



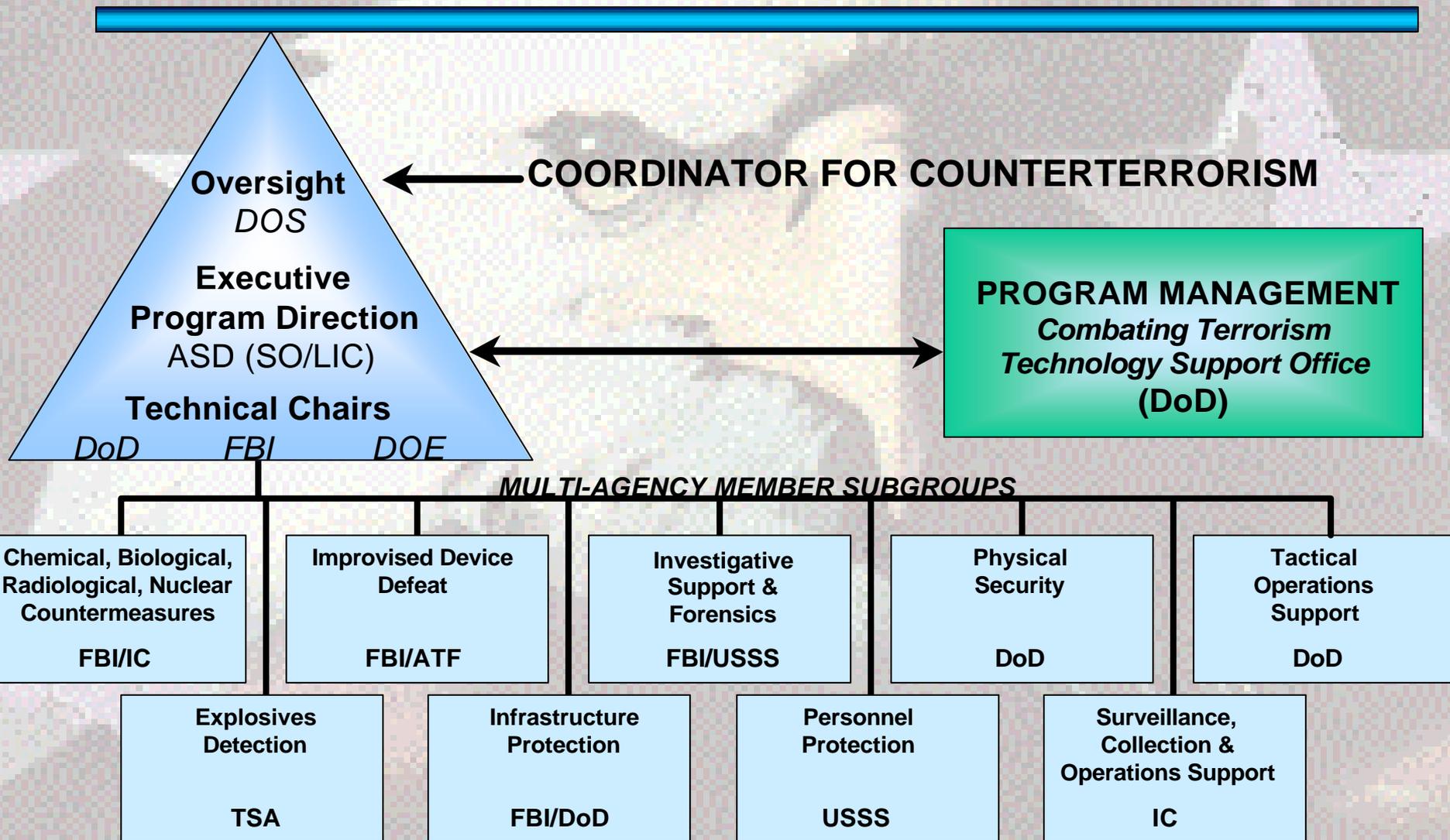
THE TECHNOLOGY FUTURE FOR COMBATING TERRORISM

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OASD (SO/LIC) RESOURCES



TSWG Structure





Operational Shortfalls

- Chemical and biological agent forensics
- Non-intrusive detection of chemical, biological and explosives
- Standoff chemical, biological and explosives detection
- Chemical and biological decontamination of civilians
- Chemical and biological personal protective equipment
- Epidemiological modeling
- Facial recognition
- Remote deception detection
- Blast effects analysis and mitigation



Operational Shortfalls (cont.)

