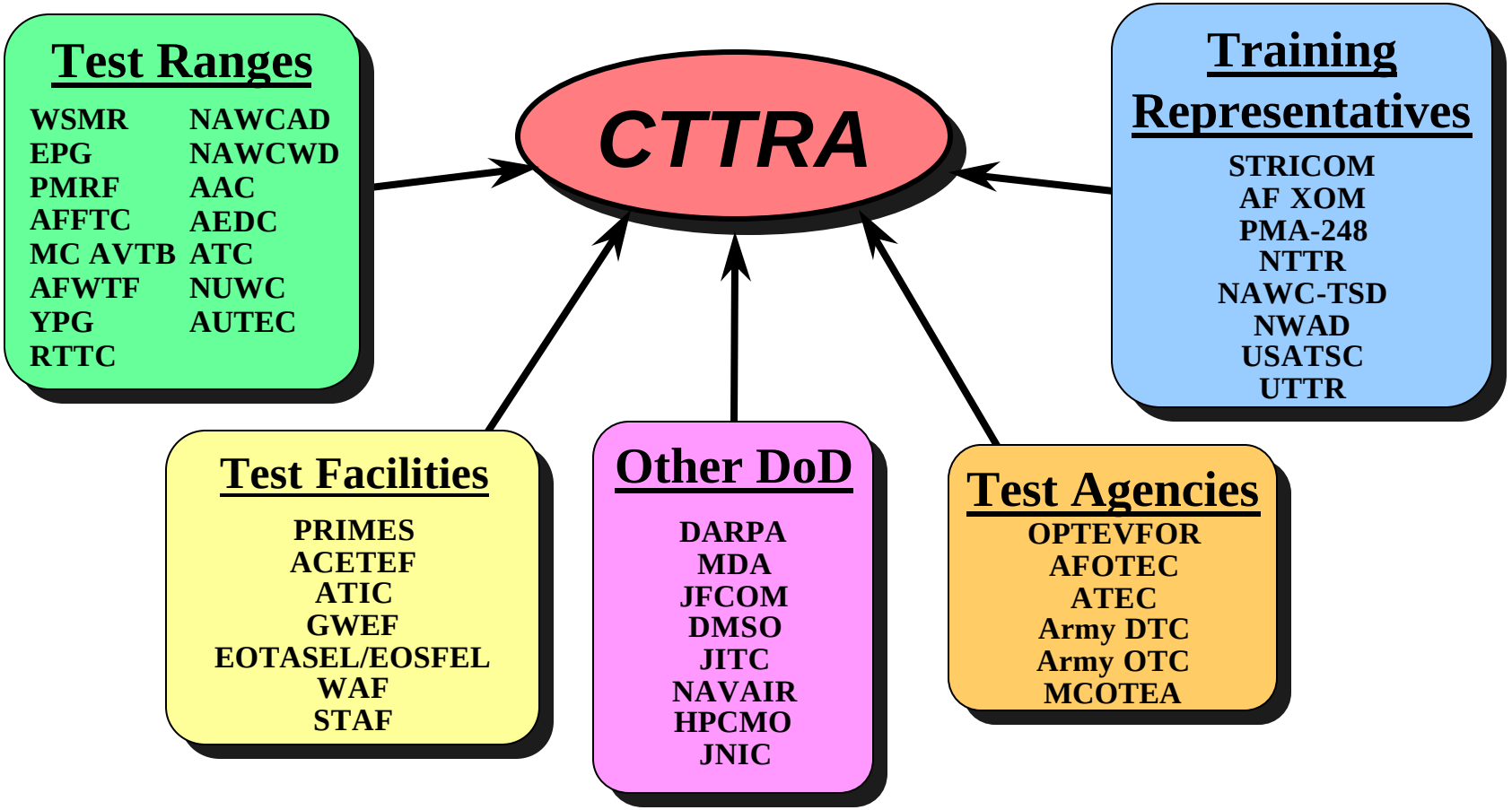
Provide the Core Products necessary to:

- **Enable Interoperability among Ranges, Facilities, and Simulations in a quick, cost-efficient manner**
- **Foster Reuse for Range asset utilization and for future developments**

- **Supports the Warfighter (Joint Vision 2010/2020)**
- **Enables SBA, STEP, CEE, JSB, and JDEP**
- **Fosters Test and Training Integration**
- **In the long term: SAVES MONEY!**

Lay the Foundation for Future Range Instrumentation

Common Test & Training Range Architecture (CTTRA)



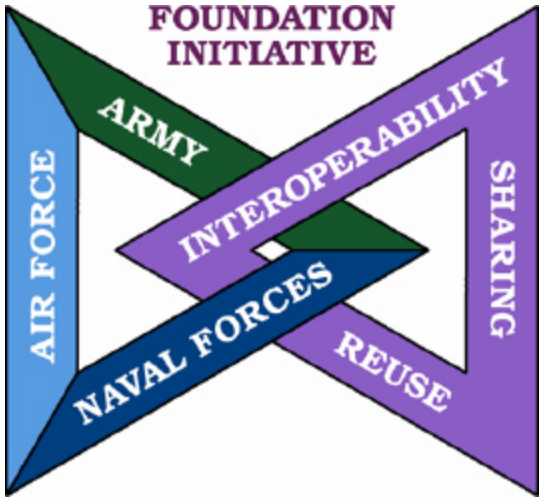
- **Systems engineers & software developers in the DoD Range and Facility community (both T&E and Training)**
- **13 three-day workshops held (usually every 6-9 months)**
- **CTTRA XIII workshop was held Feb 27-Mar 1**

Architecture Management Team (TENA AMT)

- **System Engineers & Technical Leads for the <u>current</u> major stakeholders of TENA**
  - AAC, Eglin AFB FL
  - NUWC, Newport RI
  - NAWC-AD, Pax River MD
  - WSMR, White Sands NM
  - RTTC, Huntsville AL
  - EPG, Fort Huachuca AZ
  - NAWC-WD, China Lake & Point Mugu CA
  - Virtual Proving Ground (VPG)
  - Common Training Instrumentation Architecture (CTIA)
  - PMRF Synthetic Range
  - National Unmanned Underwater Vehicle T&E Center (NUTEC)

