Joint Mission Environment Test Capability (JMETC) 101

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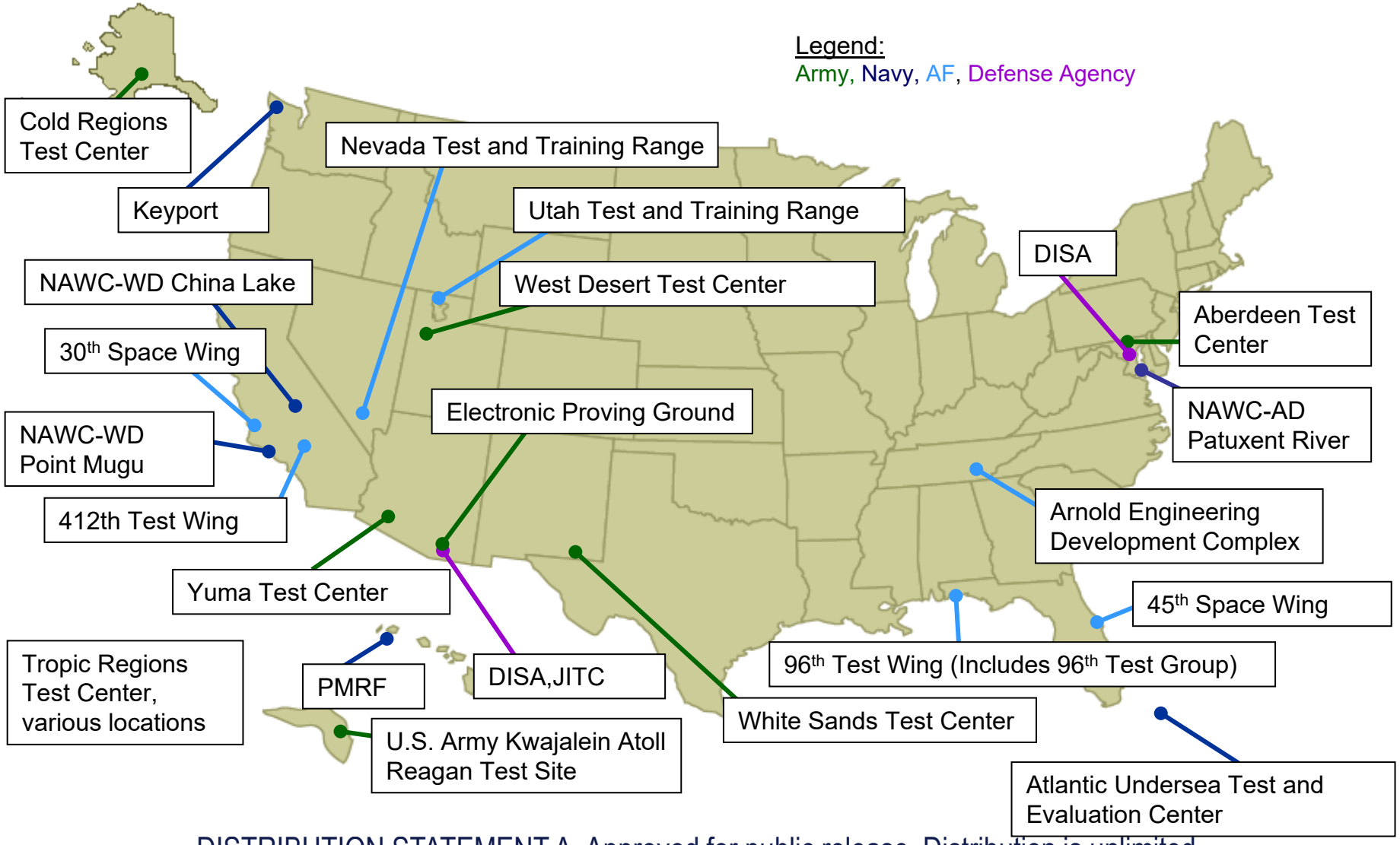
Topics

- Test Resource Management Center (TRMC) Organization
- JMETC 101
  - JMETC Investment Areas
    - Purpose, Accomplishments, and Products
    - Networks
    - TRMC Cybersecurity
    - TENA Architecture
      - Benefits of TENA
    - Big Data / Knowledge Management Initiative
    - NCRC
    - JTEX
- Q&A all along the way

Why Distributed Test

- **Distributed test** is a persistent and continuous process, for linking various geographically separated Live, Virtual, and Constructive (LVC) sites and systems together for use across the acquisition life cycle to support and conduct T&E of a system or system-of-systems
  - **Essential** for creating cheaper, faster, reusable and more rigorous test environments throughout the acquisition cycle (To include: R&D, DT, OT, Mission Planning and Mission Engineering)
  - **Enables** an integrated test and training environment that is agile, streamlined, affordable, and persistent to provide decision quality data to Decision-Makers and Warfighters
  - **Supports** tests to validate/measure system and system of systems Joint Interoperability and Joint Mission Effectiveness in a robust, operationally relevant environment.

The STEWARD of the DoD Test Infrastructure Major Range and Test Facility Base (MRTFB): The "Critical Core" 23 Sites: Army-8; Navy-6; Air Force-7; Defense Agency-2



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TRMC Organization

Under Secretary of Defense for Research and Engineering (USD(R&E))

- DDR&E (Research & Technology)
- DDR&E (Modernization)
- DDR&E (Advanced Capabilities)
- **Director TRMC** — *Field Activity*
- DARPA
- MDA
- SDA
- DIU

Other Major Organizations Reporting to USD(R&E)

Principal Deputy Director TRMC

- Chief Operating Officer
- Chief Financial Officer
- CIO // Cyber Executive Agent
- Chief Data Officer (CDO)

Test Resource – Governance (TR-G)

- Test Ranges/Facilities/Capabilities Oversight
  - Major Range and Test Facility Base (MRTFB)
  - Chemical/Biological Test Facilities
  - Cyber Ranges and Software Testbeds
- Service/Agency T&E Budget Certification
- Range Sustainability
  - Environmental / Spectrum / Other Encroachment
  - Climate Change Impact Mitigation
- Test Range & Facility Workforce
- Test Range & Facility Policy
- Real Property / Infrastructure / MILCON
- T&E Master Plan (TEMP) Review (Resources)
- International Partnerships (for test capabilities)
- Other Federal Partnerships (DoE, DoT, DHS)

Test Resource – Modernization (TR-M)

- Strategic Plan for Test Resources
  - 30-year outlook
  - Updated annually
- Future Test Needs Forecast
  - Both capability and capacity needs
- Strategic Portfolios
  - Defense modernization acceleration
- Foundational Portfolios
  - Enterprise-wide test capabilities
- Test Resource Investment Roadmaps
- DoD Modernization Test Schedule Deconfliction Clearinghouse

Test Resource – Investments (TR-I)

- Test Technology Development
  - Test & Evaluation / Science & Technology
- Test Capability Development
  - Central T&E Investment Program (CTEIP)
- Cyber Environments and Test Tools
  - National Cyber Range Complex (NCRC)
- Joint Mission Environ. Test Cap. (JMETC)
  - JMETC Secret Network (JSN)
  - JMETC MILS Network (JMN)
  - Test & Training Enabling Arch. (TENA)
- Multi-Domain Operations Testing
- Mission-level // Digital Engineering
- Cloud T&E Services // DevSecOps
- Knowledge Management // Big Data

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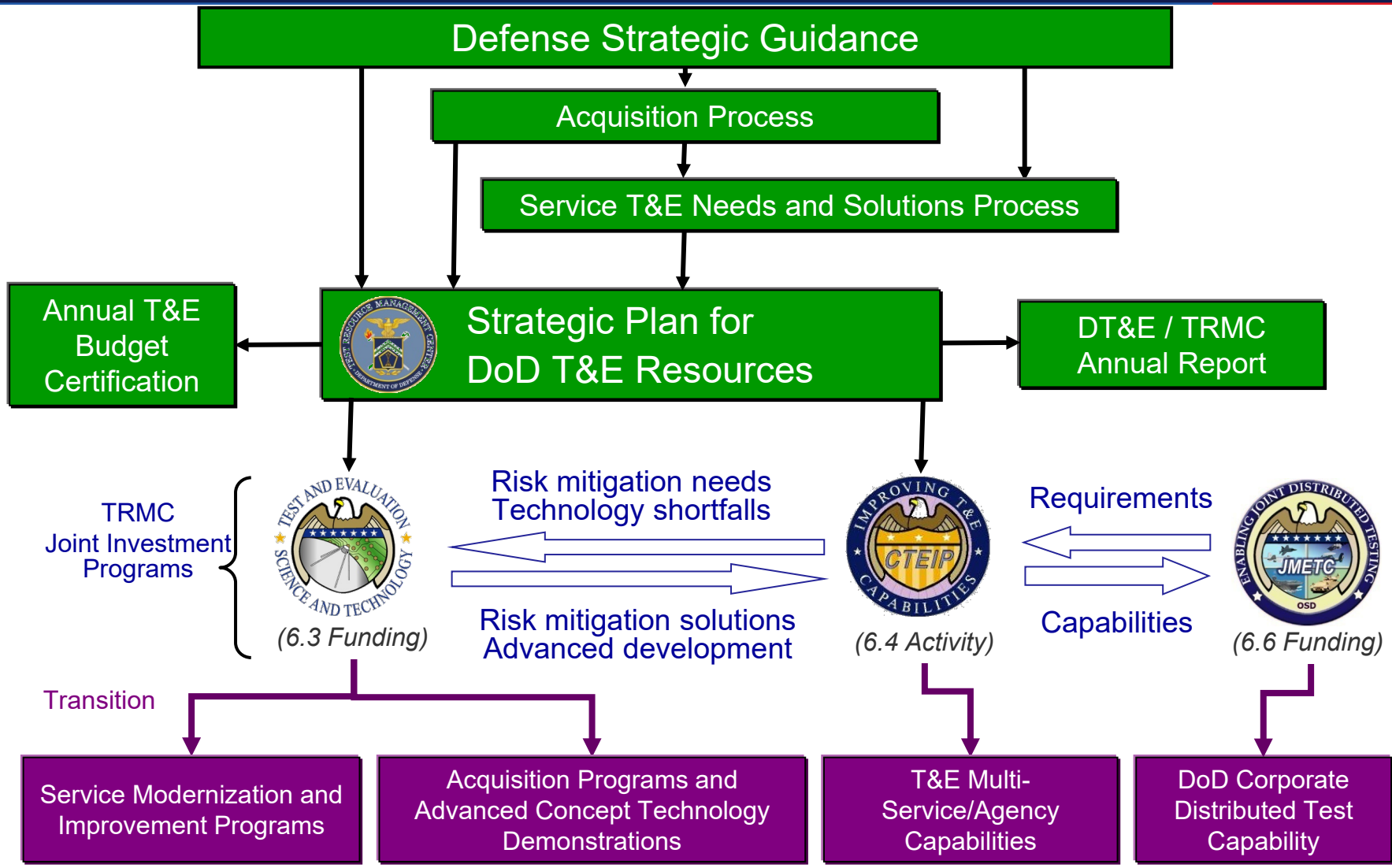
The TRMC "Blueprint": Putting Test Capabilities on the DoD Map



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TRMC Investment Portfolios

Legacy Investment Structure

Long-Term multi-Service Investments

Joint Improvement & Modernization (JIM)

JIM-Core	JIM-EW	JIM-Hypersonics
• 3-5 year requirement horizon • EMD of major multi-Service test capabilities • Development, not procurement • Services & Agencies budget for O&M • $110-140M/year, $600-$700M over 5 years	• Special DoD area of emphasis • EMD of electronic warfare (EW) test capabilities • Assess aircraft performance against complex new threats. • Service budget for O&M • Total cost ~$465 over ~7 years	• Special DoD area of emphasis • EMD of hypersonic ground test capabilities • Focus on hypersonic cruise & boost glide missiles • Service budget for O&M • Total cost ~$350 over ~5 years

Near-Term Investments

Resource Enhancement Project (REP)	Threat Systems Project (TSP)
• 1-2 year horizon • EMD of instrumentation to address near term OT shortfalls • Coordinated with DOT&E • $18-20M/year	• 1-2 year horizon • Address shortfalls in threat systems representation • Coordinated with DOT&E • $3-5M/year

Strategic Portfolios cover both Offensive & Defensive

Portfolios support testing across all paths of the acquisition framework (Major Capability, MTA, Software, etc.)

Portfolios support all types of testing (Demos, Experiments, DT, OT, etc.)

Portfolios consist of investments across all test resource categories (M&S, Test Facilities, HWIL, SIL, Test Ranges, Workforce, etc.)

Portfolio Investment Structure

- **Strategic Portfolios**
  - *Hypersonics*
  - *Directed Energy*
  - *Cyber*
  - *Nuclear*
  - *Electronic Warfare*
  - *Space*
  - *Autonomous Systems (and Artificial Intelligence)*
  - *Multi-Domain Integration*
- ***Foundational Portfolios***
  - Common Range Instrumentation
  - Target/Threat Systems
  - Knowledge Management (and Big Data Analytics)
- **Major Projects**
  - Joint Improvement Modernization Projects
  - Quick Reaction Test Capability Projects

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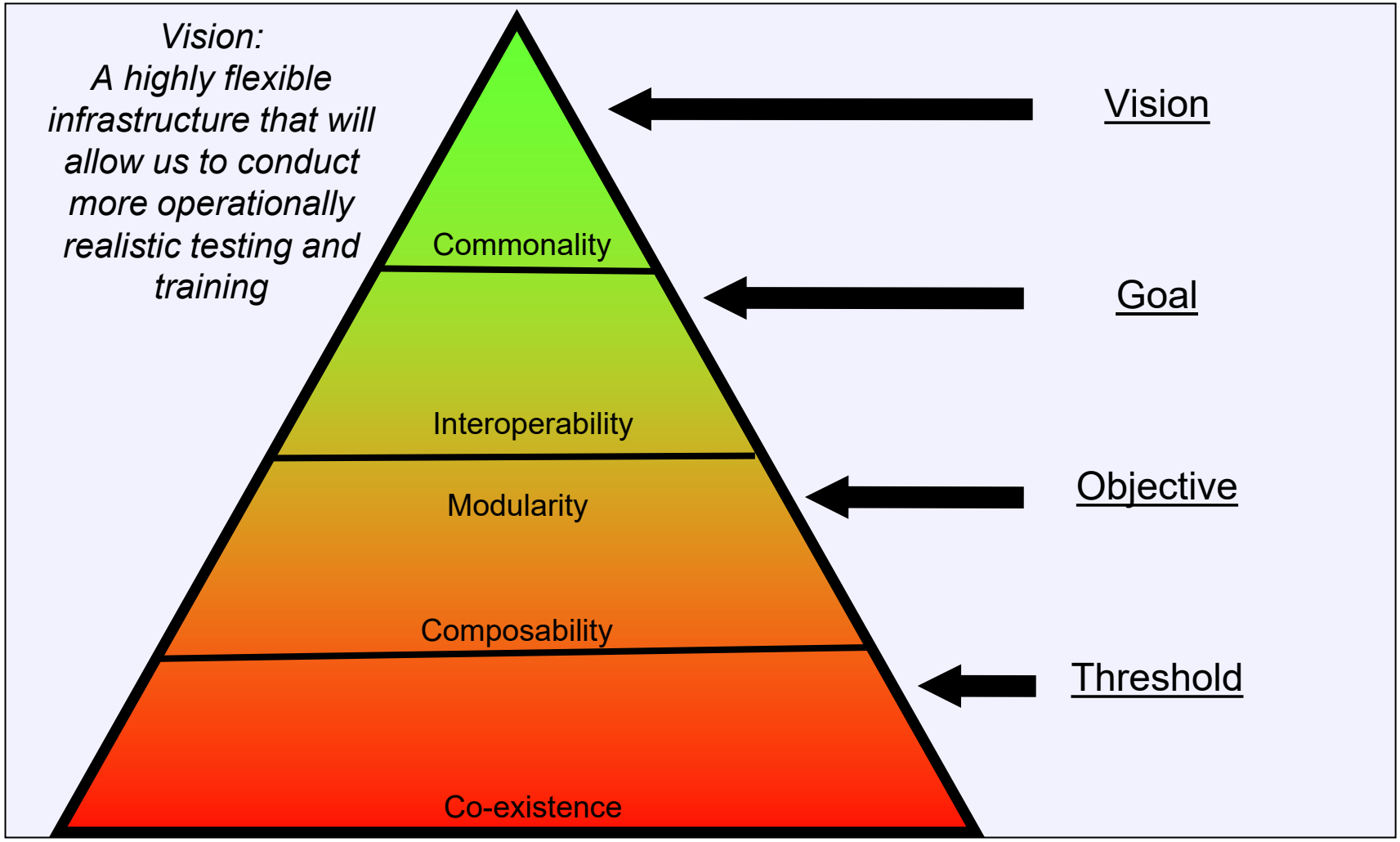
A TRMC Perspective: Vision for a Common Test and Training Infrastructure



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Why JMETC?

DoD systems are not adequately tested in Joint and Cyber contested environments

A reason:

Inadequate environments for conducting System of Systems and Cyber T&E and experimentation

A reason:

Distributed T&E is not a part of day-to-day program T&E activities

A reason:

Building the required T&E infrastructure for a single program is not cost effective

DoD Needs

Persistent & reusable enterprise T&E infrastructure that:

JMETC Provides:

- **Connects disparate DoD RDT&E and training locations**
- **Rapidly integrates Live, Virtual, & Constructive capabilities**
- **Modernizes T&E Knowledge Management and introduces Big Data Analytics tools and applications**

Acquisition's View of Future T&E
(And the Future is Now…)

- Full contractual & legal authority
- Government Purpose / Data Rights
- Cost Savings
- Non-Proprietary Open Interface Standards
- Multi-Purpose & Scalable M&S Assets
- Expanded use of Sim / Stim Environments

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Joint Mission Environment Test Capability (JMETC)

Enterprise Infrastructure for testing like we fight

JMETC Summary:	
System of Systems Infrastructure	172 Gov't & Industry Sites (69+ Addt'l Planned)
	438 JSN Test Events (FY07-FY22)
	95.5% Enterprise Reusability
Common Integration Software (TENA)	Suite of 56 Integration Tools
	Runs on all DoD-approved Operating System Environments (84 different variants)
	Used in 13 Partner Nations
Customer Collaboration (Enables RDT&E Problem Solving)	9,000 Website User Accounts
	20 million+ Webpage Views in FY18
	94,841 Downloads in FY18
Subject Matter Expertise	11,325 Help Tickets Resolved FY12-FY18
	364 Lessons Learned & Shared

JMETC Mission:

- **Optimize the DoD's distributed system of systems test infrastructure**
- **Develop & maintain common software that eliminates stove-pipes**
- **Promote Inter-Service RDT&E collaboration through website services**
- **Provide expertise to rapidly design, setup, & execute tests**

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JMETC Customer Concept of Operations

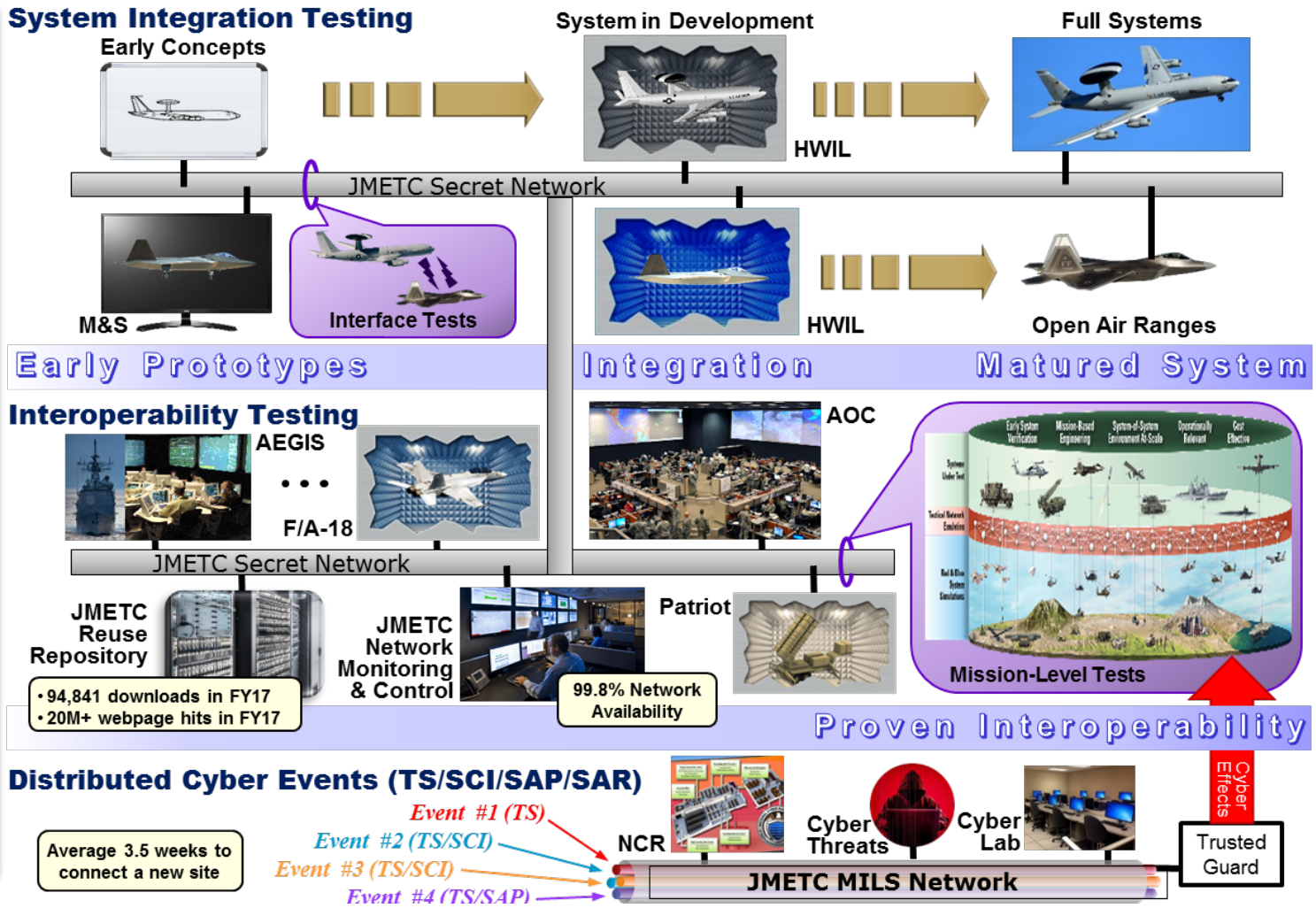
JMETC supports 905 days of testing each year

Distributed Test Prioritization Drivers:

Warfighter Capabilities
- Improve Interoperability
  - System-of-Systems
  - Mission-Level Effectiveness
  - Interoperability Certification
- Improve Resilience
  - Cyber / Electronic Warfare

Acquisition Programs
- Reduce the Cost of Testing
- Accelerate Test Schedules

T&E Needs
- Minimize Duplication
- Enhance Test Repeatability
- Enable Reuse of Test Assets
- Facilitate Multi-Service Sharing



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Example JMETC Interoperability Testing Customers

- **Joint Interoperability Test Command (JITC) Joint Interoperability Tests (JITs): DoD systems Certification tests**
  - 4-5 times per year. Also conducts Joint Analysis Review Panel (JARP) over JSN which leverage enterprise collaboration tools and services provided by JMETC (such as file sharing, VoIP) and reduces TDY expenses

- **Air Force System Interoperability Test (AFSIT): interoperability and certification for tactical data link (TDL) standards**
  - 2 tests per year. AFSIT Lab Chief: "We used SFTP to exchange data with the E-3. JSN and all the tools worked seamlessly. Another successful event using JSN."

- **US Navy (NAVSEA) Distributed Integrated Interoperability Assessment Capability (DIIAC) Interoperability Development & Certification Testing (IDCT) and Verification and Validation (V&V) tests**
  - DIIAC executes an average of 3 IDCT events per year and 2 V&V events using JSN
  - NAVSEA 05H Director was "very impressed with JMETC capabilities and wanted to ensure JMETC continues to support emerging [needs], including requirements for cybersecurity testing."

