The DoD T&E/S&T Program

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Test & Evaluation / Science & Technology Program
(TRMC, T&E/S&T)

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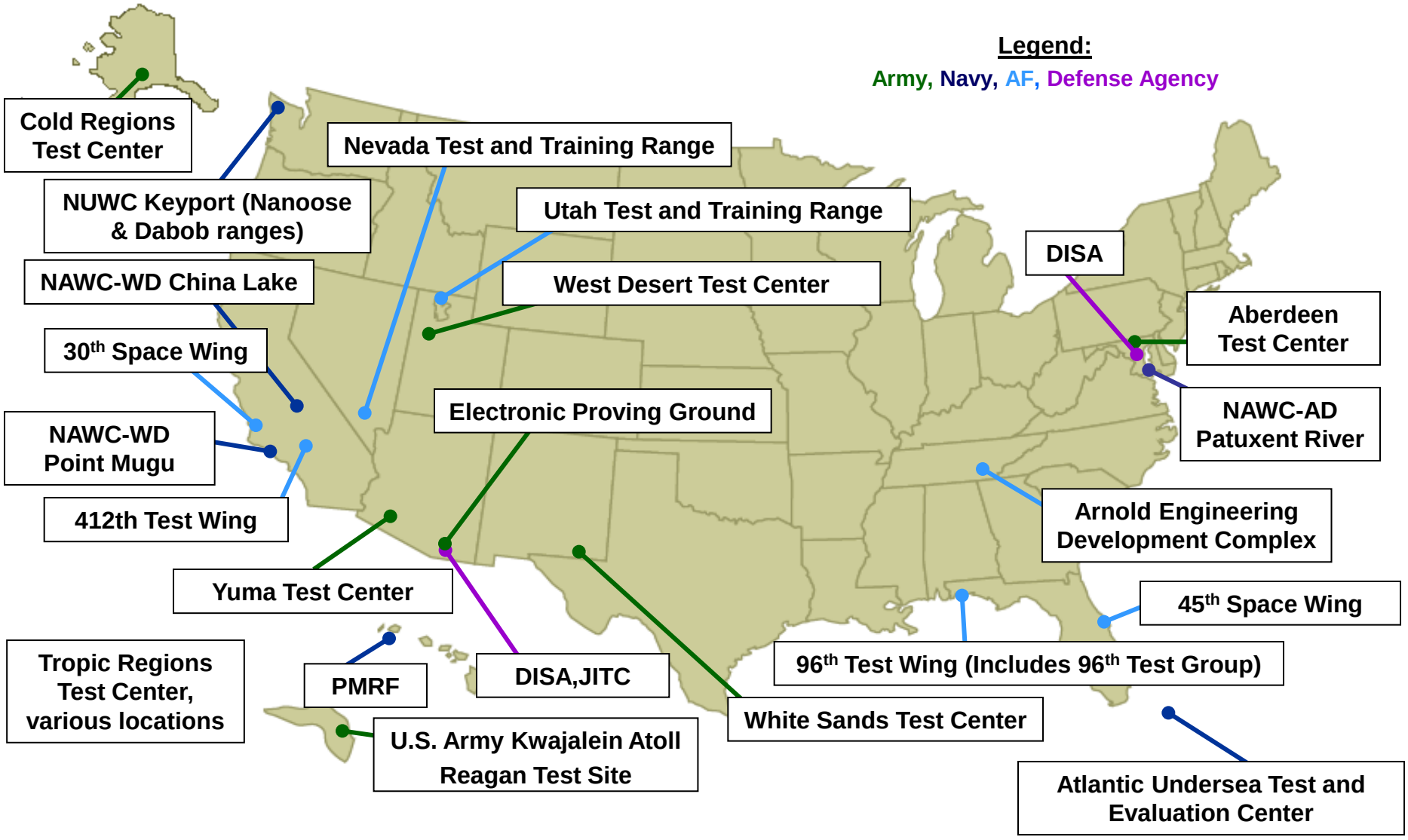
The STEWARD of the DoD Test Infrastructure

Major Range and Test Facility Base (MRTFB): The "Critical Core"

23 Sites: Army-8; Navy-6; Air Force-7; Defense Agency-2



TRMC Investment Programs Overview

Test Technology Development

T&E/S&T

- Established in FY2002
- Develops technologies required to test future warfighting capabilities
- BA 3 S&T for T&E
- ~$90M / year
- 8 Test Technology Areas
  - Electronic Warfare
  - Cyberspace
  - High Speed/Hypersonics
  - Autonomous Systems
  - C4I & Software Intensive
  - Directed Energy
  - Advanced Instrumentation
  - Spectrum Efficiencies

Test Capability Development

CTEIP

- Established in FY1991
- Develops or improves test capabilities that have multi-Service utility
- Range Modernization
- ~$250M / year
- 4 program components
  - Core Joint test capability improvement
  - Joint EW test capability improvement
  - Threat systems & threat representations
  - Near-term, emergent OT shortfalls