Meetings every 4-6 weeks

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



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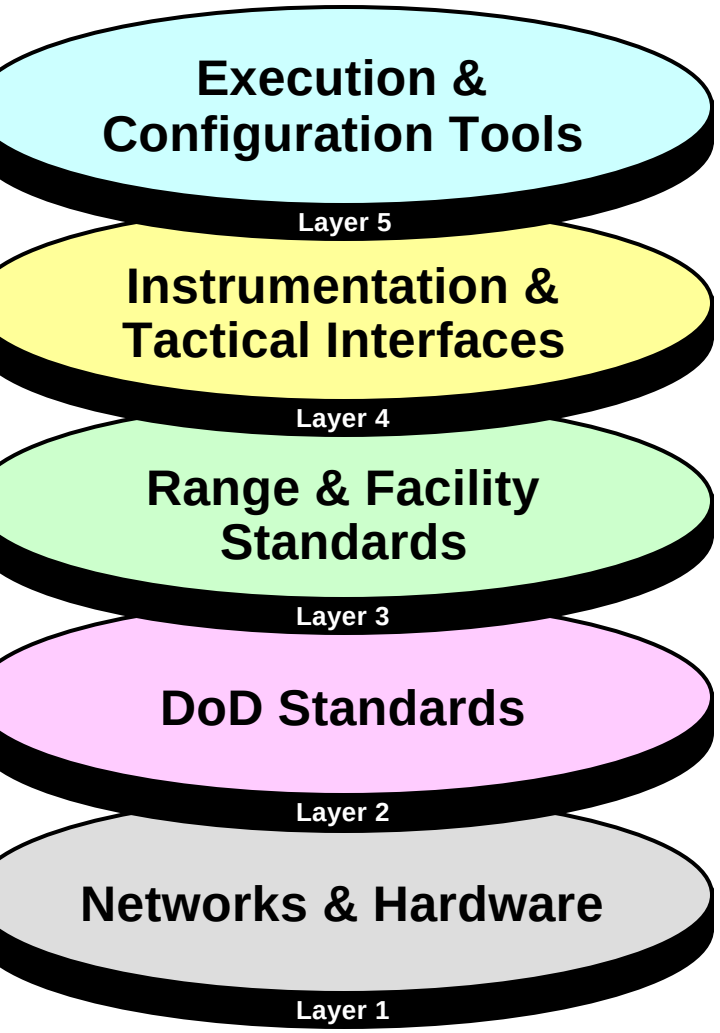
Foundation Initiative 2010
Product Summary



INTEROPERABILITY

FI 2010

- **Selected T&E resource interfaces to TENA**
- **Performance reports of commercially available communication systems**
- **Procedures for executing synthetic, multi-range tests**

Comply with the Joint Technical Architecture (JTA) & the High Level Architecture (HLA

Leverage Existing DoD Networks & Commercially Available Hardware

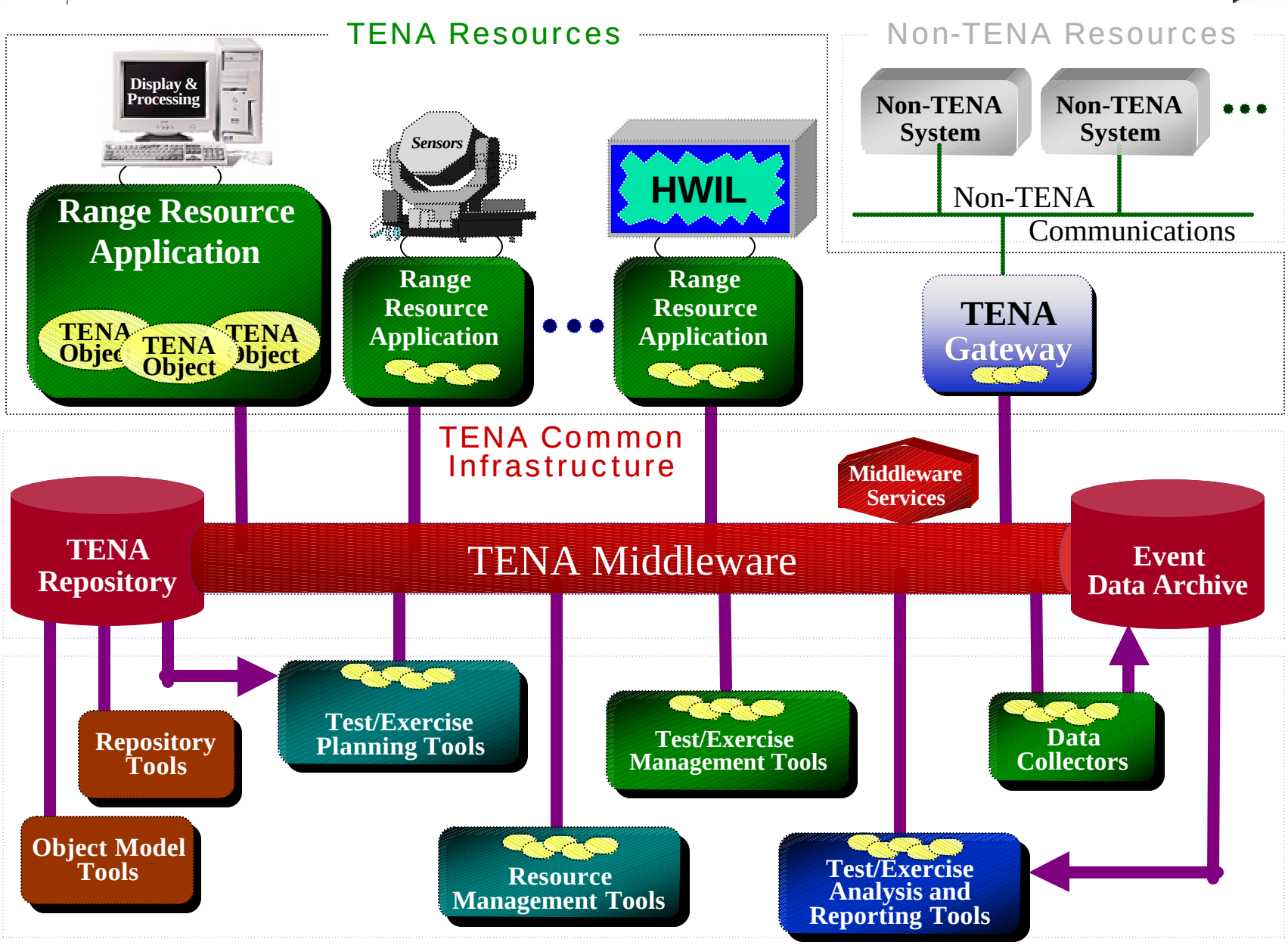
TENA Technical Driving Requirements

- **Interoperability – the ability of independently developed and deployed systems to seamlessly work together and exchange information to solve a user's problem**
  - Interoperability is required
    - Between range resources
    - Across phases of the acquisition, test, and training processes
    - Between range resources and C4ISR resources
    - Between range resources and simulations
- **Reuse – the ability to use a system or a software application or component at sites or in test or training events other than those in which the software was originally designed to operate.**
  - Reuse implies
    - Componentization and modularity
    - Standard, documented interfaces
    - Encapsulation of legacy capabilities

