Joint Mission Environment Test Capability (JMETC): Effective T&E by Improving Distributive Test Capabilities

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DoD Acquisition Today

- Systems, Systems of Systems, and Families of Systems are all designed, developed, and assembled disparately
  - Result: “Good” Integration and T&E are exponentially more difficult
  - System Evaluation is holistic under Joint Capabilities Integration Development System (JCIDS)
  - Coincidentally, acquisition programs run over budget
- Weapon Systems Acquisition Reform Act of 2009
  - Creation of Developmental T&E (DT&E) and Systems Engineering (SE) organizations
  - Competitive Prototyping Required
  - Feedback needed early in the development process to ensure that capability-based requirements are met

Distributed testing is essential for creating cheaper, faster, and more rigorous test environments that reduce program risk

The JMETC Mission

JMETC provides the ***persistent infrastructure (network, integration software, tools, reuse repository)*** and ***technical expertise*** to integrate live, virtual, and constructive systems for test and evaluation in a Joint systems-of-systems (SoS) environment

Test Resource Management Center
Future T&E Process

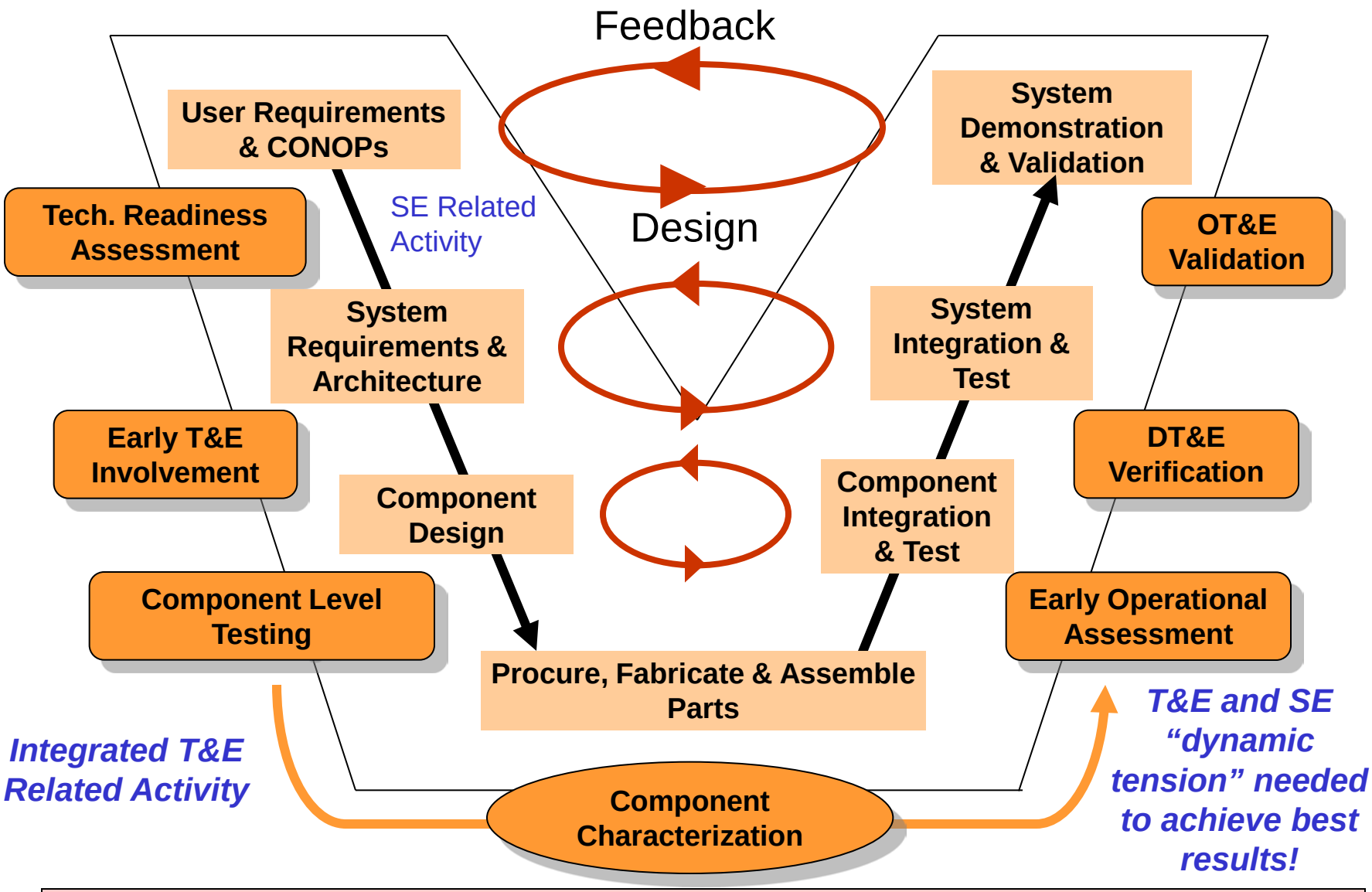
The DoD T&E process must evolve to be:

- Agile
- Streamlined
- Affordable
- Continuous

2010		*2030*
Individual Systems & Systems of Systems	*WHAT do we test?*	Mission-Level Capabilities
Events	*WHEN do we test?*	Continuously
Decision-Makers	*For WHOM do we test?*	Decision-Makers & Warfighters

Goal: Distributed, Integrated Testing and Training

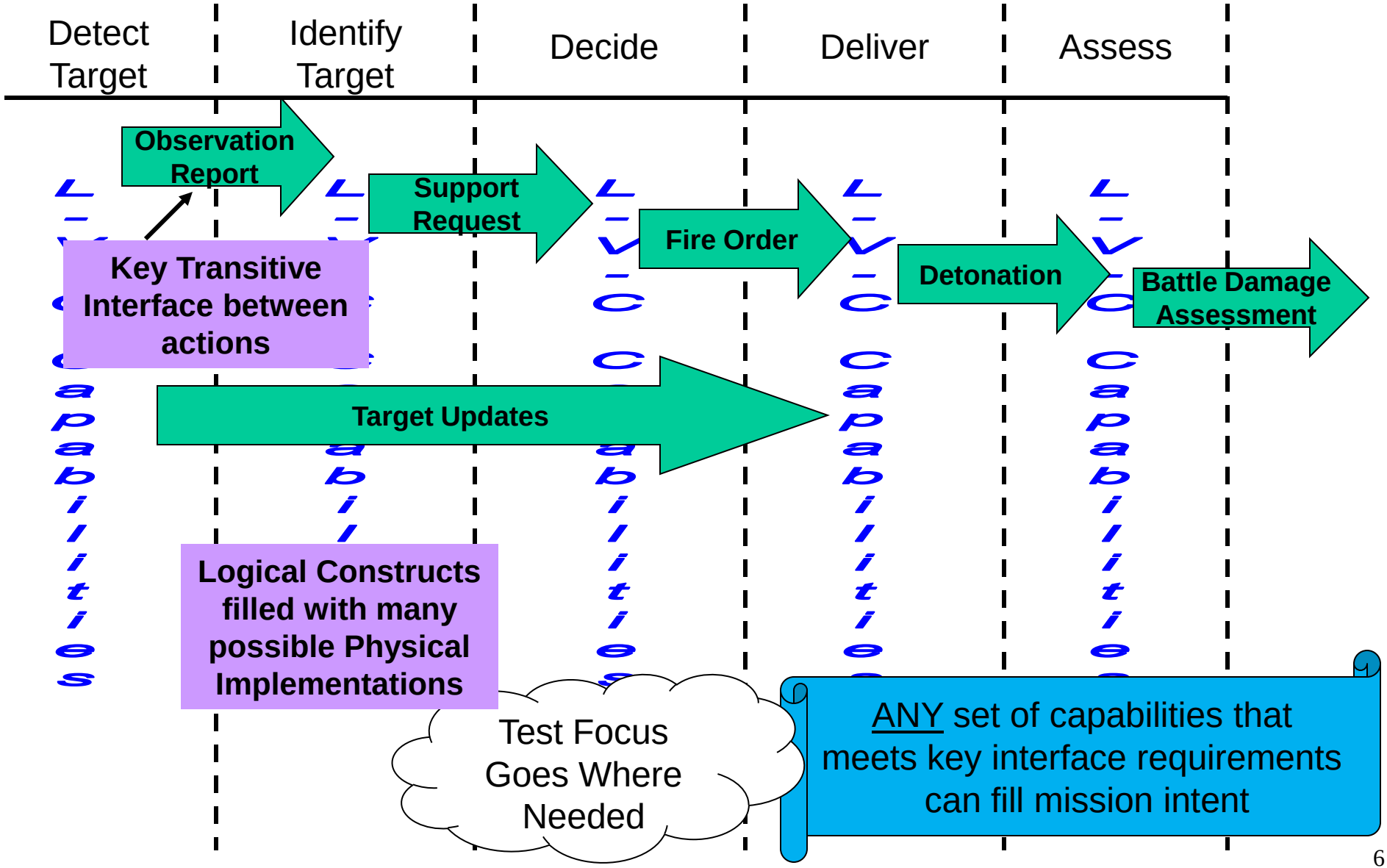
Distributed T&E Supports Systems Engineering (SE)