Example JMETC Systems Integration Customers

- **NAVAIR MQ-4C TRITON testing: uses JSN continuously 6 days per week since 2012**
  - Triton Navy Lead Test Engineer: “The Triton Test Network (DREN, SDREN, NWTE) has been an integral part of the Triton program supporting not only flight test, but ground test, and MUCH lab work (often 24/7). The "network" has been SOLID throughout. So congrats to your teams as well for your significant part in Triton. Your support is much appreciated.”
- **Air Force Small Diameter Bomb Increment II (SDB-II): capability to remotely observe live missile telemetry data from the Eglin Range and to perform real-time data analysis**
  - Testing on an ongoing basis, as needed. Raytheon, 2017: “…using the JSN infrastructure will allow real-time data analysis to be conducted locally in Tucson, AZ which will: reduce travel costs, require fewer mobile data processing kits, allow flexibility in the test team make-up, and minimize schedule impact of test postponement and cancelation.”
- **Navy P-8A Poseidon: anti-submarine warfare; anti-surface warfare; and intelligence, surveillance, and reconnaissance**
  - Using JSN to demonstrate Harpoon Block II+ air-launched anti-ship cruise missile integration / interoperability with the P-8A to evaluate Interfaces and Net-Enabled Weapon message exchanges

Joint Mission Environment Test Capability (JMETC) Program Investment Areas

- **Distributed Testing Support**
  - Event Planning and Execution Support
  - Help Desk Troubleshooting and Subject Matter Expertise
- **Distributed Testing Networks**
  - JMETC SECRET Network (JSN): Always connected
  - JMETC MILS Network (JMN): Event-specific links
- **TRMC Cybersecurity Services**
  - Risk Management Framework Support
  - RDT&E Cybersecurity Standards: Overlay, SW Certification
- **Test & Training Enabling Architecture (TENA)**
  - TENA Software Repository
  - TENA Object Models
  - TENA Web Services
- **Big Data / Knowledge Management Initiative**
  - BDKM & Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite (CHEETAS) Overview
- **National Cyber Range Complex (NCRC)**
  - Cyber Range Infrastructure, Tools, Instrumentation
  - Offensive & Defensive Cyber Tests & Events (OCO/DCO)
  - Cyber SMEs & Support Team (including skilled OPFOR)

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JMETC Overview

- **JMETC provides the infrastructure for testing in a Joint environment**
  - Developmental Test, Operational Test, Interoperability Certification, Net-Ready Key Performance Parameters compliance testing, Joint Mission Capability Portfolio assessments, etc.
- **Time and cost savings**
  - Readily-available, persistent connectivity with standing network security agreements
- **Increased capability/connectivity**
  - Enables more robust testing earlier in the acquisition process
  - Provides common, certified tools to streamline integration process
  - Establishes test capability aligned with Joint National Training Capability (test and training)
- **Being built based on customer requirements**

Used whenever you need to link resources together to conduct a distributed test event

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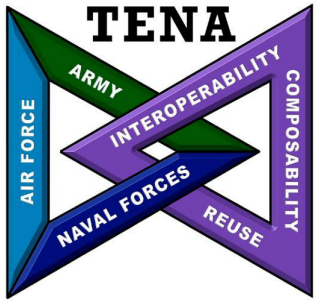
What is JMETC?

- 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

The JMETC Mission

JMETC provides the ***persistent and robust 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 and Cyber environment

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JMETC Benefits Acquisition Programs, Testers, & Evaluators

- Enables **early verification** that systems work in Multi-Domain, Joint and Cyber contested environments
  - Test whether systems work well together
  - Test whether systems are resilient to cyber threats
  - Identify issues early when they are less costly to fix
- Provides access to **high-demand, low availability systems**
  - Supplements number of live Systems Under Test (SUTs), threats, or “supporting cast” to create a realistic environment
  - Feasible alternative to Live testing in early DT and risk reduction for OT
- Provides access to **cyber ranges**
  - Ability to conduct unconstrained but nondestructive cyber activities in representative environments
- Provides a **collaborative engineering environment**
  - Gives SMEs an opportunity for collaboration without leaving home station
- Supports all aspects of **testing across the acquisition lifecycle**
  - Interoperability, cybersecurity, rapid fielding, DT, OT, etc.

Reduce Acquisition Cost, Schedule and Risk

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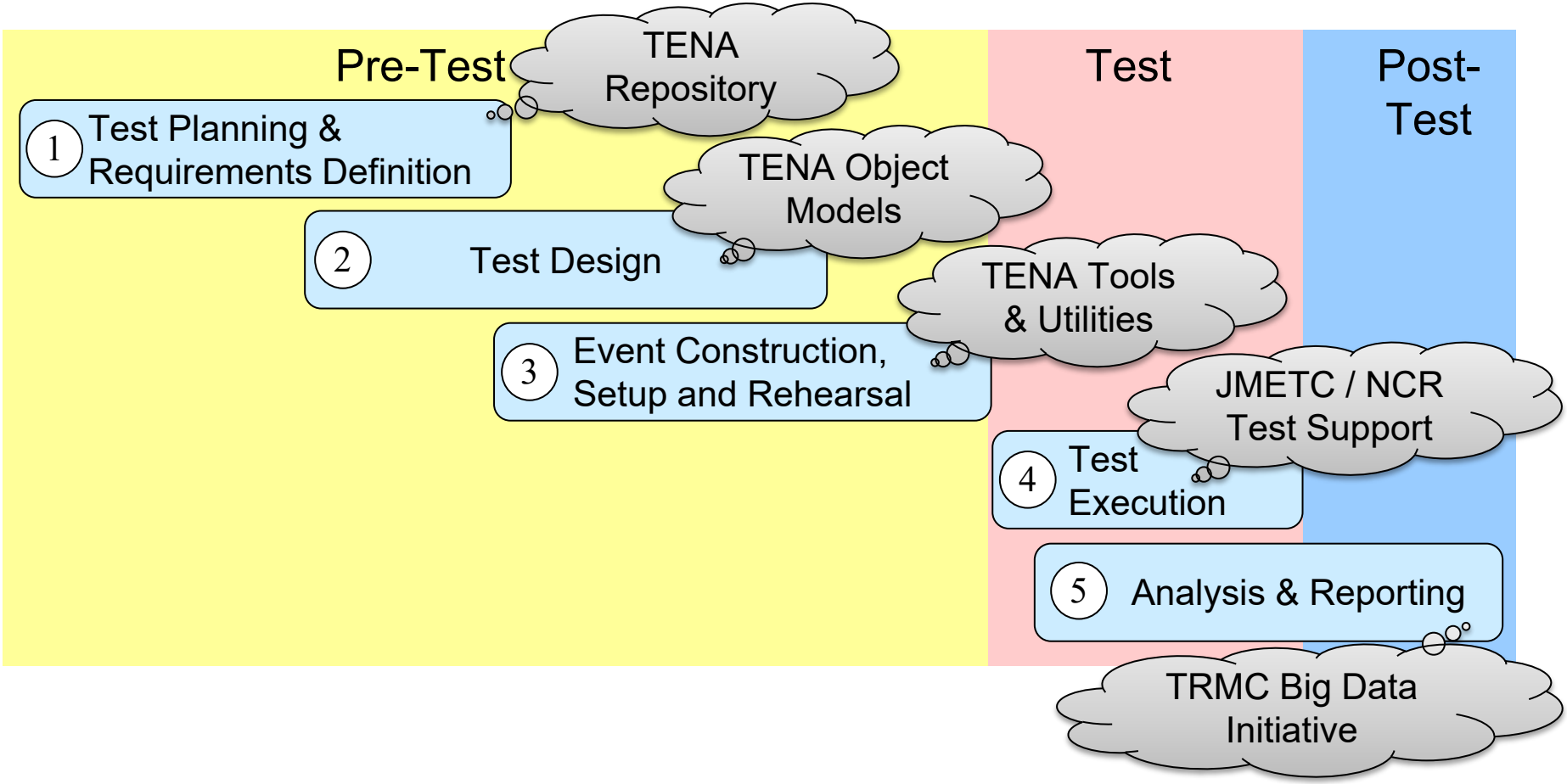
How TRMC Supports T&E: Notional Test Walkthrough

TRMC Subject Matter Expertise (SME) supports entire process



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Distributed Testing Support

- **Pre-event / Event Integration Phase**
  - Test Development / Design
    - Help users leverage JMETC capabilities and services to meet their infrastructure requirements, including TENA
  - Event / User Support
    - Ensures JMETC sites have the knowledge, skills, abilities, and site-specific examples to successfully conduct distributed events
    - Support event planning activities
  - Network / Cybersecurity Engineering
    - Provide support to ensure optimized connectivity
- **Event Execution Phase**
  - Infrastructure Support
    - Verify infrastructure readiness and troubleshoot problems as they are discovered
    - Provide collaboration tools
    - Development and instantiation (and re-instantiation) of virtualized environments
  - Event / User Support
    - Provide remote and / or onsite support to customer test activities on an as-requested basis
- **Post Event Phase**
  - Support data dissemination and analysis
  - Capture lessons learned and infrastructure gaps & limitations

JMETC Supported Product List Examples (32 software products)

- TENA Middleware
- TENA Meta-Model
- Object Models
- MagicDraw TENA Plugin
- Object Model Compiler
- Example Application Plugin
- .NET Language Binding
- Java Language Binding
- Web Language Binding
- TENA Console
- TENA Canary
- TENA Data Collection System (TDCS)
- Middleware Clock Support
- RelayNode
- Installer
- LiveDisk
- TENA Retina
- Build System
- Distributed Test Infrastructure
- Repository
- Website Services
- Mission Information Resource Controller (MIRC)
- TENA Adapters
- TENA DIS Gateway (DISGW)
- DISGW Dashboard
- TENA Platform Generator (PlatGen)
- SIMDIS TENA Plugin
- TENA Video Distribution System (TVDS)
- TENA Data Viewer (TDV)
- TENA Protocol Dissector (TPD)
- ClearPath Multicast Tool
- Multicast Sniffer

JMETC Example User Successes

- **Reduces cost of testing**
  - JSF Data Link Information Exchange Requirements (IER) testing 90% cheaper using JMETC vs. cost of original plan
- **Reduces amount of testing required**
  - In FY17, JITC conducted 4 Joint Interoperability Test Events involving 30 Joint systems that resulted in 19 assessments/certifications (36 total certifications using JMETC in FY17)
- **Reduces risk for expensive open-air range testing**
  - PMA-262 connected government & industry to execute 167 flights, 1,114 flight hours, and 2,500 ground test hours to ensure Triton was ready for operational use (2014-17)
- **Consolidates RDT&E network operating costs**
  - Navy Distributed Integrated Interoperability Assessment Capability (DIIAC) reduced networking costs 66% by moving to JMETC
- **Reduces travel**
  - SDB-II reduced travel by up to 12 engineers from Raytheon Tucson to Eglin AFB
- **Enables agile Test-Fix-Test development**
  - Integrated Warfare Systems (IWS) Interoperability Configuration Verification team only needed two days to successfully correct and verify issues found within the Aegis system
- **Delivers needed capabilities to warfighter under budget & schedule**
  - Battlefield Airborne Communication Node (BACN) Joint Urgent Operational Need (JUON) saved $1.2M & delivered capability 3 months ahead of schedule

Joint Mission Environment Test Capability (JMETC) Program Investment Areas

- **Distributed Testing Support**
  - Event Planning and Execution Support
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JMETC Network Architecture

JMETC has a hybrid network architecture

- The **JMETC Secret Network (JSN)**, based on the Secret Defense Research and Engineering Network (SDREN), is the T&E enterprise network solution for Secret testing

- The **JMETC Multiple Independent Levels of Security (MILS) Network (JMN)** is the T&E enterprise network solution for all classifications and cyber testing

Inter-Range Distributed Operations

Joint Mission Environment Test Capability (JMETC) SECRET Network (JSN)

- Leverages the SECRET Defense Research and Engineering Network (SDREN) for connectivity
- Operates at SECRET classification, available 24/7
- Continuous monitoring, troubleshooting, and optimization of the end-to-end network infrastructure
- Capable of supporting numerous simultaneous test events

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JMETC Secret Network (JSN) Improves Secret Defense Research and Engineering Network (SDREN)

SDREN Provides:

- **Network Connection**
  - High-speed RDT&E network that connects Government & Industry
  - Network cybersecurity monitoring & reporting
  - Assistance with external connections between sites
  - Reach-back to DoD High Performance Computing capabilities

JSN Improvements (no cost to user):

- **Network Quality Substantiation**
  - JMETC Active Measurement Program monitors “full mesh” network performance
- **Common Test Services**
  - Examples: Secure file transfer, VoIP, Adobe Connect, firewall configuration, COOP
  - TENA SDA maintains software necessary to integrate disparate LVC architectures
- **Subject Matter Expertise**
  - Event Support Team assists with test planning, design, setup, & execution
  - Connectivity Team provides hands-on technical & cybersecurity support
  - SYSCON at Pax River provides internal & external site troubleshooting during tests

Navy Distributed Integrated Interoperability Assessment Capability (DIIAC) achieved 66% network cost savings by moving to JMETC

JMETC SECRET Network (JSN) Teams

JMETC teams provide direct onsite or remote test activity support regarding test requirements, planning / design, execution, and post-test lessons learned and infrastructure gaps / limitations as needed

- **JSN SYSCON** – Tier 1 help desk, full mesh network characterization testing, proactive troubleshooting, test event collaborative systems (VoIP, Adobe Connect, chat, file server), security patches
- **JSN Connectivity Team** – Tier 2 network support, network characterization and analysis, walk-the-wire trouble resolution, assistance with site installation, ports and protocols management, Connection Approval Process (CAP), Information Assurance, PPS management
- **User Support Team** – Test requirements, planning, test event support tools, Test and Training Enabling Architecture (TENA), test execution, on-site event assistance

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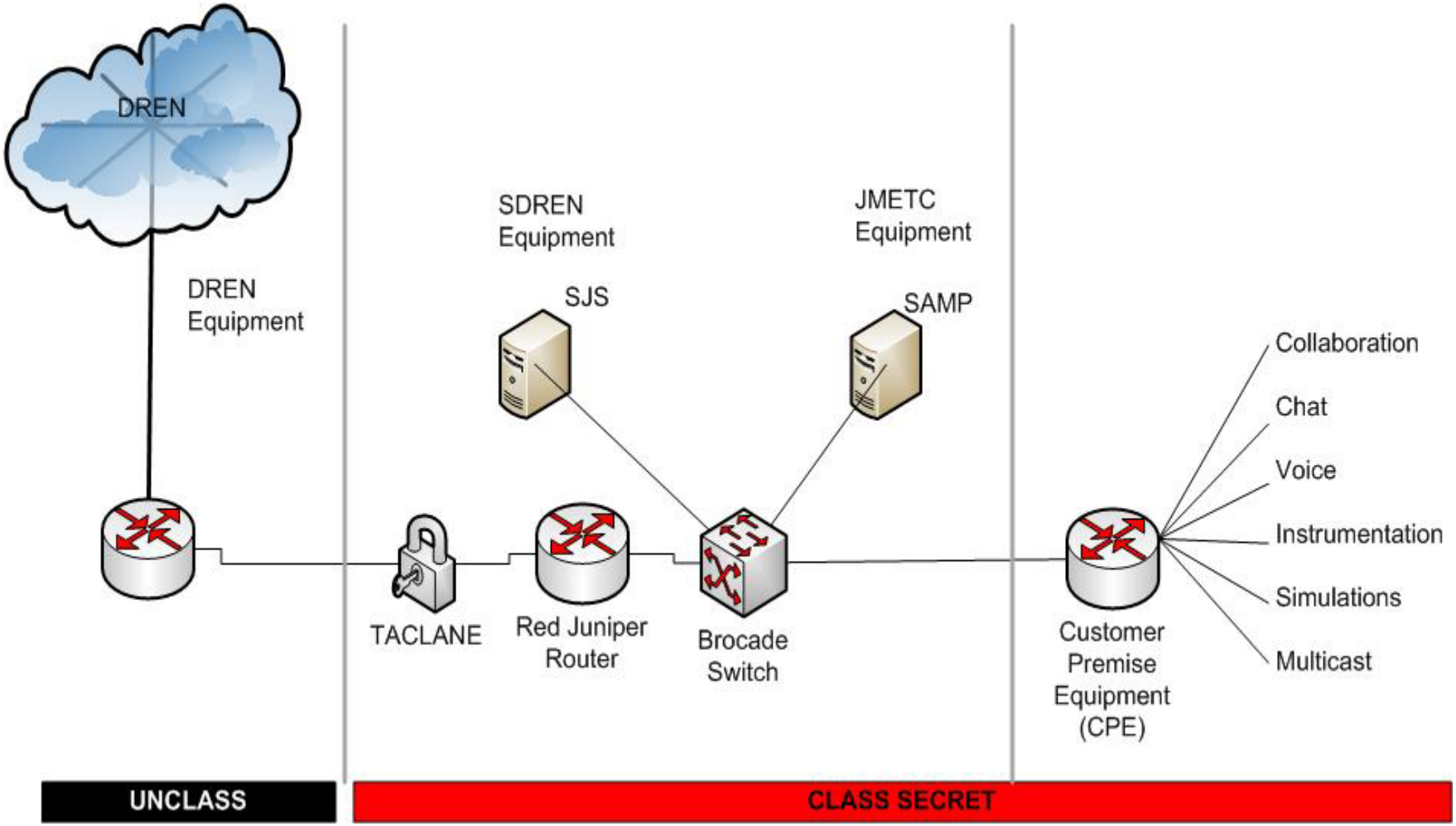
JMETC Network: Reusable Persistent Connectivity

- Reuse enables the customer to avoid:
  - Acquiring network equipment
  - Processing the security agreements
    - Obtaining Authority to Connect (ATC)
    - Obtaining Authority to Operate (ATO)
  - Generating agreements to connect with test partners
  - Testing the equipment installation
  - Testing the network configuration
- Reuse enables the customer to:
  - Test capabilities early and often
  - Execute unscheduled / unplanned testing whenever needed
  - Focus on the test rather than the network

By leveraging JMETC sites, customer time and dollars are not spent on infrastructure

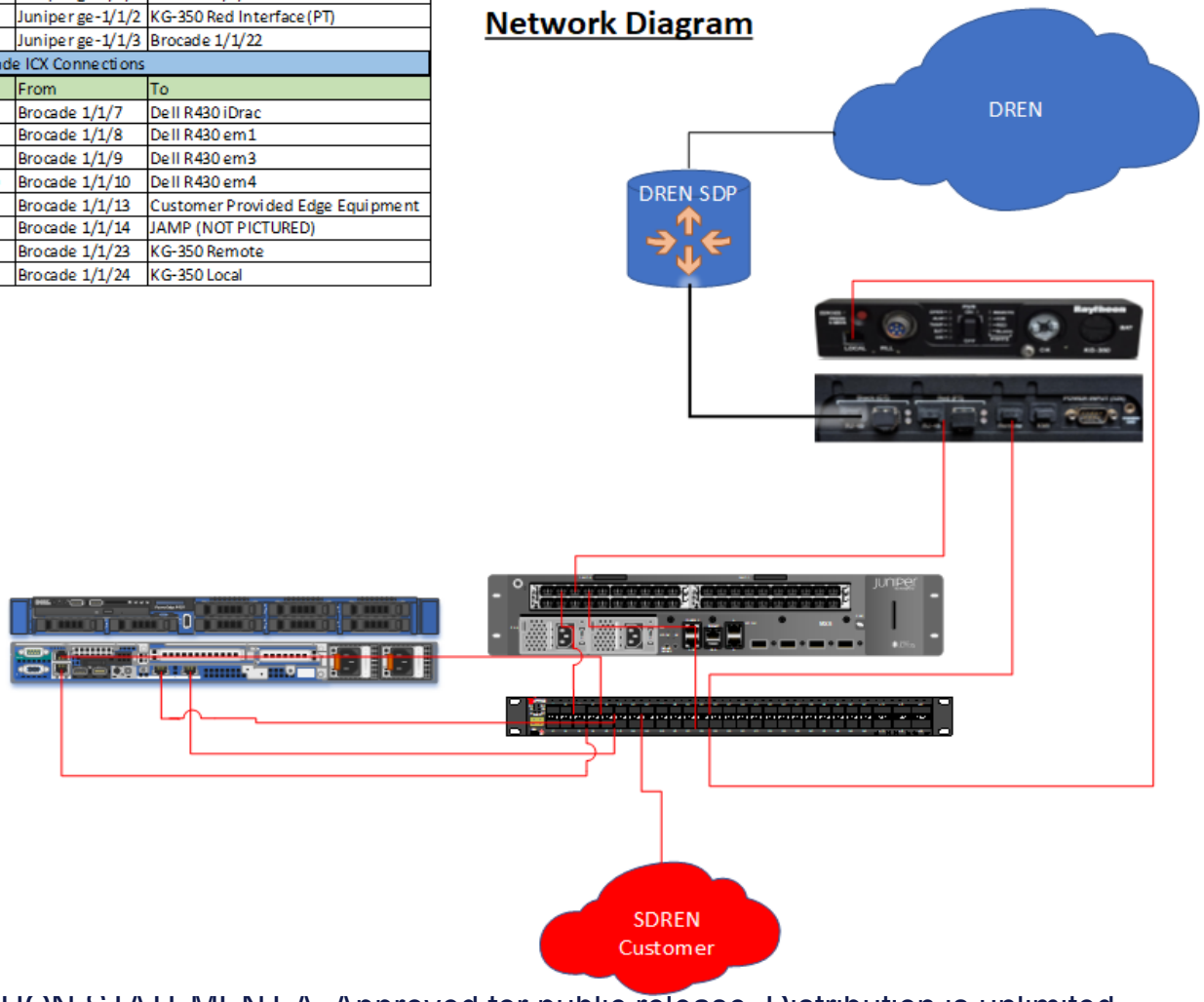
JMETC
Typical Site Configuration



JMETC Equipment

Juniper MX5 Connections		
Description	From	To
Customer Interface to Brocade	Juniper ge-1/1/1	Brocade 1/1/5
WAN Interface	Juniper ge-1/1/2	KG-350 Red Interface (PT)
Management	Juniper ge-1/1/3	Brocade 1/1/22
Brocade ICX Connections		
Description	From	To
SJS iDrac	Brocade 1/1/7	Dell R430 iDrac
SJS Management	Brocade 1/1/8	Dell R430 em1
SJS Collection	Brocade 1/1/9	Dell R430 em3
SJS Collection (Depends on sites data rates)	Brocade 1/1/10	Dell R430 em4
Customer Interface - CPE Connection	Brocade 1/1/13	Customer Provided Edge Equipment
JAMP	Brocade 1/1/14	JAMP (NOT PICTURED)
KG-350 Remote (RMI)	Brocade 1/1/23	KG-350 Remote
KG-350 Local (LMI)	Brocade 1/1/24	KG-350 Local