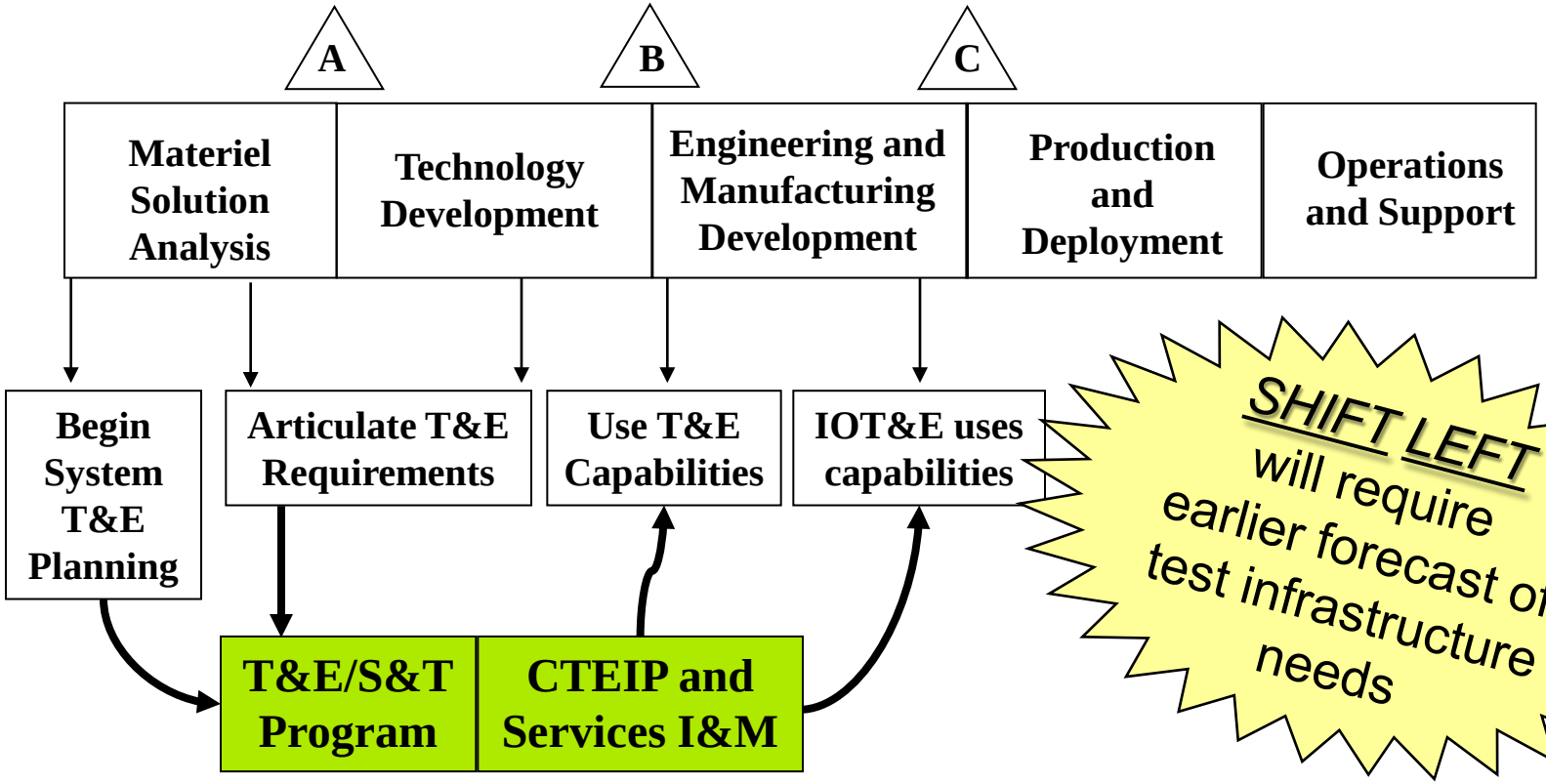
Distributed Test Integration

JMETC

- Established in FY2007
- Provides infrastructure for distributed Joint and Cyberspace testing
- Range Integration
- ~$45M / year
- 78 current sites
  - Expanding to 93 sites
- Maintains
  - Network connections
  - Security agreements
  - Integration software
  - Interface definitions
  - Distributed test tools
  - Reuse repository

T&E Capability Development Cycle

Challenge: T&E Capabilities must be available in time to provide useful insight to decision-makers and warfighters



Cycle for Test Capability Development Must Begin Early

Test and Evaluation / Science and Technology (T&E/S&T) Program Overview

Mission: Develop Technologies Required to Test Future Warfighting Capabilities

- **Established in FY02**
  - Joint DDR&E / DOT&E Initiative
  - Transitioned to TRMC in FY05
- **RDT&E Budget Activity 3 funds**
- **Purpose**
  - High Risk / High Payoff R&D for Testing
  - Foster technology transition to major DoD test ranges
  - Risk reduction for test capabilities developments

72 Active Projects

- **Annual Broad Agency Announcements (BAAs)**
  - Academia
  - Industry
  - Government Laboratories
- **Tri-Service working groups**
  - Validate requirements
  - Evaluate proposals
  - Facilitate technology transition
- **Central Oversight – Distributed Execution**