T&E Integral to System Reliability Program & Overall Performance Verification

L. Weiss 2009

JCAS Example: Enabling Persistence in Design Across Multiple Joint Mission Thread Configurations



JMETC Benefits Acquisition Programs, Testers, & Evaluators

- Enables early verification that systems work in a Joint Environment
  - Test whether systems work well together
- Supports all aspects of testing
  - Rapid acquisition, Developmental Test, Operational Test, Interoperability Certification, Net-Ready Key Performance Parameters testing, Joint Mission Capability Portfolio testing
- Helps find problems early in acquisition – when they are less costly to fix
  - Customers have run as many as 20 independent test runs in a day and fixed interoperability issues overnight
- Reduces acquisition time and cost
  - Readily-available, persistent connectivity with standing network security agreements
  - Common integration software for linking sites
  - Accredited test tools for distributed testing
- Support to Acquisition Programs
  - Expertise to integrate distributed test facilities

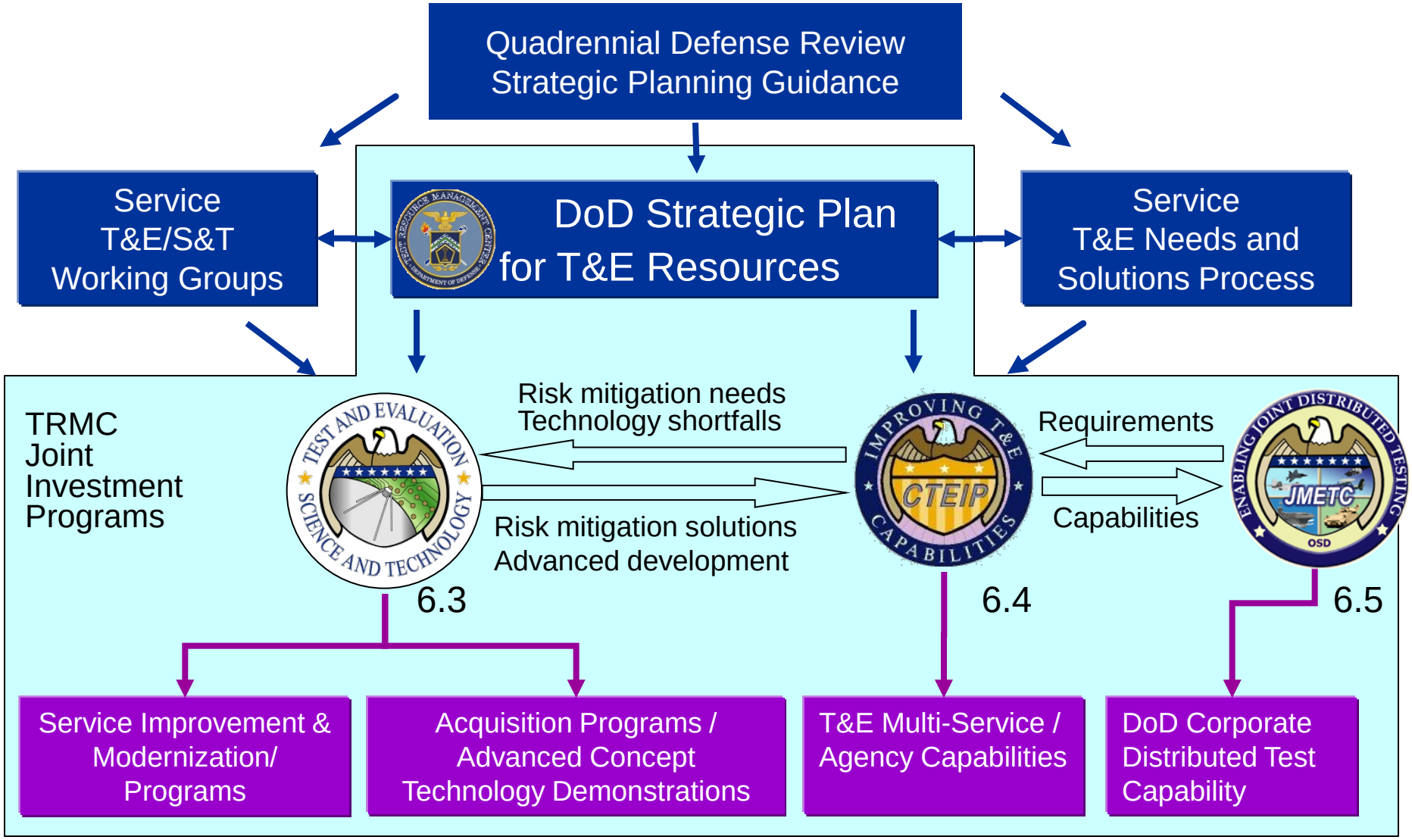
JMETC is identified in T&E Master Plans (TEMPs) as the distributed infrastructure to be used to conduct Joint testing