Notional – SDREN-NG Network Diagram

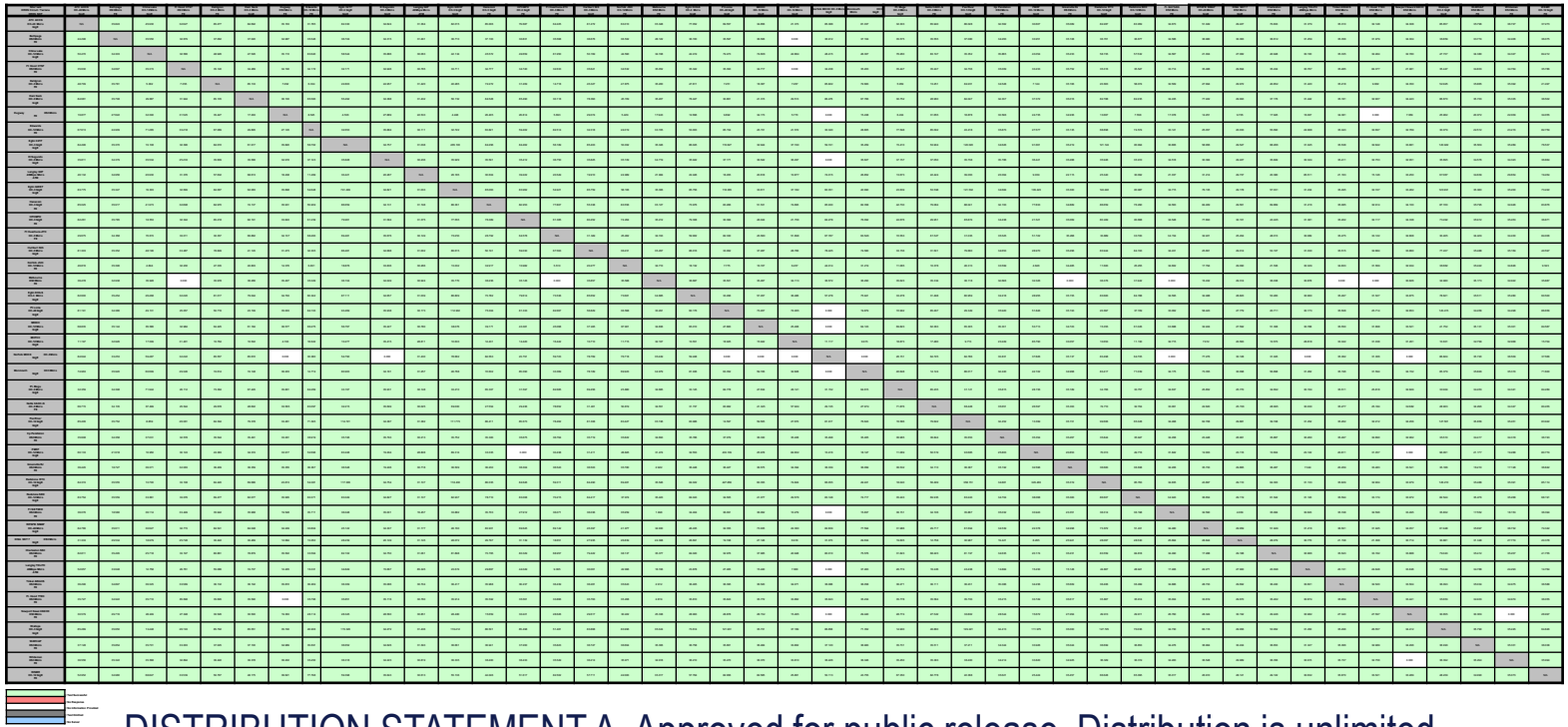


JMETC Active Measurement Program (JAMP)

- Every JMETC Network equipment stack includes a JAMP
- The JAMP is used to collect SDREN Network Performance statistics
  - Throughput (daily)
  - Latency (minimum / mean over 24 hour interval)
  - Packet Loss (% over 24 hour interval)
- Analysis is done each day to look for potential issues or to see if issues have been resolved
  - More extensive testing occurs to characterize any issues
  - Issues have been disparate but, except for a few cases, have been found to be in the local infrastructures
- JMETC can generate Unclassified Network Characterization reports for any test customer for the ranges of their testing

SYSCON Daily Network Characterization

- SYSCON performs daily network characterization across all JMETC sites:
  - Throughput (nightly)
  - Latency (measured every 15 seconds over 24 hour period)
  - Packet Loss (measured every 15 seconds over 24 hour period)



Network Services Provided

- JMETC SYSCON / Connectivity Team
  - New site network checkout and functionality testing
  - JMETC Personnel available to test, monitor, and troubleshoot network connectivity
  - Web-Based Help Desk and Phone Support
  - Assistance with Local Site configuration through Ports & Protocols management
  - Time sync available from two SDREN NTP servers
- Inter-Site Collaboration
  - VoIP Cisco Call Manager (soft phone download available)
  - Chat Server (XMPP – Jabber)
  - Secure File Transfer Protocol (SFTP) Server
  - Adobe Connect (collaboration suite similar to DCO with desktop, file, whiteboard sharing and chat) -- HTML5 capable

Network Services Provided

- Registered IP Address Space
  - Must use routable IP Addresses
  - Request IP Addresses through the JMETC SYSCON
- JMETC Domain Name Service (DNS)
  - Primary DNS IP Address (S.47.251)
  - Domain: JMETC.SMIL.MIL
- IA Compliance
  - Microsoft WSUS
  - YUM Server (available soon for Fedora and RH)
  - AV updates (McAfee and Symantec)
- SYSCON Primary Site at NAS Pax River & SYSCON Coop site at Eglin AFB
- Connection to AWS Cloud Services

JMETC Connectivity

- The footprint of the JMETC Network is very large but not all-inclusive:
  - Available:
    - Each Services' and Joint distributed RDT&E networks: AF-ICE, ATIN, NAVAIR, JTDL
    - Several Industry partner sites: Boeing, NGC
  - Not natively on JMETC Network Today:
    - Training Facilities
    - Industry Partners distributed RDT&E networks
    - Other government entities outside of the DoD
    - Coalition Partners
- JMETC Connectivity is more than the JMETC Network on SDREN
  - Peering points to Industry Partners
  - Network Aggregation

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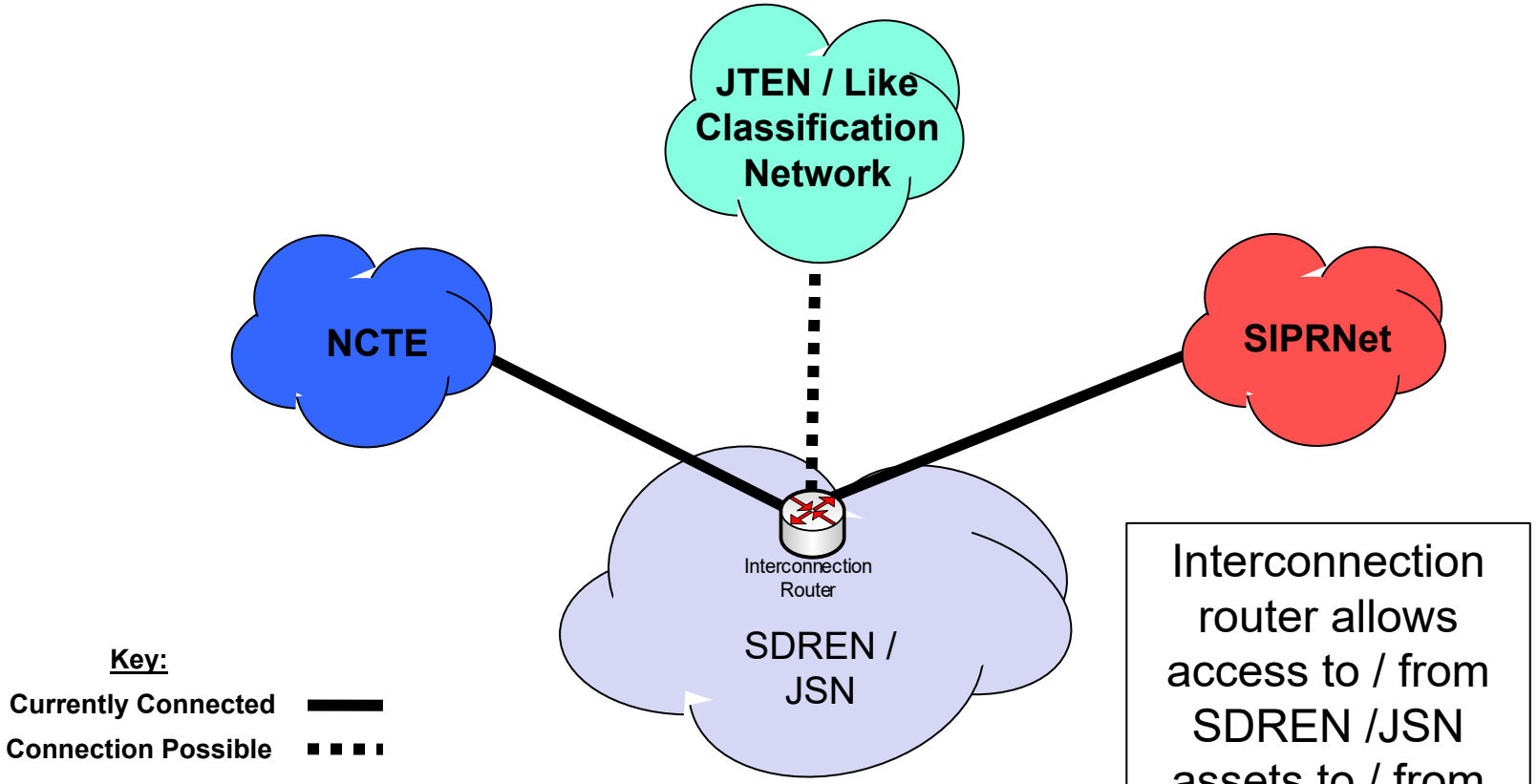
JSN / SDREN Interconnecting Networks



Interconnection router allows access to / from SDREN /JSN assets to / from assets on other connected networks

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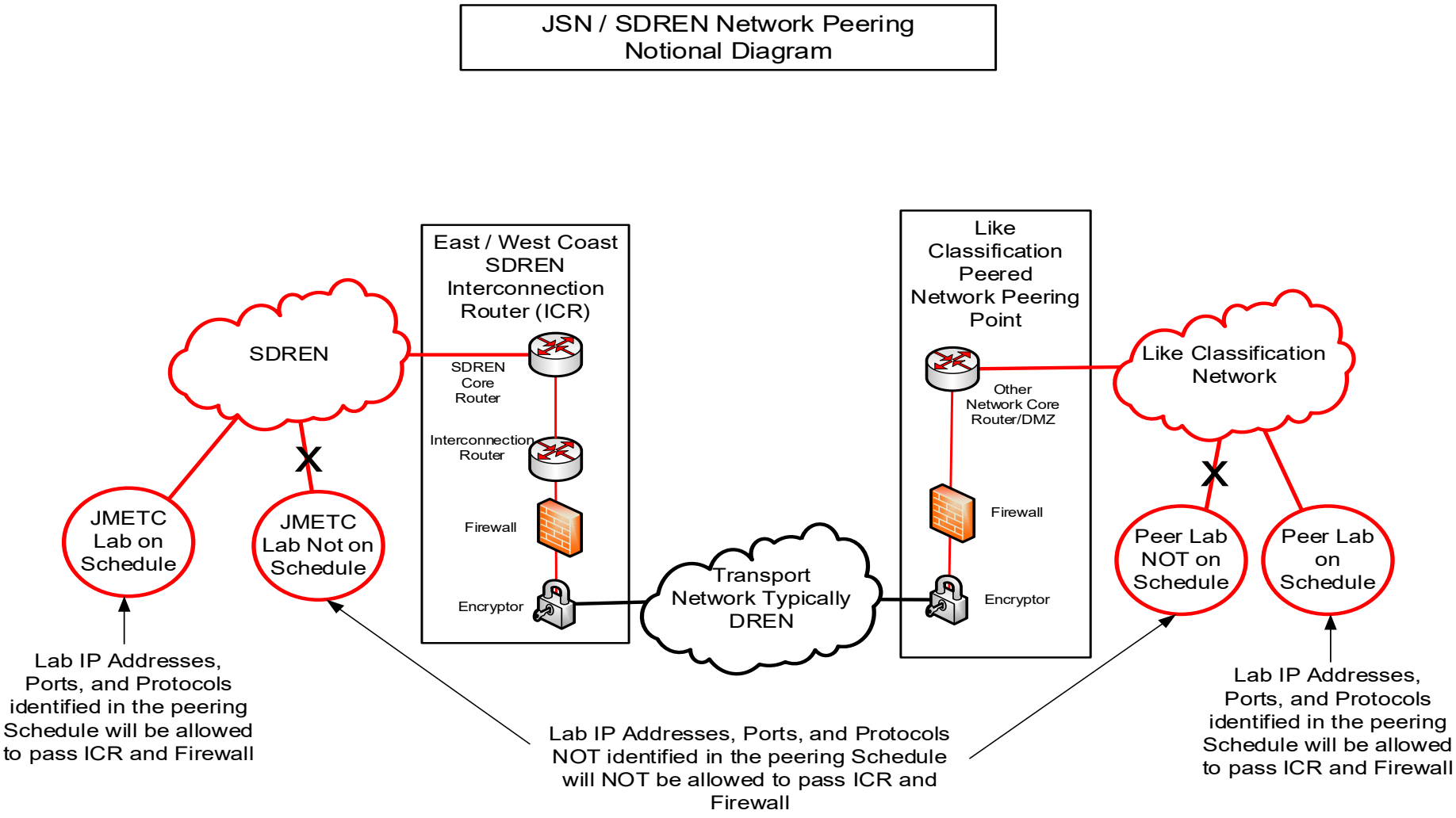
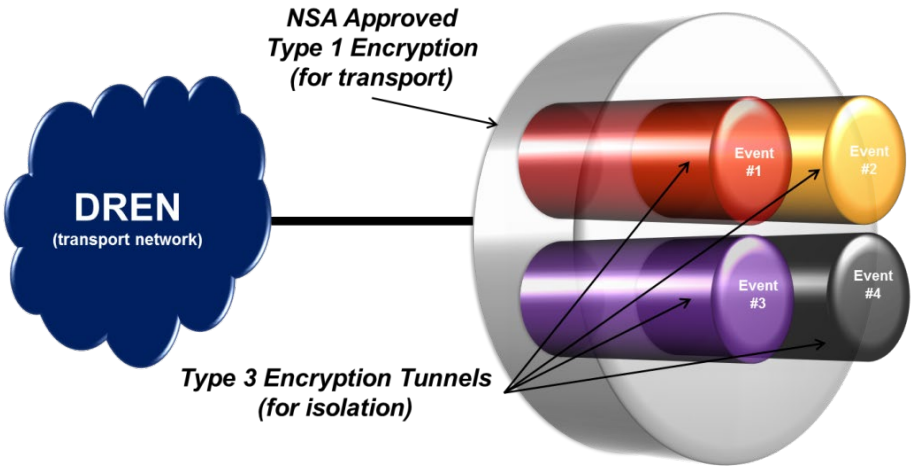
SDREN Interconnection Routers



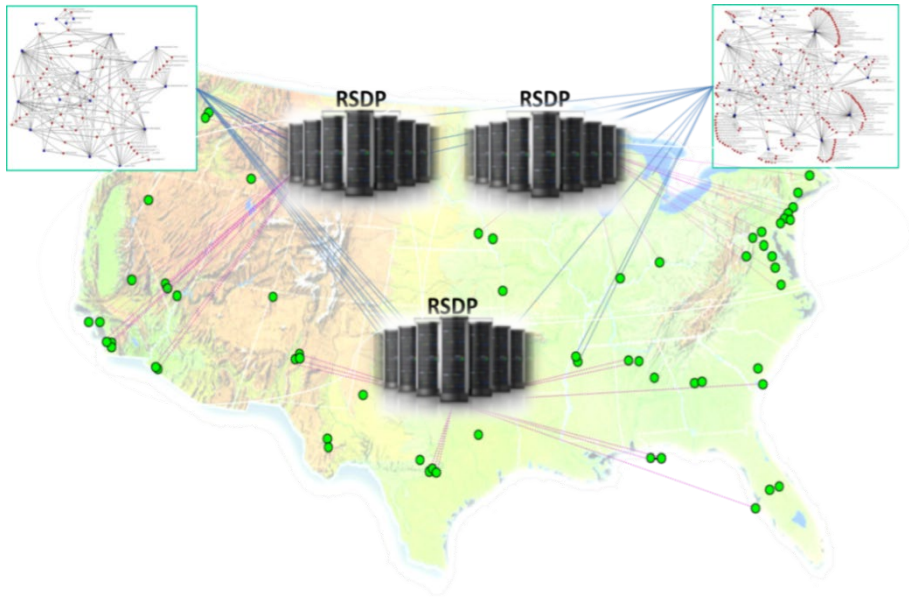
JMETC MILS Network (JMN)

- Provides **secure distributed testbeds** to support unconstrained cyber activities and users access to **enterprise resources at multiple classifications**
- Employs **Multiple Independent Levels of Security** (MILS) architecture
- Allows for segregation of data streams by protocol, system, event, COI, etc.
  - Capable of supporting multiple simultaneous events at multiple classifications concurrently
  - Ability to create isolated "sandboxes"
- Accredited by Defense Intelligence Agency (DIA) to operate up to TS//SCI/SAP/SAR
  - Included NSA Red Team assessment



Regional Service Delivery Points (RSDPs)

- Provide enterprise resources to **rapidly generate virtualized representative cyber environments**
  - Comprised of computational and storage resources to host 1000s of high fidelity virtual representations
    - Large, integrated Red-Blue-Gray environments
    - Platform specific high-fidelity representations
    - Tailored, independent student classrooms
  - Automated provisioning to minimize deployment time
  - Each is capable of supporting numerous events and varying classifications concurrently
  - Serves as a platform for tools and services
  - Geographically dispersed to minimize latency and maximize usability
  - Designed to be cost-effective and adaptable
  - Also supports more conventional types of testing



Joint Mission Environment Test Capability (JMETC) Program Investment Areas

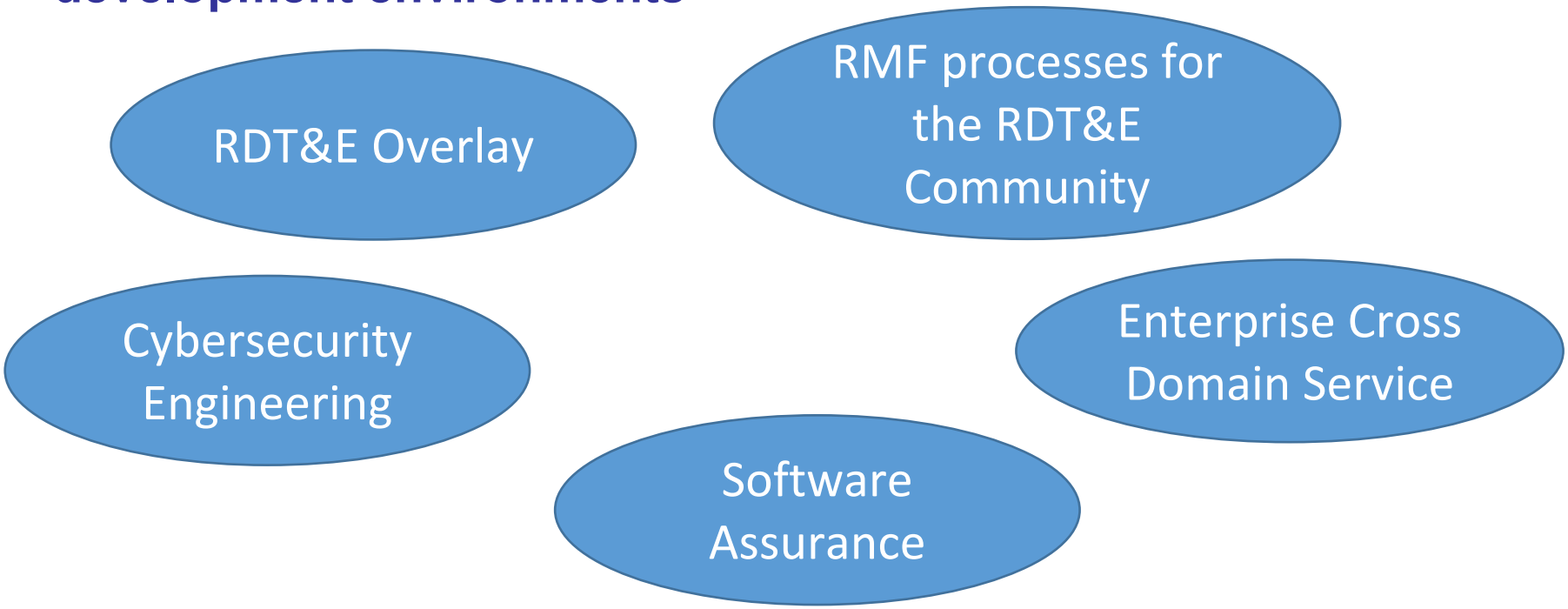
- **Distributed Testing Support**
  - Event Planning and Execution Support
  - Help Desk Troubleshooting and Subject Matter Expertise
- **Distributed Testing Networks**
  - JMETC SECRET Network (JSN): Always connected
  - JMETC MILS Network (JMN): Event-specific links
- **TRMC Cybersecurity Services**
  - Risk Management Framework Support
  - RDT&E Cybersecurity Standards: Overlay, SW Certification
- **Test & Training Enabling Architecture (TENA)**
  - TENA Software Repository
  - TENA Object Models
  - TENA Web Services
- **Big Data / Knowledge Management Initiative**
  - BDKM & Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite (CHEETAS) Overview
- **National Cyber Range Complex (NCRC)**
  - Cyber Range Infrastructure, Tools, Instrumentation
  - Offensive & Defensive Cyber Tests & Events (OCO/DCO)
  - Cyber SMEs & Support Team (including skilled OPFOR)

TRMC Cybersecurity Mission

- **Support to the DoD Research, Development, Test & Evaluation (RDT&E) community to develop common, streamlined cybersecurity processes, certified products, and enterprise services in compliance with DoD Cybersecurity policy.**
  - The goal of these efforts is to aid the RDT&E community in navigating complex and resource-intensive cybersecurity policy and processes and to implement modern DevOps and DevSecOps methodologies and technologies to promote efficiencies tailored to the RDT&E risk environment and community manpower constraints.
- **Advocate and promote the adaptation and development of common cybersecurity architectures and capability requirements in support of DoD Research Development Test and Evaluation (RDT&E) activities.**
  - Define Service-agnostic solutions to create common solutions that would minimize the time and paperwork for maintaining and upgrading RDT&E infrastructure.