Foundation Initiative 2010
Project Objectives

- **Define a common Architecture for the test / training range community – called "TENA" (Test & Training Enabling Architecture)**
  - Define a common Object Model to be used across the ranges
  - Define and build a common Software Middleware that will:
    - Comply with the architecture
    - Use the object model
    - Build on the HLA
    - Enhance interoperability and reuse among the ranges
- **Common understanding of range processes – the Logical Range ConOps**
  - Provides a common understanding to range users how logical ranges are created (from the integration of range resources), what their capabilities are, and how they are utilized, operated, and controlled
- **Define and prototype common Tools to configure and conduct multi-range, synthetic test events or training exercises**
  - Create distributed, synthetic battlespaces with real weapon systems
  - Link multiple ranges together to form a larger, cohesive range
  - Enable testing, assessment, experimentation, and training of weapon system interoperability, C4ISR, and system-of-systems

TENA Architecture Overview

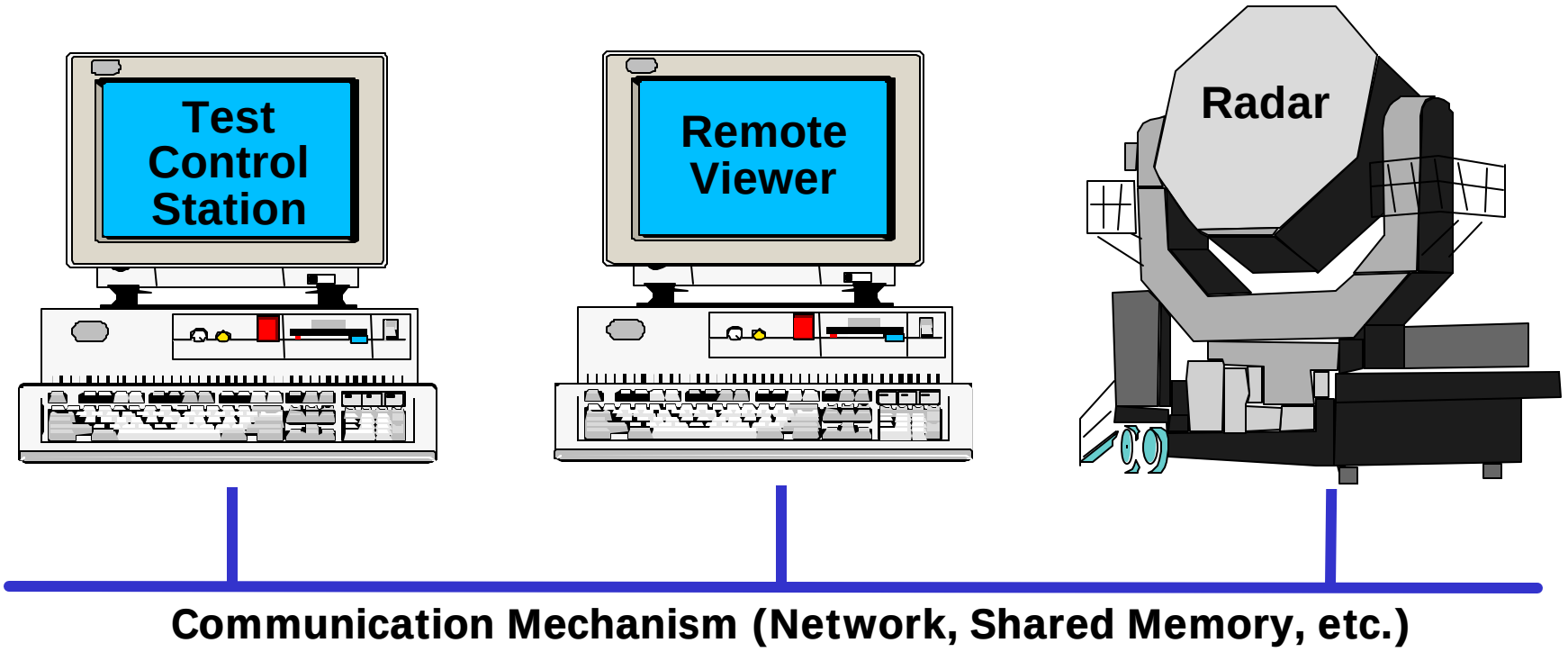


IKE 2 Design Approach

- **IKE 2 presents to the range user a unification of several powerful inter-application communication paradigms**
  - **Publish/Subscribe**
    - Similar in effect to HLA, DIS, and other PDU-based communication systems
    - Each application publishes certain types of information (the publication state) which can be subscribed to by any other application
  - **Remote Method Invocation**
    - Similar to CORBA or Java RMI
    - Each object that is published may have methods that can be remotely invoked by other applications
  - **Messages**
    - Individual messages that can be sent from one application to one or more other applications
  - **Data Streams**
    - Native support for audio, video, and telemetry
- **Architecture must support system-wide quality of service requirements (e.g., latency, predictability, reliability)**
  - Software must support diverse and often dynamic operating conditions
  - Leverage existing standards and implementations

