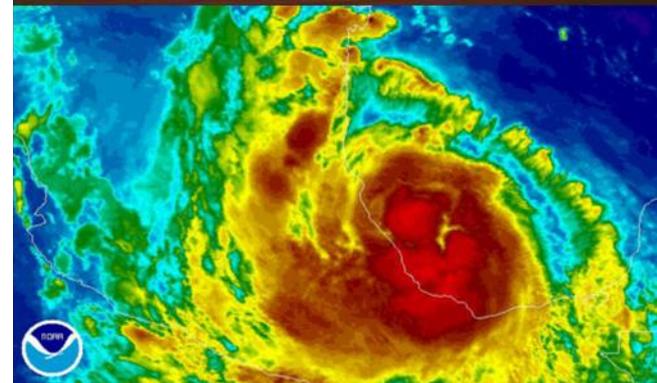


NDIA Conference on Combating
Terrorist Use of Explosives

Science & Technology to Counter Improvised Explosive Devices

April 28, 2010
Ft. Walton Beach, FL

Ruth M. Doherty, Ph.D.
PEO Counter-IED
DHS Science and Technology Directorate



Homeland
Security



Counter-IED Challenge:

Securing Special Events, Transportation Security and Beyond



U.S. Domestic Explosives Threats

- Bomb threats and suspicious packages in the U.S.
 - Over 2,300 since 2004*
 - Almost daily
- Terrorists continue planning explosives attacks in the U.S.



“Use of a conventional explosive continues to be the most probable al-Qa’ida (domestic) attack scenario” said Director of National Intelligence to Congress Intelligence Committee, January 2007

International Domestic Explosives Events

- Bomb threats continue worldwide
 - 82,000 terrorist incidents between 1970 and 2007 *
 - Top three terrorist targets:
 - Private Citizen's property 20%
 - Government 17%
 - Business 16%
 - 51% of time terrorists' tactic was bombing
- Over 600 IED attacks per month worldwide
 - Aug 2008 to Aug 2009 averaged
 - Data excluded Iraq & Afghanistan

* "Global Terrorism Trends", START presentation at the National Press Club on 14 September 2009.

A Continuing Challenge

“Just as today’s threats to our national security and strategic interests are **evolving and interdependent**, so too must our efforts to ensure the security of our homeland reflect these same characteristics. As we develop new capabilities and technologies, our adversaries will seek to evade them, as was shown by the attempted terrorist attack on Flight 253 on December 25, 2009. *We must constantly work to stay ahead of our adversaries.*”