TRMC Cybersecurity as a Service

- **The Cybersecurity initiatives within the TRMC establish and promote cybersecurity best practices in support of DoD-wide DevSecOps initiatives and the evolution of the RDT&E community towards more secure and efficient rapid/agile development environments**



TRMC Cybersecurity Team

- **Cybersecurity Managers (ISSM), Operators (ISSO) and Engineers (ISSE)**
- **Providing Cybersecurity Technical Guidance**
  - Policy, Frameworks, Architecture, Cross Domain
- **RDT&E Advocate**
  - RMF Technical Advisory Group (TAG)
  - Range Commander's Council (RCC) Cybersecurity Group (CSG)
- **RMF Templates & Best Practices**
  - RDT&E Overlay
- **Software Certifications**
- **Collaboration**
  - Monthly Cybersecurity IPT Meetings
  - JMETC Tech Talks
  - Web site (https://www.trmc.osd.mil/wiki/display/Cybersecurity/Home)

Software Assurance Certification Process (SACP)

- **Meets DoD and RMF Requirements/Guidance**
- **Standardized process (SOP) ensures the proper steps are followed each time**
- **Transparency - Process and BoE Artifacts are available to authorized personnel**
  - ConOps/SAR and detailed STIG/SAST results are available
- **Reciprocity - Other DoD organizations should accept the assessment results**
- **Accountability - TRMC and the Authorizing Official stand by this process**
- **Quicker acceptance and use of TENA products on Range Systems**
- **TRMC process is available for cloning**

RDT&E Overlay

- **Beyond the RDT&E Overlay**
  - RDT&E RMF Authorization Process
  - System Guidance
  - Categories of systems/enclaves
  - Plug-in Templates
- **RDT&E Overlay Pilot**
  - TRMC is currently working with its own developmental and operational systems to pilot the draft RDT&E Overlay
  - TRMC provided a JMETC Tech Talk on the Overlay Pilot results May 2021
  - TRMC is requesting interest in external pilots within the RDT&E Community

TRMC Enterprise Cross Domain Services

- **The TRMC solution is an authorized Multi-Level Secure (MLS) data management and collaboration network architecture for the RDT&E community managed by the Joint Mission Environment Test Capability (JMETC) program**
  - Resources, Data, and Scenarios come together from more than one level of security classification
  - The Enterprise Cross Domain Service (ECDS) provides a persistent, interoperable, and reusable cross domain capability between unclassified and classified enclaves, allowing for the transfer of data between RDT&E ranges, laboratories, and facilities

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Current TRMC Authorizations / Certifications

- JSN – PAX, ANVIL, Niceville
- JAMP
- SkyRange – 4 systems
- MLS JCNE - 3 enclaves – eCDS
- TWS
- Savanna Test Bed
- DECP
- PTEN-JSN
- SAFARI - ANVIL
- CTEIP Systems – Multiple ATOs
- EdgeConnect
- JFN Prototype Inc 1
- eCDS Reauthorization

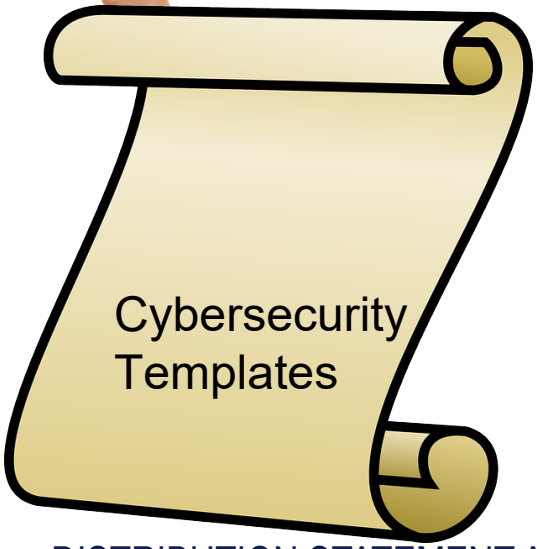
RDT&E Overlay

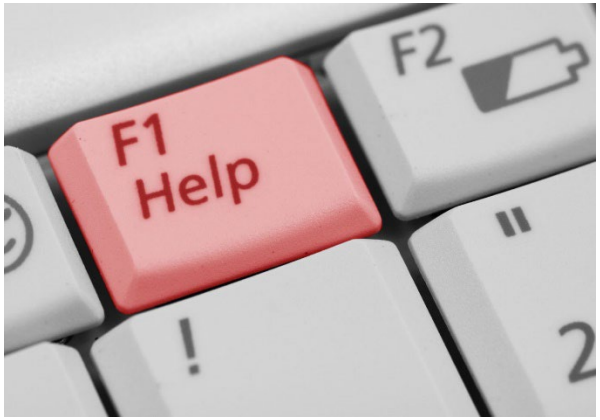
- Upcoming Systems
  - NCRC IDE
  - NCRC-RSC
  - NCRC-U
  - CATAMT
  - UC2
  - Dell Irvine
  - Sky Range 7 new systems
- Systems
- Software Certifications
  - CHEETAS
  - KMX
  - TENA Tools – 8 applications

Authorizations and Certifications are increasing at rapid pace based on user needs. Over the next year we anticipate a much larger need for system ATOs and Software Certifications

TWS Cybersecurity Group

- TWS Cybersecurity Services webpage is active
  - https://www.trmc.osd.mil/display/Cybersecurity





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TENA Mission

- **Historically, range systems tend to be developed in isolation, focused on specific 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

Benefits of TENA

- **All TENA software and support is free to users**
- **TENA is the most 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 starting points mean you never start with a blank page
  - **Rapid development** of real-time, distributed, LVC applications
  - Auto-generated test programs make integration a snap
- **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 unprecedented 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!**

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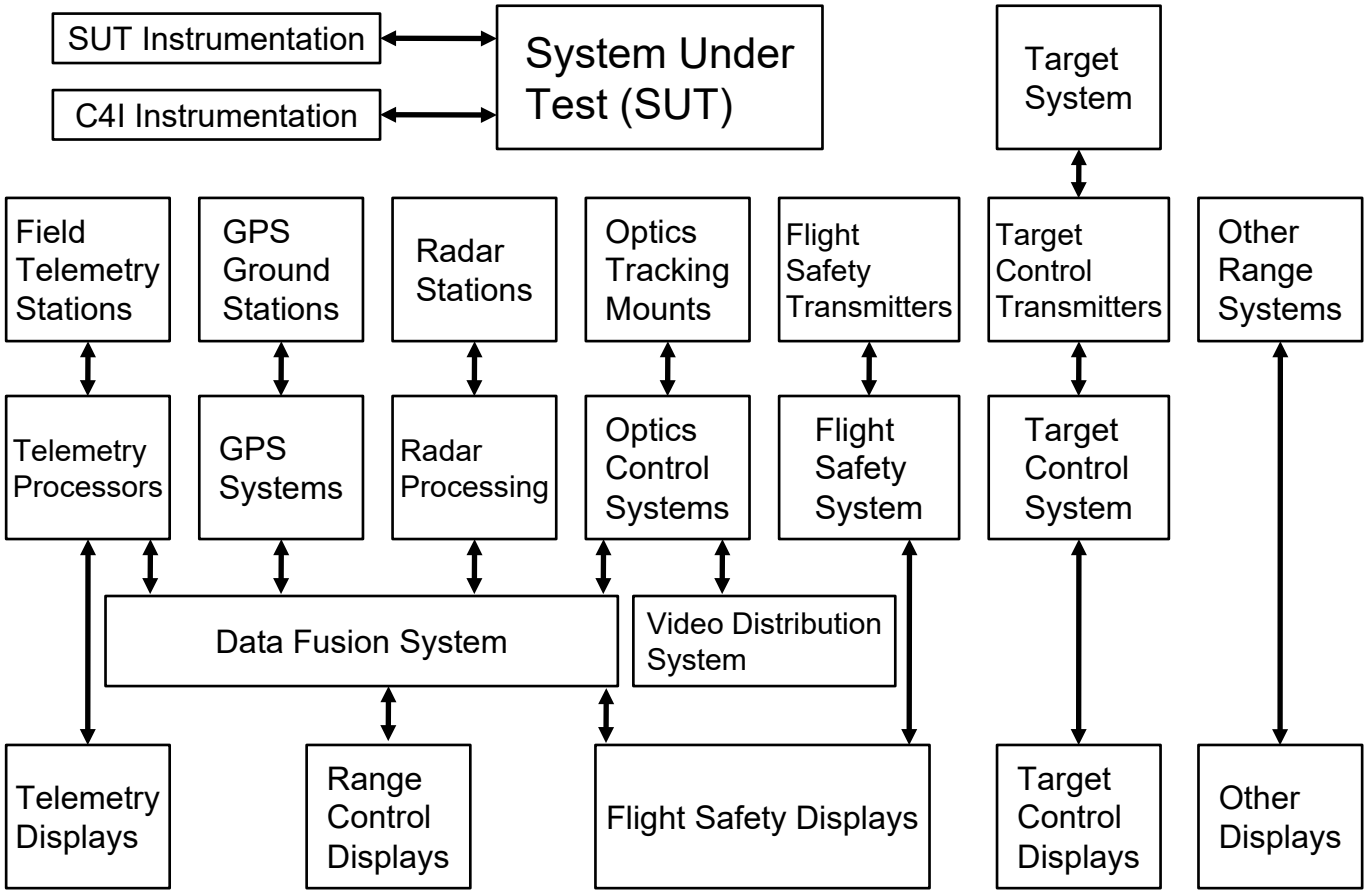
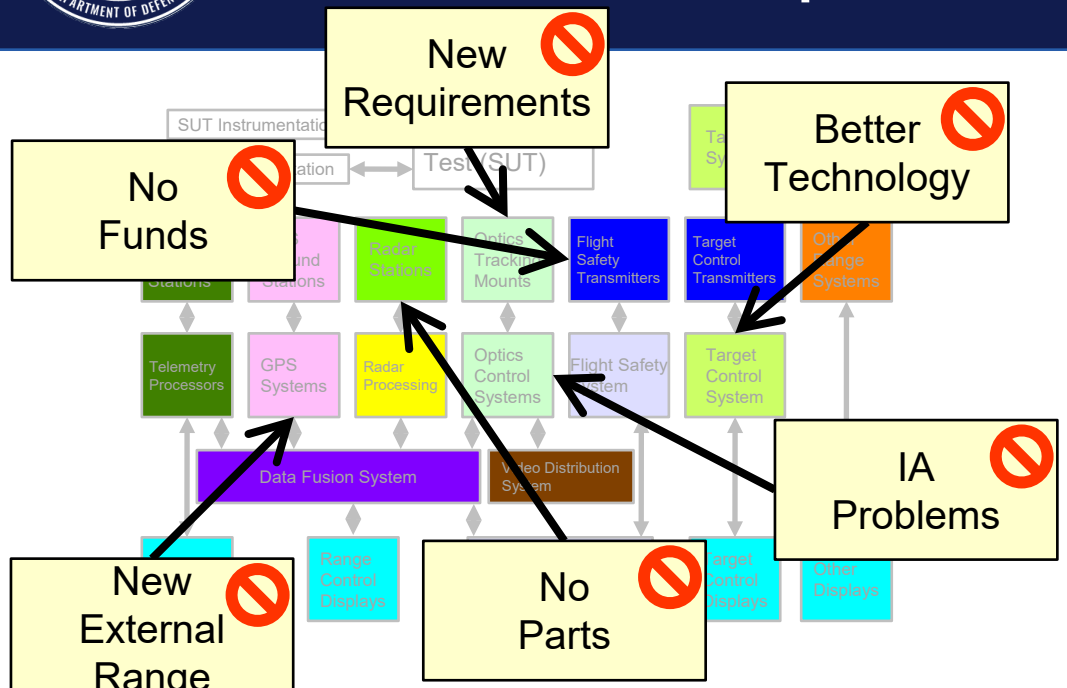
A Notional Test Range



TENA is designed (and has experience) as the common communication infrastructure for these range systems

Range System and Infrastructure Development Challenges



- General Development Challenges
  - Multiple Developers and Development Groups
  - Different Timelines and Delivery Dates
  - New Computing and Communication Technologies

- **Range Specific Development Challenges**
  - Multiple Sponsors and Funding Sources
  - Evolving Test and Training Requirements
  - Expansion of Inter-Range Connectivity
  - Information Assurance Policies and Procedures
  - Range Modernization Must Be Gradual

Challenges grow exponentially when you need to interoperate with other ranges

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TENA at a Glance

TENA is DoD's GOTS range integration architecture

- **What does TENA enable?**
  - Interoperability between inter- and intra-range assets
  - Elimination of proprietary interfaces to range instrumentation
  - Integration of multiple vendors/providers
  - Efficient incremental upgrades to test and training capabilities
  - Integration of Live, Virtual, and Constructive assets (locally or distributed)
  - Sharing and reuse of common capabilities across existing and new investments
- **What is included in the TENA architecture?**
  - Customizable "data contracts" that standardize repeatable information exchange
  - Interoperability-enabling, auto-code generated software libraries
  - A core set of tools that address common test and training requirements
  - Collaboration mechanisms that facilitate sharing and reuse
- **TENA has a plan for continued evolution and funding to execute this plan**

TENA ENABLED
Test and Training Enabling Architecture

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How TENA is currently Used In Test and Training Facilities

- Common specifications for test and training data
- Data Dissemination across variable applications, platforms, programming languages, networks, and classification levels
- Data Collection and Playback

Data Management

- Local and Remote Command and Control
- Health & Status Monitoring

Event Management

- Real-Time simulations
- Stimulation of live sensors and instrumentation
- Connecting non-interoperable inter- and intra-range systems

LVC Integration

- Eliminating proprietary interfaces to range instrumentation
- Sharing and reuse of common range tools and capabilities
- Online Collaboration and File Sharing

Sharing & Reuse

These activities are all relevant to cyber experiments

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Core Architectural Tenets of TENA

- **Promote Computer Enforceable System Interfaces**
  - For meaningful interoperability, systems should formally define their interfaces for the particular data produced or consumed and the services/algorithms provided or required
  - Generic interfaces may look appealing, but significant costs exist with performance, interoperability, and maintenance that are overlooked with this perceived flexibility
- **Utilize Auto-Code Generation to Raise the Abstraction Level**
  - Distributed programming is hard! Define higher level abstractions to automatically generate properly designed and tested source code for common distributed programming solutions—similar to comparison of modern programming languages to assembly code
- **Let Computer Detect Interoperability Errors as Early as Possible**
  - When would you like to detect interoperability problems? Many system errors can be detected by the computer during the development phase, reducing overall expense
- **Design the Middleware to Make it Hard to Use Wrong**
  - TENA Middleware is defined from a defensive posture that minimizes the opportunity for improper usage and run-time anomalies
- **Anticipate Better Techniques and Technologies**
  - Maintain separation between interfaces and implementations to simplify transition to improved techniques and technologies when appropriate

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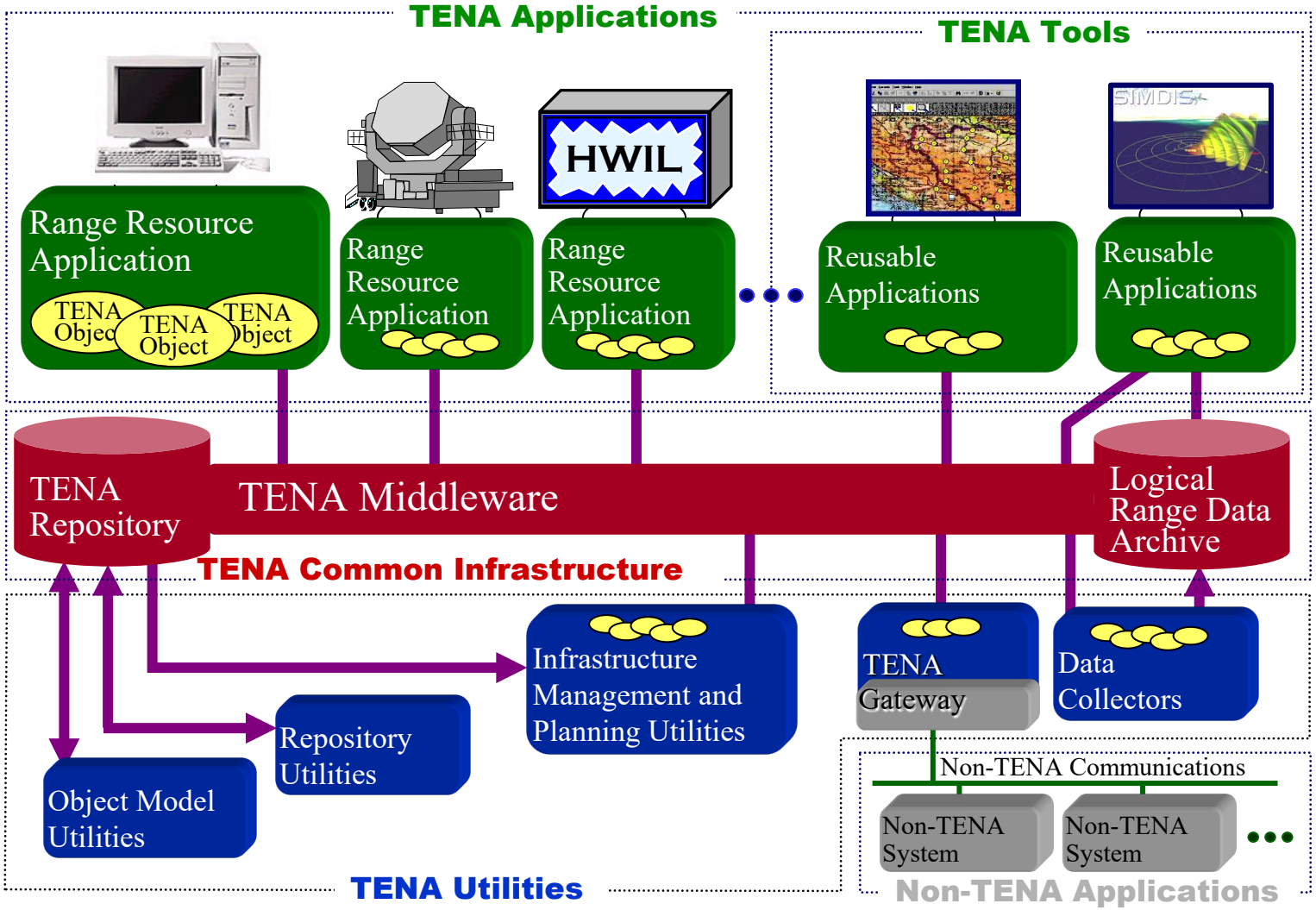
TENA Architecture Overview



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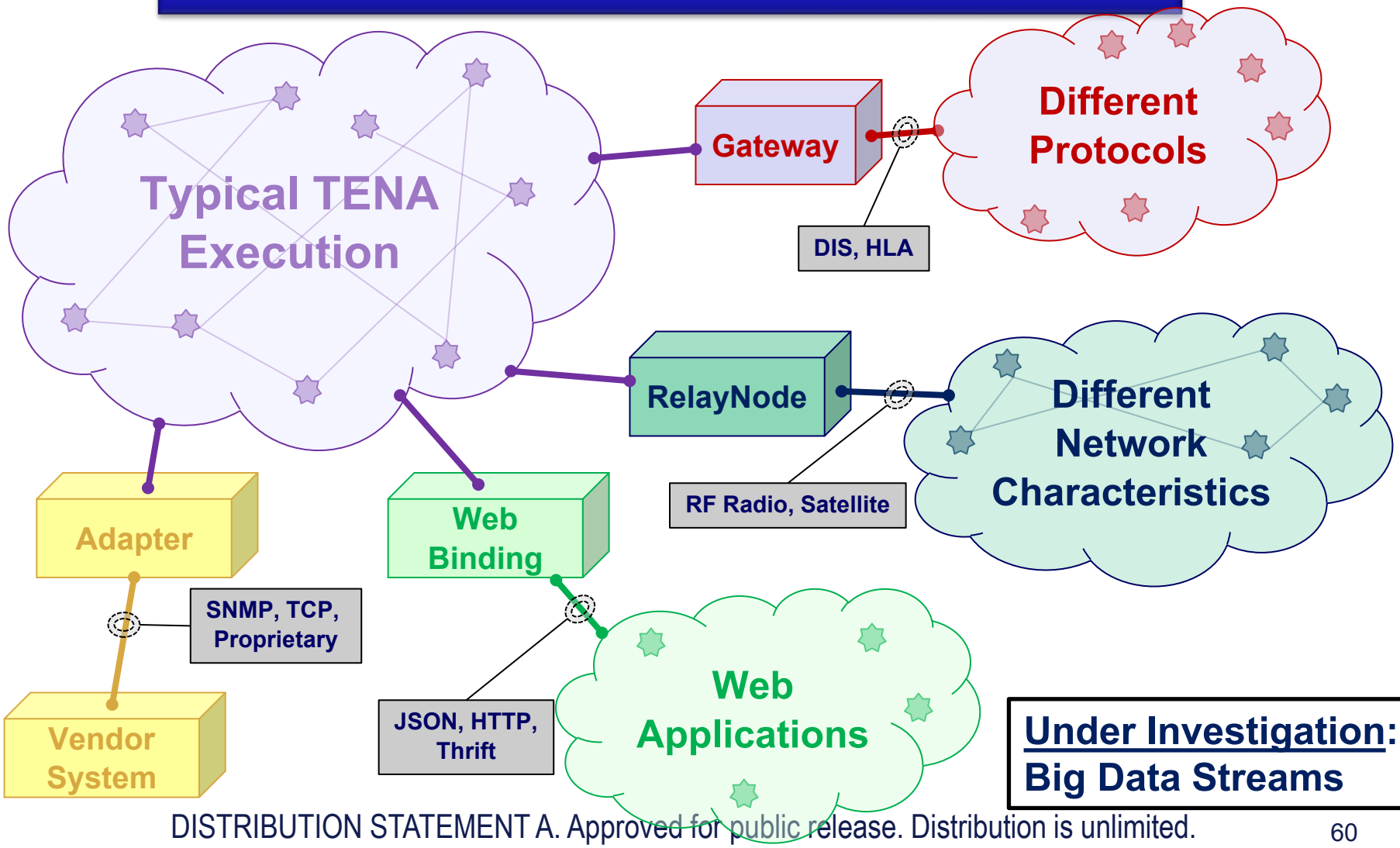
TENA Interoperability Architecture Illustration

TENA is much more than the Middleware



Under Investigation:
Big Data Streams

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The Ways in Which TENA Applications Can Communicate

TENA provides to the application developer a unification of several powerful inter-application communication paradigms:

- **Publish/Subscribe**
  - Each application publishes certain types of information to which any other application can subscribe
  - Similar in effect to HLA, DIS, CORBA Event Service, DDS, etc.
- **Remote Method Invocation (RMI)**
  - Each object that is published may have methods that can be remotely invoked by other applications
  - Similar to CORBA RMI or Java RMI
- **Distributed Shared Memory (DSM)**
  - Applications read and write the state of objects as if they were local objects, even though they are remote objects
  - A very natural, easy to understand programming paradigm that projects the illusion of working on a shared memory multi-processor machine onto a distributed computing system
- **Messages**
  - Individual messages that can be sent from one application to other applications

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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 source code for a tested and working example application 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!

