



Outline

- ***Army Science and Technology (S&T) Strategy, Funding and Enterprise***
- ***Technology Investments and Future Force Technologies***
- ***Maneuver Support Capability Needs and Enabling Technologies***
- ***Future Combat Systems and Maneuver Support***
- ***Recent Accomplishments***
- ***Basic Research Thrusts***



Science & Technology for a Campaign Quality Army with Joint & Expeditionary Capabilities

Current Force



~100 lb. load



Limited network



> 70 tons



< 10 mph

Enabling the Future Force

Science and Technology—
develop and mature technology to enable transformational capabilities for the Future Force while seeking opportunities to accelerate technology directly into the Current Force

Enhancing the Current Force

Future Force



< 40 lb. load



Fully networked



< 30 tons



> 40 mph



Elements of Army S&T Strategy



- **Ensure investments are aligned with Army missions and capability needs**
- **Maintain balanced & responsive portfolio across**
 - **Elements of investment (6.1/6.2/6.3)**
 - **Disciplines and technology areas**
 - **Performers (intramural/extramural)**
 - **Capability pull and technology push**
- **Sustain critical infrastructure—people and physical—responsive to Army needs**
- **Communicate S&T vision and approach to senior decision makers, key stakeholders, partners and customers**
- **Establish and refine processes and metrics to promote innovation, efficiency & effectiveness, and facilitate transition**



From Ideas to Systems

3 Different Types of S&T Investments

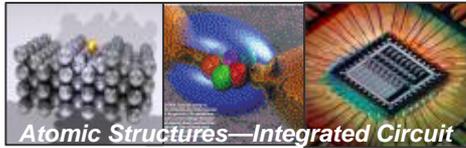
As of FY09 PB

S&T Development (RDT&E BA 4-7)
(RDT&E BA 1-3) \$8.7B (6.2% of TOA, 24.8% of RDA)
\$1.8B (1.3% TOA*, 5.3% RDA)

Acquisition (Procurement Appropriation)
\$24.6B (17.7% TOA, 70.0% RDA)

6.1: Basic Research
\$379M (21% of S&T)

Nanoscience



Atomic Structures—Integrated Circuit

- Understanding to solve Army-unique problems
- Knowledge for an uncertain future

67% Universities/Industry

6.2: Applied Research
\$724M (39% of S&T)

Integrated Textile Conductors

Embedded Input Device



Power Transmitting Textiles

Embedded Circuits

- Applications research for specific military problems
- Components, subsystems, models, new concepts

35% Industry

6.3: Advanced Technology Development
\$739M (40% of S&T)

Primary Weapon System (PWS)

120mm Gun for FCS MGv



120mm Mid-Range Munition (MRM)

- Demonstrate technical feasibility at system and subsystem level
- Assess military utility
- Path for technology spirals to acquisition—rapid insertion of new technology

60% Industry

ATO Program

Far Term

Mid Term

Near Term

*w/o supplementals



Army S&T Enterprise—Research, Development & Engineering Centers & Labs

- U.S. Army Materiel Command
- U.S. Army Medical Research & Materiel Command
- U.S. Army Corps of Engineers
- U.S. Army Space and Missile Defense Command
- Army Research Institute for the Behavioral & Social Sciences





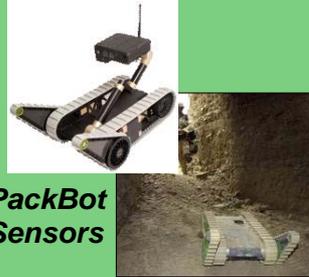
Technology Insertions for Current Operations

Benefiting from Past Investments

Interceptor Body Armor



PackBot Sensors



Blue Force Tracking



Guided MLRS



Adapting/ Accelerating On-going S&T Programs



Mobile Remote Access & Information Diagnostics

Every Soldier A Sensor Simulation



USMC Dragon Fire II with Lightweight Counter Mortar Radar (LCMR)



Mine Detecting Ground Penetration Radar (GPR)

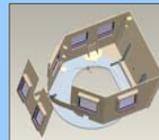


Leveraging Scientist & Engineer Expertise



Enhanced Rocket, Mortar & Sniper Detection

RG-31 Engineer Vehicle Addon Armor Kit



Hellfire Launch On Predator



HMMWV Expedient Armor





Technology Area Investments to Achieve Warfighter S&T Outcomes

FY09 \$1.8B

**Force Protection
\$370M**

ISR \$149M

C4 \$144M

Lethality \$161M

Medical \$140M

Soldier \$135M

Logistics \$92M

Rotorcraft \$72M

Classified \$62M

Unmanned Vehicle \$54M

Mil Eng & Environment \$47M

Advanced Simulation \$37M

**Basic Research
\$379M**

*Enabling the
Future Force*

Enhancing the Current Force



List of 37 Tier One Warfighter S&T Outcomes (1 of 2)

