

GROUND ROBOTICS IN THE PUBLIC SAFETY MARKET

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Combating Terrorism Technical Support Office



**Special Operations/Low-Intensity
Conflict & Interdependent
Capabilities**



**Combating Terrorism
Technical
Support Office**



**Department
of State**



**Technical Support
Working Group**

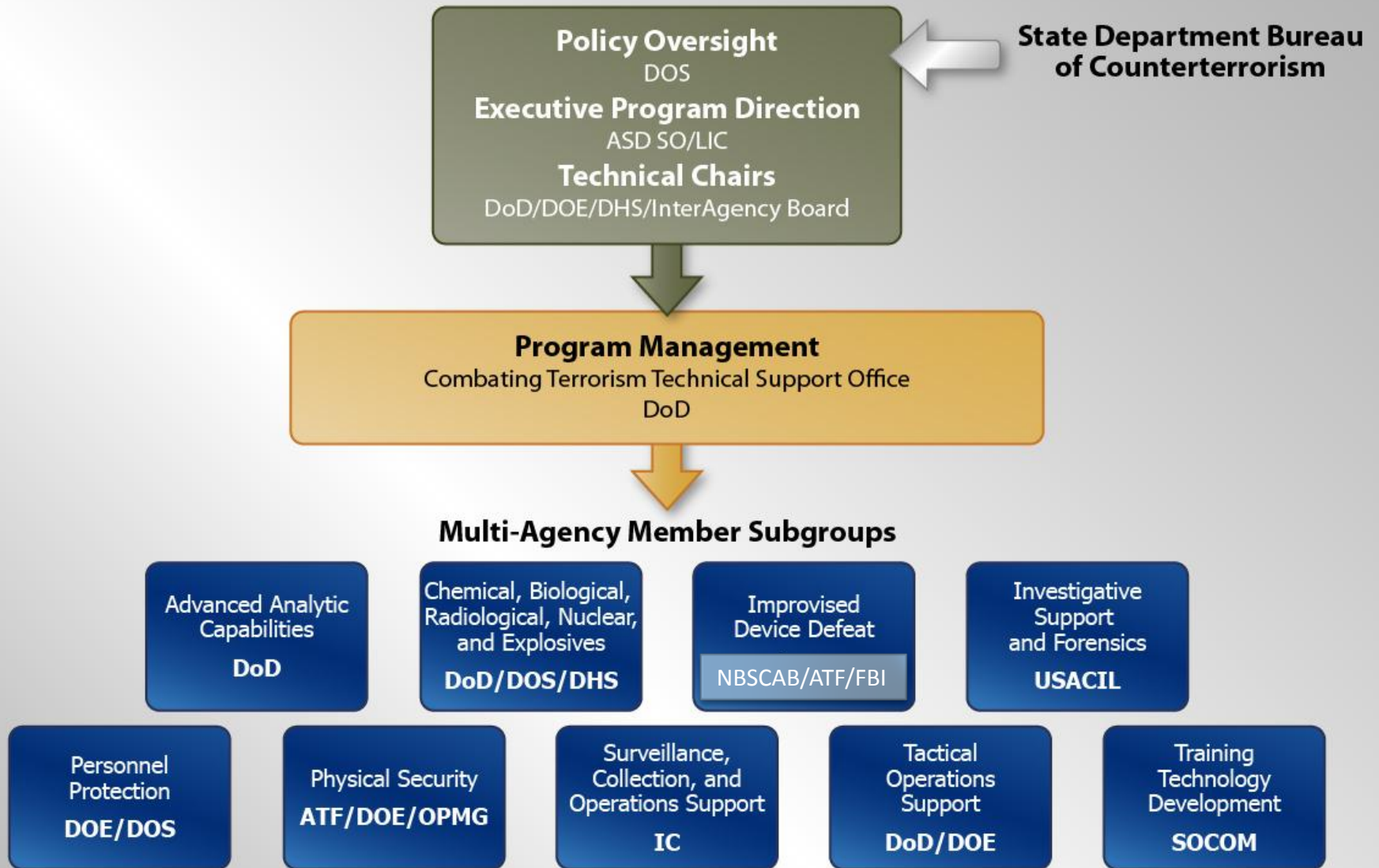


**Explosive Ordnance
Disposal/Low-Intensity
Conflict**



**Irregular Warfare
Support**

TSWG Organization





**INTERNATIONAL
PROGRAMS**



NATIONAL BOMB SQUAD COMMANDERS ADVISORY BOARD (NBSCAB)

