DTRA S&T Overview to the 18th Annual NDIA S&ET Conference

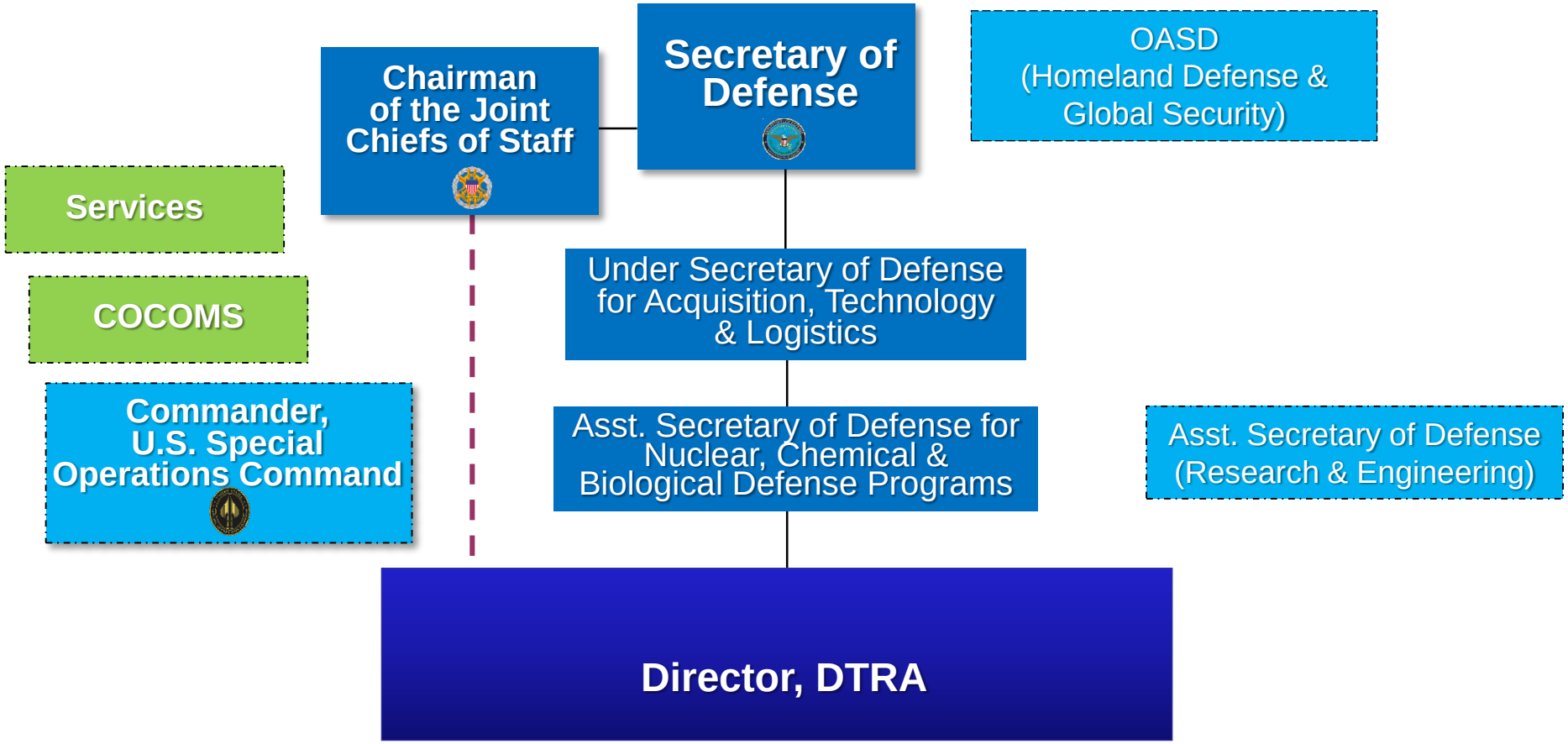
Dr. Steven G. Wax

Chief Scientist, DTRA J9

Countering the Threats

Our Mission: *Safeguard the United States and its allies from global weapons of mass destruction and improvised threats by integrating, synchronizing and by providing expertise, technologies and capabilities.*