Eight Test Technology Areas

High Speed Systems 15 Active Projects	Unmanned & Autonomous Systems 4 Active Projects	Spectrum Efficiencies 8 Active Projects	Advanced Instrumentation 13 Active Projects
Directed Energy 9 Active Projects	Cyberspace 2 Active Projects	Electronic Warfare 16 Active Projects	C4I & Software Intensive Systems 5 Active Projects

FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021
$79.1M	$89.3M	$87.1M	$89.6M	$97.1M	$98.3M	$100.3M

Shaping Technology into Tomorrow's T&E Capabilities

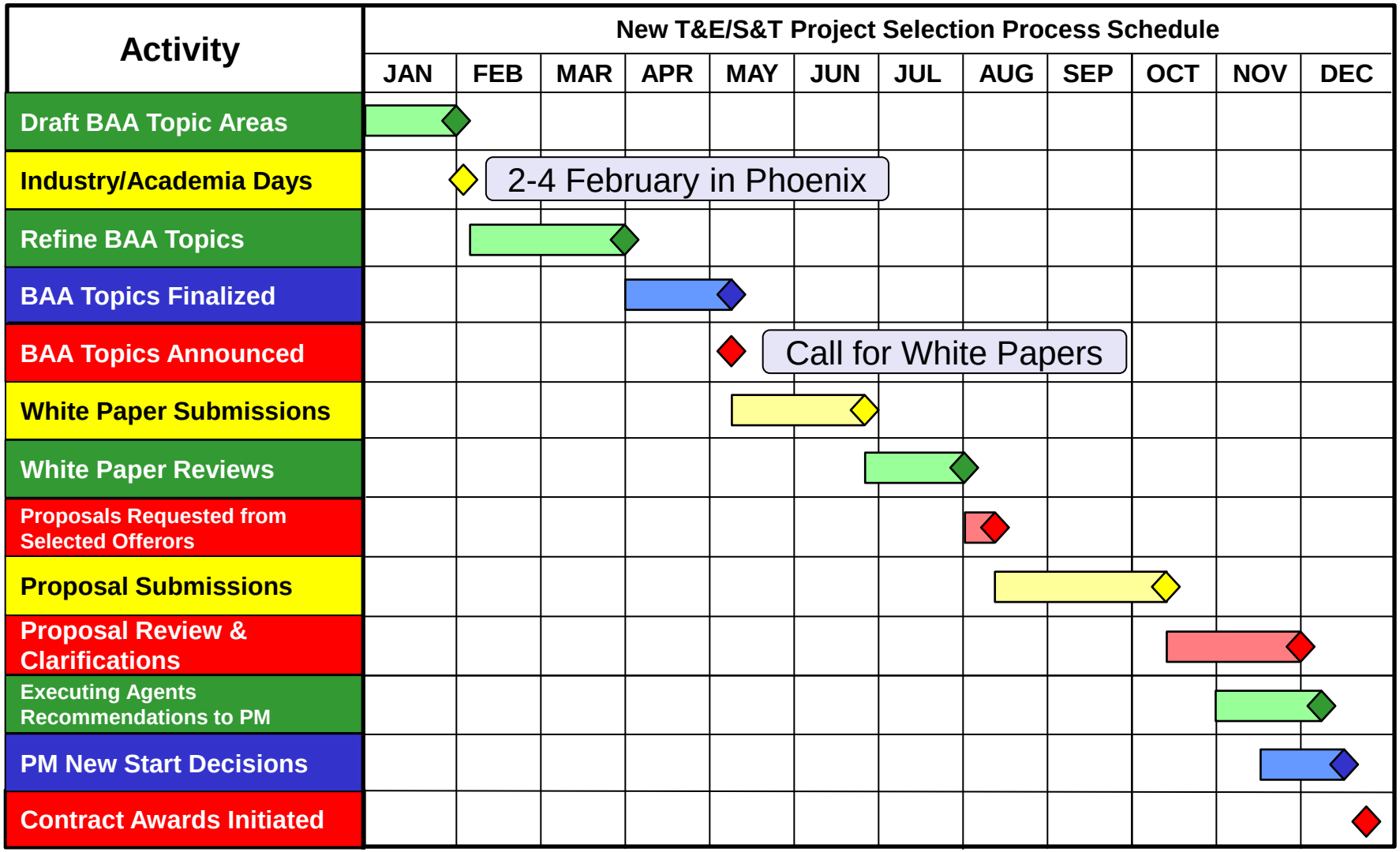
T&E/S&T Program

Broad Agency Announcements

- **Topics for Industry, Academia, and Government Laboratories to propose test technology solutions**
- **In-cycle Process**
  - **Declared schedule for white paper submissions (deadline)**
  - **Requires an allocation of available funding**
  - **Priority over out-cycle white papers (must be processed first)**
- **Out-of-cycle Process**
  - **White papers submitted anytime after "in-cycle" deadline**
  - **Offerors "highly encouraged" to contact Executing Agent before submitting white paper**
    - **Ensures interest**
    - **Can address whether a 'chance' exists for funding**
- **All BAAs include an "Other Test Technologies" topic to enable offerors to propose test technology developments that were not previously identified by the Government**