Distributed T&E Example: JIAMDO JSI & C/DIT 10

- Joint Integrated Air & Missile Defense Organization (JIAMDO) sponsored programs addressing full scope of System Track Management
  - Joint Sensor Integration (JSI) Goal: Integrate national, theater, and tactical sensors and processors to better utilize existing sensor inputs
  - Correlation / DeCorrelation Interoperability Test (CDIT) Goal: All-Service & Coalition Integration of Track Management to fully realize existing capabilities
- JMETC Infrastructure Serves as Joint Development Testbed
  - Identify Joint and Multi-mission architectural issues as they apply within: Net Centric Operations, Battle Management, Command and Control (C2), and Intelligence, Surveillance, and Reconnaissance (ISR)
  - Integration behavior anomalies are discovered, modifications made and retested in real time
  - Modified Infrastructure as needed to support testing
    - Changed scenario files, Test Roles, IFF loads, Participants, etc. without need for re-integration

Rapid Testing / Rapid Turnaround / Rapid Progress!

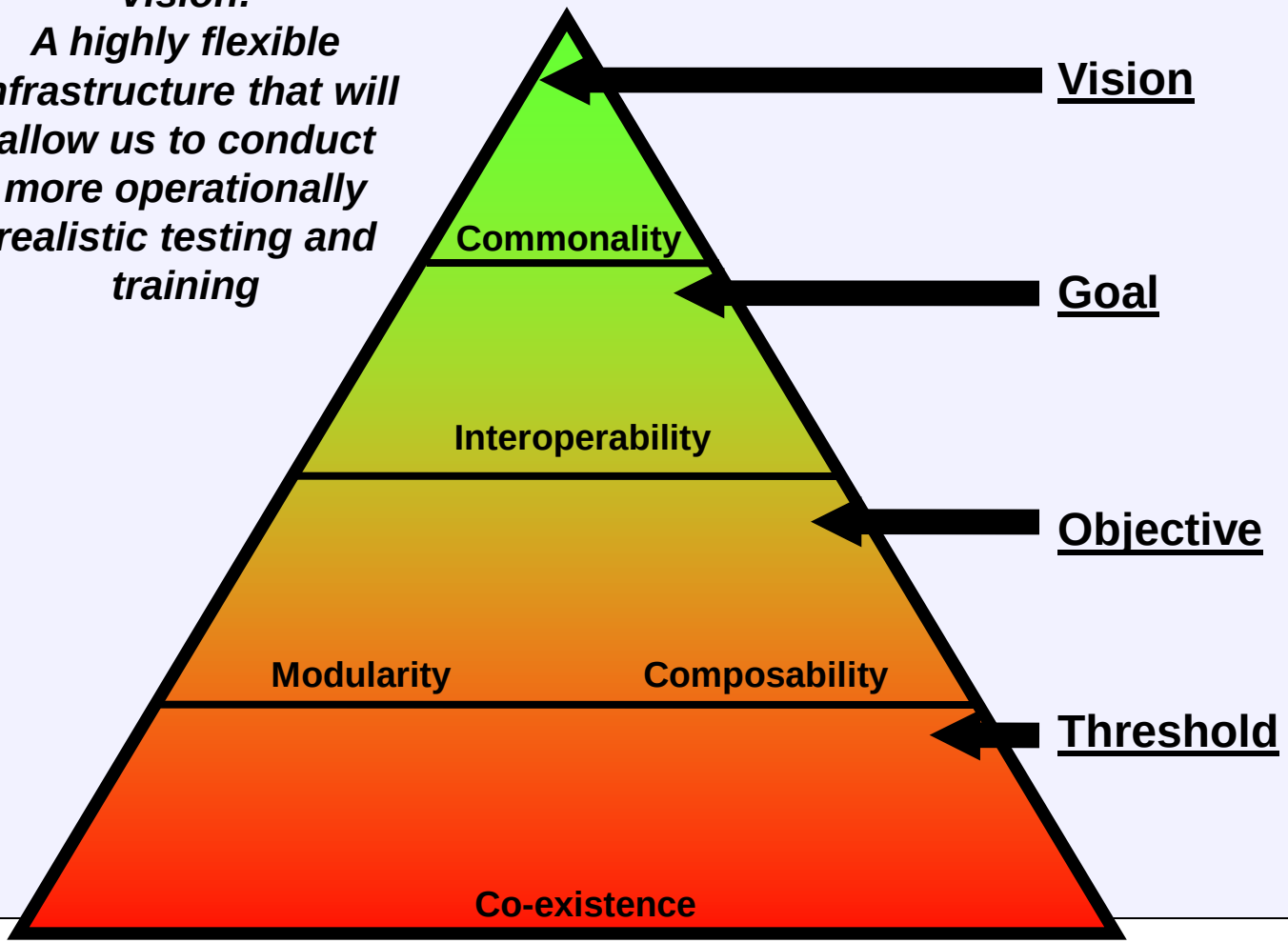
Relationship within TRMC
Synergy through Aligned Investment