Object Models (OMs)

- **Object Models**
  - Object Models formally define system information and services with support for automatic code generation
  - Users are permitted to derive extensions to TENA standard OMs, or users can establish their own OMs
  - TENA SDA collects requirements and implementation considerations from user community and candidate TENA standard OMs published for community review and testing purposes
- **Range Instrumentation System Classes (e.g., telemetry, radar, optics)**
  - Class inheritance hierarchy (16 separate classes with a total of ~120 attributes and ~25 remote methods)
  - Intended to be used by range instrumentation system vendors and range organizations, with unique derived class with proprietary and legacy attributes when necessary
  - Abstract base classes can be used by subscribing systems that just need basic information common to all range instrumentation systems (e.g., senior operator needs view of the operating status value for all antenna control units independent of any organization/vendor specialized derived classes)
- **Range Instrumentation Pointing and Track Representations**
  - A Pointing object is used for instructing an instrumentation system to look at a particular position, potentially at a future time (e.g., predicted missile impact position)
  - Range systems can use Pointing objects for multiple operational use cases (e.g., system operator can select a particular Pointing, system can automatically select the best Pointing, a remote operator can instruct the system which Pointing to use)
  - Tracks are based on instrumentation system measurements indicating what was sensed (e.g., azimuth and elevation angles to a test article's beacon signal at a particular time)
- **Range Instrumentation Sub-System Classes**
  - Definition of remote operation interfaces for instrumentation sub-systems, e.g., receiver, spectrum analyzer, controllable power strip, antenna control unit (similar to System class structure where derived classes permitted)
  - Designed for effective, multi-operator, remote monitoring and control of instrumentation sub-systems

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 TENA Architecture Management Team (AMT) now JMETC Configuration Review Board (JCRB)**
- **TENA Middleware exists and is being used to support real events**
  - Government owned, without proprietary software
- **TENA is freely releasable (Distribution A) to non-US entities**
  - We have many non-US users in Britain, France, Sweden, Denmark, etc.
- **Currently there are no plans for standardizing TENA in the same way as DIS and HLA have been standardized (IEEE)**
  - However, we are looking into innovative mechanisms to get the same usability and confidence with TENA as we do with open standards
  - TENA's business model is not the same as the DIS and HLA business models

Some Examples of TENA Usage

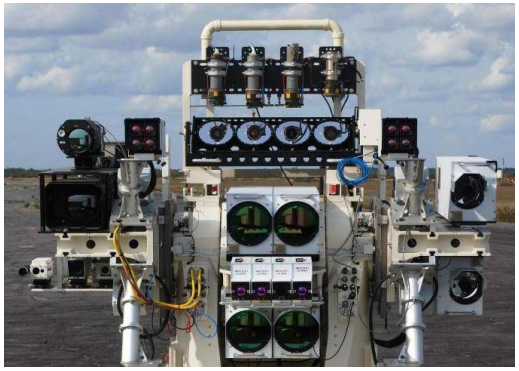
- TENA DIS gateway / dashboard
- TENA RelayNode
- TENA Console / Execution Manager
- TENA Canary
- TENA Data Collection System (TDCS)
- InterTEC (C4ISR stim/sim/collection)
- JDAS (data archive)
- TVDS (video distribution)
- JMITS (live range IR threat emulator)
- SIMDIS (range display)
- Starship (event 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)
- 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)
- Live video – synthetic scene integration
- Link-16 translator (Link-16 over WAN)
- TENA DataView
- ADS-B Adapter
- Instrumentation Assignment Tool
- LVC Transmogrifier
- X-Plane Adapter
- 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 electr. attack lab)
- OT-TES (tactical engagement sys for OT)
- ADMAS (embedded vehicle instruments)
- HWIL RF threat injection system
- Radars (tracking, surveillance, miss-distance)
- 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

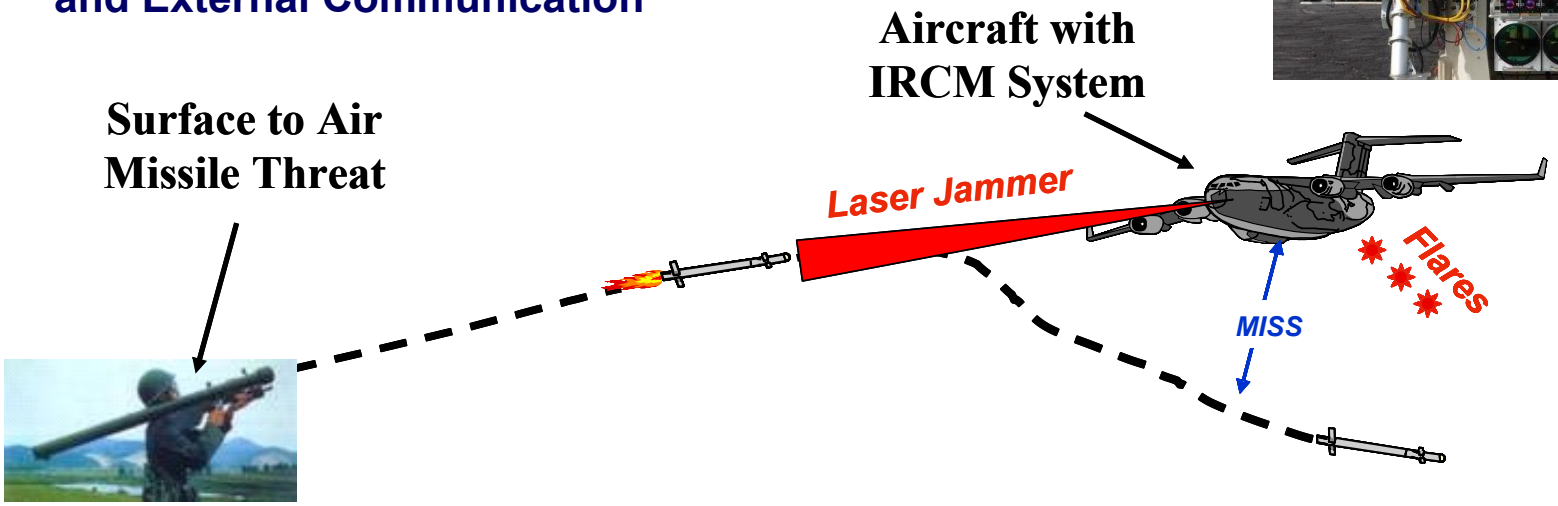
Partial Listing of Recent Testing, Training, and Experiments Using TENA-Compliant Capabilities

- ***Test Events***
  - Air Force Systems Interoperability Test (AFSIT),
  - Navy Distributed Integration & Interoperability Assessment Capability (DIIAC)
  - Interoperability Development and Certification Testing (IDCT)
  - JITC Joint Interoperability Tests (JIT)
  - Integrated Air Defense System Southwest Operational Scenario (IADS-SWOS) Test
  - PNTAX 20 Excursion
  - Navy Service Interoperability Test (NAVSIT)
  - Integrated Air Defense System Southwest Operational Scenario (IADS-SWOS) 3.0 Event
  - Missions Threads & Combat Systems Testing
  - Navy Certification Testing
  - Joint Strike Fighter (JSF) Test
  - Joint Distributed IRCM Ground-test System (JDIGS)
  - Air-to-Ground Integrated Layer Exploration (AGILE)
  - Joint Integration Air & Missile Defense Office (JIAMDO) Joint Sensor Integration (JSI)
  - JIAMDO Correlation / Decorrelation Interoperability Test (CDIT) United Kingdom
  - JIAMDO CDIT CONUS
  - Broad Aerial Maritime Surveillance (BAMS) Test
  - Battlefield Airborne Communications Node (BACN) Joint Urgent Operational Need (JUON)
  - B-1B Link-16 Interoperability Testing
  - Joint Electronic Warfare Assessment for Test and Evaluation
- ***Training Exercises***
  - Navy Gemstone Events (Diamond, Emerald, Fire Opal, Goldstone, Hematite, Jamborite)
  - IFX-3A & 3B
  - NEWCIP Capstone Training
  - Network Enable Weapons Controller Interface Module (NEWCIM) FY2020 Navy Innovative Science and Engineering (NISE)
  - Daily Training, Eielson and Fallon AFB
  - Red Flag Alaska (RFA) and Unified Endeavor (UE)
  - Joint Close Air Support (JCAS) Distributed Test
  - JDEWR Cope Tiger and Talisman Sabre
  - Talisman Sabre and Northern Edge
- ***Experiments***
  - Apollo Kill Chain
  - NAVAIR Decisive Sting
  - Fenceless Ranges
  - GWEF & China Lake Connect Test
  - JITC Space Track Demo
  - Naval Integrated Live, Virtual-Constructive (LVC) Environment (NILE)
  - PNTAX 20 Excursion
  - Unmanned Underwater Vehicles Intelligence Surveillance Reconnaissance Novel Training Concept (U2VISRNTC)
  - Joint Surface Warfare (JSuW) Joint Capabilities Technology Demonstration (JCTD
  - Joint Expeditionary Force Experiment (JEFX)

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

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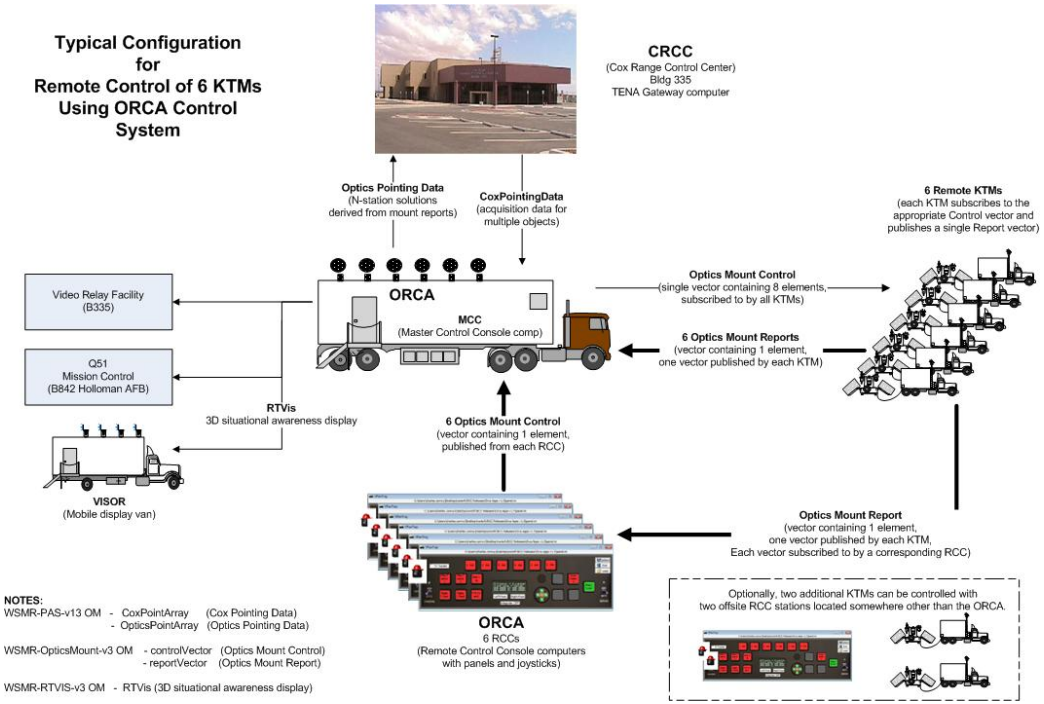
TENA at White Sands Missile Range (WSMR)

- **TENA has been supporting the real-time distributed operation of the WSMR optics systems for the past 10 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

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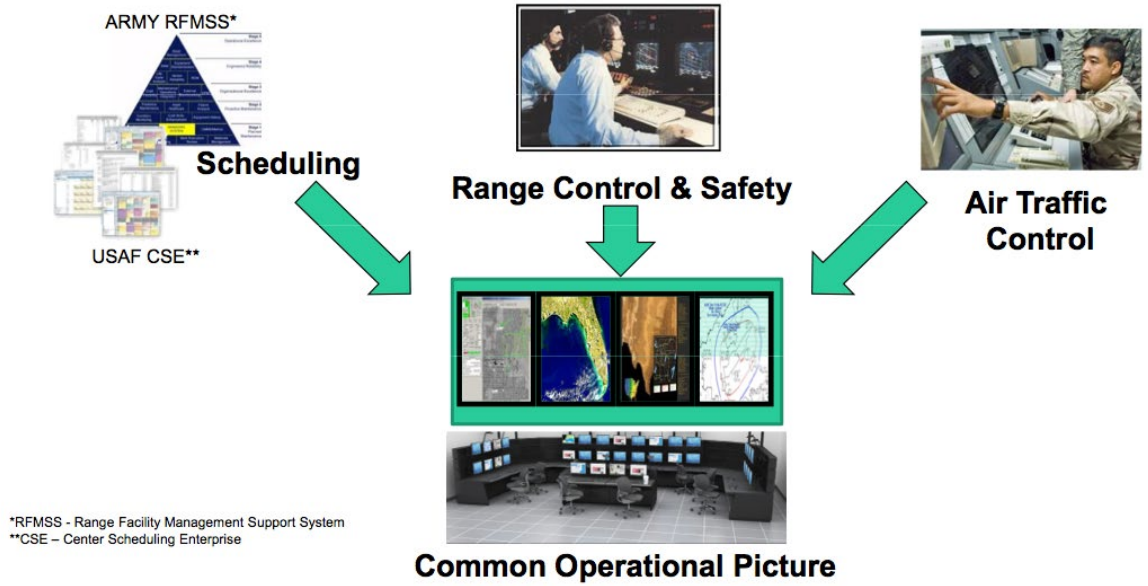
TENA at Eglin Air Force Base

- **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

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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

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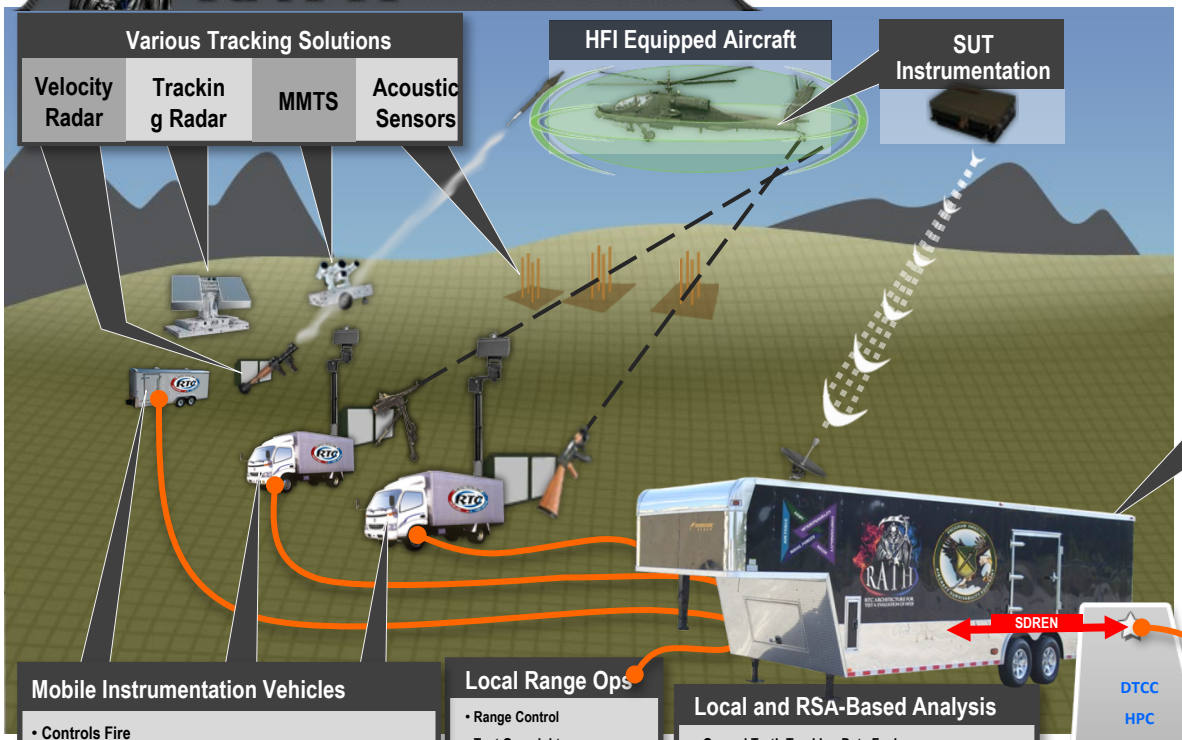
RTC/ASE Architecture for Test & Evaluation of Hostile Fire (RATH)

RATH RTC ARCHITECTURE FOR TEST & EVALUATION OF HFDS



Other Instrumentation

- Multispectral In-band Instrumentation Suite
- Firing Stand Position/Orientation
- MET Stations
- High Speed Cameras
- High Definition Cameras

Command and Control Vehicle

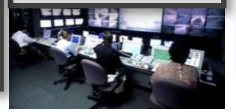
- Interfaces w/ Local Range Ops
- Conducts/Controls Test
- Manages Real-time SA
- Central Point for Data Management
- Houses Real-time Analysis Stations
- Real-time Info TENA Enabled
- Networks to RSA (Objective)

Mobile Instrumentation Vehicles

- Controls Fire
- Collects and Distributes SA Video
- Provides Local Data Storage
- Control Velocity Radar
- Real-time Info TENA Enabled

Local Range Ops

- Range Control
- Test Oversight
- Fire Abort Capability



Local and RSA-Based Analysis

- Ground Truth Tracking Data Fusion
- SUT Analysis
- Plotting and Reporting
- Test Recreation

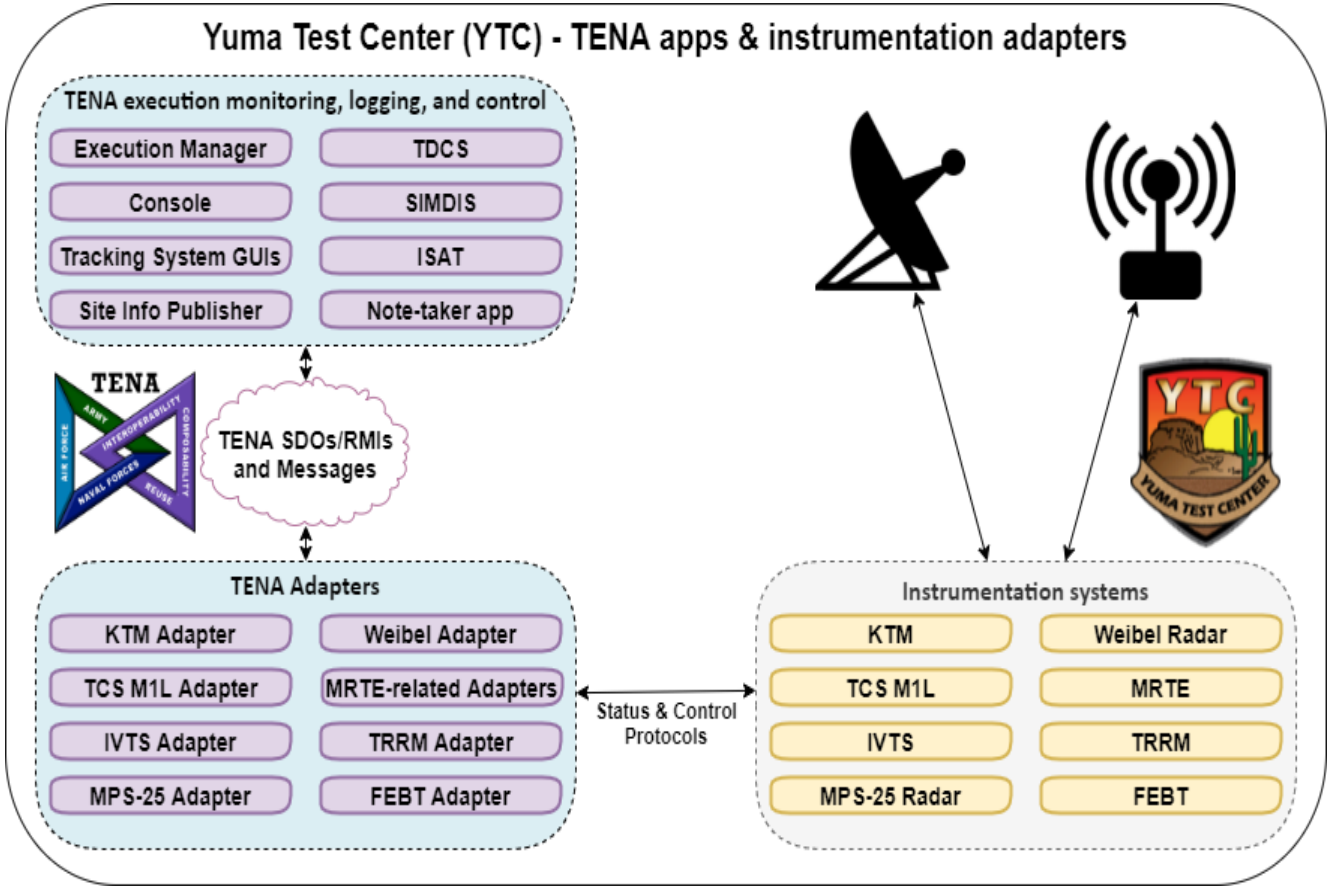
Distributed Observation and Data Analysis

"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

Yuma Proving Ground Range System Distributed Communication Modernization

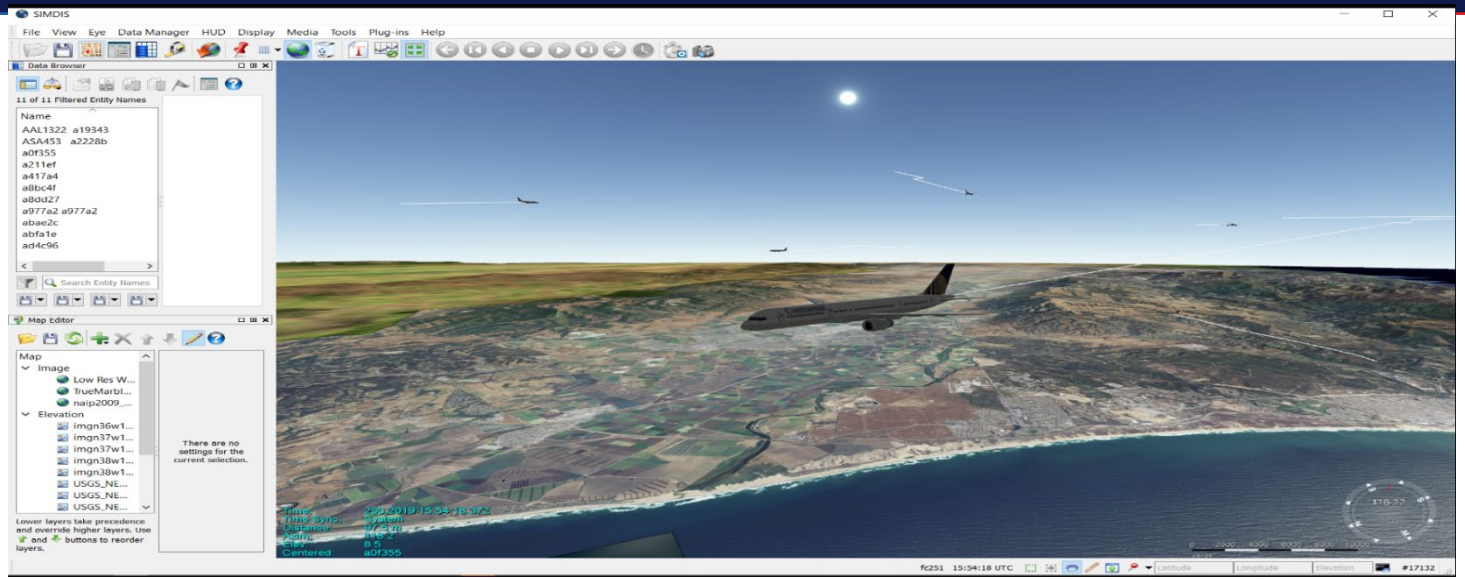
- **YPG initiated "RealTime TENA Adoption Plan" in 2013**
  - Initial phase successfully demonstrated passive pointing of telemetry antenna control system by real-time tracking system
- **Collaborative Adapter Development**
  - Radar Adapters (e.g. MPS-25 and Weibel)
  - Telemetry Antenna Control System Adapters
  - Modular Real-Time Enterprise (MRTE) related adapters
  - Other adapters and related tools



What is meant by an Adapter?