"Current" Reporting Structure and Relationships



We are a Defense Agency and a Combat Support Agency

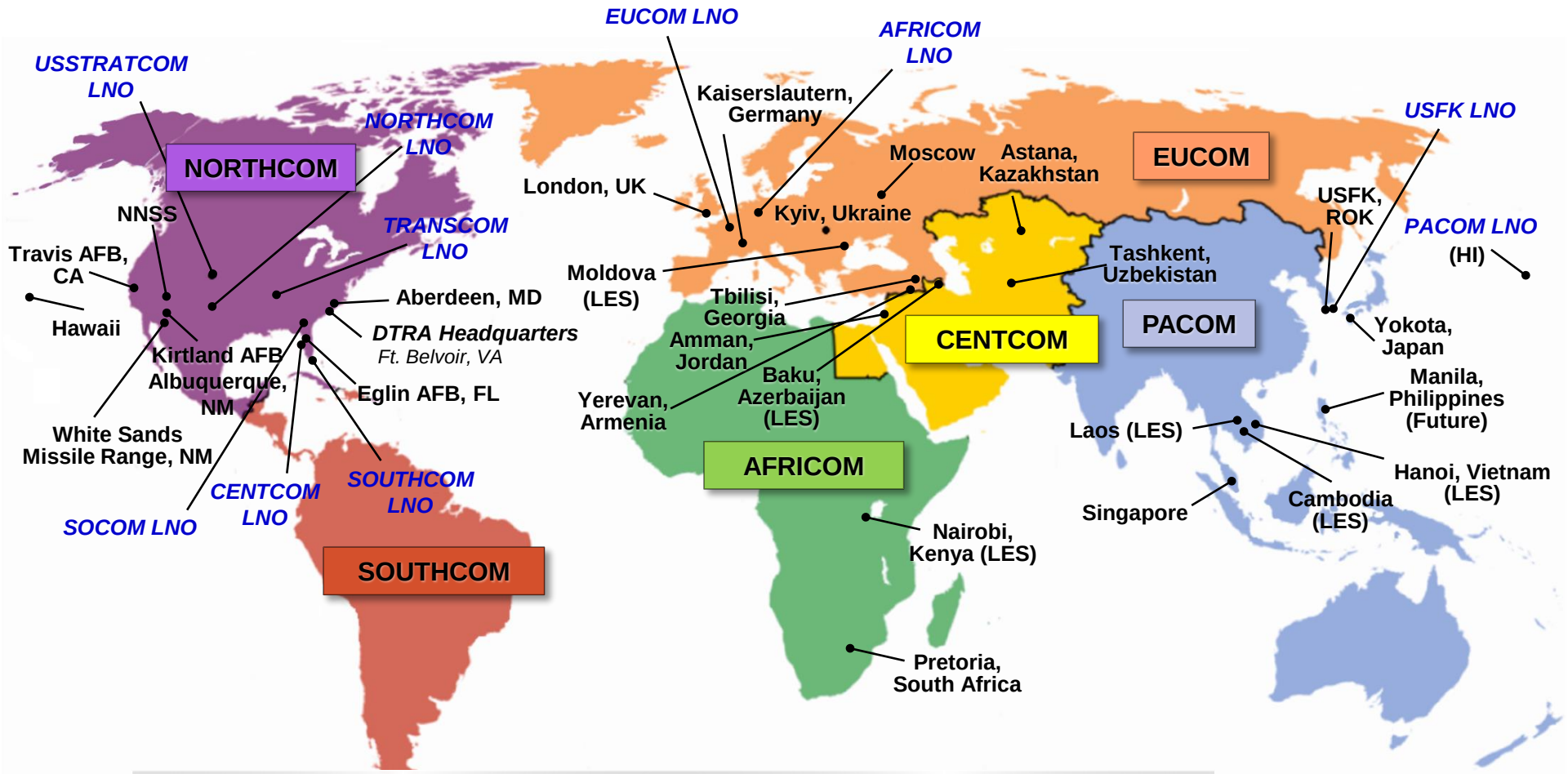
Our Missions

Prevent Acquisition

Contain and Reduce Threats

Respond to Crises

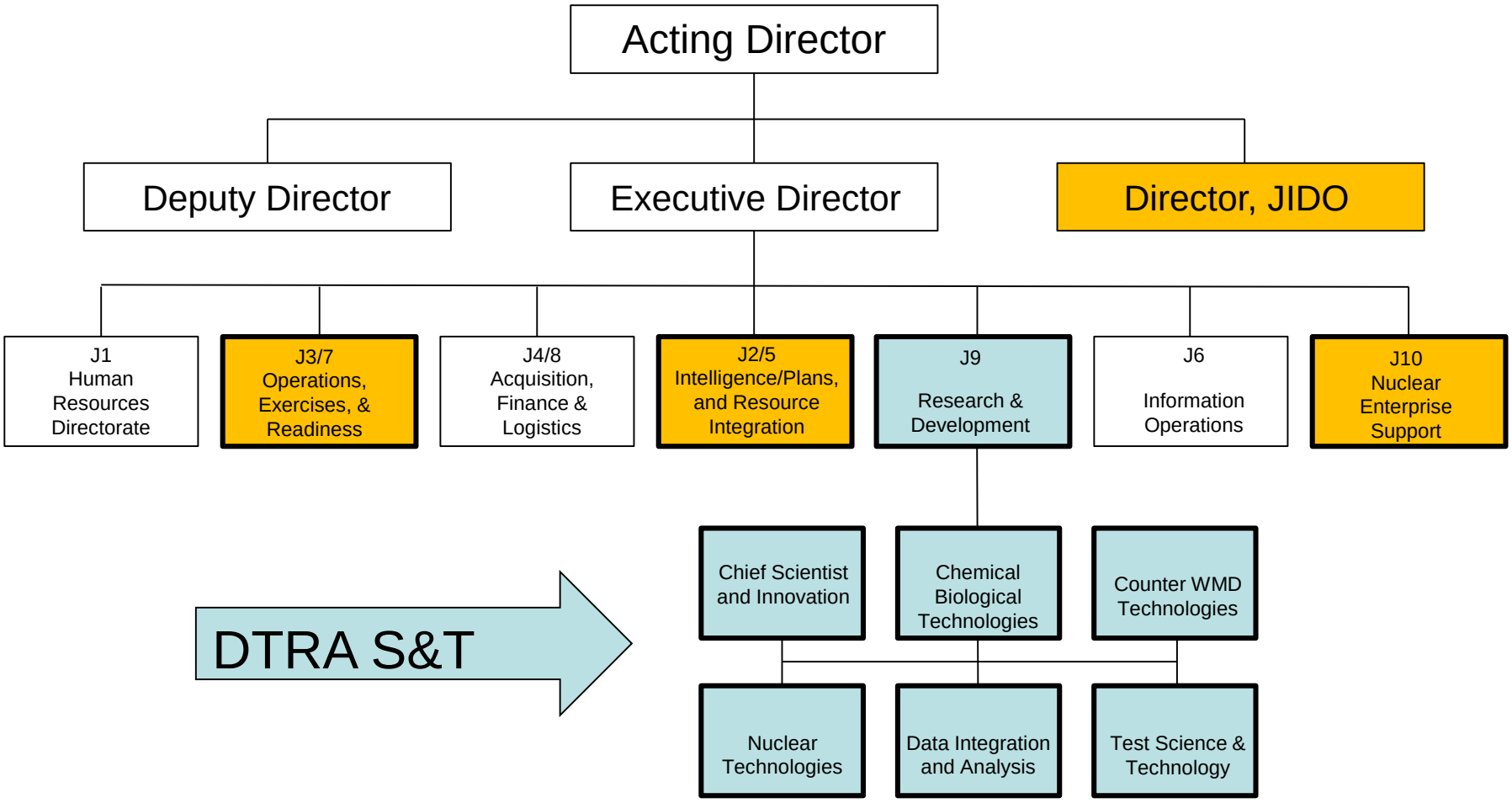
Global Mission = Global Presence



- Liaisons at all CCMDs, USFK, Joint Staff, National Guard Bureau
- Additional staff deployed around the world in support of military operations

*LES: Locally Employed Staff

DTRA Organization Chart



CWMD COI Defines S&T Goals

DoD Strategy for Countering WMD – June 2014

Synchronizing Activities and Tasks

Incorporate CWMD Efforts & Leverage Enabling Capabilities

Integrate, Harmonize, Employ

Foundational Activities and Tasks

Maintain and Expand Technical Expertise
Recruit, Develop, Retain

Cooperate with and Support Partners
Partner, Coordinate

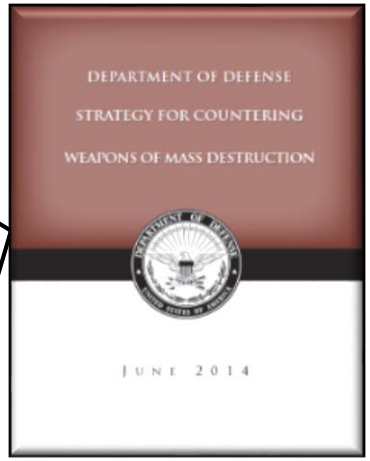
Specialized Activities and Tasks

Understand the Environment, Threats, and Vulnerabilities
Locate, Identify, Characterize, Assess, Attribute, Predict