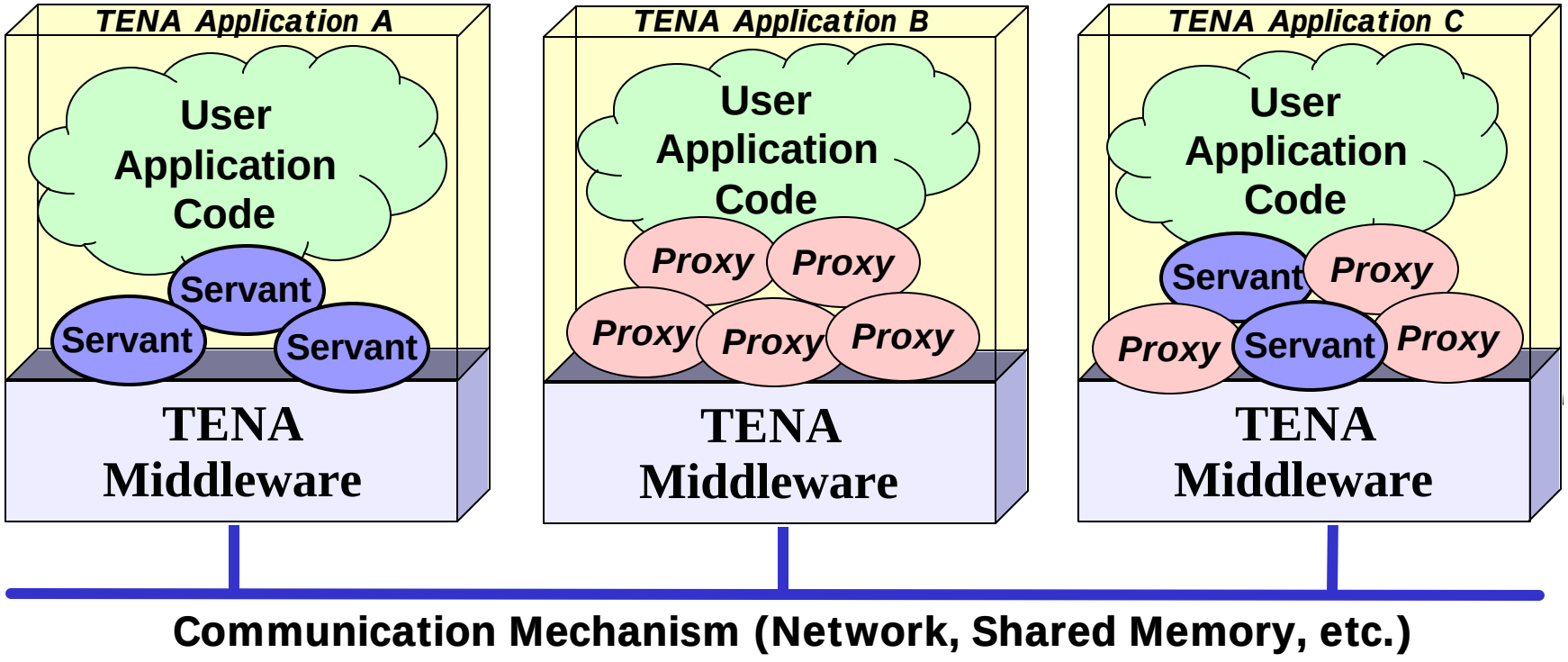
Logical Range Simple Example

TENA specifies an architecture for range resources participating in logical ranges

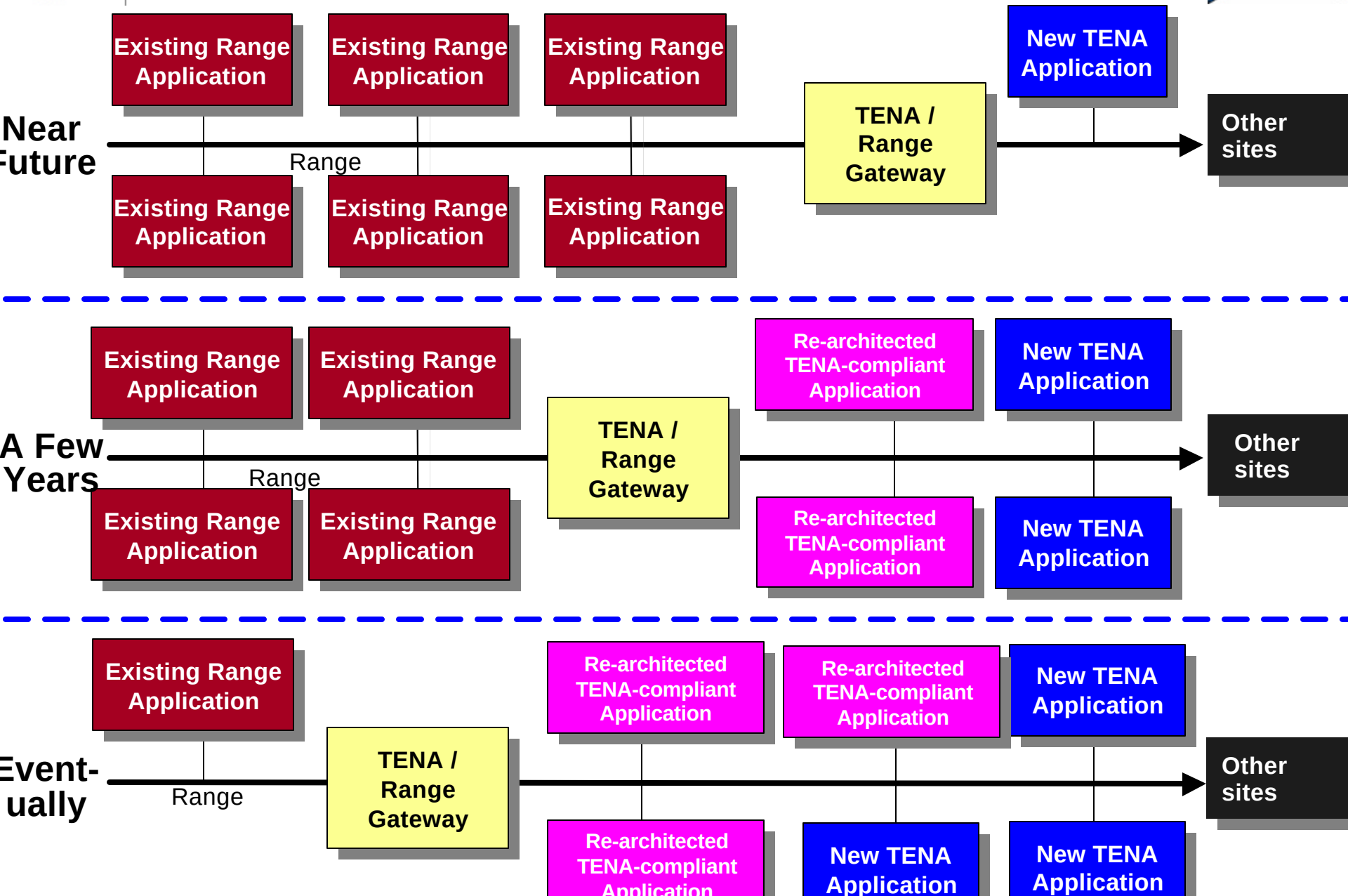


Logical Range Simple Example

- **TENA specifies a peer-to-peer architecture for logical ranges**
  - Applications can be both clients and servers simultaneously
  - In their role as servers, applications serve TENA objects called "servants"
  - In their role as clients, applications obtain "proxies," representing other applications' servants. Only servers can write to their servant objects' publication state
- **The IKE 2 Middleware, the TENA objects, and the user's application code are compiled and linked together**