- **DoD Test Resource Management Center (TRMC) is creating a library of software products called Range System Adapters**
  - Adapters present a common distributed communication mechanism for the **remote configuration, monitoring, and control** of range systems
  - Adapter software is GOTS and freely available
  - Adapter software maintained as a collection that evolves to follow best practices
- **Adapters enable range community to define/use common Interfaces**
  - Rich meta-model used to **define range system interfaces** authoritatively
  - Designed to support code generation and remote operation/automation
- **Common Communication Architecture**
  - Range system interface supports remote monitoring and control, as well as the exchange of information between systems in a **flexible publish-subscribe** manner
  - Many pre-event, during event, and post-event range event tools exist
- **Side-by-Side Operation**
  - Adapters can be used **side-by-side with existing range systems** to introduce new capabilities in an effective and IA compliant manner

Aircraft from TENA ADS-B Adapter in SIMDIS



- **Live aircraft to TENA**
  - **Aircraft broadcast information; including identification and TSPI Information is received by a low-cost (less than $100) antenna and radio Signals are translated into TENA Platform SDOs or TENA State3D SDOs.**
  - **Aircraft can be displayed in SIMDIS and used to point tracking systems**
- **Uses "Automatic dependent surveillance – broadcast"**
  - **Surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts position, enabling it to be tracked**
  - **Used for air traffic control**
  - **Starting January 1, 2020, all US aircraft must be equipped with ADS-B to fly in most controlled airspace (most aircraft already comply)**

Adapter Library

Adapters on the TENA Repository

- APC-7900 Power Strip Controller (SNMPv3)
- Tripplite LX Power Strip Controller
- FPS-16 Radar (WSMR network protocols)
- IRTS (Yuma real-time data processing system)
- IVTS (Yuma GPS System)
- MPS-25 Radar (Yuma network protocols)
- RDDS (Pax. River message protocol) Common TSPI
- RTDPS (WSMR real-time data processing system)
- TCS 600 Telemetry Antenna Control Unit
- TCS M1L Telemetry Antenna Control Unit (Pax Interface)
- TCS M1L Telemetry Antenna Control Unit (Yuma network protocols)
- TCS M1L Telemetry Antenna Control Unit (TCS TENA Server)
- LPT Spectrum Analyzer (LP Technologies 3000, 6000)
- KTM Optics (Yuma network protocols)
- Flightgear
- X-Plane
- MRTE Track Interface
- MRTE Track3D Output
- TRRM Radar
- Zodiac Telemetry Receiver RX-1
- ADSB
- Quasonix RDMS 3
- iBootBar Power Strip Controller
- Weibel RTP-2100
- Rohde & Schwarz FPS Spectrum Analyzer

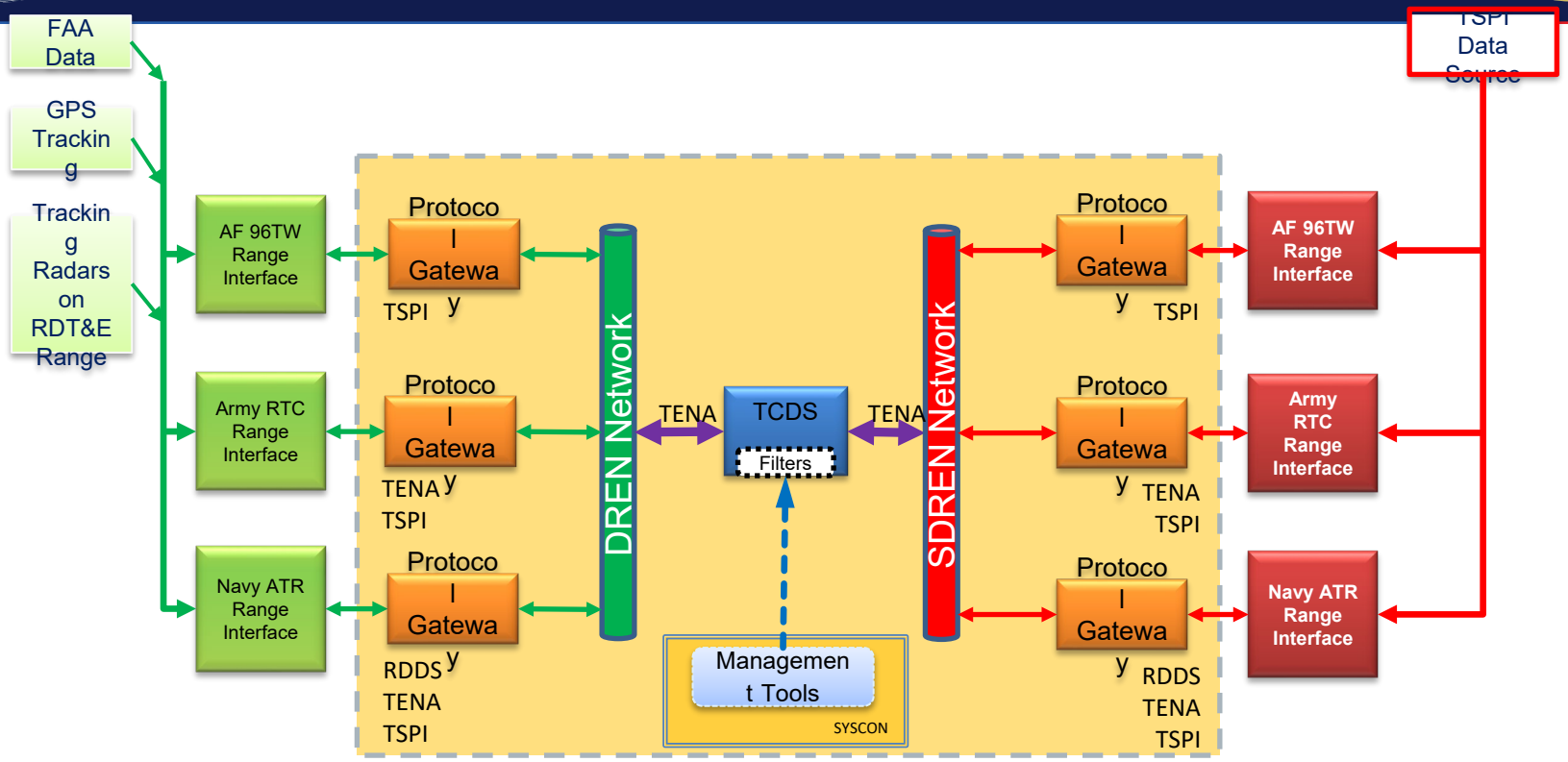
In Development

- Multiple Object Tracking Radar (WSMR MOTR Upgrade)
- Multiple Mount Object Tracker (MITS project)
- FEBT Thermal Target
- Technovative Applications Radar
- RDDS LVC Gateway
- VOICES DoT Distributed Testing (various systems)
- ViaSat 3880
- SEMCO R600A Telemetry Receiver
- Smartronix 5000 Decommutator
- SRI RM-6300 RF Signal Simulator

Source Code Publicly Released

- APC-7900 Power Strip Controller Adapter
- Power Strip Controller GUI
- Platform to Track3D Translator

MLS-JCNE CDS System Design Diagram



The Goal of the Block 1 MLS-JCNE implementation is to provide the RDT&E community with a persistent, interoperable, and reusable capability to exchange unclassified data between unclassified and classified enclaves

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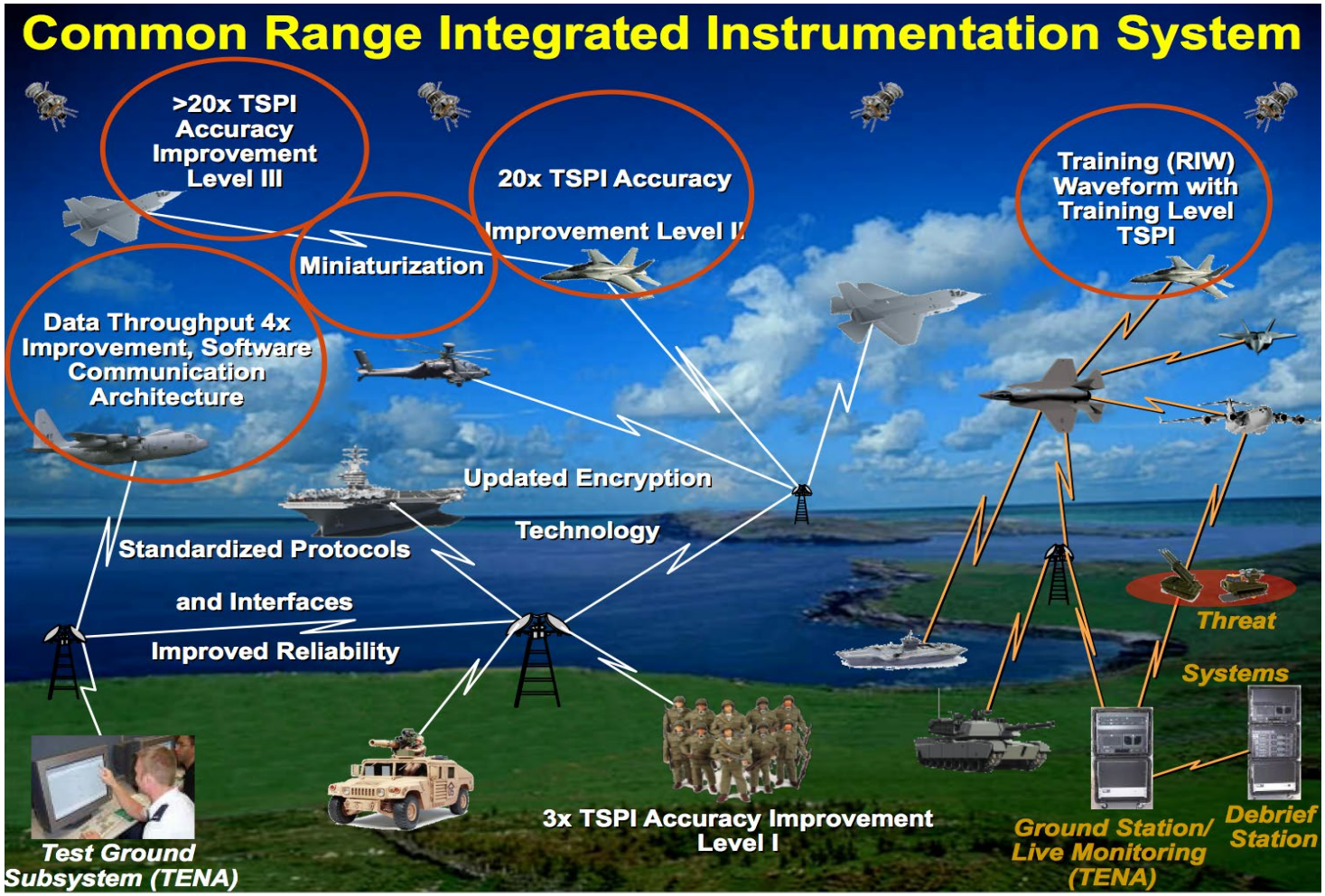
Common Range Integrated Instrumentation System (CRIIS)

- **TENA specified in CRIIS acquisition program requirements for ground system communication**



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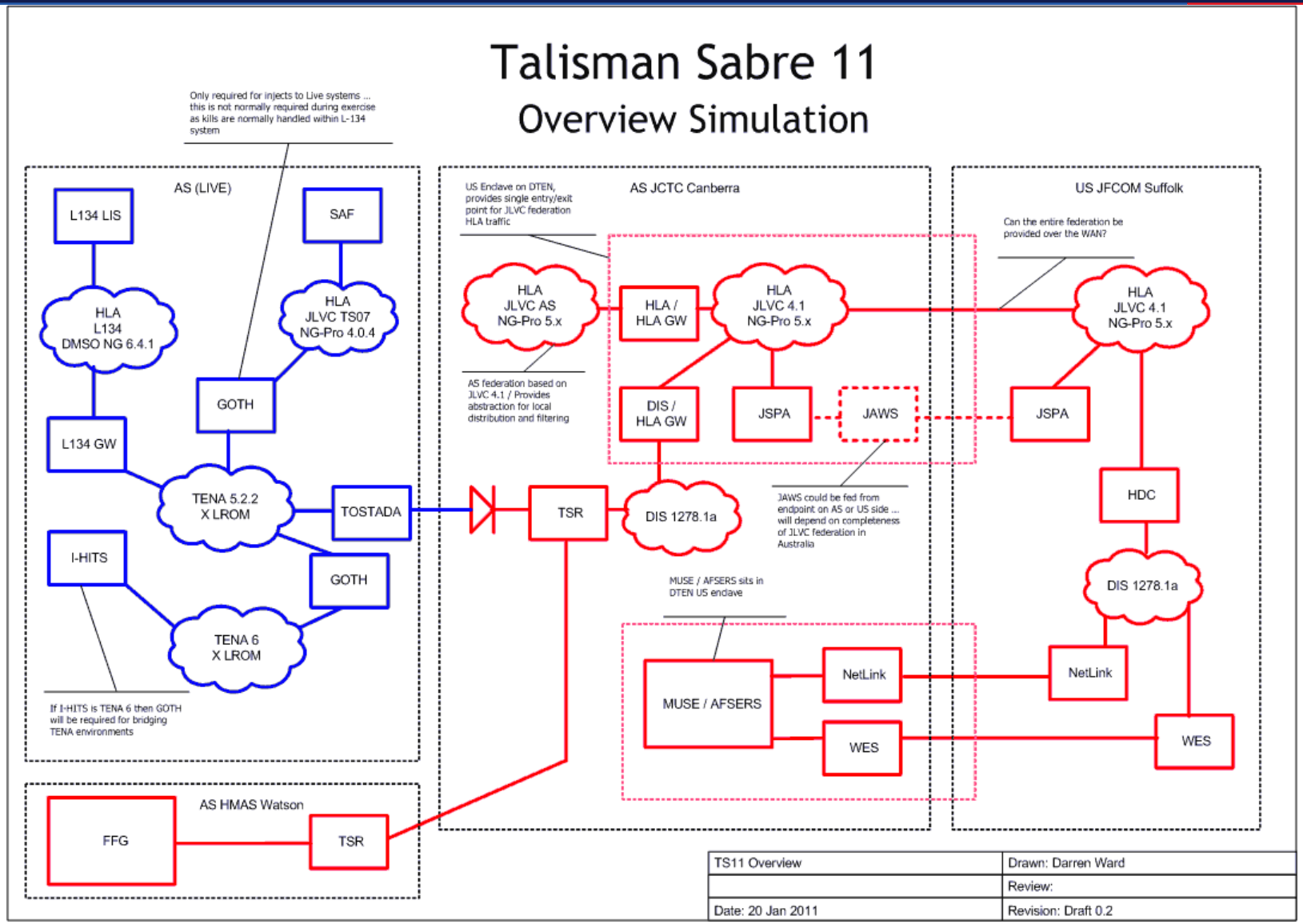
Talisman Sabre 2011Applications from PARC and JNTC



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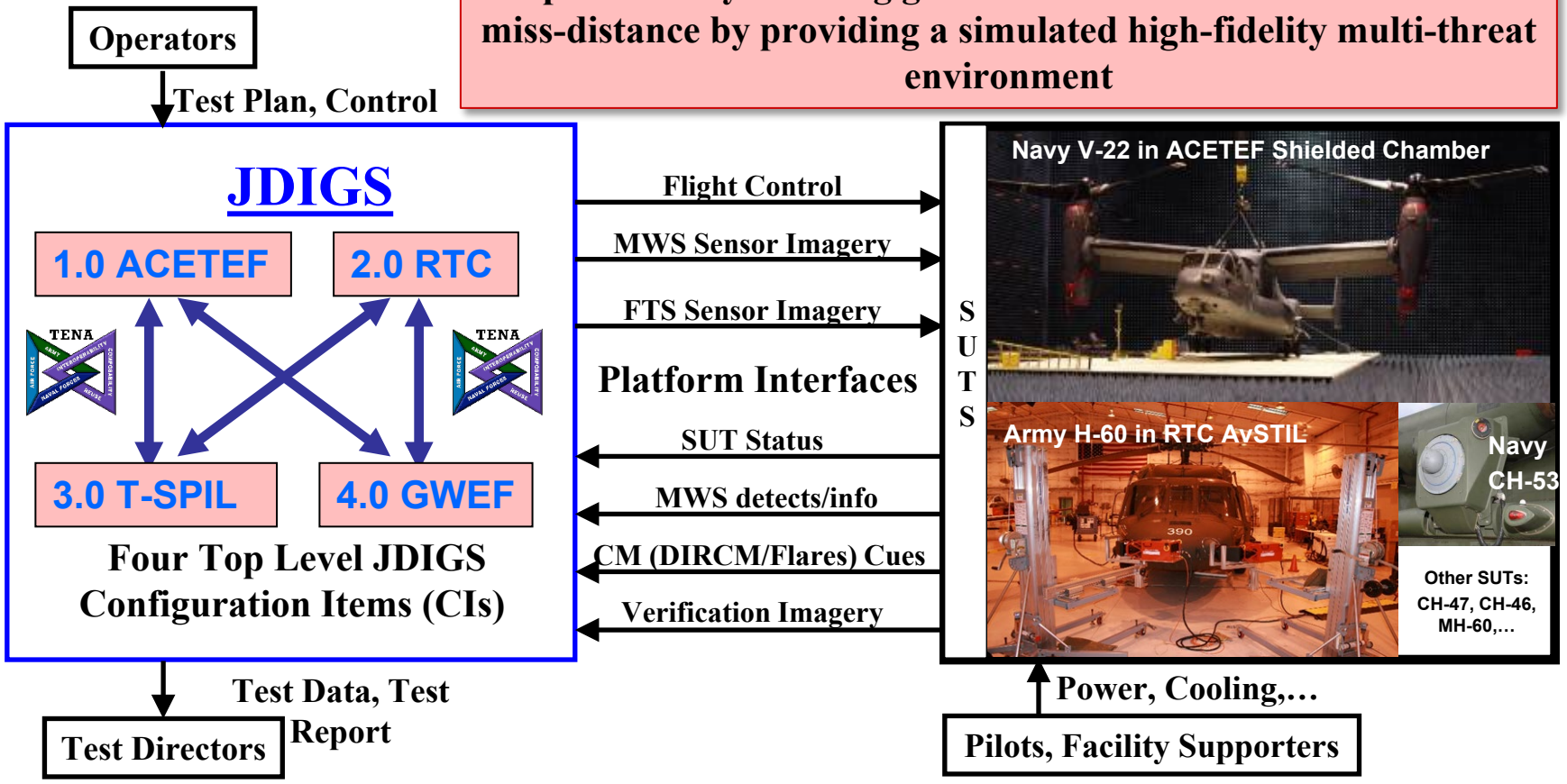
Joint Distributed IRCM Ground-Test System (JDIGS)

JDIGS is a tri-service project that upgrades IRCM T&E capabilities by enabling ground-test of missile break-lock and miss-distance by providing a simulated high-fidelity multi-threat environment



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TENA By the Numbers

9,000+ user accounts

250+ separate activity groups

20+ million page hits in 2020

3,104 helpdesk cases resolved in 2020

84 supported computer platforms

56 supported test / training tools

1,724 different object models

94,841 downloads in 2020

100% Government-off-the-Shelf (GOTS)

TENA Website (wiki and helpdesk)

TENA Software Repository

TENA Product List (30 software products)

- Middleware
- Meta-Model
- Object Models
- MagicDraw TENA Plugin
- Object Model Compiler
- Example Application Plugin
- .NET Language Binding
- Java Language Binding
- Web Language Binding
- TENA Console
- TENA Canary
- Data Collection System
- Data Playback Tool
- Middleware Clock Support
- RelayNode
- Installer
- LiveDisk
- Build System
- Distributed Test Infrastructure
- Repository
- Website Services
- Mission Information Resource Controller (MIRC)
- TENA Adapters
- DISGW
- Interface Verification Tool (IVT)
- SIMDIS TENA Plugin
- TENA Video Distribution System (TVDS)
- TENA Protocol Dissector (TPD)
- ClearPath
- Multicast Sniffer

TENA User Documentation

- Middleware -v6 User Guide
- Middleware Introduction -v6
- Object Model -v6
- Application Development -v6
- Middleware Services -v6
  - Configuration Mechanism -v6
  - Execution Management Services -v6
  - Publication Services -v6
  - Subscription Services -v6
    - Observer Mechanism -v6
    - Callback Framework -v6
    - Object Model Subsetting -v6
    - Subscription Slicing -v6
  - Advanced Filtering -v6
    - Filtering Context -v6
      - Computing Filtering Context based on State Update -v6
    - Filter -v6
    - Stateful Distributed Object -v6
  - Middleware Threading Model -v6
  - Middleware IDs -v6
  - Middleware Metadata -v6
- Execution Manager -v6
- Message -v6
  - Message Sender -v6
  - Message Constructor -v6
  - Message Implementation Registration -v6
  - Message Subscription -v6
  - Message Inheritance and Polymorphism -v6
  - Message Unsubscribe -v6
  - Message ID -v6
  - Adding Message Support to Existing Application -v6
- Local Class -v6
- Event Management -v6

Advanced Filtering

Nominally, the publish-subscribe behavior of the middleware operates on matching the object model type being published with the type of interest for the subscriber. Advanced filtering extends this type-based filtering to allow publishers and subscribers to provide additional criteria to provide finer control of subscription interests to minimize the amount of unwanted information that would occur with a pure type-based filtering system.

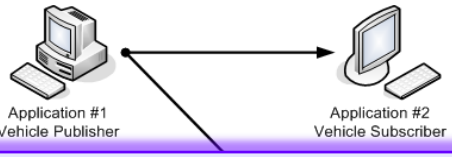
Description

The TENA Middleware provides a peer-to-peer publish and subscribe capability in which the underlying software connects publishers with interested subscribers. Once connected, a publisher will attempt to provide the data of interest to the subscriber. The TENA Metamodel supports Stateful Distributed Objects (SDOs) and Messages that can be exchanged between publishers and subscribers. A key objective in many distributed publisher-subscriber systems is to minimize the unwanted data that is sent to the subscribers, for the purpose of improving network utilization and minimizing unnecessary computer processing. If the subscribing application has to perform "receive-side" filtering to throw away a large percentage of received network messages, there is wasted computer resources in sending and processing the unwanted network messages.

Note that the term "object" will be used in the following discussion to represent either an SDO Servant or an SDO Proxy, depending on whether the object exists in the publishing or subscribing application, respectively.

A primary technique that is used to support publisher-subscriber filtering is based on the particular data types defined in the object model. Type-based filtering ensures that a subscriber will only receive data associated with either an SDO or Message type that matches a subscription request made by the subscribing application. For example, if an object model includes an SDO type named `Vehicle`, and if a subscribing application only subscribes to the `Vehicle` SDO type, then any other data that is published in the execution will not be delivered to the subscribing application.

A simple illustration of type-based filtering is shown in the figure below. In this hypothetical scenario, Application #2 only subscribes to type `Vehicle` and will not receive any of the `Person` data published by Application #3. Application #4 subscribes to both type `Vehicle` and type `Person`, so it will receive data from both Application #1 and Application #3.