Secretary Janet Napolitano

***Quadrennial Homeland Security Review
February 2010***



**Homeland
Security**

Domestic IED Threat Domains

Person-Borne IED

Suicide bomber or leave behind bomb

Vehicle-Borne IED

Parked vehicle or suicide attack



Rail



Public arena events



Border crossing or vehicle raveling to high-value target



Government Facilities



Buildings, malls and National Monuments



Terminals



VIP events



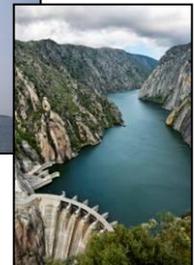
Seaport, ships and ferries



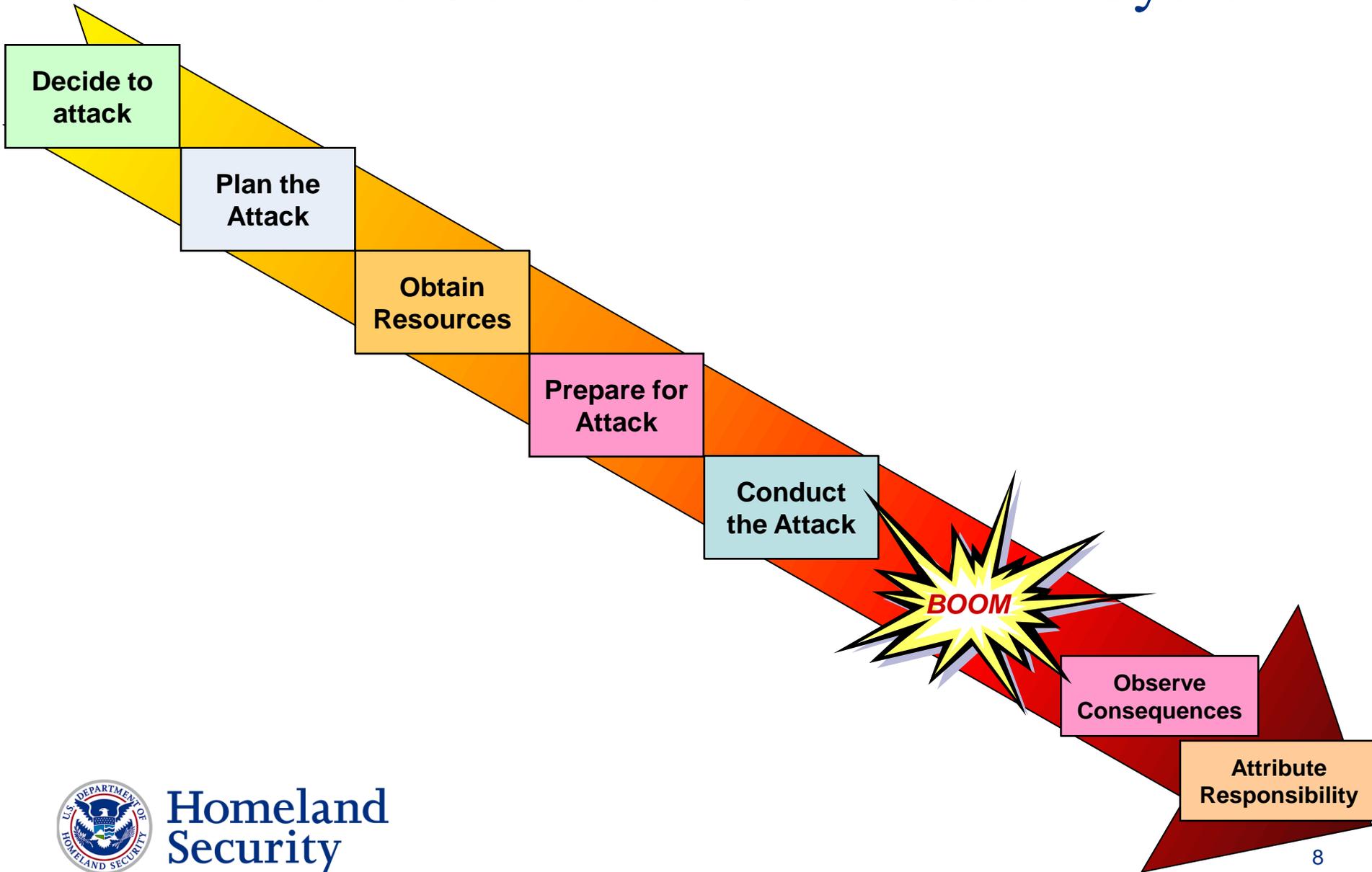
Utilities



Tunnels, bridges and dams



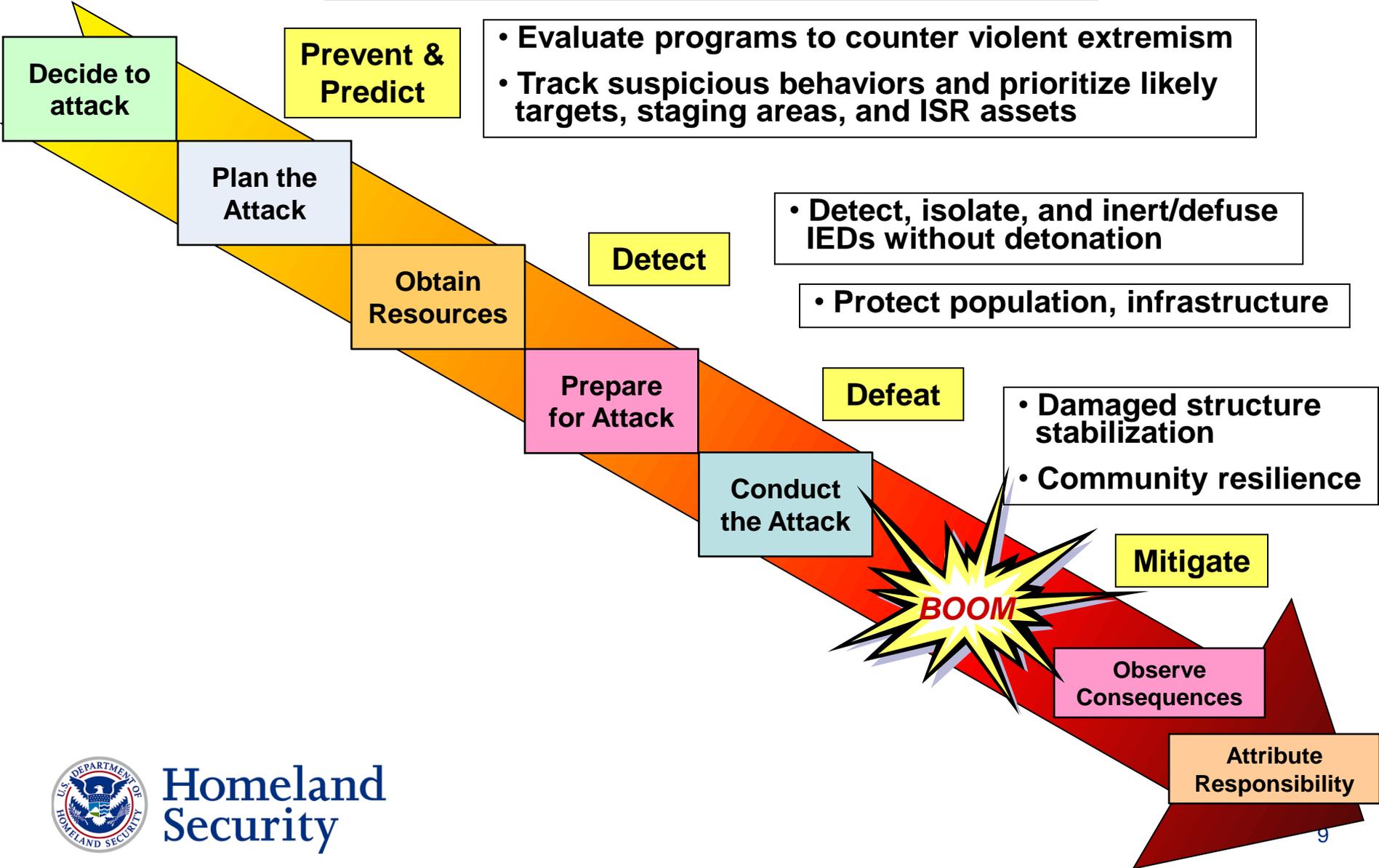
Domestic Terrorist IED Attack Cycle



Homeland Security

DHS C-IED Investment Emphasis

• Identify indicators of radicalization in the U.S.



S&T Countering Domestic Explosive Threats Program



Prevent/Deter

Actionable Indicators & Countermeasures

- Community Characteristics
- Group Characteristics
- Pre-incident Behaviors & Rhetoric
- Integrated Framework
- Countermeasure Evaluation

Predict

Predictive Screening

- Behavior Analysis
- Video Tracking
- Video Identification & Alert

Risk Prediction

- Target Prediction
- Staging Area Prediction

Detect

- Person Borne IED
- Suicide Bomber
- Leave-behind
- Vehicle Borne IED
- Integration & Demonstration
- Canine

Defeat

Bomb Access & Diagnostics

- Type of Explosive
- Device Triggers