All T&E/S&T BAAs are always open for new white papers

New Project Selection Schedule



Evaluation Criteria Refinement

- **Gatekeeper Criteria (Must haves)**
  - T&E Need
  - S&T Challenge
- **Secondary Criteria**
  - T&E Merit
    - Wide-ranging / Payoff
  - Technical Approach
    - Development Strategy / Phasing Strategy / Deliverables / Risk Reduction / Schedule / External Dependencies
  - Transition Potential
    - Transition Feasibility / Adoption Readiness / Data Rights
- **Tertiary Criteria**
  - Cost

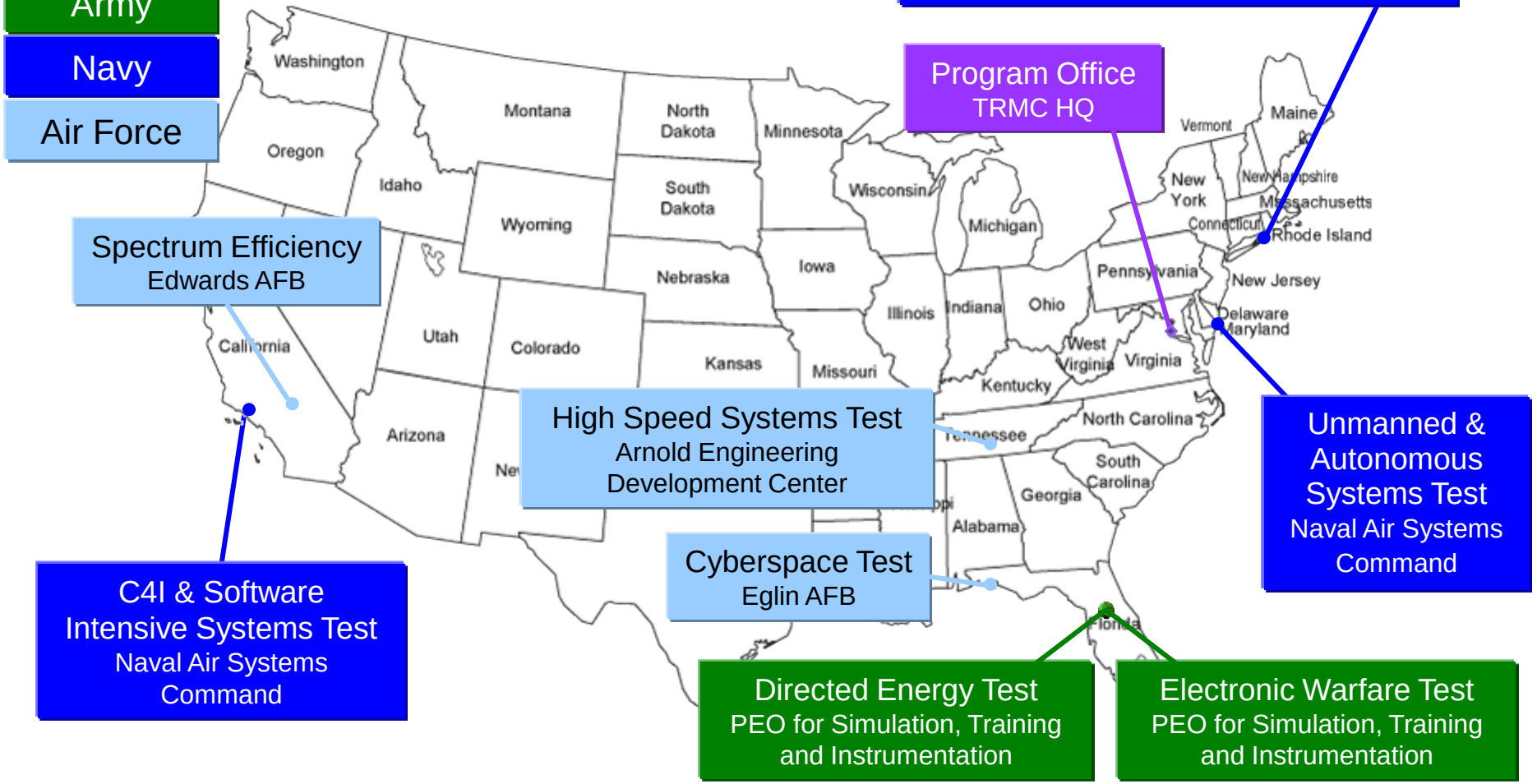
T&E/S&T Test Technology Area
Executing Agent Organizations