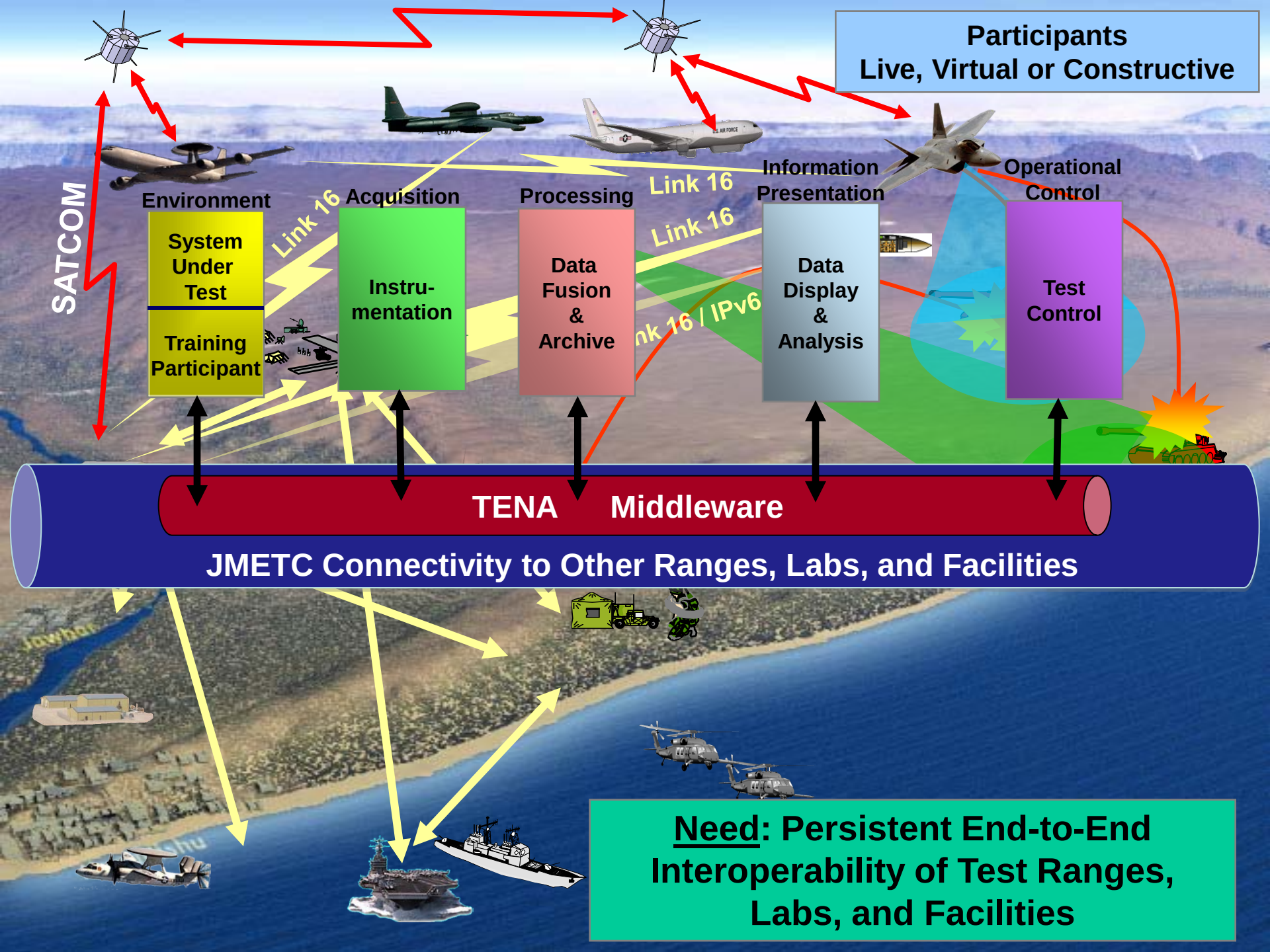


A TRMC Perspective:

Vision for a Common Test and Training Infrastructure

Vision:
A highly flexible infrastructure that will allow us to conduct more operationally realistic testing and training




Participants
Live, Virtual or Constructive
SATCOM
Environment
System Under Test
Training Participant
Link 16
Acquisition
Instru-mentation
Processing
Data Fusion & Archive
Link 16
Link 16
Link 16 / IPv6
Information Presentation
Data Display & Analysis
Operational Control
Test Control
TENA Middleware
JMETC Connectivity to Other Ranges, Labs, and Facilities
Need: Persistent End-to-End Interoperability of Test Ranges, Labs, and Facilities

JMETC Infrastructure Overcomes Common Distributed T&E Challenges

Challenge:	JMETC Enables Through:
• Site Interconnectivity	→ **JMETC Network on SDREN**
• No common enabling transport architecture	→ **TENA Middleware**
• Interface Incompatibility Across Distributed Applications	→ **TENA Standard Object Models**