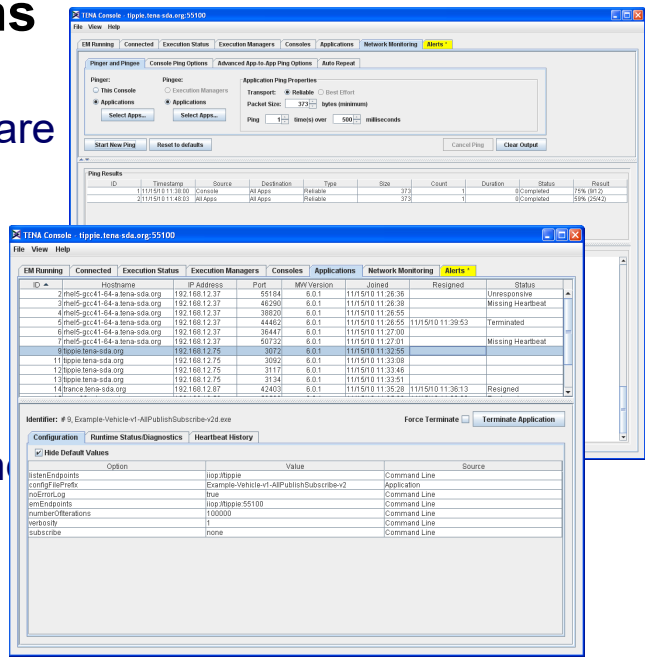
Extensive user documentation that includes code examples and practical guidance for middleware and related products

Test Construction / Setup: TENA Tools

- **Tools are applications, components, or utilities required to support a successful test execution**
- **The TENA SDA maintains a library of tools that address common test requirements**
  - Common tools enable a consistent depiction of the test environment
  - All tools and supporting documentation available through the TENA Repository
- **Some example tools include:**
  - Collaboration and Sharing: TENA Repository
  - Help Desk and Troubleshooting: TENA Issue Tracking System
  - OM Design Support: MagicDraw UML-to-TDL Plugin
  - Legacy Test Asset Integration: TENA Adaptor
  - Test Event Management: TENA Console
  - 3D Visualization: SIMDIS TENA Plug-in
  - Video Sharing: TENA Video Distribution System
  - Data Logging: TENA Data Collection System

TENA Console

- **TENA Console is a GUI-based event management tool used to evaluate and monitor applications and network**
  - Utilizes capabilities automatically built into the middleware
  - Multiple TENA Consoles can be run anywhere on the network
- **Application Diagnostics**
  - Evaluate middleware and application configuration
  - parameters to detect incorrect settings
  - Obtain runtime diagnostic values related to the state an
  - performance of the application
- **Network Monitoring**
  - Perform TCP and (unobtrusive) UDP Multicast “ping” operations between applications to test communication
  - Establish continuous ping operations to notify operators of transient network problems
- **Application Alerts**
  - Notify operators of application warnings that require investigation



Release 6.0.9 Platform Support

	Platform Descriptor	Computer Operating System	Compiler	Status / Notes
1	**rhel9-gcc11-64**	Linux - Red Hat Enterprise Linux 9.0 (Plow)	GCC 11.2.1 (devtoolset-11)	– new for 6.0.9
2	**rhel8-gcc11-64**	Linux - Red Hat Enterprise Linux 8.6 (Ootpa)	GCC 11.2.1 (devtoolset-11)	– new for 6.0.9
3	**rhel8-gcc8-64**	Linux - Red Hat Enterprise Linux 8.6 (Ootpa)	GCC 8.4.1	
4	**rhel7-gcc11-64**	Linux - Red Hat Enterprise Linux 7.9 (Maipo)	GCC 11.2.1 (devtoolset-11)	– new for 6.0.9
5	**centos7-gcc11-64**	Linux - CentOS 7.9.2009 (Core)	GCC 11.2.1 (devtoolset-11)	– new for 6.0.9
6	**u2204-gcc11-64**	Linux - Ubuntu 22.04.1 (Jammy Jellyfish)	GCC 11.2.0	– new for 6.0.9
7	**u2004-gcc9-64**	Linux - Ubuntu 20.04.04 (Focal Fossa), 64-bit	GCC 9.4.0	
8	**macos12-clang14-arm**	macOS 12.6 (Monterey)	Xcode 14.0.1 (Clang 14.0.0)f	– new for 6.0.9
9	**macos12-clang14-intel**	macOS 12.6 (Monterey)	Xcode 14.0.1 (Clang 14.0.0)	– new for 6.0.9
10	**ws22-vs2022-64**	Windows Server 2022 LTSC (21H2)	Visual Studio 2022 (17.3.3)	– new for 6.0.9
11	**w11-vs2022-64**	Windows 11 (21H2)	Visual Studio 2022 (17.3.3)	– new for 6.0.9
12	**w10-vs2022-64**	Windows 10 (21H2)	Visual Studio 2022 (17.3.3)	

Test Analysis / Reporting: Data Collection and Analysis Framework

- **Data Collector**
  - Using TENA object models, data collection software is automatically generated to record object and message attribute values in a persistent data store (currently SQLite and MySQL database representations)
  - Plan to provide add-on collection capability to allow publisher side collection, as well as subscriber side collection – which requires collection management capabilities
- **Data Analysis Support**
  - Extractor tool provided to convert data into format that can be used by Microsoft Excel
  - Analysis capabilities and tools are often highly specialized, and the intent of TENA is to provide a framework for user community to extend to support their unique data storage and analysis needs
- **Data Playback**
  - Automatically generated playback tool can be used to re-play collected data for various forms of testing and analysis

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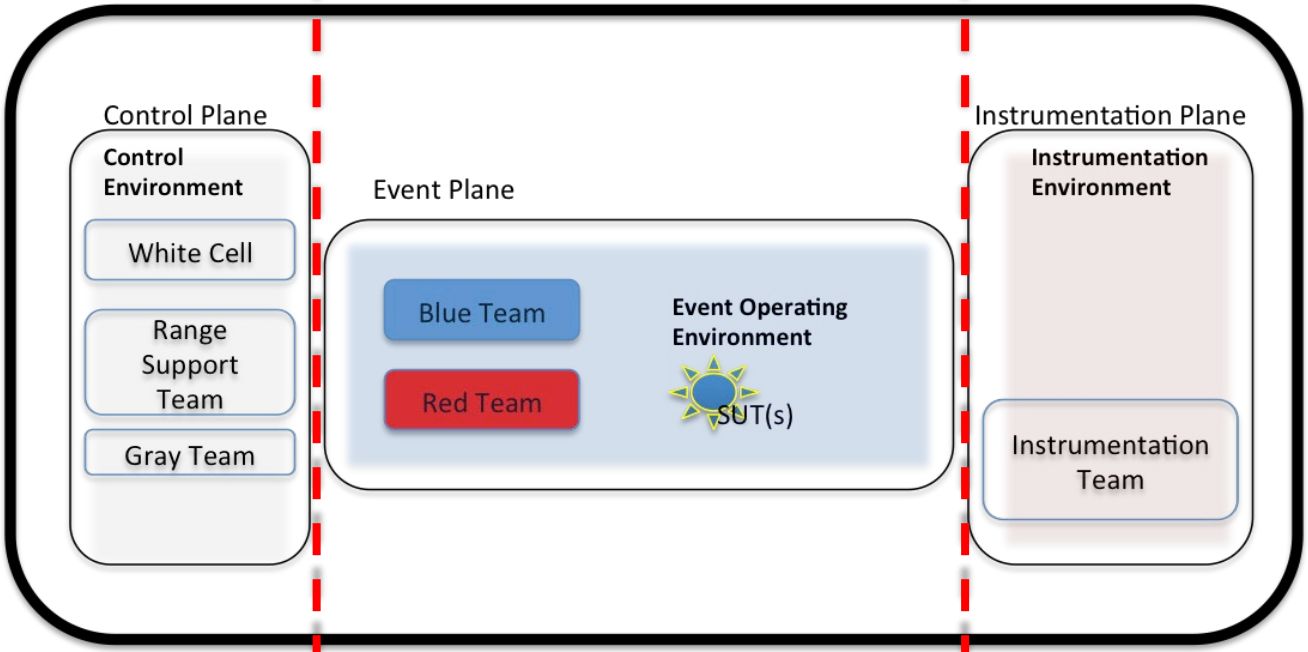
Where TENA Fits in Cyber



TENA Communication & Tools

"Real World" / "Tactical" Traffic

TENA Communication & Tools

TENA is an implemented integration architecture; NOT a cyber tool suite

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From CRIS WG Event Interoperability Fundamentals for Cyber---Range Tools and Processes

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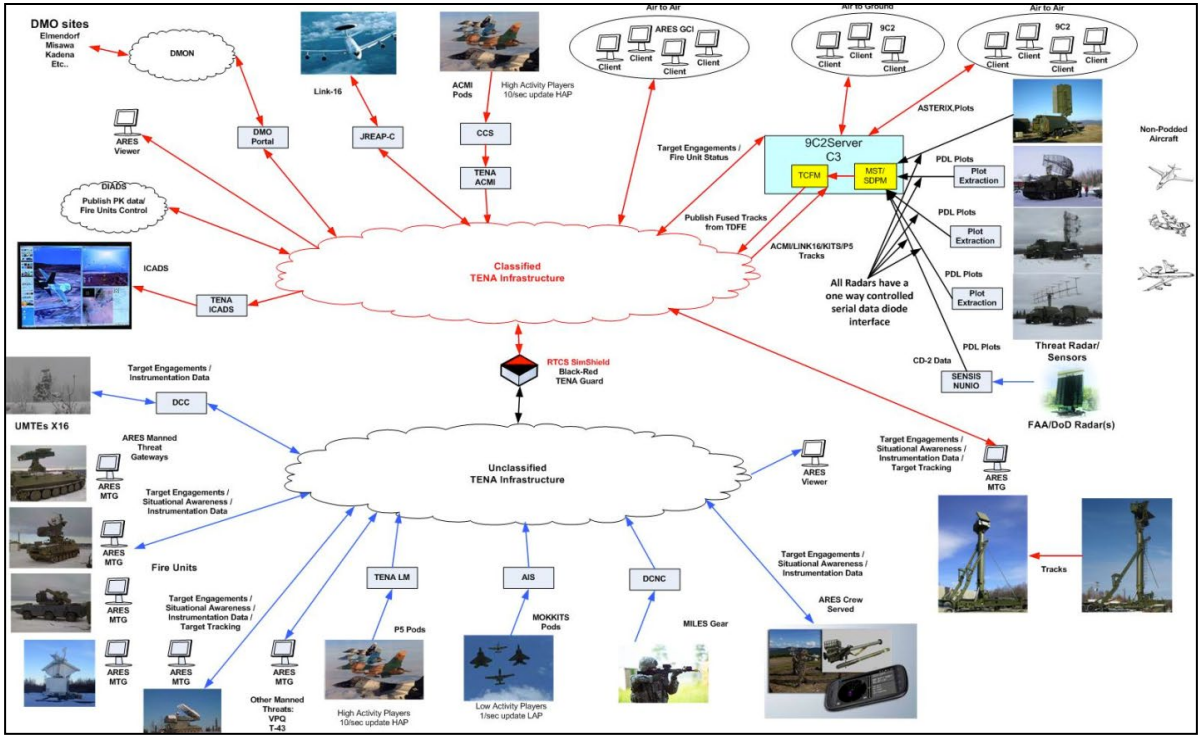
TENA at Joint Pacific Alaska Range Complex (JPARC)

- **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

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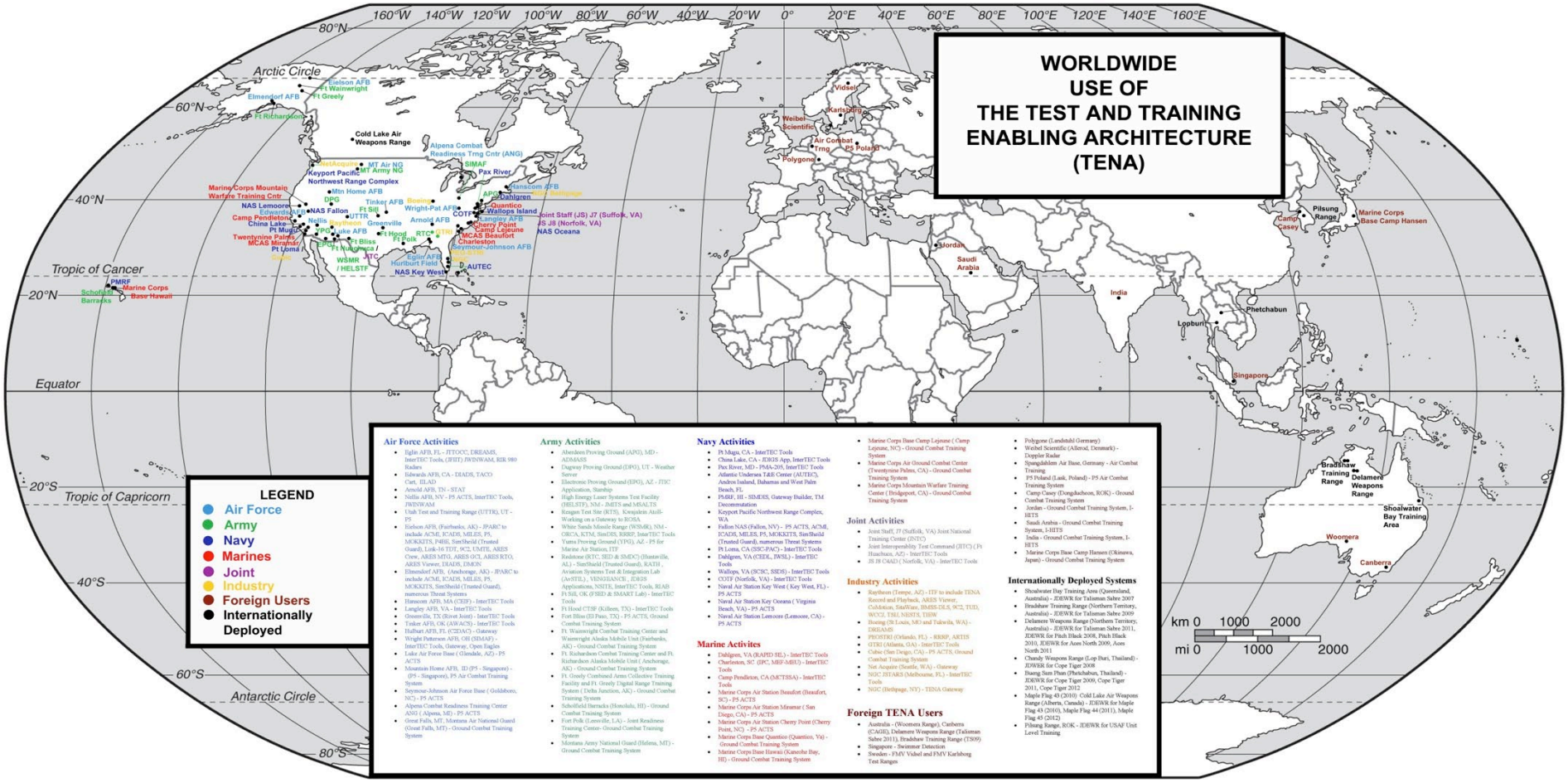
Worldwide Use of TENA



- **92% of MRTFB and 93% of RCC members use TENA to help integrate systems**
- **Many existing T&E S&T and CTEIP investments come with TENA interfaces & support**
- **All future CTEIP investments will use TENA for System of Systems integration**

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Summary: Benefits of TENA

- **TENA represents an enormous amount of practical experience focused on addressing common range infrastructure requirements**
  - More than 7,000 registered users who have contributed to making TENA support their needs
  - More than 170,000 user downloads of middleware and object models used across the range community
- **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 unprecedented understanding of a distributed event
- **TENA auto-code generation capability simplifies the creation of quality range infrastructure code**
  - Auto-generated example applications mean you never start with a blank page
  - Rapid development of real-time, distributed, LVC applications
  - Auto-generated test programs make integration a snap
- **TENA has many standard object models enhancing interoperability**
  - Building blocks already exist for common data structures and algorithms
  - More than 1,200 user object models exist in the TENA Repository for reusability
- **All TENA software and support is free to users**
  - TENA is the most capable and sophisticated interoperability solution for the range community
  - TENA software is thoroughly tested and very reliable
  - The TENA web site/repository has extensive documentation, training, and collaboration capabilities
- **TENA has a plan for continued evolution and funding to execute this plan!**

Joint Mission Environment Test Capability (JMETC) Program Investment Areas

- **Distributed Testing Support**
  - Event Planning and Execution Support
  - Help Desk Troubleshooting and Subject Matter Expertise
- **Distributed Testing Networks**
  - JMETC SECRET Network (JSN): Always connected
  - JMETC MILS Network (JMN): Event-specific links
- **TRMC Cybersecurity Services**
  - Risk Management Framework Support
  - RDT&E Cybersecurity Standards: Overlay, SW Certification
- **Test & Training Enabling Architecture (TENA)**
  - TENA Software Repository
  - TENA Object Models
  - TENA Web Services
- **Big Data / Knowledge Management Initiative**
  - BDKM & Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite (CHEETAS) Overview
- **National Cyber Range Complex (NCRC)**
  - Cyber Range Infrastructure, Tools, Instrumentation
  - Offensive & Defensive Cyber Tests & Events (OCO/DCO)
  - Cyber SMEs & Support Team (including skilled OPFOR)

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Ingredients for Robust All-Domain RDT&E Environments

- Planning Tools
- Design Tools
- Optimization Tools
- Configuration Tools
- Verification Tools
- Management Tools
- Monitoring Tools
- Simulation Tools

Govt & Industry RDT&E Facilities

NATIONAL CYBER RANGE COMPLEX — Test Resource Management Center

JMETC Networks

JOINT DISTRIBUTED CYBER INTEROPERABILITY MISSION ENVIRONMENT — JMETC — TESTING

CHEETAH — Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite

INTEL NETWORKS

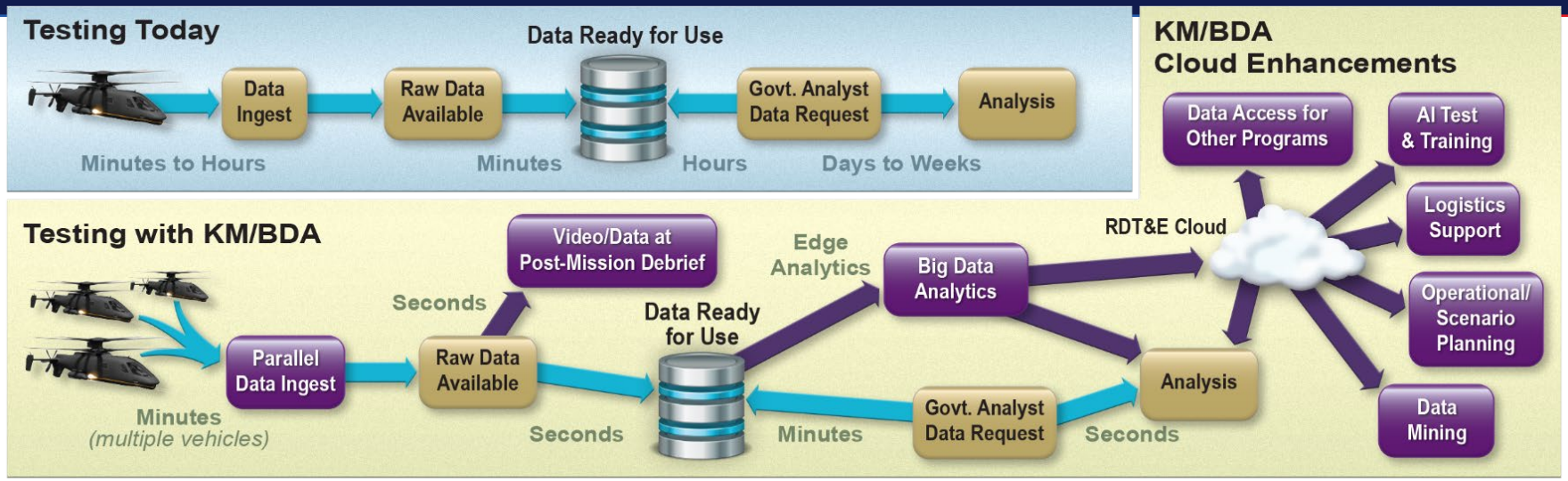
Cross Domain Solutions MLS-JCNE

TRAINING NETWORKS — JTEN

TACTICAL NETWORKS — DISA

DoD CLOUDS — PLATFORM ONE — milCloud 2.0 — FENCES — aws — cloud ONE — Azure

TRMC Knowledge Management (KM) Portfolio Summarized



- **Problem: Evaluation infrastructure investments are not keeping up with the data volume and complexity of today's acquisition systems**
  - T&E analysis and report timeliness is inadequate to support decision-making
  - T&E deliverables are incomplete with no continuous analytics across lifecycle
  - T&E resources are used inefficiently discovering data and/or re-running unnecessary tests
- **Solution: An evaluation revolution is required**
  - Provide analytics at the edge to reduce analysis and decision-making timelines
  - Leverage COTS tools and cloud offerings for continuous data mining and machine learning
  - Enable discovery / reuse of data across programs / systems

RDT&E KM Infrastructure must be modernized to realize NDS

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Key Challenges to Modernizing RDT&E Knowledge Management Infrastructure

Bottom Line: How do we leverage our existing workforce's strengths to modernize DoD analysis tools & methods?

- Enabling a **gradual culture shift** from current tools and methods towards data science and big data analytics
- Reducing analysts' time processing, discovering, accessing, and ordering data so they can **focus on analysis**
- Maintaining consistent **user interfaces** across the data enterprise that reduce modernization learning curve
- **Sharing analysis** algorithms, tools, and products is ad-hoc at best – and non-existent at worst
- Ensuring government can access and **share data** wherever it resides or whatever its native format
- Resource friendly on-ramp needed for programs and facilities to realize the DoD Data Strategy

CHEETAS
Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite

TRMC maintains a GOTS tool suite to address these challenges

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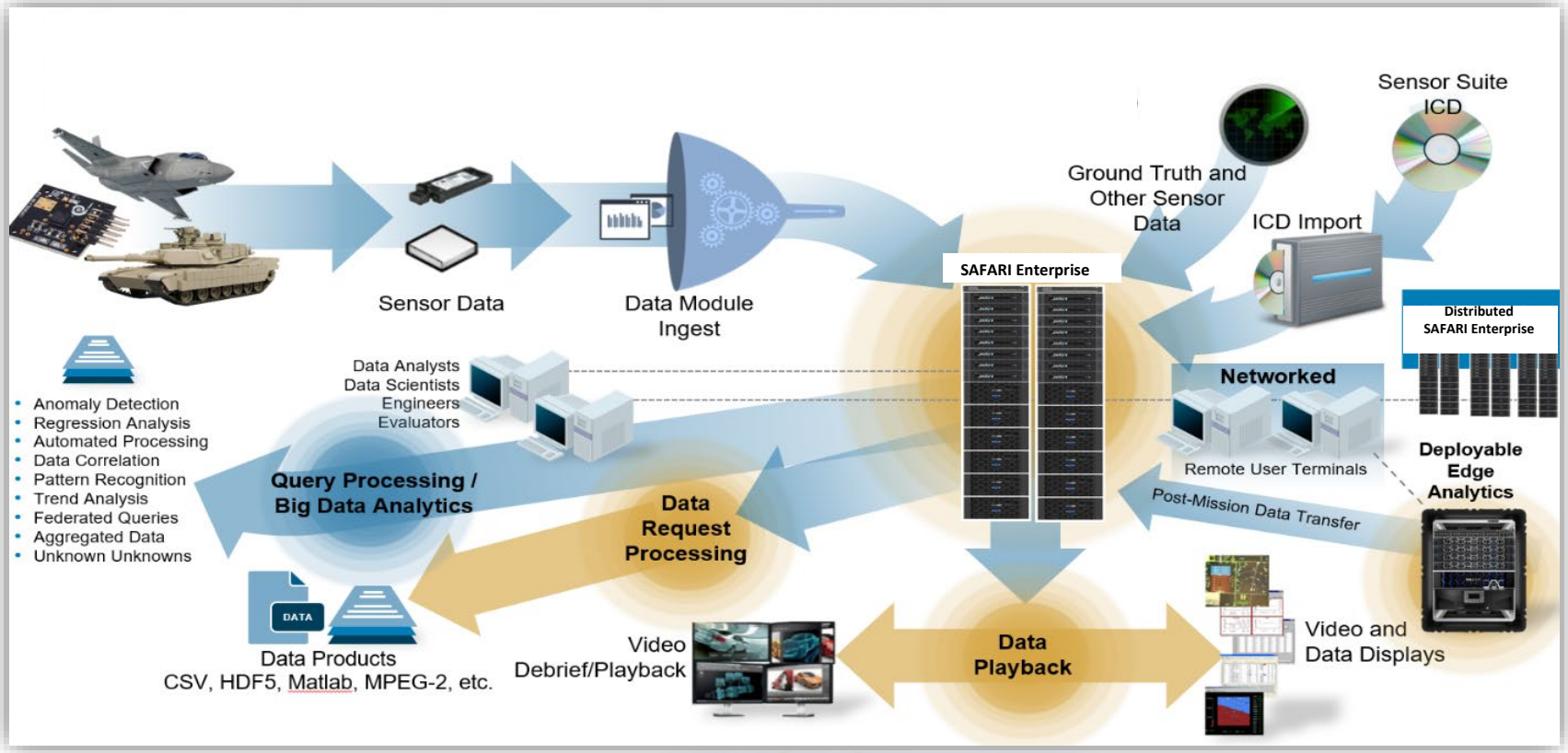
Use Case: DoD Test Ranges



Enables

RDT&E Data Modernization is critical to realizing a data-centric DoD

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Key Enablers to KM Infrastructure Modernization

- **Community-approved Reference Architecture that codifies requirements & design constraints**
  - https://www.trmc.osd.mil/wiki/display/CHEETAS/CHEETAS+Documentation (Log-in Required)
- **TRMC Knowledge Management Foundational Portfolio**
  - Supports all TRMC Strategic Portfolios
  - FY19 DOT&E National Defense Strategy Big Data Portfolio was strong force multiplier
- **Proof-of-Concept prototypes**
  - F-35; F-22; B-52; Autonomy; others negotiable
- **Supported software tool suite with extensible API**
  - CHEETAS: Cloud Hybrid Edge to Enterprise Evaluation & Test Analysis Suite
  - https://www.trmc.osd.mil/wiki/display/CHEETAS/CHEETAS+Home
  - Savanna UNCLASS Testbed (*Coming in FY23*)
- **Community feedback**
  - JMETC Technical Exchange Meetings
  - JMETC Tech Talks: https://www.trmc.osd.mil/wiki/display/TRMC/JMETC+Tech+Talks