- Non-lethal weapons
- Digital data and evidence analysis
- Cyber location/analysis
- Tagging and tracking
- Infrastructure network linkage analysis
- Diagnostic imaging in the field
- Light weight body armor
- Sniper detection
- Through structure imaging
- Canine detection of explosives and other materials
- Entry point screening of vehicles



S&T Deficiencies

- S&T Needs are Multi-Disciplinary
- Requirement Areas
 - Chemistry/Materials Science
 - Computer and Information Sciences
 - Physics/Applied Physical Sciences
 - Engineering Sciences
 - Biochemistry/Genetics/Microbial Biology
 - Physiology



Chemical and Biological Agent Forensics

- Terrorists working with CBR must be identified. Forensically link terrorists in custody to work with toxic chemicals, biological warfare agents, or radiological devices in a legally defensible manner.
 - Biochemical and/or biophysical changes resulting from intermittent less than lethal exposure to chemical warfare agents; ionizing radiation radiological dispersion devices; and biological warfare agents.
 - Expedient field assays and definitive laboratory protocols.
 - Matrices of interest include clothing, hair, skin, blood, bodily wastes, teeth and bone.
 - Changes must be sufficiently stable to be detectable days to weeks after the individual's exposure.





Non-Intrusive Chemical, Biological and Explosives Detection

- Detection/identification of explosives, chemical warfare agents and biological agents at short standoff or limited contact/access.
 - Analysis of bulk suspect materials in solid or liquid form.
 - Penetration of various packaging materials.
 - Accurate assessment in cluttered environment.
 - Rapid data acquisition, integration and processing.
 - Improve signal to noise and suppress false positives.
 - Integration of spectroscopic results with literal images.
 - Real time subtraction/suppression of chemical, physical, or magnetic noise.



Standoff Chemical, Biological and Explosives Detection

- Detection of explosives, toxic chemicals and hazardous biological agents at a distance (>10 feet) at PPB and below in a high background environment.
 - Active and/or passive spectroscopic methods across all spectral bands.
 - Gas phase emanations or surface contamination.
 - Rapid data acquisition, integration and processing.
 - Multiple spectral band instrumentation and data fusion to improve signal to noise and suppress false positives.
 - Integration of spectroscopic results with literal images.
 - Background signal identification, measurement and subtraction/suppression in real-time.
 - Other than electromagnetic phenomena.



Chemical and Biological Personnel Decontamination

- Current decontamination technologies were designed for worst case scenario use by trained, physically fit, English speaking and middle age military personnel with protective equipment.
 - Reactive chemicals to quickly neutralize chemical before skin adsorption causing adverse health effects or prevent infection following contamination of skin with pathogens.
 - Rapid acting reagent with broad spectrum of action.
 - Advanced toxicity screening methods to identify chemicals that are environmentally benign, eye-safe, skin-safe, and have low oral/inhalational toxicity.
 - Long term health effects of the toxic exposure across the full diversity of the population and identify treatments to prevent or mitigate.





Chemical and Biological Personal Protective Equipment

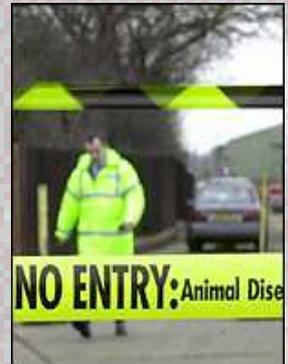
- Current protective equipment reduce mobility, degrade tactile sensitivity and place a high heat stress burden on the wearer.
 - Selectively permeable materials to permit evaporative heat loss while preventing entry of a wide range of military chemical agents and toxic industrial chemicals and biological warfare pathogens.
 - Tough materials capable of use in the field.
 - Able to be decontaminated or disposable.
 - Sorbent or reactive filter materials to reduce breathing resistance, space and weight of gas mask canisters.
 - Effective against a broad spectrum of organic, inorganic and organo-metallic gases/aerosols.
 - High loading factor with minimal off-gassing.
 - Benign reaction products.