Gradual Deployment of TENA

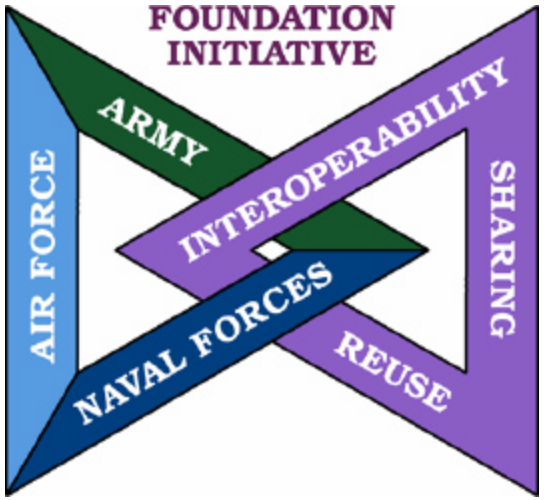


IKE 2 Platform/Language Support

- **Platforms Supported**
  - Windows NT 4.0 with MSVC++ 6.0sp5
  - Windows 2000 with MSVC++ 6.0sp5
  - Linux Red Hat 7.1 with gcc 3.0.3
  - Sun Solaris 8 (SunOS 5.8) with gcc 3.0.3
  - Sun Solaris 8 with SunPro 5.3 compiler (aka Forte Update 2)
  - SGI IRIX 6.5.12 with MIPSPro 7.3.1.2
  - SGI IRIX 6.5.12 with gcc 3.0.3 on SGI hardware
  - VxWorks, compiler TBD
- **Languages Supported**
  - C++
  - Java

User Support

- **Training Classes**
  - Technical Introduction Course
  - Hands-On Training Course
- **IKE 2 Web Site <http://support.fi2010.org/>**
  - Users register to download software and submit help desk requests
    - Registration back-end currently handled manually
  - Users not permitted to distribute the software beyond their local network
- **IKE 2 Users Email Reflector**
  - Share experiences/problems/questions with user group and developers
  - Used to issue developer announcements concerning the IKE 2 software
  - Send an email to majordomo@fi2010.org with body “subscribe ike2-users”
- **Help Desk**
  - Initial submission must be done through web page, then email can be used
  - Public solutions will be used for searching common difficulties or problems



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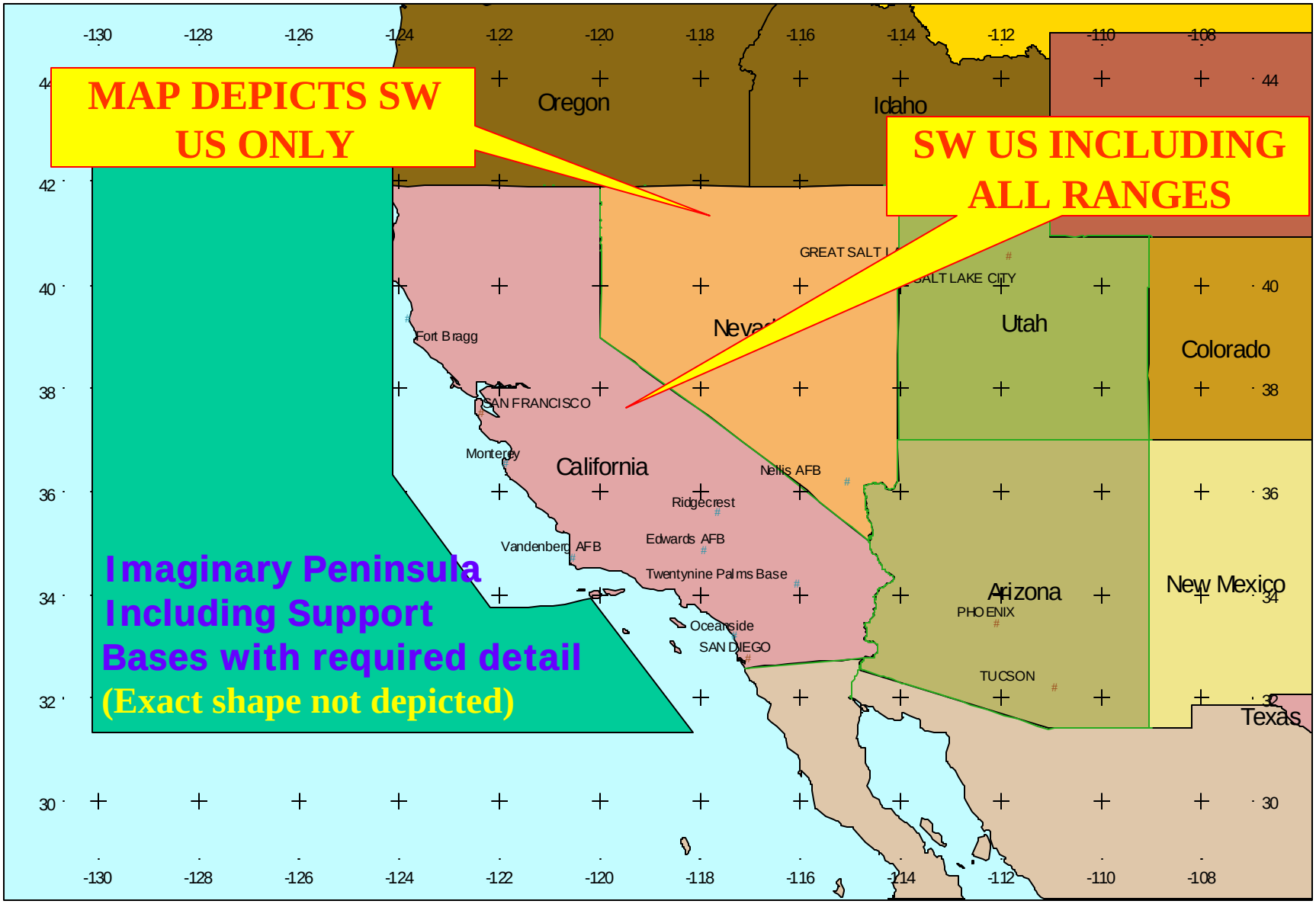
JFCOM Objectives for MC02

- **"Build upon past efforts and advance the concepts that will rapidly co-evolve enhanced joint capabilities for conducting rapid, decisive, joint operations in a 2007 timeframe."**