Control
Isolate, Divert, Intercept, Secure, Seize

Defeat	**Disable**	**Dispose**
Delay, Disrupt, Destroy, Neutralize	Exploit Degrade, Destroy	Reduce, Redirect Dismantle, Monitor,

Safeguard the Force and Manage Consequences
Mitigate, Sustain, Support



CWMD S&T Strategic Objectives*

Understand the Environment, Threats, and Vulnerabilities

Control, Defeat, Disable, and/or Dispose of WMD Threats

Safeguard the Force and Manage Consequences

** S&T for Strategic Deterrent is included in these objectives*

CWMD S&T Strategic Goals and Enduring Capabilities

Understand the Environment, Threats & Vulnerabilities

- **Achieve Comprehensive Situational Awareness in CWMD Domain**
- **Locate, Detect, Characterize and Assess WMD Worldwide**
- **Provide Technical information to Support Attribution**
- **Understand Current and Emerging Threats**
- **Predict Consequences**

Control, Defeat, Disable and/or Dispose WMD Threats

- **Control WMD**
- **Defeat* WMD**
- **Dispose WMD**

* Includes Disable

Safeguard the Force and Manage Consequences

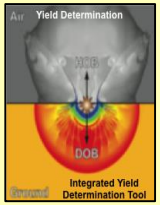
- **Sense CBRN Hazards**
- **Shape Force Commanders' understanding**
- **Shield Individuals and Equipment**
- **Sustain and Restore Combat Power**

DTRA RDT&E Overview Mission Sets

Prevent → Contain → Respond

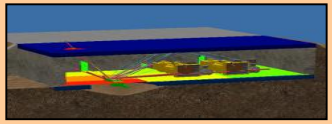
Understand Environment, Threats, and Vulnerabilities


MFK COP Presented on an Android Device



- *Global Situational Awareness*
- *Threat Detection*
- *Forensics*
- *Weapons Effects*
- *Verification and monitoring*
- *Consequence of Execution*
- *Identifying Emerging Threats*

Control, Defeat, Disable and/or Dispose WMD Threats



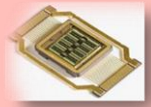
- *Special operations support*
- *WMD ISR*
- *WMD targeting and defeat*
- *HTBT characterization and defeat*

Enabling Technologies

- *Basic Research*
- *CWMD Testing Capabilities*
- *24/7 Technical Reachback*
- *Advanced Analytics*
- *Interagency/international leverage*

Safeguard the Force and Manage Consequences


Point-of-Need Diagnostics in Relevant Environments



- *System Survivability*
- *Threat Agent Mitigation*
- *Hazard Characterization and Prediction*
- *Personal Protection*
- *Medical Diagnostics & Analysis*
- *Vaccines/Therapeutics*
- *Rapid response and restoration*

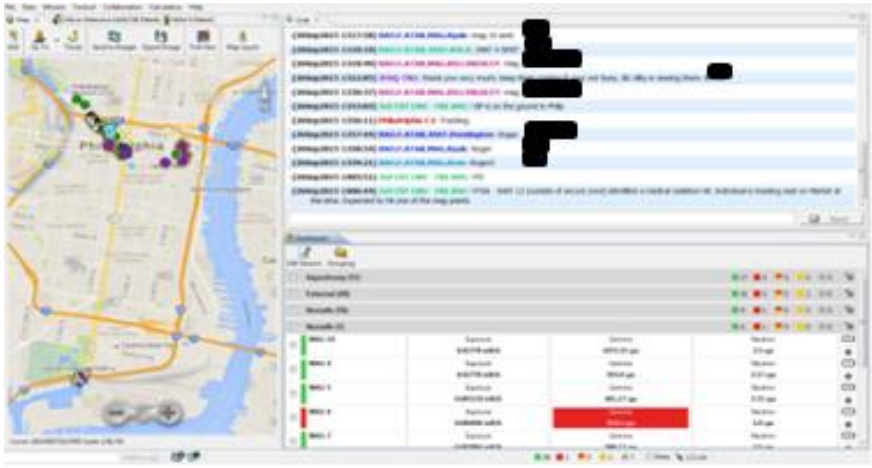
Understand the Environment, Threats, and Vulnerabilities