Epidemiological Modeling

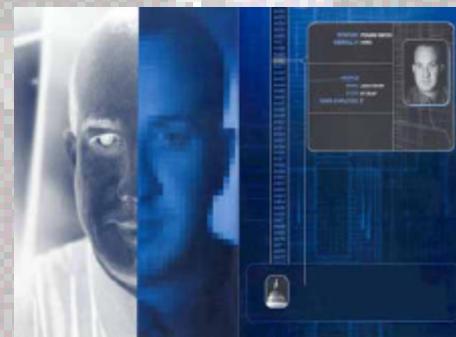
- Macro- and meso-scale models of bioterrorism human, animal and plant disease spread. Projections (next 1-7 days) needed to support implementation of protective measures and efficient allocation of limited response resources.
 - Macro-scale epidemiological modeling integrating:
 - Susceptible and carrier population and pathogen distribution.
 - Environmental factors (weather, land use, hydrologic).
 - Transportation infrastructure and patterns.
 - Response planning tools to efficiently allocate resources.
 - Command and control links across multiple echelons.





Facial Recognition

- Provide security personnel facial recognition technology that has low missed detection and false positive/false negative rates to deter terrorists and increase rate of apprehension of visa violators.
 - Advanced image processing algorithms
 - Segmentation to isolate faces in cluttered backgrounds, under high contrast lighting, when eyes obscured or averted.
 - Isolate individual faces from a group and tracking/capturing multiple images of suspect individual and fusing data.
 - Matching to enrollment reference image under significantly altered appearance; i.e., facial hair, glasses, and hair styles.
 - Three-dimensional enrollment profiles and captured image processing and correlation.





Remote Deception Detection

- Border crossing officials have limited probability of detecting and acting on deceptive behavior with direct security implications.
 - Laser doppler vibrometry/Thermal imagery analysis
 - Statistical distribution of deceptive physiological responses across the population – age, ethnic and cultural groups, health status, psychological profiles and environmental factors.
 - Identify any population subgroups that would consistently register as deceptive.
 - Rapid image processing and analysis.





Blast Effects and Mitigation

- Efficiently identify vulnerabilities and weak points in new construction design phase and analysis of existing structures providing cost-effective mitigation retrofit options.
 - New construction materials to harden structures against collapse and reduce risks from flying glass and other materials.
 - Low cost instrumentation and real time analysis of high rise buildings to warn of imminent collapse.
 - Survivable escape route designs.
 - Shock wave dissipating features.





Non-Lethal Weapons

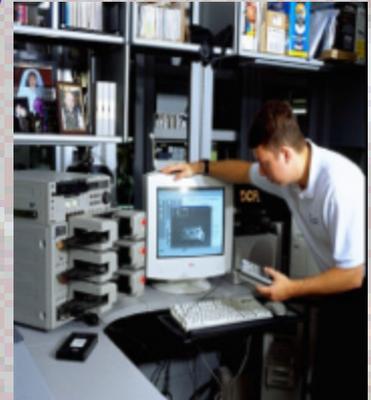
- Weapons with effective and selectable stopping power against personnel and vehicles with low probability of lethal effect at long range (>300 feet) and suitable for use in close quarters to provide security forces with option short of conventional firearms against potential terrorist in ambiguous situations and to minimize risks to bystanders.
 - Non-penetrating kinetic energy.
 - Other directed energy means.
 - Human physiology susceptibilities to odor, sound, heat, or cold.
 - Vehicle stoppers.





Digital Data Evidence Analysis

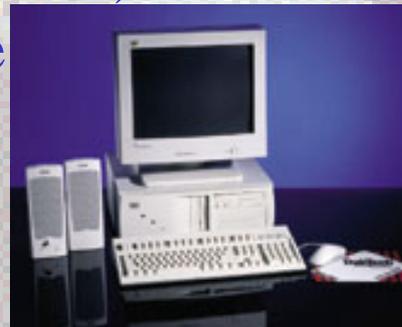
- The volume of digital data of potential evidentiary value in a terrorism case can be overwhelming and without effective analysis tools critical linkages may be missed.
 - Effective data mining tools across diverse database structures, formats and naming conventions.
 - Complex pattern analysis tools effective across multiple datasets and time with the ability to identify and test linkages.
 - Wireless device (pager and cell phone) stand-off covert download technology.





Cyber Location/Analysis

- Terrorist exploitation of the relative anonymity and ambiguity in location of cyberspace to hide their planning and activities complicates real-time tactical reaction and post-event investigations.
- Active query or signature analysis of current and archived voice and data communications (line, internet, wireless and satellite) to transform from cyberspace to geographic location.