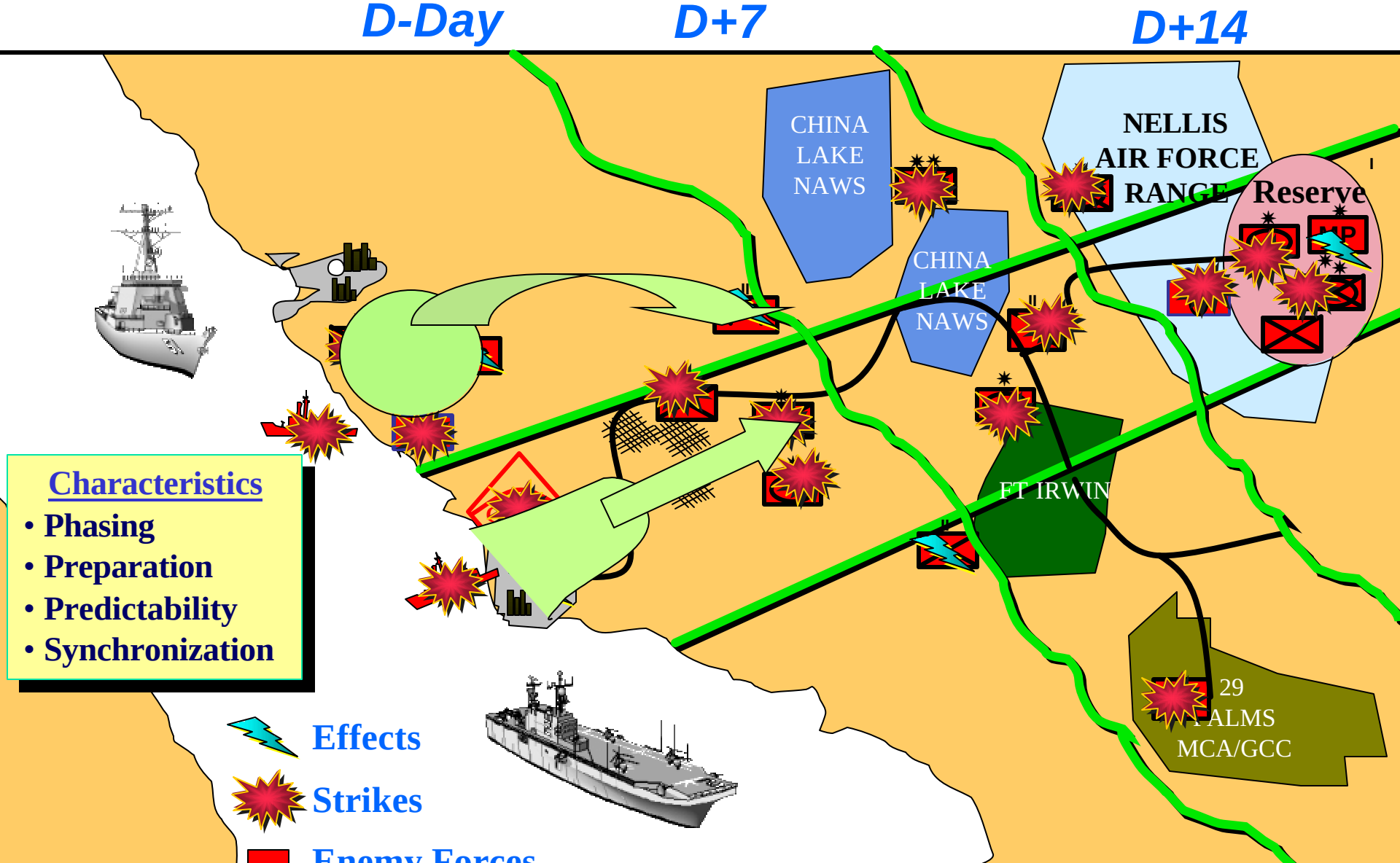
- **"Emphasize the integration of innovations in doctrine, organization, training, material, leadership, personnel and facilities that enhance the future joint force commander's operational level command and control"**