Locate, Detect, Characterize and Assess WMD Worldwide

Mobile Field Kit (MFK) for Chemical, Biological, Radiological and Nuclear (CBRN)

- Real-time communications network and suite of tools that automates collection, sharing, and display of detection and identification data from multiple sensors
- Adopted by all 57 National Guard Civil Support teams
- Used at 20 Jan Inauguration; accommodated more than 400 unique users from multiple agencies and organizations, including the FBI, Secret Service, Capitol Police, Park Police, the Department of State's Diplomatic Security Service, and the Washington, D.C., Fire and Emergency Management System

MFK screenshot from Pope Francis Support Ops

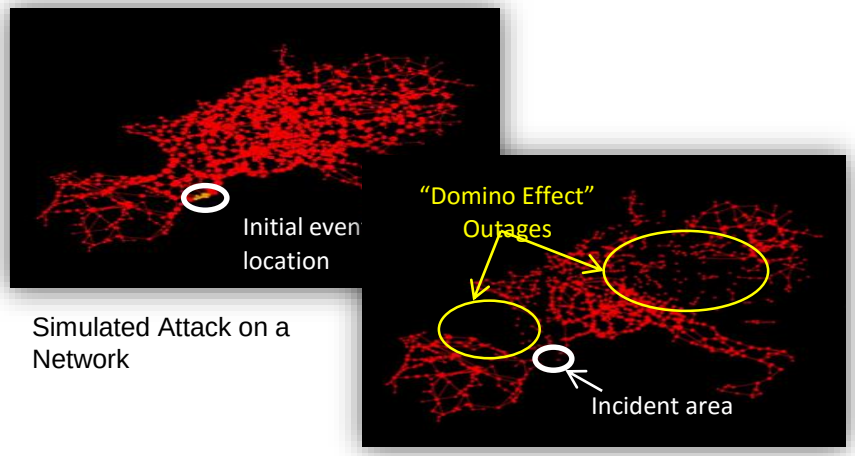


MFK data on Android Device

Understand the Environment, Threats, and Vulnerabilities

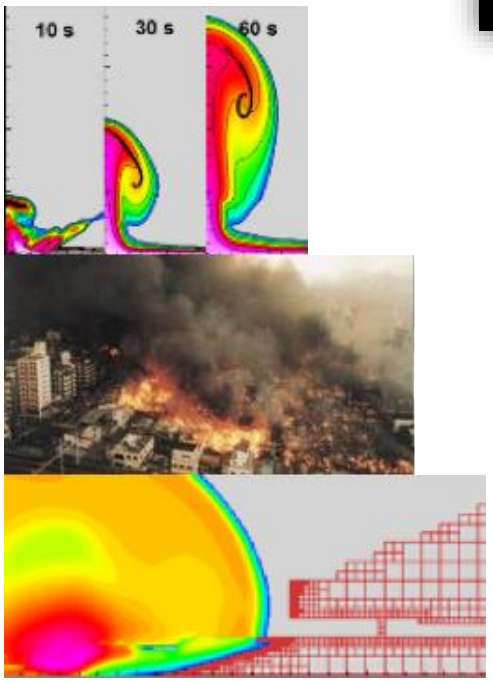
Predict Consequences

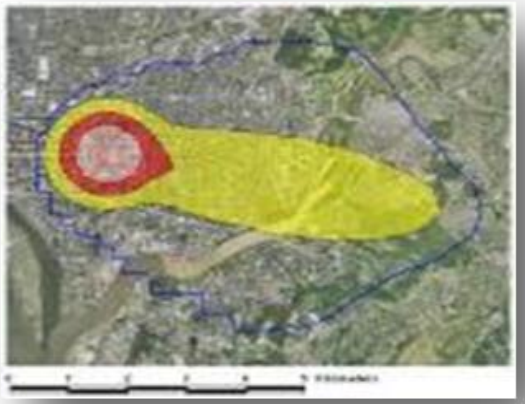
- Predict, with high confidence levels, the 1st, 2nd, and 3rd order effects of one or more CBRN event (including EMP) on personnel, equipment and infrastructure and patterns of life
- Assess the effectiveness of defeat actions & post attack defeat
- Development of a thermal and blast database within the Enhanced Nuclear Weapon Effects Database system, improving accuracy and speed for strategic and operational nuclear planning