- NBSCAB's twelve voting members serve as the leadership element of the U.S. Bomb Squad program, which includes 466 accredited bomb squads
- NBSCAB provides advice to Federal agencies that support bomb squads and act as the final decision making authority on guidelines and standards for the profession
- One of the responsibilities of NBSCAB is to provide input and guidance on IED defeat research and development needs

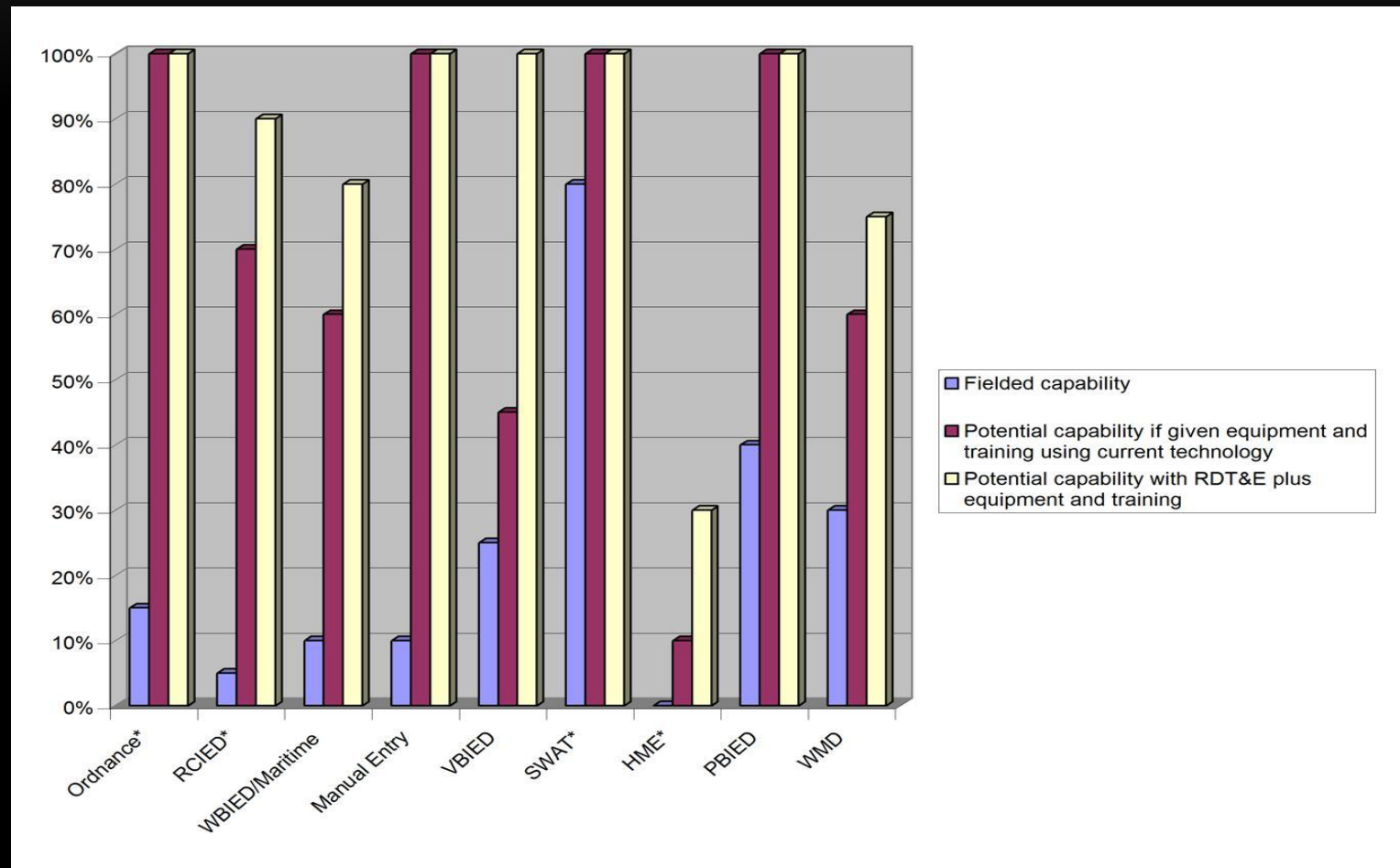


● Yellow Dots – Military EOD Units

● Blue Dots – Public Safety Squads that Routinely Request Military Assistance

● Red Dots – Public Safety Squads that do not Routinely Request Military Assistance