• Inconsistent Tools	→ **JMETC "Best of Breed" Process**
• Test Participant Collaboration	→ **Reuse Repository**
• Analysis of Disparately Stored Data	→ **Data Management Solutions**

TENA: Test and Training Enabling Architecture

JMETC Connectivity

- Functional Sites: 57
- New Sites Planned: 6
- Connection Points to Other Networks: 4

- 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: Tukwila
Keyport: NUWCD
Ft Lewis: EPG

Hanscom AFB: CEIF
Bethpage: NGC BAMS
Ft. Monmouth: JOIN

Dugway Proving Ground
WPAFB: SIMAF
Schriever AFB: JEWL
Whiteman: B-2
Boeing: Berkeley
Nellis AFB: CAOC-N
Tinker AFB: AWACS
Redstone (5): DTCC, GMAN, SED-Patriot, SED-THAAD, SED-FAAD
Charleston (2): IPC, MEF-MEU
WSMR: IRCC
Greenville: Rivet Joint
Ft Huachuca: (2) JITC, JTDL
Ft Hood (2): CTSF, TTEC
Melbourne: NGC JSTARS

Sites in SoCal
- Edwards: Ridley
- China Lake (3): AV-8B, F/A-18, IBAR
- Point Mugu (2): ITEC, AEA
- El Segundo: NGC B-2
- Camp Pendleton: MCTSSA
- Corona: NSWC
- Point Loma: RLBTS, SSC-PAC
- West Agg Rtr.