Simulated Attack on a Network

Cascading Damage Extends Far Beyond Initial Event Location





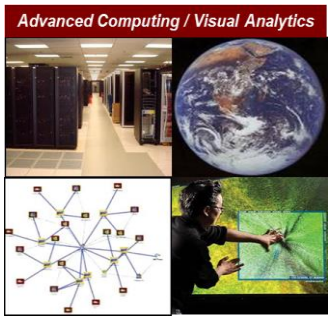
Hazard Characterization and Prediction

Understand the Environment, Threats, and Vulnerabilities

Understand Current and Emerging Threats

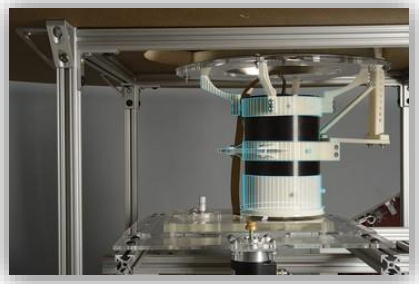
Dynamic Picture of the Operating Environment (DPEO)

- Visualization, analytic, and data processing high-performance computing platform allowing analysts to search a federated collection of all-source message traffic, finished intelligence, and other products to forecast plausible weapons of mass destruction threats and supports the planning of operations, actions, and activities to combat these threats



Technology Threat Foreasting

- Forecasting the impact of current and emerging technology that could significantly impact CWMD missions. Develop methods to provide insight on current and future capabilities and intentions of actors of concern

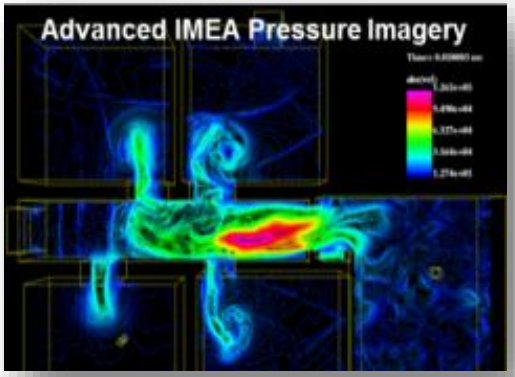


Additive Manufacturing
(e.g. 3D Printer)

Unmanned Ariel
Vehicle (UAV)

Defeat WMD Threats

Render nonexistent or interrupt the entire spectrum of WMD development and employment and focus on specific nodes, links and support networks prior to an adversary's acquisition of WMD.



- Lengthen the amount of time it takes for an actor to gain access to WMD, or interrupt any portion of an actor's pathway to WMD acquisition
- Render nonexistent the related nodes, links, or supporting networks prior to an adversary's acquisition of WMD.

- Render biological & chemical agent harmless.
  - Assess the effectiveness of defeat and/or disable actions and post attack defeat
  - Test the ability to defeat and/or disable WMD threats
  - Reduce the potential harm or consequences of a WMD should it be employed.

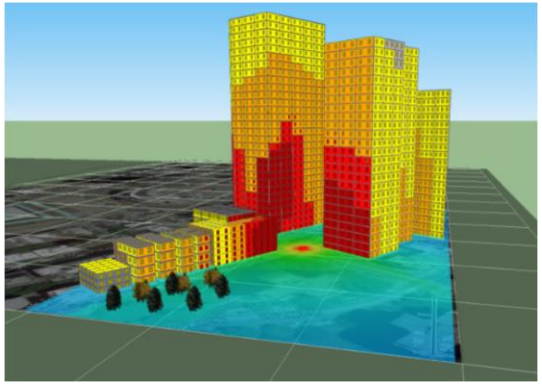

WACS on the US Army RQ-7B Shadow

Safeguard the Force and Manage Consequences

Shield Individuals and Equipment

Vulnerability and Protective Options (VAPO)

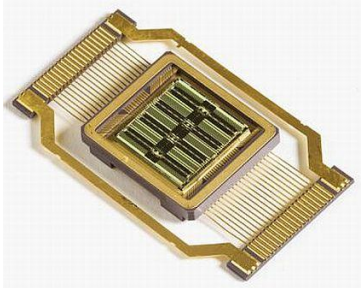
- Continuously updated high-fidelity weapons effects models and structures database to identify vulnerabilities and risk-mitigation options



Vulnerability Modeling

System Survivability

- Developed standards and test capabilities to assess survivability of critical systems for the DoD
- HEMP survivability support for Presidential Helicopter enables nuclear C3 systems to meet survivability standards
- Completed first-ever HEMP survivability testing of F-15E dual capable aircraft for Air Combat Command