Render Safe

- Electronic Countermeasures
- Inerting

Robotics

Mitigate

Blast Mitigation

- Blast resistant materials
- Protective countermeasures
- Stabilize damaged structures
- Urban blast effects
- Predictive models

Effective Risk Communications

Cross Cutting:

Standards, Technology Demonstration/ System Integration

Outreach, Integration of Public Perception Data, Community Resilience

Information Sharing: Intelligence Data Sharing (Intel Community); Interagency Technology, Resource & Test sharing (DoJ, DoD, DoE)

Counter-IED Investment Areas

- Social and behavioral science to identify potential IED threats
 - Real-time, automated video-based identification of suspicious behaviors
 - Framework integrating social and behavioral science indicators of radicalization
- Strategies to prevent potential IED attacks before they occur
 - Tested, effective strategies to counter violent extremism in domestic context



**Homeland
Security**

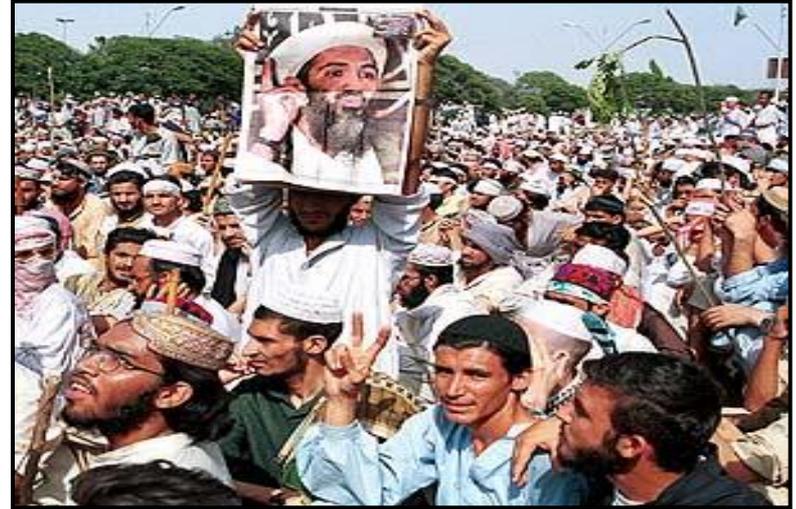
**A portfolio focused on identifying
and preventing potential IED threats**

HFD Research on Violent Extremism

Program Goals: Improved ability to assess and counter potential extremist violence

Needs/Gaps:

- Identify indicators that actors are moving toward extremist violence
- Analyze the impact of countermeasures used to prevent extremist violence and IED attacks



Strategy/Approach:

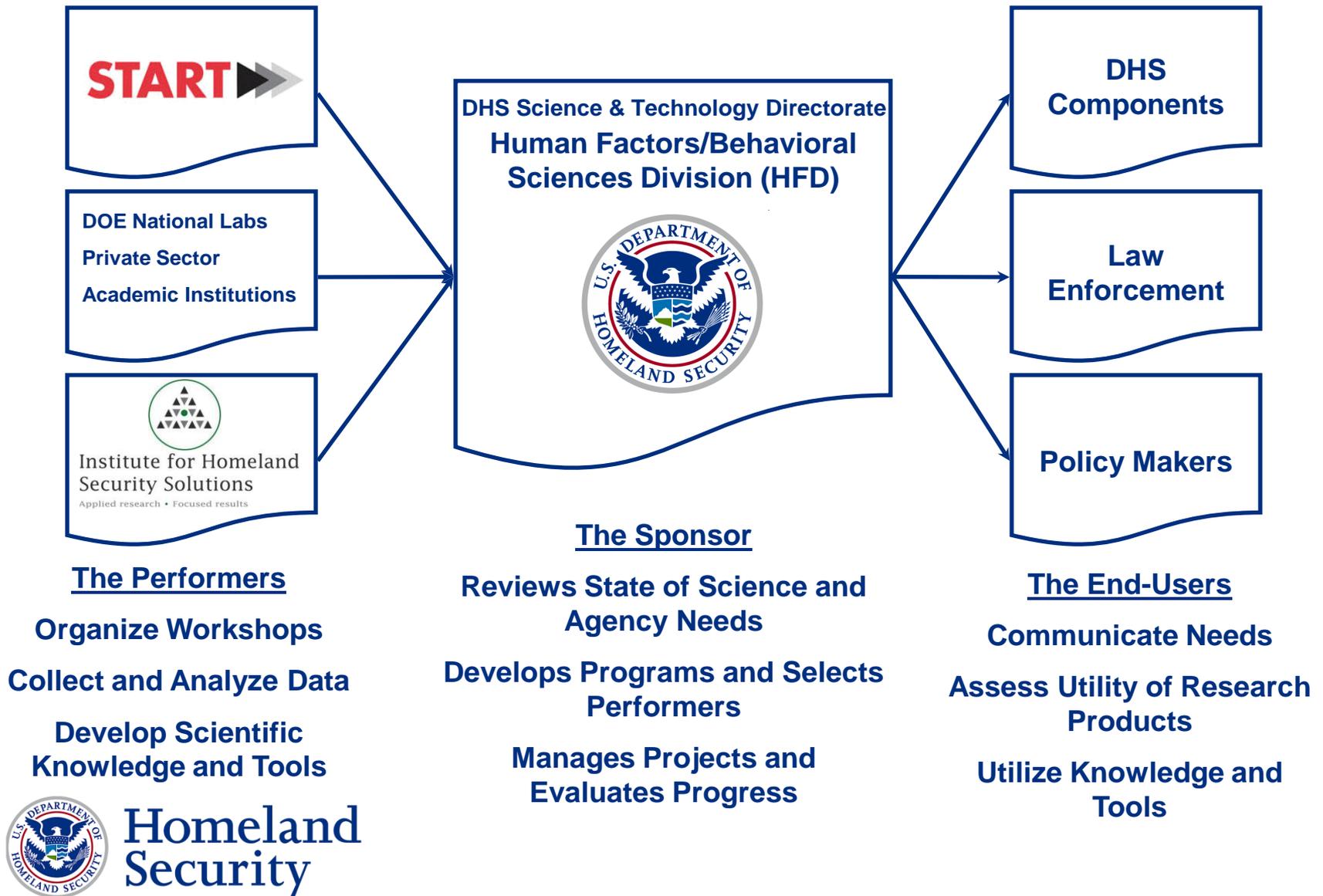
Utilize multiple social and behavioral science methods to extract indicators