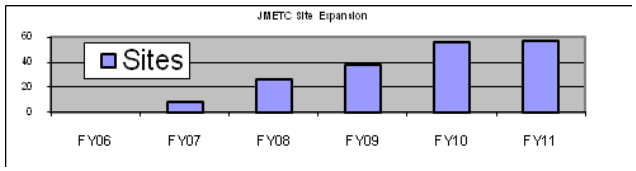
Sites in Hawaii
- PMRF: Bldg 105
- MHPCC

Site in Alaska
- Ft. Greely: CRTC

Sites in Gulf Range
- Hurlburt Field: C2DAC
- Eglin AFB (4): AOC, DTF, GWEF, KHILS

Sites in MD, DC, VA
- Aberdeen: ACCN
- Pax River (5): ESTEL E2C/D, ACETEF, SAIL, ACETEF-MCL, ATR
- JMETC SYSCON
- East Agg Rtr.
- Pentagon: WARCAP
- DISA: Sky 7
- Dahlgren (2): CEDL,IWSL
- JFCOM: JSIC
- Langley: (2) GIIF, TDLITC
- Norfolk: COMOPTEVFOR
- Norfolk:C2F Mitscher Ctr
- Dam Neck: CDSA
- Wallops Island: (2) SCSC, SSDS
- Newport News: NGC VASCIC

- Army
- Air Force
- Navy
- Marines
- Joint
- Industry



As of 18 Oct 2010

JMETC Uses TENA to Integrate Sites

(Can gateway to existing DIS and HLA simulations)

- TENA is:
  - Developed, upgraded, and sustained by CTEIP and JNTC
  - Middleware that provides a single, universal data exchange solution
  - Common for test and for training (core standard in JMETC and JNTC)
  - Available for download at www.tena-sda.org for free
- TENA provides:
  - Interoperability among range systems, hardware-in-the-loop laboratories, and simulations in a quick, cost-efficient manner
  - A capability to rapidly and reliably develop LVC integrations
  - A set of community-agreed object models that define the data elements used in LVC integrations – maximizes reuse from event to event
  - An auto-code generator to drastically reduce TENA incorporation time
- Newest version of TENA (version 6.0) provides:
  - Advanced data filtering (only data of interest sent over the wire)
  - Improved fault tolerance and embedded diagnostics
  - Downloadable on the TENA Website

JMETC Has Realized Benefits from Using TENA

- **Lowers the cost to integrate systems together**
  - Systems have been made TENA-compliant for under $20K
- **Decreases the time to integrate systems together**
  - Auto-code generator creates C++ interface (50K+ SLOC) in hours
  - Legacy systems upgraded to TENA compliancy in < 1 week
  - HLA-compliant display system made TENA-complaint in 1 day
- **Lowers the cost to develop new systems**
  - New systems can use middleware (1.5M+ SLOC) & existing object models for free
  - New systems do not need to develop multiple interfaces to various range protocols
- **Lowers cost of upgrades through gradual deployment**
  - TENA can be gradually deployed (system by system) at DoD Ranges and Laboratories rather than requiring all systems be redesigned
  - Easy incorporation of existing/legacy systems
- **Improves reliability of integrating systems together**
  - Consistency checker to verify every system has compatible versions installed
  - More reliability from reusing systems from one event to the next
  - Auto-code generator ensures that every system has same baseline of source code
  - Standard, validated algorithms (such as coordinate translations or unit conversions) are embedded in TENA rather than burden software applications of managing and performing translations

TENA is an Open Architecture

- **SEI 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 TENA Architecture Management Team (AMT)**
  - **TENA Architectural Specification is publicly defined and available on the web**
  - **TENA Middleware Specification (API) is publicly available on the web**
  - **TENA Object Model is publicly available and downloadable without restriction**
    - » **An Event Designer can create or modify object models for a given event to satisfy their particular event requirements**
- **TENA Middleware exists and is being used to support real events**
  - **Built on open source software – CORBA ACE/TAO**
  - **Government owned, without proprietary software**
  - **Studying possible open source release**

TENA Upgrade Support Offer

- **The TENA team is available to offer advice and assist any organization looking to use TENA**
  - **Advice on overall design approach and trade-offs to consider**
  - **Recommended Object Models to reuse**
  - **Recommendations on how to design new Object Models**
  - **Implementation / Code Designs Reviews**
  - **Awareness of similar systems and lessons learned**
  - **Hands-on training classes on TENA capabilities**
  - **Hands-on training classes on using "TIDE" (a TENA Development Tool)**
    - » **Eases developing TENA interface**
    - » **Assists incorporating different Object Models**
    - » **Upgrade utility for HLA applications migrating to TENA**