TRMC HQ

Army

Navy

Air Force



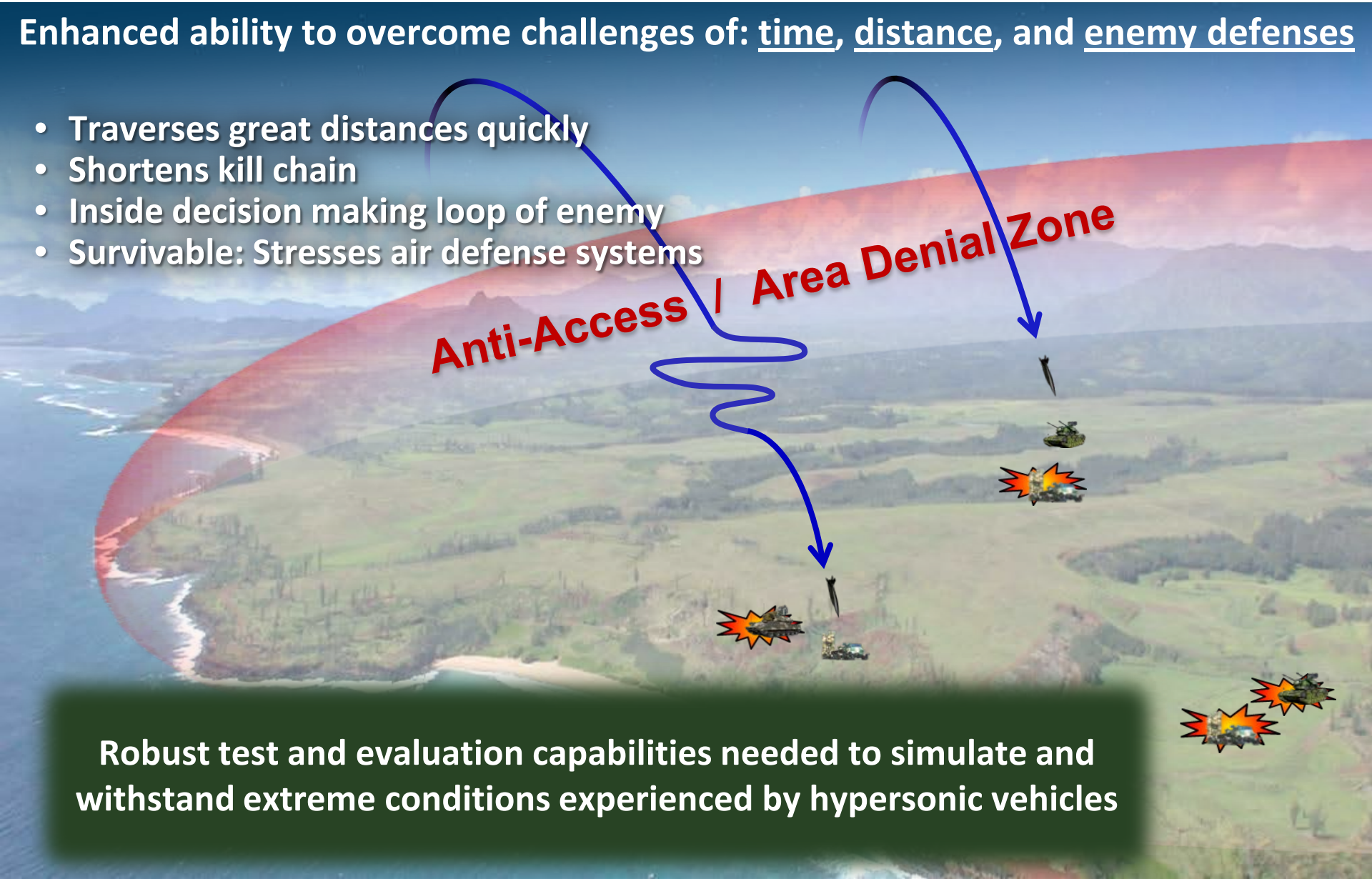
Central Oversight – Distributed Execution

High Speed Systems

Offer Disruptive Advantages…and Present T&E Challenges

Enhanced ability to overcome challenges of: time, distance, and enemy defenses

- Traverses great distances quickly
- Shortens kill chain
- Inside decision making loop of enemy
- Survivable: Stresses air defense systems



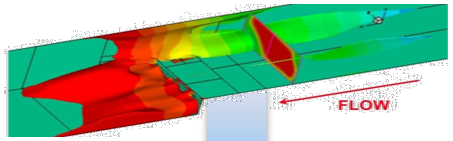
Robust test and evaluation capabilities needed to simulate and withstand extreme conditions experienced by hypersonic vehicles

High Speed Systems Test Domains

Advanced Propulsion

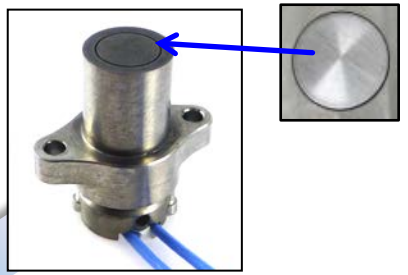
Improving Propulsion Ground Test Methods, Expanding Test Envelopes, Improving Accuracy & Fidelity