Develop and validate an integrated framework

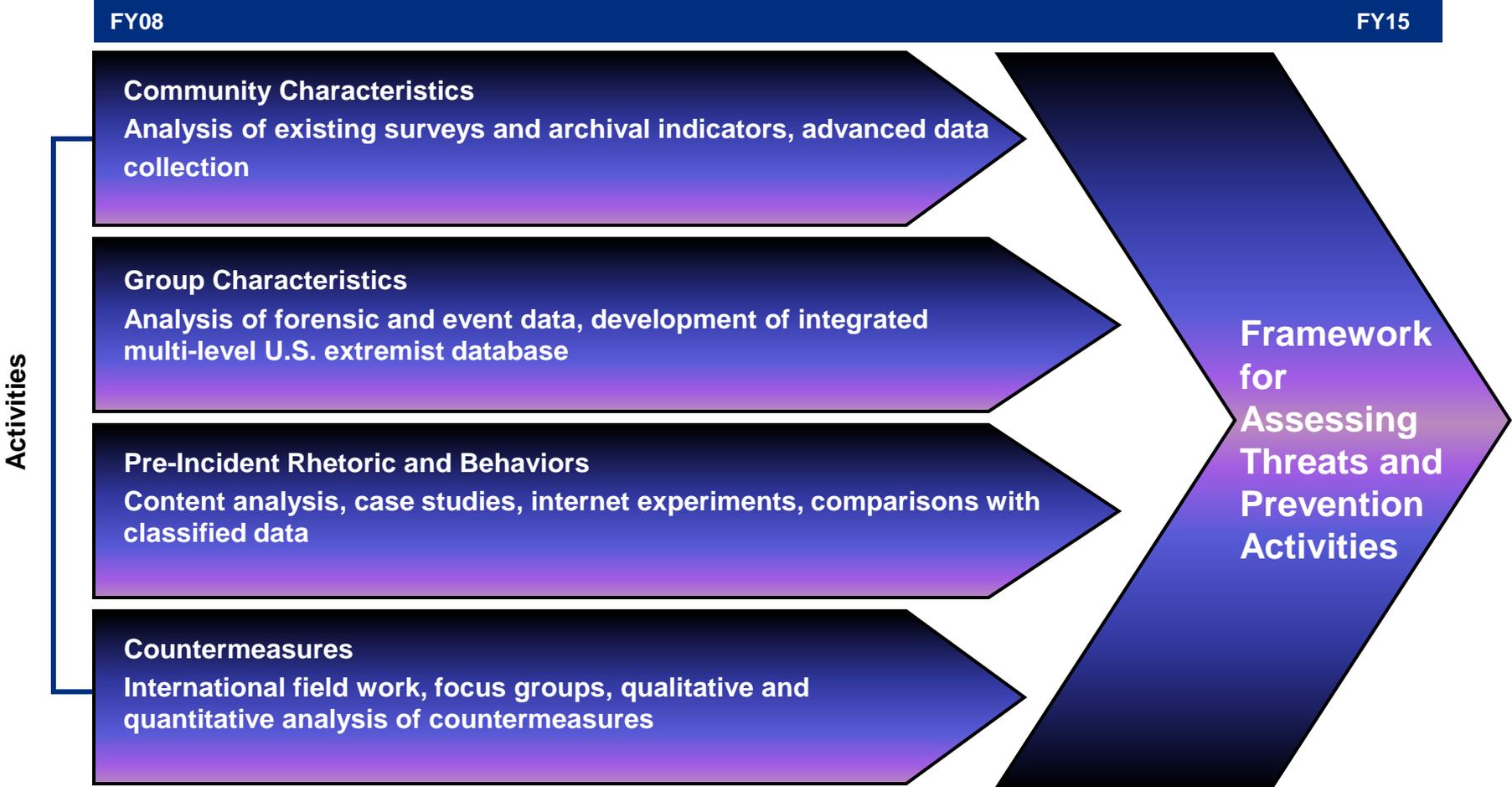
Systematically assess the efficacy of countermeasures using qualitative and quantitative methods



HFD Research on Violent Extremism



HFD Research on Violent Extremism



HFD Research on Violent Extremism

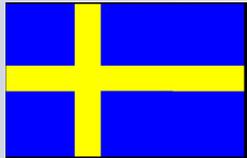
Early Activities

- Delivered reports on
 - Characteristics of IED incidents based on analysis of Global Terrorism Database (GTD)
 - Existing polls of U.S. Muslims (preliminary)
 - Five international “de-radicalization” programs and the measures used to evaluate their efficacy
- Sponsored interagency workshops on
 - Coding methodologies for case studies
 - Community-level indicators of radicalization
 - The role of the internet in radicalization
 - Survey methodologies for assessing attitudes toward terrorism and counterterrorism initiatives



International Programs' Research on Violent Extremism

Radicalization in Europe and North America: Parallels and Divergence



START ▶▶

Social Determinants of Terrorist Organizations' Resilience in Latin America



The Impact of Israeli Counterterrorism Interventions on Rate and Intensity of Terrorist Activity



Threat Assessment of Terrorist and Extremist Organizations in Indonesia, the Philippines, and Thailand



Homeland Security

Counter-IED Investment Areas

- Improved detection capabilities for known and emerging IED threats
 - Imaging technologies
 - Spectroscopic and trace detection technologies
- Improved probability of detection by screening for IEDs more efficiently while minimizing effect on flow of people and commerce
 - Non-contact interrogation
 - Enhanced algorithms for automation
- Improved first responders' ability to react to and defeat discovered IED threats
 - IED identification and defeat tools
 - Radio frequency jamming equipment



**Homeland
Security**

**Diversified investment portfolio to
maximize potential for success**

C-IED Detect

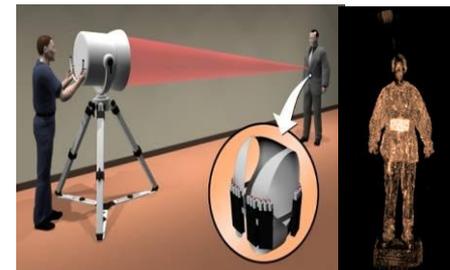
Program Goal: Develop enabling technologies and operational solutions to improve customer IED threat detection capabilities

Customers/Partners:

- USSS, OIP, TSA, FPS, CBP, and USCG
- JIEDDO, USMC, ONR, DTRA, NIST, DNDO, NRL, NSWC-DD, and TSWG

Needs/Gaps:

- Detect explosive devices worn or carried by individuals (person borne threats)
- Detect explosive devices in unattended packages (leave behind threats)
- Detect explosive devices at a checkpoint concealed within stationary or slow moving vehicles (vehicle borne threats)



**Homeland
Security**

C-IED Detect

Strategy/Approach:

- Perform signature characterization studies of realistic explosive threat devices: provides data for detection requirements, test standards and performance benchmarks for detector development
- Develop cueing, tracking and target selection systems: incorporates advanced hardware and software solutions into layered security architectures
- Perform system analysis, engineering and architecture design: provides analysis of alternatives, baseline systems design, and integration of component technologies
- Develop high resolution detection technology: provides advanced imaging and trace detection hardware and software with improved detection performance characteristics to address broadening threat detection requirements
- Perform laboratory and operational test and evaluation of existing and emerging security solutions: baselines existing system performance, measures advanced system capabilities and defines technology shortfalls



C-IED Detect

Accomplishments:

- Demonstrated the use of a broadband, tunable laser system to enhance stand-off threat detection capability
- Established a standoff detection test bed with interagency partners to demonstrate an integrated system approach towards explosives detection
- Initiated programs
 - to detect vehicle borne explosive devices through the use of high energy techniques
 - to detect individuals carrying or wearing explosive devices, based upon acoustic and infrared detection techniques
 - for standoff and non-contact detection of trace amounts of explosives



C-IED Response/Defeat

Program Goals: Initiate, prioritize, and execute research and development projects that meet bomb squad requirements to effectively render explosive devices safe, placing specific emphasis on technologies to access, diagnose, and defeat terrorist improvised explosive devices (IEDs)

Customers/Partners:

- OBP, OIP, FBI, ATF, USSS, USCG, CBP, State/Local Bomb Squads
- JIEDDO, TSWG, NIJ, FBI

Needs/Gaps:

- Analyze vehicles and leave behind packages utilizing Access and Diagnostic tools to determine content
- Defeat the improvised explosive devices (IEDs) containing both sensitive and insensitive explosives and enhanced payloads (includes VBIED, PBIED, WMD devices).
- Increase standoff distances, reduce collateral damage, and enhance the safety of bomb squad technicians.



C-IED Response/Defeat

Strategy/Approach:

- Develop and adapt a suite of interoperable response tools to improve and standardize bomb squad capabilities (e.g. platforms, interfaces, common architecture, standards, ECM, RF-based bomb squad technologies)
- Leverage existing robotics technology to provide advancements in stand-off and remote diagnosis and defeat
- Evolve advancements in robotic arm manipulation, while increasing power supply, decreasing overall weight, extending operational time, and improving navigation, communication, safety and operational control
- Enable detect sensors to integrate with bomb squad robotic platforms
- Conduct Test and Evaluate at the Bomb Squad test Bed (transition via the FBI's Hazardous Device School)



C-IED Response/Defeat

Accomplishments:

- Established an interagency technical requirements working group to gather future Electronic Countermeasures (ECM) technical requirements
- Established the Bomb Squad Test Bed with the Michigan State Police to perform test and evaluation on prototype equipment
- Verified the following technology at the Michigan test bed:
 - Single-Sided Imaging System to image suspect VBIEDs
 - Pneumatic Water Canon to render a suspect VBIED safe
- Drafted and delivered the Bomb Squad Strategic Plan, as well a explosive tool test data, to state and local bomb squads

Future Direction:

- Develop future Render Safe Tools through derivation and validation of vehicle bomb characteristics
- Continue to advance the capabilities of the current fleet of robots (e.g. employ surgical precision tools)
- Develop an intuitive diagnostics capability that can be quickly deployed when vehicle bombs are suspected
- Develop DHS-centric performance requirements for the next generation ECM systems
- Improve the Test and Evaluation and Transition processes by leveraging the Bomb Squad Test Bed and the FBI Hazardous Devices School



Counter-IED Investment Areas

- Enhanced blast resistance
 - Advanced blast-resistant materials
 - Models for assessing damage from blast
- Mitigation of effects
 - Rapidly deployable means to stabilize damaged structures
- Community resilience
 - Communication of clear, understandable, credible warnings in the event of an IED threat
 - Recovery in the aftermath of an attack

Preventive measures to reduce effects of an event, help for recovery afterwards



**Homeland
Security**

Advanced Materials Research

- Conduct basic research and testing of materials such as ultra-high performance concretes, ceramics, foams, layered composites, woven and nano-enabled materials
- Report on the current state of the art for use of advanced materials to counter IED effects
- Research UHPC/RPC to advance
 - Ultra high strength
 - Ductility, flexibility
 - Toughness, Impact resistance
 - Durability
 - Impermeability
 - Freeze/thaw, corrosion resistance
 - Abrasion resistance

Ductal® Components



Canopies

Struts



Columns

Tie Beams



**Homeland
Security**

Novel materials may have more desirable environmental, durability, weight, aging, and cost properties.