Opportunity to Get Assistance in Using TENA

E-mail request to: feedback@tena-sda.org

Distributed T&E Community Growth Areas

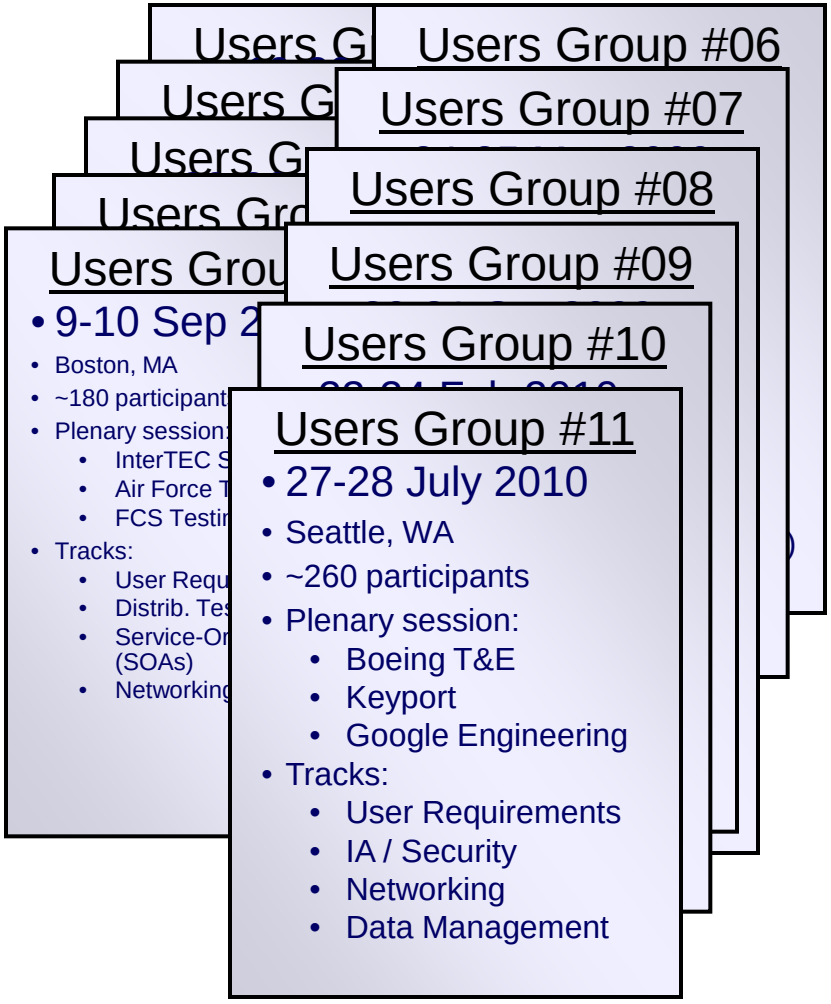
- "Good" Test & Analysis Plans are critical to a successful distributed **test**
- Software and Network Configuration Management must be taken more seriously in distributed test environments
- Elimination where possible of Protocol Converters and Gateways as single points of failure
- Continued emphasis in community on “test early and often”
- Community is getting really good at quickly collecting and storing lots of test data. What are we going to do with it?

JMETC Users Group Meetings

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

Next JMETC Users Group Meeting:

- Scheduled for 13-14 December
- Location: San Diego, CA
- Potential Tracks:
  - User Requirements
  - Information Assurance / Security
  - Data Management
  - Networking
  - Tools
  - Software Interface



Summary

- JMETC supports the full spectrum of Joint testing, supporting many customers in many different Joint mission threads
- JMETC and TENA are being built based on customer requirements
  - JMETC Network on SDREN established and expanding
  - TENA the enabling architecture (commonality with Training)
  - Gateway devices available to convert legacy systems to TENA
  - Common tools used extensively at many sites
  - Constructing Reuse Repository based on user requirements
- JMETC is partnering with Service activities and leveraging existing capabilities
- JMETC is coordinating with JFCOM to bridge test and training capabilities
- JMETC Users Group provides an open forum to present emerging requirements as well as new technologies & capabilities

JMETC Program Points of Contact

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Questions?

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