BOMB SQUAD CAPABILITY LEVELS*

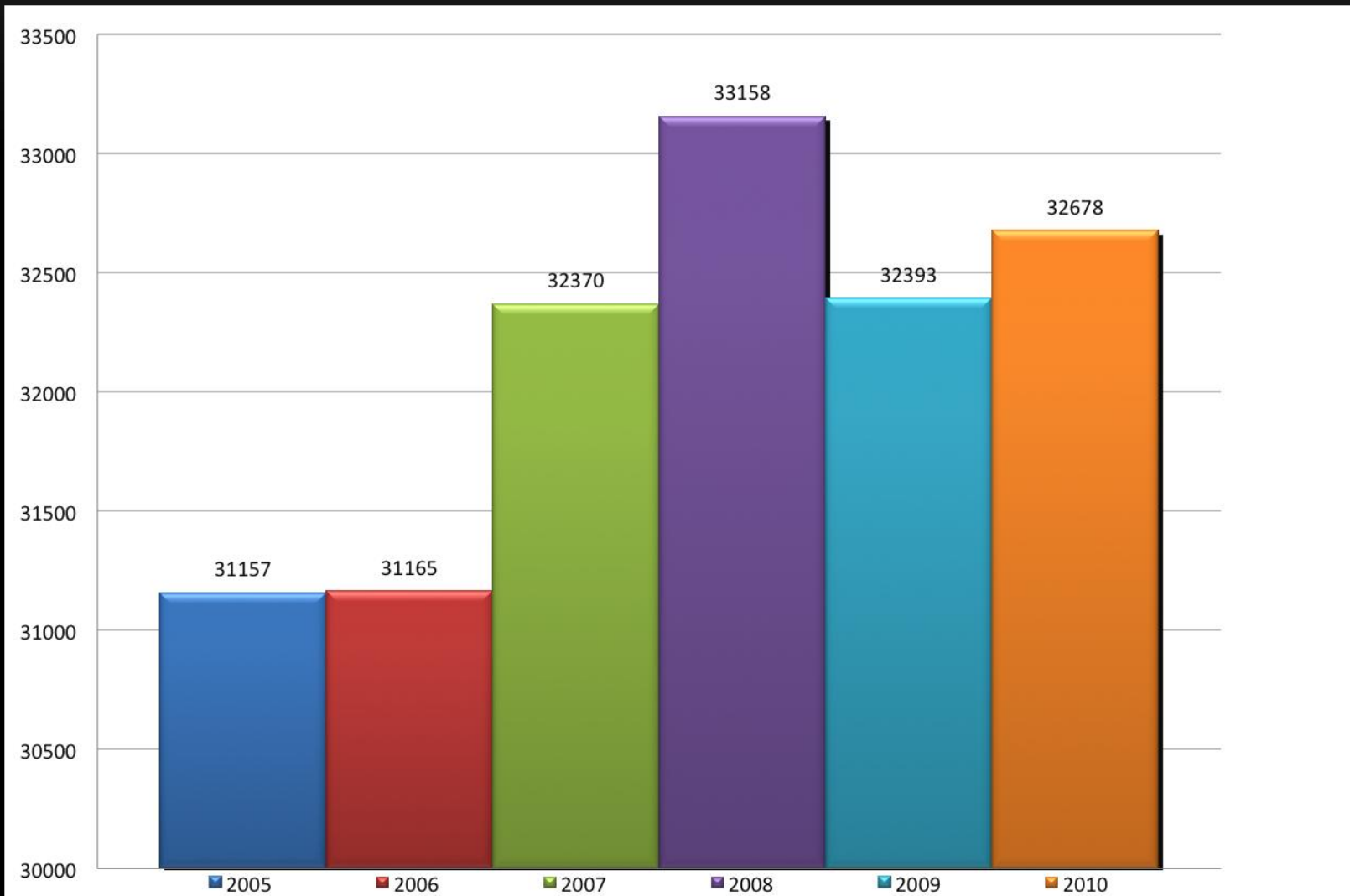


* As assessed by the National Bomb Squad Commander's Advisory Board, Sept 2013

BOMB SQUAD CAPABILITY LEVELS

- Military Ordnance is the primary responsibility of military EOD, but data shows that public safety bomb squads are responding to numerous ordnance incidents, even though only about 15% have been trained in ordnance identification and safety.
- At present, only about 0.4% of public safety bomb squads have an ECM (jamming) capability, even though ECM assets are theoretically available through federal channels within 2 hours.
- The Boston Marathon bombing has demonstrated the necessity for integration of bomb technicians into tactical operations, but bomb response tools and equipment are often not “backpackable.”