Computational Tools



Advancing Modeling & Simulation (M&S) Capabilities for Hypersonic T&E

Instrumentation



Innovative New Sensors, Improving Accuracy, Increasing Measurement Ranges

Aerodynamic & Aerothermal

Improved Aeroheating & Ablation Test Capabilities, Improved Flow Quality, High Speed / Hypersonic Systems (HS/H) Munitions Dispensing Testing

Weapon Systems

Flight Test

Improving Mission Assurance and Launch Flexibility, Developing In-Flight Measurements, Increasing Data Capture per Flight

Cyberspace Test Technology
Domains

- **Develop advanced technologies and methodologies to test and evaluate DoD capabilities and information networks to defend and conduct full-spectrum military operations across cyberspace**
- **Three Domains of CTT**

1. **Cyber-Physical Systems:** Kinetic systems, cyber-physical networks, embedded systems - computer systems with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints

2. **Tactical Edge Networks:** Information systems & connectivity supporting tactical edge communications and distributed operations – includes line-of-sight and beyond-line-of-sight data links, and other networked systems in the battlespace

3. **Enterprise Information Systems:** Broad scope of unified communications and integration of telecommunications, computers, necessary enterprise software, middleware, storage, and audio-visual systems which enable users to access, store, transmit, and manipulate information

Electronic Warfare Test
Domains

Electronic Warfare Test (EWT), organized into EO and RF domains, operates across the electromagnetic spectrum to improve Electronic Attack (EA), Electronic Protection (EP), and Electronic Support (ES) test technologies and capabilities

Electro-Optical (EO)

- Missile Warning Sensor (MWS)
- Infrared Countermeasure (IRCM)
- Precision-Guided Munitions (PGM) EO/IR/UV seekers
- EO/IR Intelligence, Surveillance, and Reconnaissance (ISR) sensors on airborne platforms

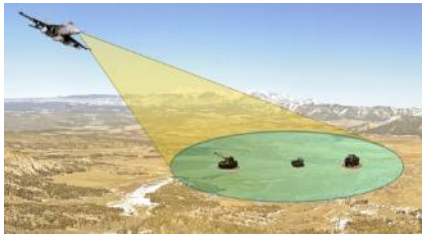
Radio Frequency (RF)

- Radars and communications
- Radar Warning Receivers (RWRs)
- Electromagnetic sensors
- Jamming systems
- RF seekers on PGMs and RF ISR sensors on airborne platforms
- Integrated air defense system (IADS)