CHEETAS
Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite

Investments driven by user priorities & requirements

TRMC F-35 KM / BDA Solutions Overview

- **QRIP – DT / OT miniaturized on-board data capture to replace vendor solution**
  - 97% cheaper, 98% lighter, and 99.5% smaller compared to prior data collector
  - Supports full scope and operational profile for F-35 OT flight test missions
  - Allows any production aircraft to be used for OT with a 3 day mod / de-mod process
  - QRIP-1 has supported over 500 F-35 flights with a 99.53% reliability rate
- **RAPIDS – Govt owned, ruggedized, and portable data ingest / validation solution for analytics at the tactical edge**
  - Facilitated timely access to DT & OT data sets for JSE V&V
  - Eglin weapons test video replay allowed analysts to verify data sets & affect next day missions. Resulted in test completion almost 2 weeks ahead of scheduled range time
  - Enabled deep dive data analytics in the field during Northern Edge 2019 exercise
- **JSF-KM – Big Data Analytics & Evaluation System to find "unknown unknowns"**
  - Reduced 9 hour routine analysis process to 23 ms
  - Reduced data profile time from 5+ hours to 47 seconds per query
  - Identified issue with ground flight sensor believing it was on-ground for ~300 ms mid-flight
  - Data scientist identified flights with engine issues & created predictive model for identifying future failures
- **QRIP, RAPIDS, and JSF-KM are all required technologies in JSF Block 4 TEMP**

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B-52 Example Successes

- **CHEETAS resolved data collection, processing and conversion corruption issue**
  - Previous data ingest workflow took weeks to deliver data to analysts
  - Instrumentation team and vendor now have full insight into the data ingest process
- **CHEETAS software eliminated downstream data processing problems**
  - Near-future data will be pre-processed on the flight line to spot new or recurring data fault issues
- **CHEETAS expedited data ingest and conversion from weeks to hours**
  - B-52 analytics team can now receive high-quality reliable data in time to inform follow-on flight missions
- **Enterprise KM hardware deployed to Edwards January 2021**
  - Enabled analytics team to identify hidden issues within systems or weapons on B-52
  - Similar hardware footprint to F-35 installations
- **CHEETAS software proven extensible to other platforms/weapon systems**
  - Leveraging F-35 deliverables reduced B-52 capability roll-out from years to months
  - B-2 and B-1B have now expressed interest in evaluating CHEETAS

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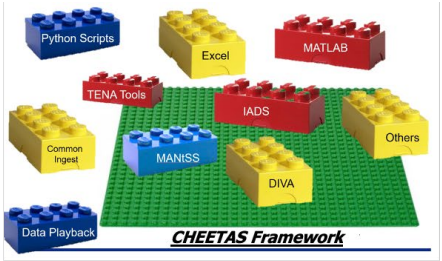
Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite (CHEETAS)

Cloud/Edge-agnostic analytic framework that helps analysts embrace big data analytics tools & techniques

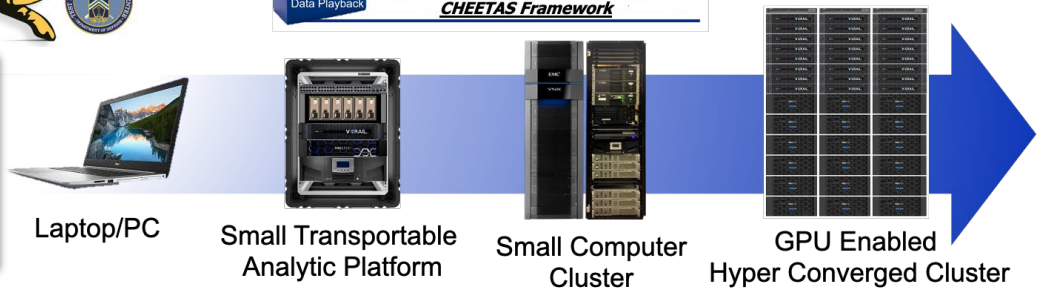
- 100% Government-owned
- Agile, sprint-based CI/CD development
- Containerized with Apps Marketplace
- User extensible via Public API
- Hardware and Vendor agnostic
- TRMC Software Certification
- Open, extensible architecture
- Able to deploy in any edge or cloud environment
- Promotes tool and source code sharing
- Used daily by F-35 and B-52 Modernization RDT&E

CHEETAS

Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite



16 site installs
40+ Organizations in Planning / Evaluation



https://www.trmc.osd.mil/wiki/display/CHEETAS/CHEETAS+Home (Log-in Required)

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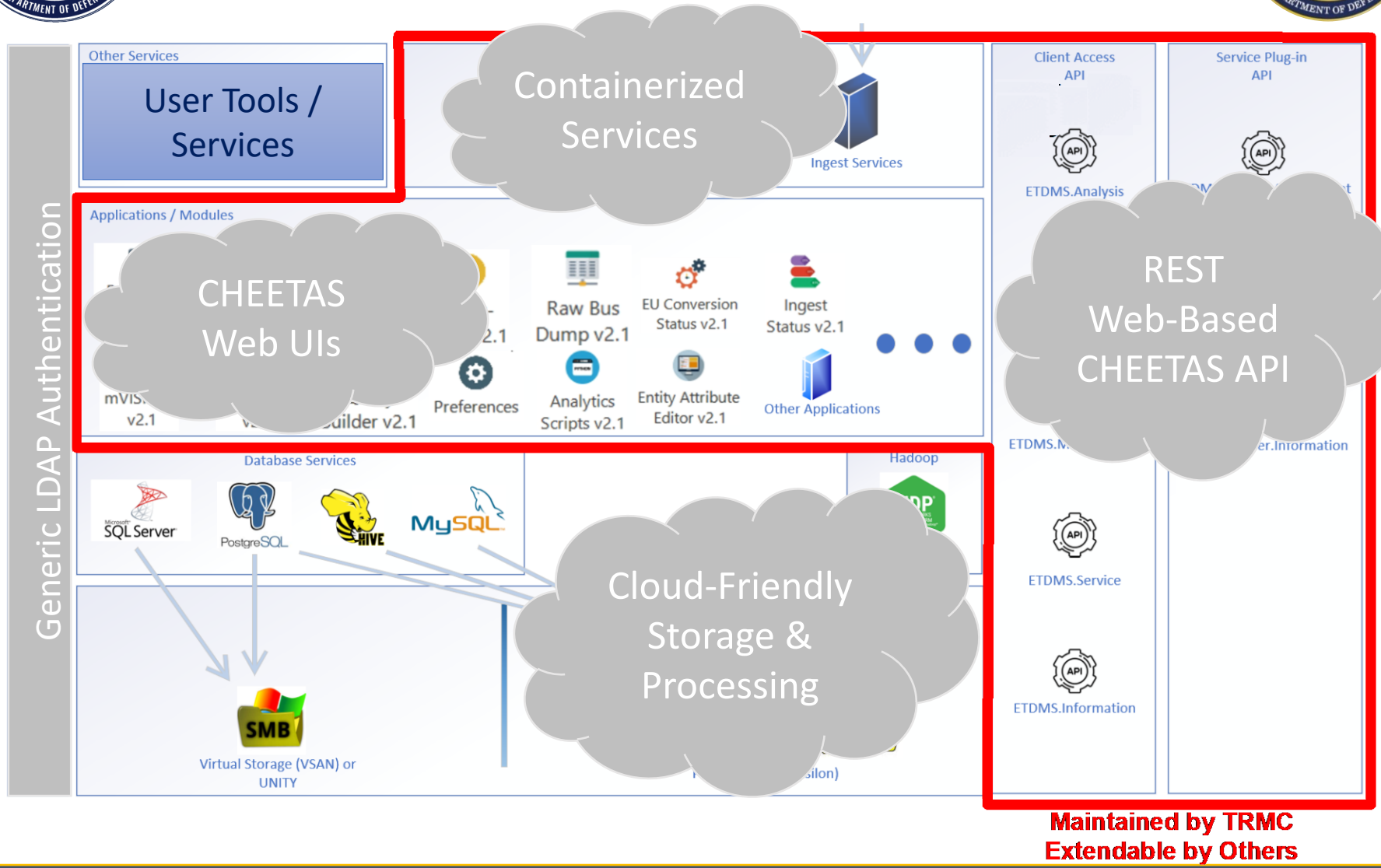
CHEETAS Main Features



CHEETAS is 100% GOTS & designed for Enterprise Scalability

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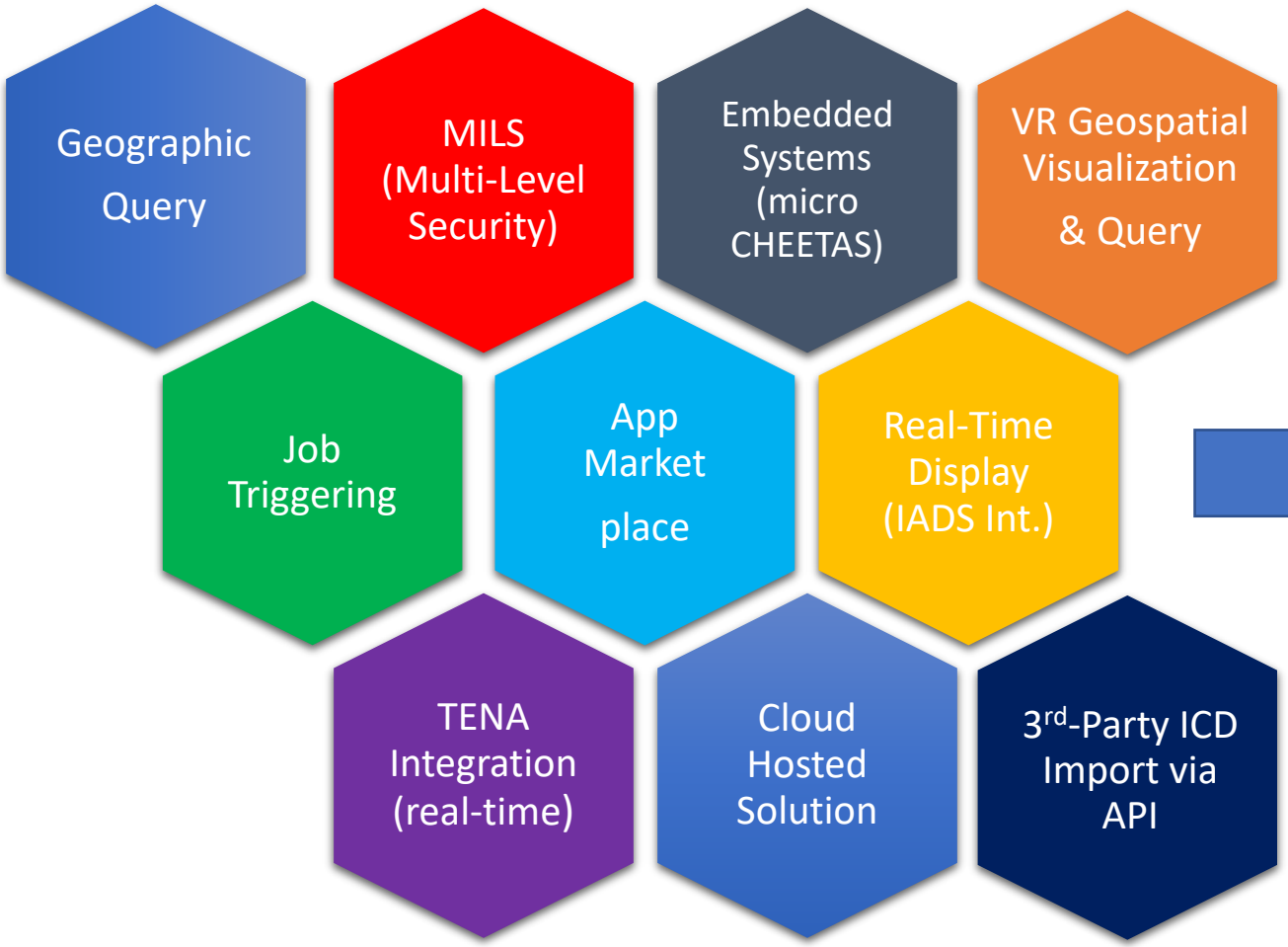
CHEETAS Usage

- **Using CHEETAS Today**
  - 413th FLTS Hurlburt Field
  - 47th Cyber
  - AFOTEC Det 6
  - B-1
  - B-52
  - F-22
  - F-35
  - Navy COMOPTEVFOR
  - Navy SATR
  - Northern Edge
  - PACOM
  - Weapon One
- **Next 6 months**
  - FA-18 (COTF)
  - INDOPACOM
  - Innovation Proving Ground
  - JANETT
  - RC-135 Big SAFARI
  - Sentinel
  - TENA
- **Next 12+ months**
  - ADTR
  - FA-18 (Patuxent River)
  - Project Convergence
  - RTC
  - Sky Range
  - YPG

CHEETAS – Looking Out 1-5 Years



CHEETAS
Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite

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KM Portfolio Summary

- **TRMC investments are leading an "evaluation revolution" to modernize technical data analysis & evaluation**
- **TRMC is working across government & industry to develop an enterprise framework for evaluation infrastructure. Goals:**
  - Integrate RDT&E infrastructure into cohesive knowledge management enterprise
  - Modernize RDT&E practices & processes to leverage big data analytics techniques
  - Apply big data analytics tools & techniques to the RDT&E mission space
- **CHEETAS provides a common GOTS analytics framework that:**
  - Enables existing analysts to become data scientists
  - Emphasizes user time spent on analysis rather than data gathering
  - Provides consistent access regardless of data location and/or amount
  - Promotes sharing & reuse of tools & techniques across the community
  - Implements the DoD Data Strategy for RDT&E

https://www.trmc.osd.mil/wiki/display/CHEETAS/CHEETAS+Home

Joint Mission Environment Test Capability (JMETC) Program Investment Areas

- **Distributed Testing Support**
  - Event Planning and Execution Support
  - Help Desk Troubleshooting and Subject Matter Expertise
- **Distributed Testing Networks**
  - JMETC SECRET Network (JSN): Always connected
  - JMETC MILS Network (JMN): Event-specific links
- **TRMC Cybersecurity Services**
  - Risk Management Framework Support
  - RDT&E Cybersecurity Standards: Overlay, SW Certification
- **Test & Training Enabling Architecture (TENA)**
  - TENA Software Repository
  - TENA Object Models
  - TENA Web Services
- **Big Data / Knowledge Management Initiative**
  - BDKM & Cloud Hybrid Edge-to-Enterprise Evaluation & Test Analysis Suite (CHEETAS) Overview
- **National Cyber Range Complex (NCRC)**
  - Cyber Range Infrastructure, Tools, Instrumentation
  - Offensive & Defensive Cyber Tests & Events (OCO/DCO)
  - Cyber SMEs & Support Team (including skilled OPFOR)

Summary and Q&A

JMETC Technical Exchange Meeting (JTEX)

- **Purpose:**
  - Capture user feedback on needs & requirements
  - Provide latest information on JMETC products & services
  - Propagate lessons learned throughout community
- **Participation: Government meeting open to all JMETC users – including industry & coalition partners**
  - 93 action items captured & questions answered during JTEX-01 & JTEX-02
- **Example Feedback from last JTEX Meeting:**
  - Big Data: Big Data tools training requested
  - Networking: Establish dedicated cybersecurity track at next meeting
  - LVC: Deep dive on interoperability / integration best practices
  - Enterprise Software: Bring in additional community tools
  - General: Continue JMETC / TENA tools demonstrations

JTEX-07 on June 5-8 (Ventura, CA):

JTEX Day 1

JMETC Technical Exchange (JTEX) -07

Ventura Marriott
2055 E Harbor Blvd, Ventura, CA 93001

Tuesday, 6 June 2023

	Plenary Session **Buenaventura Ballroom**					
Time	**Topic**				**Presenter**	
0830-0900	Welcome and JTEX Overview				Ryan Norman	
0900-0945	Digital Technologies for T&E				Dr. Jeremy Werner	
0945-1030	DREN Modernization Update				Brett Evenstad	
1030-1045	***Break **Tools Demo Open*****					
1045-1115	National Cyber Range Complex Update				Cisca Vuong	
1115-1200	JMETC Program Update and JTEX Action Item Review				Ryan Norman	
1200-1330	***Lunch***					
	Networking **Buenaventura Salon I**		**Big Data/Knowledge Management** **Buenaventura Salon II**		**Cyber T&E** **Buenaventura Salon III**	
Time	**Topic**	**Lead**	**Topic**	**Lead**	**Topic**	**Lead**
1330-1445	Network Track Introduction	Gary Harras	BDKM Track Day 1 Introduction	Tracy Mullendore Jason Bolin	Cyber T&E Track Introduction	John Rutledge
	Update on DREN and SDREN	Brett Evenstad	CHEETAS Background and General Overview	Tracy Mullendore	Test and Evaluation/Science and Technology Cyberspace Test Technology Measure & Share	Min Kim & Pete Firey
			CHEETAS Technical Update: CHEETAS Evolution Since JTEX-06	Chris Moyer		
1445-1500	***Break **Tools Demo*****					
1500-1700	Setting Up/Using Layer 2 Connections on JSN	Gary Harras	RDT&E Cloud Strategy Update	Dr. Ed Powell	C2C for Cyber C2	William (Bailey) McCreery
	Security Information and Event Management (SLIEM)	Philip Prophett	TRMC SAVANNA Testbed	Todd Medley	TKE Overview Brief	Mark Mejeur
	Austere Location Data Transport using Satellite Connections	Gary Harras & John Rutledge	TRMC Data Scientists: Using AI / ML for DoD Projects	Dr. Allen Gee	Cyber Data Exchange Model (DEM) Update	Dr. Katherine Morse
	Questions and Closing	Gary Harras	BDKM Day 1 - Closing	Tracy Mullendore	NE2S - Cyber Effects Situational Awareness with Retina (CESAR)	Derek Bryan / Stacy VanWinkle

JTEX Day 2

JMETC Technical Exchange (JTEX) - 07

Ventura Marriott
2055 E Harbor Blvd, Ventura, CA 93001

Wednesday, 7 June 2023

	Multi-Domain Integration Buenaventura Salon I		Big Data/Knowledge Management Buenaventura Salon II		Electronic Warfare Buenaventura Salon III	
Time	**Topic**	**Lead**	**Topic**	**Lead**	**Topic**	**Lead**
0830-1030						
1030-1045	*Break ** Tools Demo *****					
1045-1200						
1200-1330	*Lunch*					
	Multi-Domain Integration **Buenaventura Salon I**		**Big Data/Knowledge Management** **Buenaventura Salon II**		**Electronic Warfare** **Buenaventura Salon III**	
1330-1445						
1445-1500	*Break ** Tools Demo *****					
1500-1700						

JTEX Day 3

JMETC Technical Exchange (JTEX) - 07

Ventura Marriott
2055 E Harbor Blvd, Ventura, CA 93001

Thursday, 8 June 2023

	Cybersecurity Buenaventura Salon I		Big Data/Knowledge Management Buenaventura Salon II		Enterprise Software Buenaventura Salon III	
Time	**Topic**	**Lead**	**Topic**	**Lead**	**Topic**	**Lead**
0830-1030	TRMC Update - TRMC ATOs/RMF Assistance	Robin Deiulio	Big Data Track Day 3 Intro	Tracy Mullendore / Jason Bolin	TRMC Website Services Update	Steve Bachinsky
	Zero Trust Briefing	Frank Alvarado	Big Data from B-52: *Establish of KM at the Global Power Bomber CTF*	Jeff Martin	DevSecOps Roadmap	Sergio Nirenberg
	CONOPS Writing	Marshall Hawkins	IRIG 106 Synthetic Data Generation for Big Data Analytics Development	Bob Baggerman		
1030-1045	***Break **Tools Demo*****					
1045-1200	Common Control Provider / TRMC Process / HPCMP CSSP CCP	Candice Holt & Peter Cline	CTI: Merlin EW Toolset & CHEETAS Plans	Matthew Goldsbury	TENA Update	Steve Bachinsky
			Community Actions/Desired Next Steps/JTEX-08 Topic Ideas	Tracy Mullendore	Middleware 6.1 Beta2	Brant Kyser
	Software Assurance - Technical Details for Code Analysis	Ed Gannaway	BDKM Track Conclusion	Tracy Mullendore	Universal Command & Control Technical Update	David Drake
1200-1330	***Lunch **Tools Demo Closed*****					

	Plenary Session **Buenaventura Ballroom**	
Time	**Topic**	**Presenter**
1330-1445	JTEX Outbriefs	Track Leads
1445-1530	Action Item Review & Closing	Ryan Norman

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JMETC Configuration Review Board (JCRB)

First Meeting: Aug 23, 2018

- **Purpose: Evolve and maintain JMETC infrastructure investments to support distributed T&E**
  - Identify requirements & priorities
  - Formalize distributed testing standards
  - Realize JTEX investment recommendations

- **JCRB Membership: Stakeholder organization's appointed representative(s)**
  - JCRB Voting Members: US Government stakeholders
  - JCRB Advisory Members: non-US Government stakeholders

- **JCRB Standards for Approval:**
  - Big Data Architecture Reference Document
  - Range Instrumentation OM Collection

JMETC may need assistance identifying appropriate stakeholder(s) for each test organization

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JMETC Tech Talks

Tech Talks are scheduled monthly
https://www.trmc.osd.mil/wiki/display/TRMC/JMETC+Tech+Talks

JMETC also keeps all Tech Talk documentation and software on-line and available thru the Tech Talk link above. 78 Tech Talks to date.

- **Topics**
- **Big Data/Knowledge Management (8)**
- **Cybersecurity (16)**
- **Networking (14)**
- **Live, Virtual, and Constructive (10)**
- **Cyber T&E (8)**
- **Software Enterprise (18)**
- **User Requirements (4)**

Summary

- **Problem: Building robust environments for System of Systems and Cyber testing is costly & time consuming**
- **JMETC Mission: Provide an agile distributed T&E infrastructure capability for testing like we fight**
- **The JMETC Team helps programs with all facets of distributed T&E**
  - Event Planning / Design / Development / Integration / Monitoring / Execution for cyber and non-cyber T&E
  - TENA “Free Upgrade” support offer
  - Local and Distributed Network Engineering support
  - Corporate knowledge of assets available for distributed use
  - Information Assurance / Cybersecurity assistance
- **JMETC investments are driven by user requirements**
  - Deployment of JSN / JMN nodes are based on user need
  - JMETC provided tools and services are based on user input
  - JTEX meetings formalize feedback and user community engagement

TRMC Joint Mission Environments Test Capability (JMETC) POCs

Chief Data Officer and Lead, Joint Mission Environments (JME)
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Event Scheduling / Event Questions

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Linking Sites

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JMETC Cybersecurity

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Big Data Knowledge Management

TRMC KM Portfolio Projects
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CHEETAS

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Connectivity / Network Questions

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Secret Only

Always Connected

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JMETC Enterprise Cross Domain Services

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MLS-JCNE

Miscellaneous Questions

For JMETC questions: jmetc-feedback@trmc.osd.mil
For TENA questions: tena-feedback@trmc.osd.mil
For NCRC questions: ncrc-feedback@trmc.osd.mil
For CHEETAS questions: CHEETAS-feedback@trmc.osd.mil

Websites

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Help Desk

Action Items, Questions, Tasks, Software Needs, Bug Reports: https://www.trmc.osd.mil/helpdesk

TRMC JMETC & NCRC POCs

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National Cyber Range Complex (NCRC), Director
AJ Pathmanathan: (571) 372-2702; arjuna.pathmanathan.civ@mail.mil

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Distributed Test and Training Missions
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Linking Sites

Cyber Events
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NCRC Events

Range Support And Training

TENA and JMETC User Support
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gene.hudgins@tena-sda.org

TENA Products / Software Repository

TENA Software Development
Steve Bachinsky
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steve.bachinsky@tena-sda.org

NCRC Expansion / Site Questions

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JMETC Cybersecurity

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JMETC Secret Network (JSN)
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JMETC MILS Network (JMN)
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Big Data Knowledge Management

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tracy.mullendore@tena-sda.org
CHEETAS

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JMN Engineering
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Above / Below Secret
Connected During Event

JMETC Enterprise Cross Domain Services

Information Systems Security Engineering (ISSE)
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frank.Alvarado@tena-sda.org
MLS-JCNE

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