- While more bomb technicians are being trained on homemade explosives response operations, many of the existing tools used for standard explosives response operations could set off improvised materials.

IED Incident Response by Public Safety Bomb Squads in the US



“We always bring robots. Always.”

The bots are great because it makes our lives easier and safer. There are devices that require a delicate human touch though, using a robot is like use a sledgehammer to drive a nail.

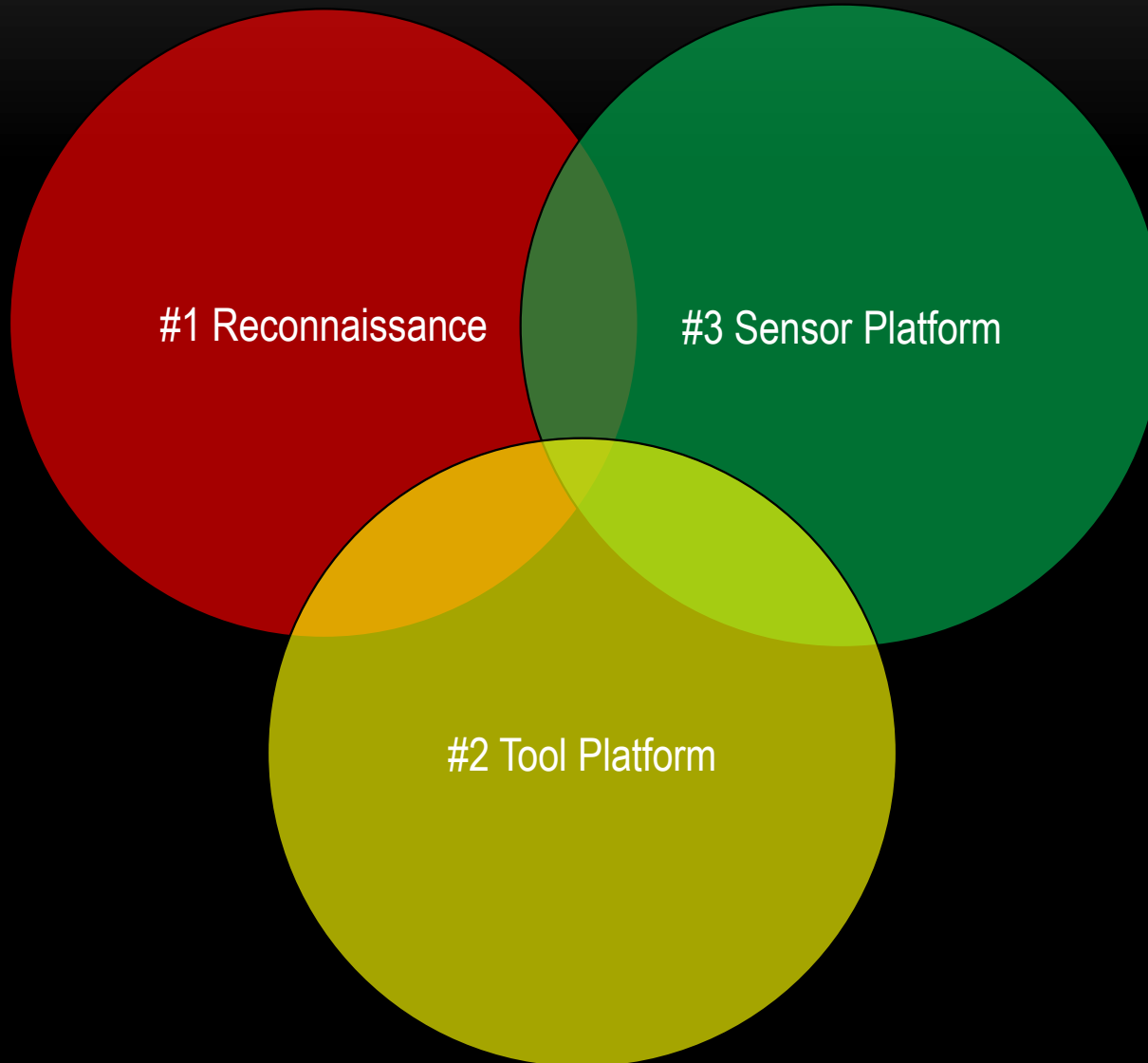
You do develop an attachment to your robot. It's like a dog. We named our robot and everything. That piece of machinery is an extension of you.