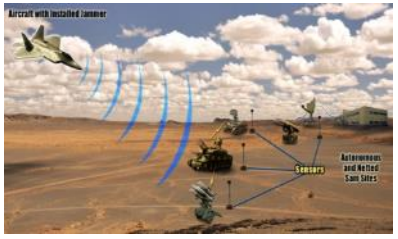
Infrared Countermeasures

Multimode Seekers

Synthetic Aperture Radar



Jammers



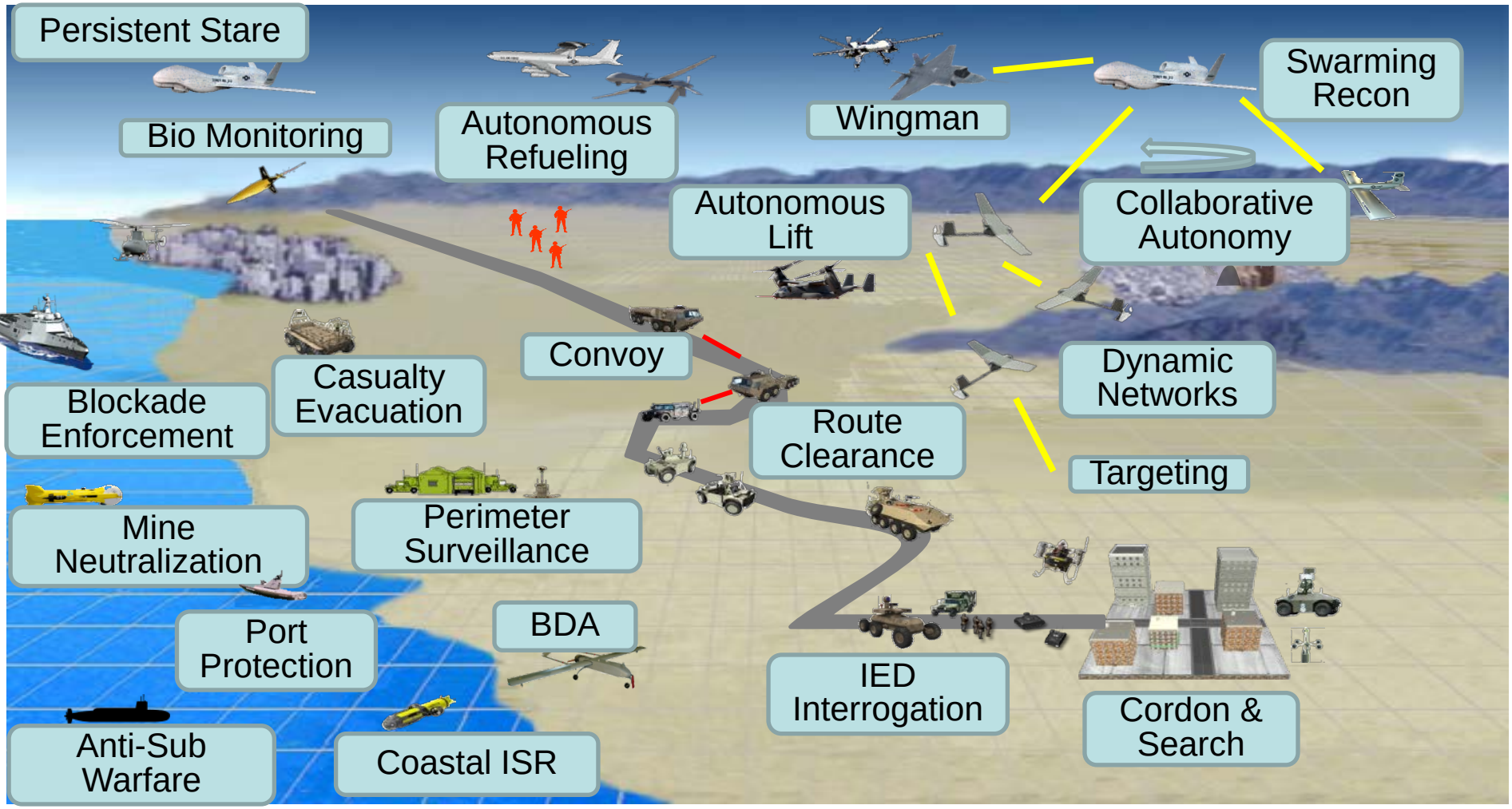
Directed Energy Test
Domains

Directed Energy (DE) Weapons, organized in High Energy Laser (HEL) or High Power Microwave (HPM) domains, use the electromagnetic spectrum (light & radio energy) to attack targets at the speed of light.

DET will develop and demonstrate the technologies to determine DE at and inside the target platform with minimally intrusive instrumentation, and to determine how DE causes destruction, mission kill, temporary failure, or deterrence.

- **HPM Instrumentation**
  - Non-intrusive, compact dielectric field sensors
  - Multiple inexpensive sensors
  - Beam characterization target boards
  - HPM source and target interaction in complex environments (modeling and simulation [M&S])
- **HEL Instrumentation**
  - Irradiance/fluence and temperature sensors
  - Adaptive optics and imagery sensors
  - Atmosphere effects

Unmanned & Autonomous Systems Test
Overview of Use Cases



Better Testing of Autonomous Systems leads to greater Warfighter Trust in their mission performance

C4I & Software Intensive Systems Test Domains

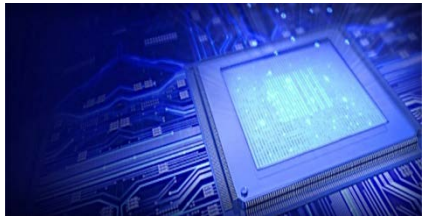
Complex Warfare Environments

Innovative approaches to how we fight, posture our force, and leverage our asymmetric strengths and technological advantages*

Battle increasingly sophisticated adversaries in increasingly complex environments*

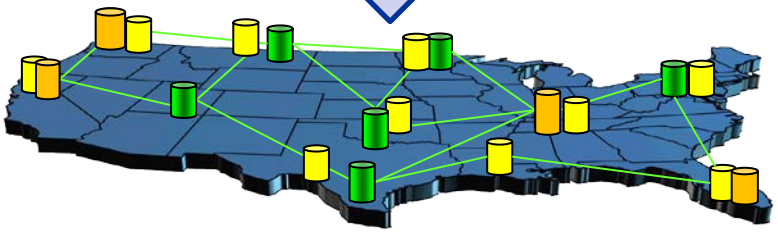
* 2014 Quadrennial Defense Review

BIG DATA & CLOUD COMPUTING



Test Automation (TA)

- Advance Big Data Collection, Analysis & Visualization
- Improve Test Execution thru Automation/Cloud Computing
- Advance Testing for Next Generation of Handhelds
- Improve Automated Control of Targets



Distributed Testing (DT)

- Reduce Distributed T&E Effects
- Improve Security Posture of Systems
- Advance Mission Context Data Collection
- Analysis & Visualization