Ref: Initial Planning Conference (16-19 jul 01) IPC_msg 131514ZJUN01

MC02 Scenario / Playbox



MC02 Ranges & Sims Scenario Map



MC02 Experiment Organization

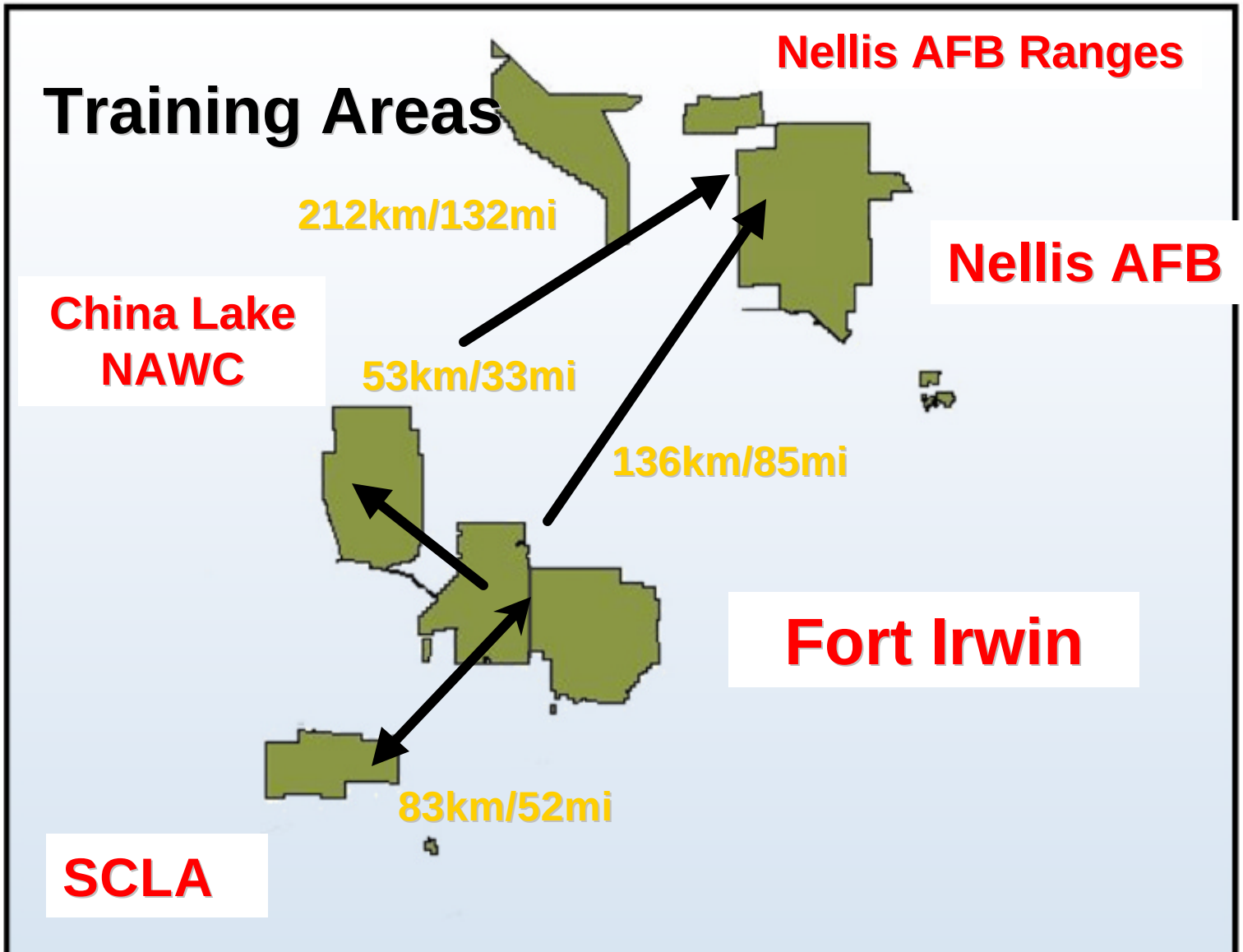
Simulation Based Joint Experiment

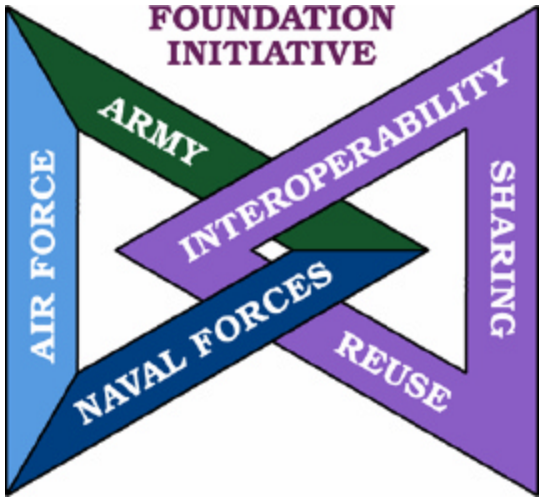
followed by:

Service Experiments w/ mixed Live / Sim

- **Some replication of Joint (Sim-based) in Live / Sim Service Experiments**
- **Each Service defines Live / Sim mix for its Experimen**
- **Range Integration opportunity is in Service experiments**
  - **Yet need to show value to Joint as well as Service**

MC02 Live Deep Strike





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JFCOM Objectives for "Range Integration"

- **"Demonstrate potential linkage of Western Ranges to show feasibility for the purposes of joint training and experimentation"**

- **"Demonstrate integration of live and simulated actions in an environment that feeds situational awareness at the operational level."**

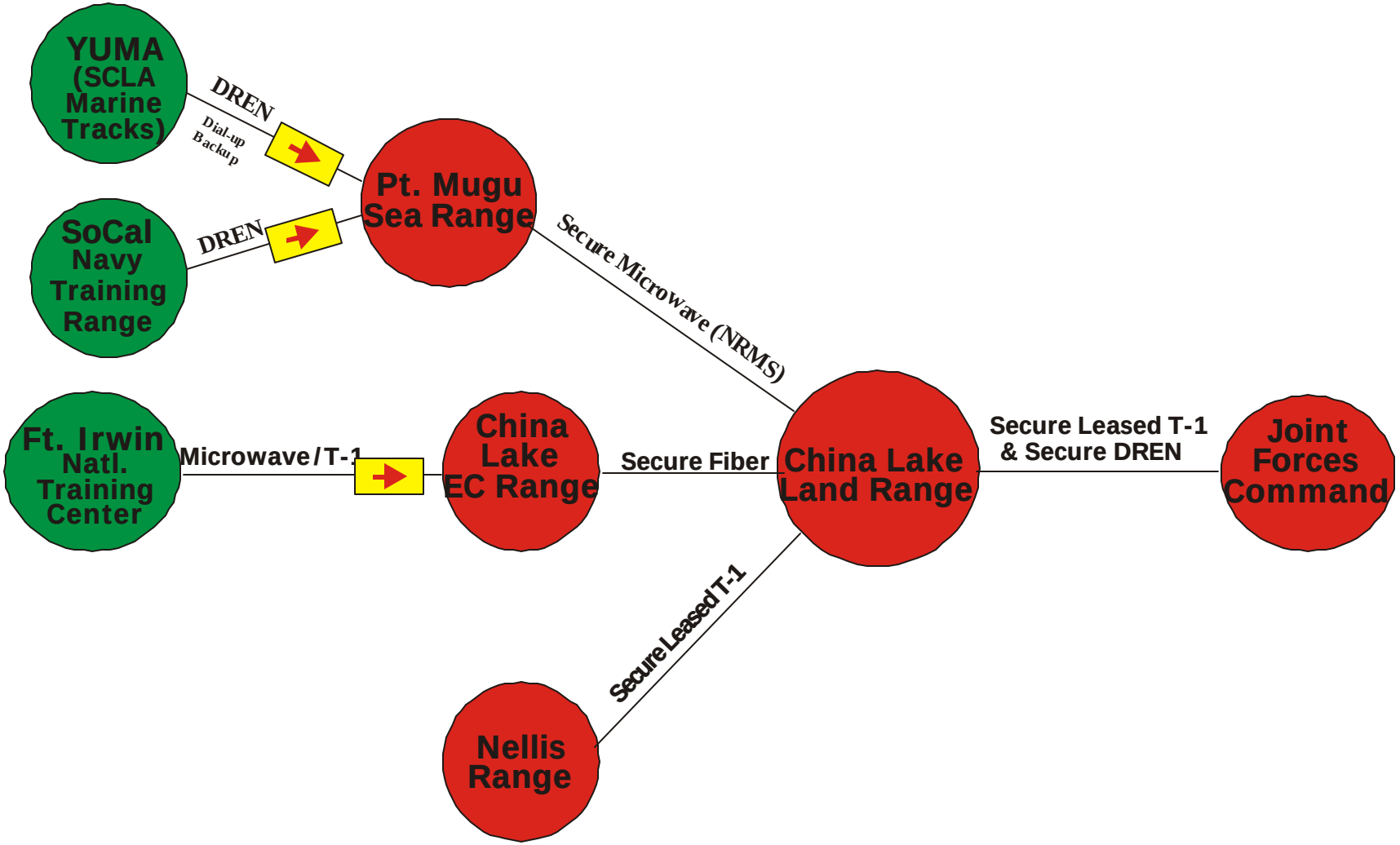
Ref: J7 White Paper of 9 Aug 01, "Range Integration in Support of MC02 Exercise Objectives"

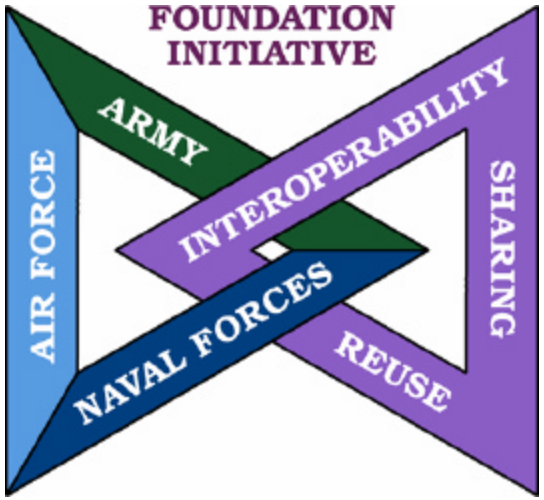
Western Ranges Integration Team: Desired "Operational Capabilities"