We had a Talon with a pink teddy bear that we taped to the antenna. That robot made it 11 months and survived hundreds of incidents until he was blown up by a car bomb.

RIP Scooby :'(

Source: Bomb Tech on Reddit

Current Robot Use by Public Safety



US Bomb Squad Robot Platforms (as of 2010)

Platform	Quantity
Andros F-6	72
Andros F-6A	543
Andros HD-1	28
Andros Mini-2	107
Andros MK V	29
Andros MK V-A1	40
Andros MK VI-A	14
Andros Wolverine	30
Icor Caliber	8
MURV-100	11
Other	100
Pedasco RMI-9	48
Talon	60
Vanguard MK-2	99

NBSCAB' s Top Ground Robotics Requirements*

- NBSCAB' s top priority is to prepare bomb squads for a VBIED attack
- Continue the development of the national bomb squad ECM program and the technologies that support defeating the full range of RCIED threats
- Develop the ability for bomb squads to provide render-safe support to tactical teams

* As assessed by the National Bomb Squad Commander' s Advisory Board, Sept 2013

NBSCAB's Top Ground Robotics Requirements

- Improvements to existing robots
- Develop remote 3-D capability for all aspects of bomb squad remote operations
- Develop the capability to evaluate and clear HME using remote means
- Develop technological capabilities for bomb squad operations at or near the Southwest Border of the U.S. with Mexico

RCIEDs, ECM, and Robots

- The FBI and OBP are working on the development of a national bomb squad ECM program
- Other federal agencies, such as TSWG and DHS S&T, are working on other technologies to defeat the full range of RCIED threats
- As equipment is developed to counter RCIEDs, response equipment needs to be shielded against ECM use

Bomb Squad/SWAT Operations

- Many bomb squads now provide render-safe support to tactical teams, especially in dynamic entry, and hostage takeover situations
- A review of bomb squad operations during the 2013 Boston Marathon bombing have demonstrated a need for fast-paced operations, and immediate action techniques
- Small, low-cost, lightweight, backpackable, high capability reconnaissance and render safe robots are needed for such high speed, high threat situations

Improvements to Existing Platforms

- Continue the development of non-tethered operations capabilities for bomb squad robot operations
- Assess whether mobile mesh network systems can be effective for bomb squad operations
- Continue improvements to the dexterity of the end effector, including force feedback
- Develop self awareness and obstacle avoidance capability for bomb squad robots, including retrofit systems for existing robots

3-D Robot Operations

- A 3-D capability is needed for all aspects of bomb squad remote operations
- This includes:
 - Robot driving
 - Robot manipulator operations
 - Computer imaging of vehicle contents
 - X-ray analysis
 - Robot mounted weapons aiming

Homemade/Improvised Explosives Operations

- A capability needs to be developed to evaluate and clear HME using remote means
- This includes the ability to remotely sample, identify, desensitize, and dispose of sensitive explosives
- If sensitive explosives cannot be moved, a capability is needed to safely collect, and transport these explosives to a containment vessel, or disposal site

Southwest Border Operations

- Special, standardized tool sets and backpacks for dismounted operations to remote areas
 - Specialized robots for dismounted operations
 - Specialized robots for tunnel operations
- Need to continue development of remote methods for unscrewing grenade fuzes

NBSCAB's top priority is to prepare bomb squads for a VBIED attack!