Stabilization of Buildings

- **Criteria** for interpretation and dissemination of data, triage, and decision-making methods

(Near-Collapse Buildings Workshop, TEEEX April 28-29th, 2010)

- ***First Responders Search and Rescue Issues***

(Monitoring and Sensing Workshop, Oxford, MS April 6-7th, 2010)

- Identify sensor technology to allow effective monitoring
- Identify user-friendly technology that will not hinder the mission of first responders
- Facility reconciliation of field data with analytical models



Bridge Vulnerability

PROJECT DESCRIPTION

- Study the vulnerability of steel plates, girders, and cables to terrorist threats, particularly explosives, and updating computational models based on the results.
 - Specimens to evaluate vintage bridges will be taken from
 - Golden Gate Bridge (CA)
 - Crowne Point Bridge (NY) and
 - Williamsburg Bridge (NYC)
- as they are being refurbished or demolished in order to evaluate IED effects on vintage bridges.



Impact

- Provides vulnerability information for bridge components subjected to aging, wear, and weathering
- Data can be used to validate and improve numerical models that predict failure for bridges subjected to explosives
- Understanding failure mechanisms for bridge components enables more effective design of protective countermeasures



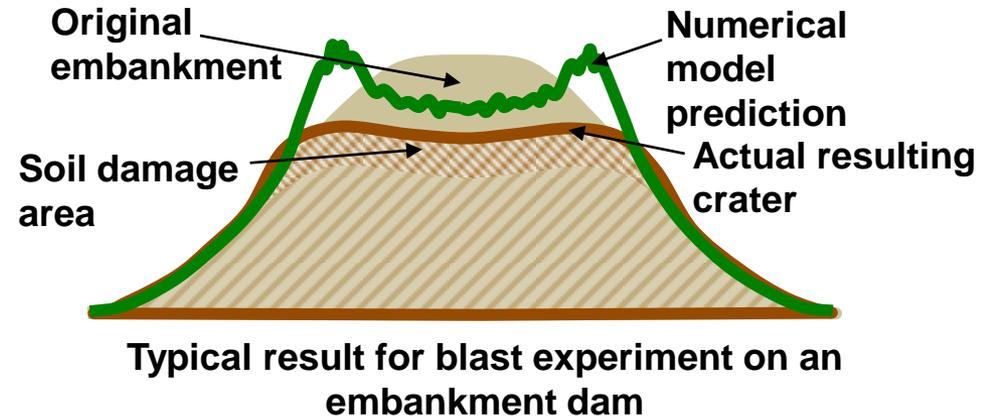
**Homeland
Security**

Capitalizing on existing assets provides data on effects of real-world aging on material properties

Improved Numerical Modeling of Soils

The Problem

- Existing numerical & constitutive models for blast effects in soils do not match the test results
- Current estimates are
 - based limited data sets
 - have insufficient information about soil damage
 - unable to evaluate the integrity and condition of remaining material



Our Approach

- Conduct physical tests and numerical simulations to determine the shortfalls of current models and how they can be improved
- Improve on current physics based, 1st principle approaches to modeling soils subjected to blast and seismic loads

Impact

- Accurate models will reduce the need to conduct extensive and expensive physical tests to address new threat scenarios.



Community Perceptions of Technology Panels

- A formal process
 - to understand and incorporate community perceptions of critical technologies within the US.
 - to maintain the balance between security and personal privacy/civil rights and liberties
- Provides DHS agencies and Program Managers with insight prior to development and deployment of technology.
 - potential reactions
 - issues
 - obstacles to a technology
- Engages the public, making them active stakeholders in the research and development of critical technologies.



Community Perspectives into Technology Development: Challenges and Issues

- Civil Rights, Civil Liberties
- Privacy, Intrusiveness and Invasiveness
- Privacy of information
- Convenience and Comfort
- Perception of Threat
- Location
- Cost
- Complexity, usability
- Safety
- Tradeoff value



Incorporating Community Perspectives into Technology Development

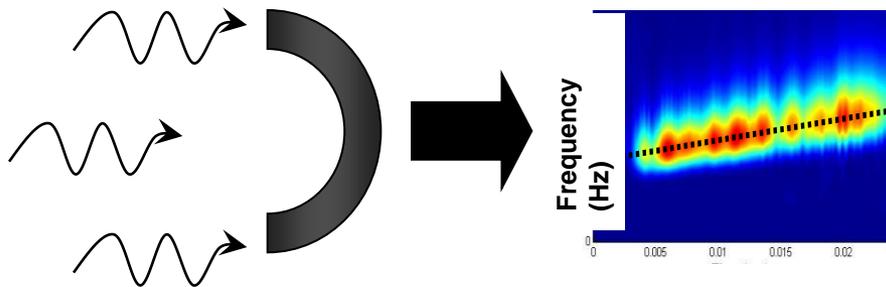


• CPT Panels 2008

- Microwave Vehicle Stopping
- Raman Spectroscopy- IED Standoff Explosive Detection
- Mobile Biometrics
- Nonlinear Acoustic IED Standoff Threat Detection