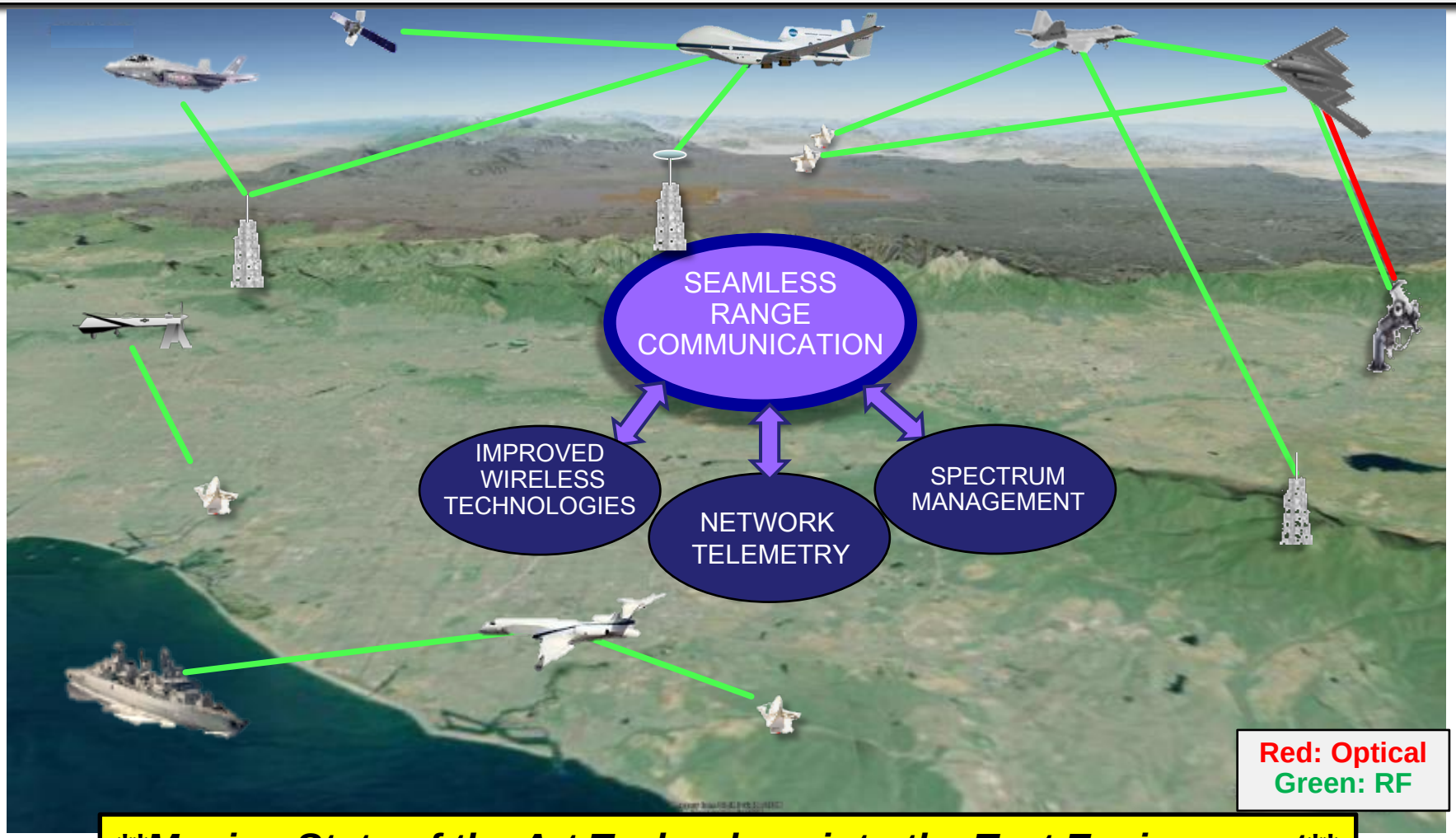
Modeling & Simulation (M&S)

- Required Fidelity in Live and Simulated Environments
- V&V Techniques
- Aggregation Techniques
- Run-time Performance for RT Applications
- Systems, Communications, Environmental Representations

Innovate T&E: Early, Often, and Agile

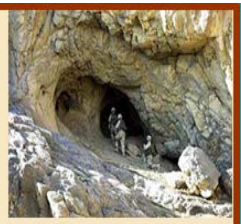
Spectrum Efficient Technology
Vision

Revolutionize the RF test range environment by leveraging network & cellular based technologies to support real-time wireless data communications



Moving State of the Art Technology into the Test Environment

Adv. Instrumentation Sys. Technology
Domains

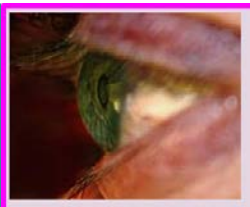
TSPI

High accuracy and continuous TSPI for high speed/high dynamic and GPS-degraded environments



Advanced Sensors

Enhanced performance sensors that meet emergent T&E needs


Human Performance Measurement & Assessment

Technologies to assess the human-machine interface, including improved methods to measure warfighter cognitive & physical workload



Advanced Energy & Power

Improved energy/power density systems for T&E



Range Environmental Encroachment

Technologies to mitigate impacts of environmental policies on test range operations



Non-Intrusive Instrumentation

Advanced data acquisition and processing components designed to be embedded within the system under test


T&E/S&T Program
Summary

- **T&E/S&T Program initiated to address critical T&E needs tied to S&T drivers**
  - Advancing the state of the art in T&E technologies
- **The only DoD S&T program dedicated to T&E**
- **BAA Call to Industry, Academia, and Government Laboratories to address test capability needs**
- **Competitive technology developments to get the best technologies possible to the test community**
- **Focused on transition into needed test capabilities**

Looking Ahead, Responsive, and Agile

Questions?

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Improve the Testing…Improve the Process…Improve the Product