Radiation Hardened 64MB SRAM Chip

Safeguard the Force and Manage Consequences

Chem Bio Defense S&T Priorities

- **Medical Countermeasure Development** to Protect the Warfighter
- **Integrated Early Warning (IEW)** through CB Detection & Diagnostics Development and Wearable Technologies
- **Emerging Threat Preparation and Response** through Threat Agent Science, Biosurveillance, Decision Support Tools, Advanced Technology Demonstrations, and Basic Science
- **Hazard Mitigation and Individual Protection**

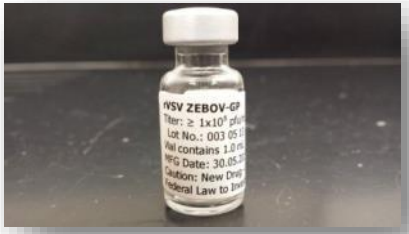
Point-of-Need Diagnostics in Relevant Environments

Safeguard the Force and Manage Consequences:

Medical Countermeasures Against Ebola Zaire (ZEBOV) emonstrated rapid transition from warm-base to operational use

Fast-tracked candidate ZEBOVvaccine and therapeutic

- Demonstrated that rVSVΔG-Ebola elicits complete protection against ZEBOV in non-human primates (NHP)
- Manufactured over 25,000 vials of rVSVΔG-Ebola vaccine to replace aging stockpile for use in clinical trials
- Initiated Phase I clinical trials of rVSVΔG-Ebola vaccine at Walter Reed Army Institute for Research
- Compiled data from Phase 1 clinical and NHP challenge study supported dose selection
- Supporting NIAID Phase 2 clinical trials of rVSVΔG-Ebola vaccine in Liberia



ZMapp™

- Identified the final ZMapp™ cocktail formulation
- Demonstrated that ZMapp™ is the most effective candidate therapeutic developed to date, with 100% protection in symptomatic NHPs when administered up to 5 days post infection with ZEBOV

rVSV (recombinant vesicular stomatitis virus)

Enabled fielding of Ebola vaccine and therapeutic for trials in West Africa

Safeguard the Force and Manage Consequences: Integrated Protective Fabric System (IPFS)

Lightweight Protective Garment

IPFS → UIPE 2

- Objective*:* Develop and transition scientific data demonstrating improvements in protective garment supporting technologies which can be used to understand and manage tradeoffs for the UIPE II program
- Impact: These deliverables are used by the JPM-P to help develop the UIPE II garment design. The data is used to inform tradeoffs for competing parameters and technologies so that specific properties can be adjusted to meet overall requirements
- Customer: All Warfighters (Army, Navy, Air Force, USMC)

UIPE: Uniform Integrated Protection Ensemble

Safeguard the Force and Manage Consequences: JIDO Focus Areas


Standoff Detection


Miniaturization & integration of sensors


Vehicle attached IEDs


Situational Understanding in A2AD environments


Identifying explosive threats within structures


Personnel-Borne IEDs (PBIEDs)


Counter VBIED


ECM for advanced wireless signals & techniques


Virtual Advise & Assist

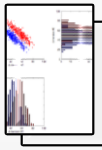

Remote neutralization of HME and pre-cursors


Detecting and defeating Small UAS (RCMA)