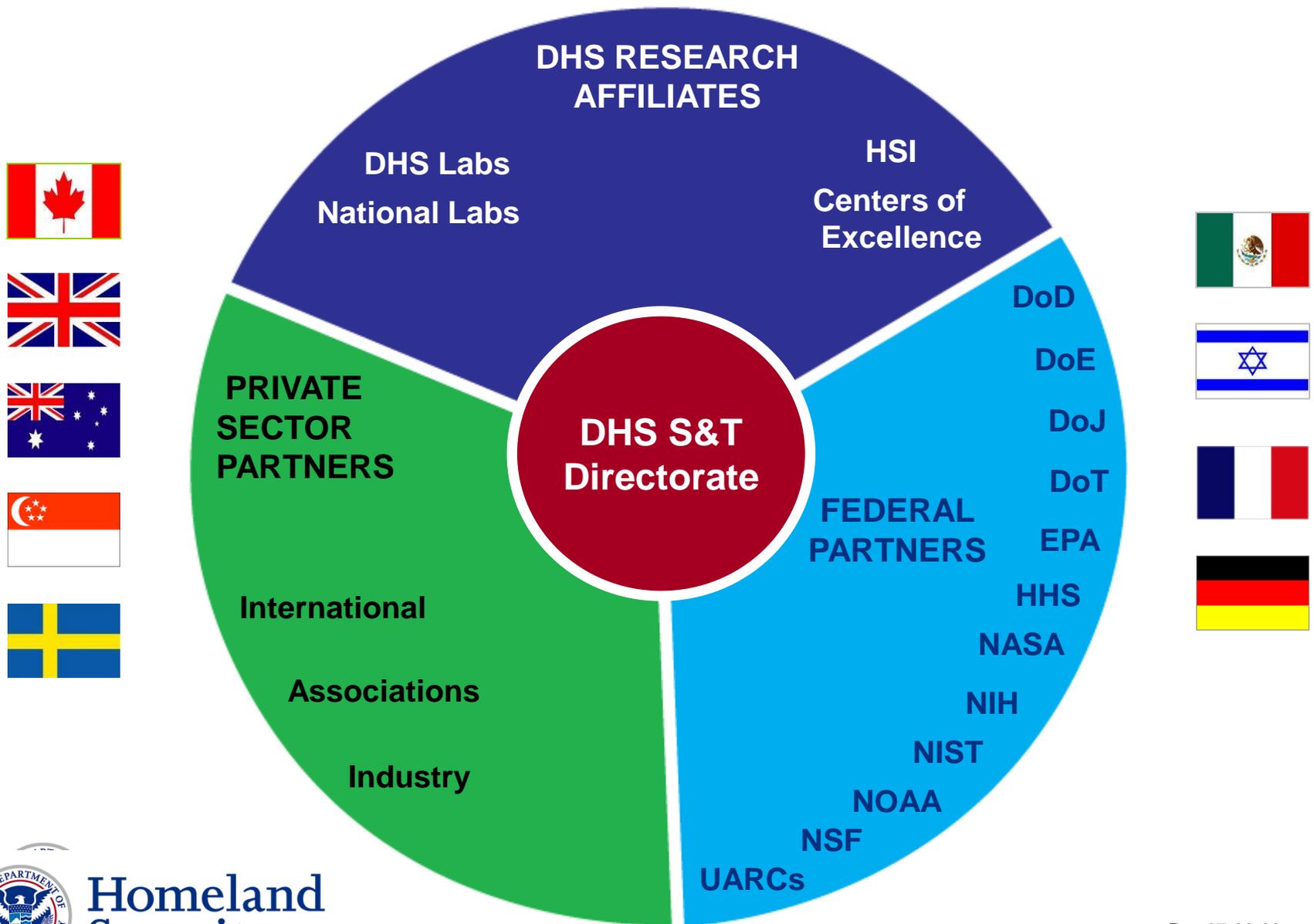
• CPT Panels 2009

- Northern Border Technology - RFID Registration and Low Resolution Imaging (Joint panel with Canada)
- Standoff Threat Detection- Imaging Systems



**Homeland
Security**

Homeland Security S&T Enterprise



Homeland Security

Summary

- The domestic threat is real; preparation is vital
- To protect our people in a free and open society, we must get ahead of the terrorists
 - Counter violent extremism/radicalization
 - Prepare people and infrastructure
- Cooperation makes us stronger
 - Domestic
 - International



Contact Information

- PEO, C-IED: SandT.cied@dhs.gov
- Broad Agency Announcements Solicitation Topics
 - Long Range BAA – addresses needs of 6 S&T divisions
 - **For more about BAAs, visit www.FedBizOpps.gov and <https://baa.st.dhs.gov>**
- NSTC Domestic IED Subcommittee report, *Research Challenges in Combating Terrorist Use of Explosives in the United States:*

<http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc-domestic-ied-2008.pdf>



**Homeland
Security**



Homeland Security



**Homeland
Security**

What is “terrorism”?

- Title 18 USC Section 2331, (5)
 - (5) the term “domestic terrorism” means activities that—
 - (A) involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State;
 - (B) appear to be intended—
 - (i) to **intimidate or coerce a civilian population**;
 - (ii) to **influence the policy of a government** by intimidation or coercion; or
 - (iii) to **affect the conduct of a government** by **mass destruction**, assassination, or kidnapping; and
 - (C) occur primarily within the territorial jurisdiction of the United States.