Tagging and Tracking Technology

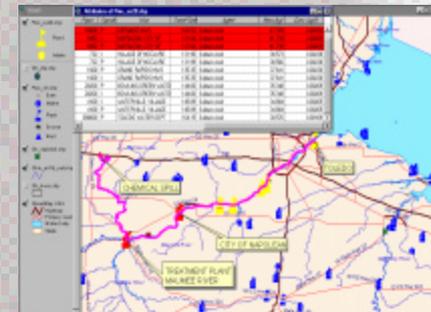
- Current tagging and tracking tools for use against individuals, vehicles, facilities and packages are limited in range, subject to compromise, risky to put in place, and expensive to monitor.
 - Active, query-response and passive tagging and tracking tools with very high signal to noise ratio detectable at a distance across diverse of natural and man-made environments.
 - New materials with unique signatures over a wide spectral range requiring special sensing techniques to preclude compromise.





Infrastructure Network Linkage Analysis

- Attacks on complex interconnected infrastructure (communications, natural gas, electric, water and transportation) networks may create more serious unanticipated second order effects than the primary damage.
- Continental-scale network analysis tools accommodating interdependencies between networks. Conduct vulnerability calculations to identify critical nodes and paths requiring protection or redundant paths to ensure continuous service and damage mitigation.





Diagnostic Imaging in the Field

- Field analysis of improvised explosive, chemical or biological dissemination devices depends on two-dimensional portable x-ray systems.
 - Improve resolution and speed of single-sided x-ray image capture.
 - Tomographic 3-D image reconstruction based on a constrained sample set – small number of images at limited number of angles.





Lightweight Body Armor

- Body armor needs to be lighter, more flexible and conform to various body forms (male and female), while providing protection against threat ballistic projectiles for National Institute of Justice protection Level IIIA and IV standards.
 - Low density flexible materials with very high tensile strength and toughness to counter rifle bullets.
 - Optimize rapid impact energy distribution and dissipation in the material or weave design as a function of material pliability, strength and toughness. (e.g., spider silk, woven metal fibers).
 - Integrate impact energy distribution and dissipation into the material structure itself.



Sniper Detection

- Enhance capability of sniper detection systems especially in crowded environments where the public brings various optical systems.
 - Retro-reflection Systems
 - High speed processing of high resolution images across a wide spectral band to characterize and discriminate between retro-reflection signals from optical systems to support quick identification of threat.
 - Change detection or other cueing options to aid search.
 - Alternative concepts for detecting presence of weapons at a distance.



Through-Structure Imaging

- Reduce uncertainty during covert and overt surveillance by locating and monitoring persons inside a structure, tunnel or rubble to discriminate between terrorists and hostages, and distinguish among living, injured and dead.
 - Penetrate all types of construction materials.
 - Identify, locate and track presence/movement of all people in areas under surveillance at sufficient spatial and time resolution to provide tactical information to users.
 - Signal Processing to determine material composition, thickness; screen out confusing returns (clutter, etc.) and display real-time literal images conforming to the area under investigation.





Canine Detection of Explosives and Other Materials

- Used extensively to detect explosives, drugs, and currency. Benchmark and improve sensitivity, selectivity, and reliability.
 - Genetic and psychological (training/handler interaction) contributions to canine olfactory detection performance.
 - Quantitative Trait Loci analysis of canine olfactory performance (what makes a good nose).
 - Genomics contribution to breeding program to improve performance and reduce washout rate.
 - Genetic engineering to improve physiological/olfactory performance minimize genetic defects.
 - Physiological basis of play versus food rewards on performance.
 - Impact of food rewards on olfactory acuity through interaction of food intake-related neuropeptides (satiation).





Entry Point Screening of Vehicles

- Current manual vehicle searches are manpower intensive, create traffic delays that reduce worker productivity and create additional vulnerabilities.
- Inspection technology for cargo, especially tank trucks carrying water, waste, fuel oil or other liquids.
 - Non-intrusive.
 - Real time.
 - Complex matrices.





Challenge

How do we interest the Basic and Applied Research communities in addressing these needs?

- Formulate requirements for the national/international scientific community
- Influence focus and funding of the basic science community to meet combating terrorism technology needs,
- Establish metrics and enforce accountability