Anti-armor IED detect & defeat


Tunnel Detection & Defeat


PED for integrated sensors


Data Analytics


Pre-detonation capabilities


Detecting and defeating GPS jamming signals


Mounted detection for dismounts that enable rate of advance

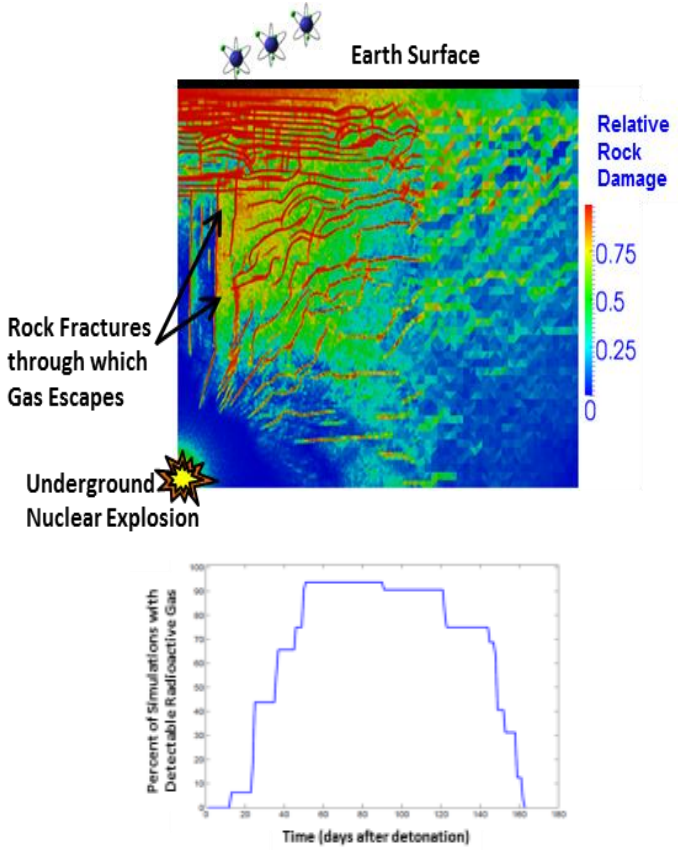
Future capabilities must be:

Scalable – Affordable – Adaptable – Expeditionary – Domestic Application – Whole-of-Government Approach

Enabling Capabilities: Basic Research

Basic and Fundamental Research fills knowledge needed to address operational CWMD technology challenges

- Optimized gas sampling for detection of underground nuclear testing
  - Developed rock fracture-gas escape model
  - USAF adopted model for operational use.

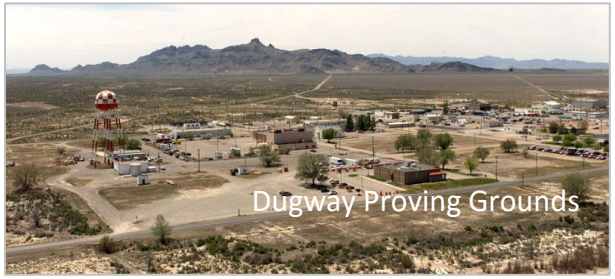


Statistical gas diffusion model, developed by Dr. Dale Anderson at Los Alamos National Laboratory, predicts the optimal time for collection of signature radioactive gases after a suspected underground nuclear explosion.

CWMD S&T Community Leverages DoD's Unique and World Class Capabilities

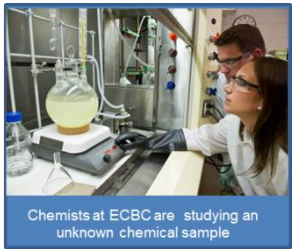
Recapitalization/Modernization of DoD Laboratory facilities/ equipment is providing unparalleled R&D capabilities

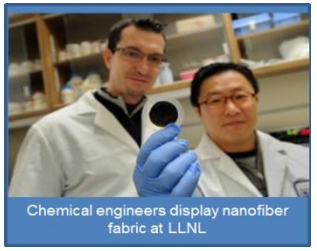
DoD Test Ranges and specialized equipment enabling DT&E for most of CWMD portfolio



DoD laboratories and test ranges provide the cutting-edge capabilities, flexibility, and agility the CWMD S&T community requires to address current and emergent threats.

DoD CWMD S&T investments fund hundreds of CBRN scientists and engineers with unique expertise/experience not readily available in the private sector


Chemists at ECBC are studying an unknown chemical sample


Chemical engineers display nanofiber fabric at LLNL


Scientist weighs aluminum powder for an energetics project in laboratory at NSWC.


Scientists are conducting BSL-4 training at USAMRIID

DoD CWMD S&T workforce morale faces many of the same challenges as broader S&T community. Inconsistent application of policies for attendance/participation in scientific conferences a significant concern for S&E seeking to maintain currency in their field. Declining budgets a concern for S&E seeking to advance new ideas and initiatives.

In CWMD - Partnerships are Essential

U.S. Government Partnerships

Understand the Environment, Threats, and Vulnerabilities*

Control, Defeat, Disable, and Dispose of WMD Threats*

Safeguard the Force and Manage Consequences*

International Partnerships

Objective

Accelerate development of capabilities by accessing unique foreign S&T resources and sharing costs

Currently engaged with 10 countries on 21 separate efforts across the globe

Examples of Major R&D Areas

- Detection, diagnostics, and biosurveillance
- Modeling and simulation
- Medical countermeasures
- CBRN protection
- Contamination mitigation
- Managing Consequences
- Autonomy, Analytics, Big Data