The First Generation of EOD Robot



The first Wheelbarrow was invented by Lieutenant-Colonel 'Peter' Miller in 1972

US EOD Robot in Action



VBIED Response Robot Functions

- Mobility
 - Small Vehicles
 - Large Vehicles
- Strength
- Cameras
- Communications
- Manipulators and Tools
- Weapons
- Sensor Attachments
- Power
- Human Factors
- Reliability
- Other considerations

Mobility – Small Vehicles

- Limitations within open door areas
- Large arms are limited within vehicles especially trunks and rear seats
- Challenges keeping trunks and doors open

Mobility – Larger Vehicles

- Height challenges
- Cab surveillance
- Access to cargo area (opening locks, panels, etc.)
- Truck cargo beds difficult to access
- Long distance disablement shots within cargo areas
- Reading text at long distances
- Physically getting robots into a truck is difficult

Strength

- Manipulators and end-effectors (Power Hawk is 30+ lbs)
- Towing tools and equipment (AXISS is 250+ lbs)
- Opening and bending doors/trunks
- Lifting full containers (fuel containers, drums, ordnance items, etc.)
- Carrying disablement disruption and render safe charges (full SIDDD weighs 250+ lbs)

Cameras

- Obscurants
 - Dust, water drops, and other obscurants
 - Window glare and tinting
- Variable placement often restricts arm maneuverability
- Resolution for reading at a distance
- Low-light capabilities
- Over-watch cameras improved situational awareness
 - Raise high enough to clearly view box truck interiors and pickup truck beds

Communications

- Range requirements in VBIED response
- Fiber Optic considerations
 - Length
 - Multiple robots and overlap of fibers
- ECM compatibility
- Frequency allocations
- Backbone for additional systems

Manipulators and Tools

- Variable end effectors
 - Window breakers, etc
- Grabbing items within vehicles
- Limited mobility
- Opening locked and unlocked doors
- Gripper modifications potentially limit ability to effectively grab items

Weapons

- Dual disrupter mounts very useful
- Nearly always fired both disrupters on VBIED responses for access and disablement
- Weapons reduce mobility inside vehicles
- Targeting and distance measurement

Sensor Attachment

- Sensors/detectors have no standard placement methods or locations
 - Duct and electrical tape
 - Improvised baskets
- Optimization of sensor location for field of view
- Sampling tools
- Ability to transmit data or read via robot camera or hear via audio (challenges with ambient noise)

Sensor Attachment



Power

- Response will likely be several hours long (potentially 5+)
- Response will involve long travel times from Incident Command Post to target (potentially 1000+ yards)
- Alternate power sources desirable
 - Hybrids, Fuel Cells, Li-Ion batteries

Human Factors

- Dual robot operations
- Human-machine interface
- Navigation
- Perception

Reliability

- Frequent breakdown, even on well maintained robots
- Power supply usually not sufficient
- Communications
- Tracks vs. wheels
- Connectors (radio, batteries, sensors, cameras, weapons)

Other Considerations

- Variability in platforms
- Number of robots
 - Michigan State Police and Las Vegas Fire Department Bomb Squad require dual robot response for VBIED calls
 - Some operators express a desire for 3
- Potential for operations in contaminated environments
- Integration of new tools and technologies

Summary

- Robot requirements are complicated, and current available capabilities require conflicting trade-offs
- Current platforms were not specifically designed with the full VBIED threat in mind
- While numerous robot requirements are known there are many more that must be identified

THE TECHNOLOGY SWEET SPOT



Here comes Edward Bear now,
down the stairs behind
Christopher Robin. Bump!
Bump! Bump! on the back of
his head. It is, as far as he
knows, the only way of coming
down stairs. He is sure that
there must be a better way, if
only he could stop bumping for
a moment to think of it.

A.A. Milne,
Winnie the Pooh, 1926



Questions?