- **Provide for interoperability of range Time Space Position Information data**
- **Provide information to user sites**
- **Provide distributed fused view of the battlespace in a C4ISR format**
- **Provide for exercise control**
- **C4ISR/instrumented data correlation testing**
- **Provide data collection systems**
- **Provide for data analysis**

Key Product: the JFCOM-desired view of the "Common Relevant Operational Picture" (CROP)

Overview Of Range Integration Connectivity For MC02





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TENA Use Cases

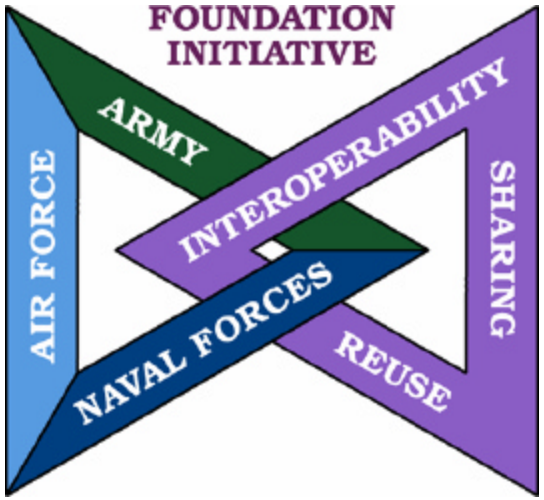
Test Case Name and Source	Code Name	Tech POC	TENA User
Eglin (AAC)			
ENMI – JSF Weapons Server	JSF-Weapon Svr	Glenn Conrad	AAC
Modular Range Interface (MODRI)	ModRI	Shawn McCooey	AAC
SCW – Sunburst – Ray 1	Sunburst Ray 1	Greg Schultz	96CG
TSP Primes Generic System Under Test Support	PRIMES	Kim Hastings	PRIMES
TSR Coherent Signal Processing (COSIP) Radar System Link	COSIP	Dennis Quiaro	46TW
TSR Gulf Range Instrumentation (TSPI) System (GRITS)	GRITS	Jimmy Webb	46TW
TSR Joint Range Instrumentation and Control System Link	RICS	Chris Snider	46TW
TSW GWEF JMASS	GWEF-JMASS	Jerry Griffith	GWEF
Newport (NUWC)			
NUWC PMRF – Use Case #1 (Non-interference with NTADS)	NUWC#1	Ed Dunn	NUWCDIVNPT
NUWC PMRF – Use Case #2 (Simulation info via HLA DI)	NUWC#2	Ed Dunn	NUWCDIVNPT
Pax River (NAWC-AD)			
Radar Data Distribution and Slaving	Radar	Mike Flinn	ATR
ATR (Atlantic Test Range) HLA Gateway	ATR-HLA	Mike Flinn	ATR
Suretrack (Remote Radar Control, Digital Radar Image Transfer)	Suretrack	Mike Flinn	ATR
Aircraft Sensor Stimulus – NAVAIR/ACETEF (01)	ACETEF 01	Mike Flinn	ACETEF

TENA Use Cases (continued)

Test Case Name and Source	Code Name	Tech POC	TENA User
WSMR			
Radar Data Over Networks	Radar over Net	Dan Bissell	NRO
Remote Optical Instrumentation Control & Monitoring	ROIC&M	Dan Bissell	NRO
PAS (Precision Acquisition System) Over Network	PAS over Net	Dan Bissell	NRO
Patriot C4I Stimulation	Patriot C4I	Dan Bissell	Patriot
Real-Time Optical Tracking Visualization	RTOTV	Dan Bissell	NRO
Real-Time Data Processing System	RTDPS	Dan Bissell	NRO
Patriot TACCSF in the Loop AWACS Simulation	Patriot TACCSF	Dan Bissell	Patriot
Redstone (RTTC)			
TOW - Fire and Forget	TOW-FF	Daryll Burnette	TOW F&F
SCRRIP - Base Capability	SCRRIP	Dave Browning	RTTC
Radar – Remote Radar Control and Monitoring (Part of SCRRIP)	Radar	Dave Browning	RTTC
Rocket – Rocket Simulation Control (Part of SCRRIP)	Rocket	Dave Browning	RTTC
Viewer – RTTC 3-D Remote Visualization (Part of SCRRIP)	Viewer	Daryll Burnette	RTTC
Gepard – International Distributed Test	Gepard	Daryll Burnette	Gepard

TENA Use Cases (continued)

Test Case Name and Source	Code Name	Tech POC	TENA User
EPG			
Starship-to-Starship Transfer	Starship	Bill Schoen	EPG
NTC – Starship	NTC-Starship	Janet McDonald	EPG
NAWC-WD			
Flight Termination System (FTS)	FTS	Dave Tersigni	NAWCWD
Real-Time Instrumentation Display Distribution	RTIDD	Dave Tersigni	NAWCWD
Electronic Combat Range (ECR) Real-Time Data System	ECR RTDS	Dave Tersigni	Echo Range
Land Range Gateway	Land Range Gtwy	Dave Tersigni	Land Range
Virtual Missile Range (VMR)	VMR	Dave Tersigni	NAWCWD
Sea Range (RHII to TIER)	Sea Range	Dave Tersigni	Sea Range
Aberdeen Test Center			
Advanced Distributed Modular Acquisition System	ADMAS	Paul Oxenberg	ATC
AFOTEC			
Vision (CTTRA XI)	Vision	Bob Mass	AFOTEC
KMR, BMDO, MIT Lincoln Labs			
BMDS Fusion Toolbox	BFT	Ted Roe	MIT Lincoln Laboratory



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Summary

- **Foundation Initiative 2010 serves to acquire the necessary products for interoperability and reusability among ranges, facilities, and simulations**
- **Provides:**
  - A common architecture called TENA (including data standards and middleware)
  - A common process for executing a mission that uses TENA-compliant resources
  - A common definition for supporting tools
- **TENA is slated to support major modernization efforts, including VPG, JDEP, JSB, CEE, and the MDA Data Fusion effort**
- **TENA is supporting numerous weapon system programs and Joint experiments, including JSF, Patriot, Comanche, and the range integration effort of MC-02**
- **MC02 Range Integration is an initial effort in support of JFCOM**
  - Requires Ranges show “value added” in MC02
  - Likely use again supporting:
    - J7 in Roving Sands 03
    - J7 Role in emerging JNTC (Joint National Training Capability)
- **TENA Prototype is being tested at over 10 ranges and facilities**
- **For more info visit FI2010.jcs.mil or send email to fipmo@jcs.mil**