- Battle Command Network*
- Counter IED and Mine*
- Power & Energy*
- Human Dimension*
- Training*
- Communicate in the Combined/Joint Environment
- Future Force JIM Interoperability
- Austere A/SPOD Physical Assessment
- Austere A/SPOD Protection and Security
- Austere A/SPOD Enhancement
- Analysis and Reporting of Intelligence Information
- Observe and Collect Information Worldwide
- Collect and Manage Biometric Data
- Standoff Sense Through Walls
- UGV Autonomous Movement
- UGV Autonomous Tactical Behaviors
- Responsive and Sustainable Aviation Support
- Effective Aviation Operations in the Contemporary Environment

**"Big 5" Integrated
Warfighter S&T Outcomes**



List of 37 Tier One Warfighter S&T Outcomes (2 of 2)

- RSTA and Attack Operations
- Networked Precision Fires and Effects
- Scaleable Effects Versus Platforms
- Scaleable Effects Versus Personnel
- Point Neutralization of CBRN - explosive hazards
- Visual and virtual obstacle marking system
- Improved Soldier Protection
- Lightweight Soldier Ballistic Protection
- Lightweight Platform Ballistic Protection
- Reliability
- Prognostics & Diagnostics
- Alternative Energy Sources
- Force Health Protection Initiative
- Increase control of unmanned systems
- Future Force Multi modal Human Computer Interface
- Increase Future Force Soldier Cognitive Functions While Under Stress
- Language and cultural awareness
- Dismounted soldier virtual training environment
- Adaptive training system



Future Force Technologies

Force Protection

Army component—Joint High Power Solid State Laser Program



Structural Armor



High Energy Laser

KE Active Protection System

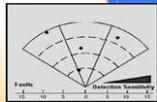


Integrated Rotorcraft Protection

C4/ISR



Knowledge Fusion

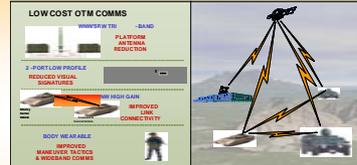


Sense Thru Wall

Flexible Displays



Advanced Antennas



Tactical Network & Communications Antennas

Directional Antennas

Tactical Mobile Networks



Unmanned Systems



Unmanned System/Human Interface Technology

Unmanned Ground Vehicles

Unmanned Air Vehicles

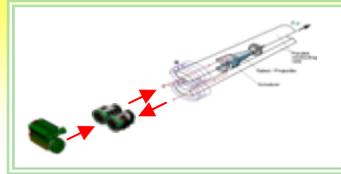
Unmanned Ground Vehicle Technologies





Future Force Technologies

Lethality



EM Gun



Warhead Small Arms Technology

Non Line of Sight - Launch System (NLOS-LS)



Scalable Effects

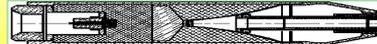


Inert Frags



Reactive Frags

Urban Assault Munitions



<p>Seeker Miniaturization & Cost Reduction</p>	<p>Multi-Purpose Warheads to Defeat Armor, Fortifications & Personnel</p>	<p>Electronics Miniaturization & Cost Reduction</p>	<p>Novel Maneuver Techniques</p>
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Smaller, Lighter, Cheaper Munitions

Soldier Systems

Combat Rations



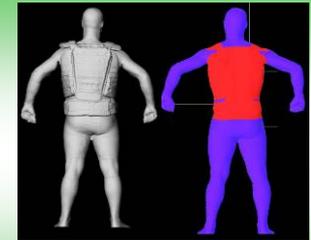
Soldier Mobility and Advanced Load Carriage



System Flame Test



Current New
LiCFx Half-Size
BA-5590
Battery



Armor Coverage

Logistics

Power & Energy



Hybrid Electric Drive

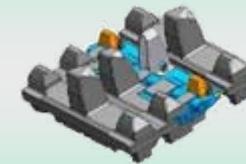
Sustainment

Fuel Cell Development



Advanced Hybrid Engines

Segmented Band track



Deployability



Precision Air Drop 30k lbs



PB09—Increased Emphasis

Force Protection



- **Advanced Lightweight Armor**
 - Multi Threat Ballistics Protection
 - Lightweight Materials



• Basic Research

➤ Army Laboratory Research

Army Single Investigator Research Program

Armor and High Deformation Rate Physics

Advanced High Performance Computing

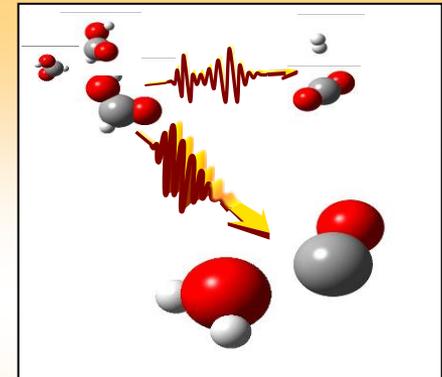
Bio-inspired Sensing and Power

Materials Research and Processing at Small Scale

Robotics Autonomy, Human Robotic Interaction

High Efficiency Propulsion

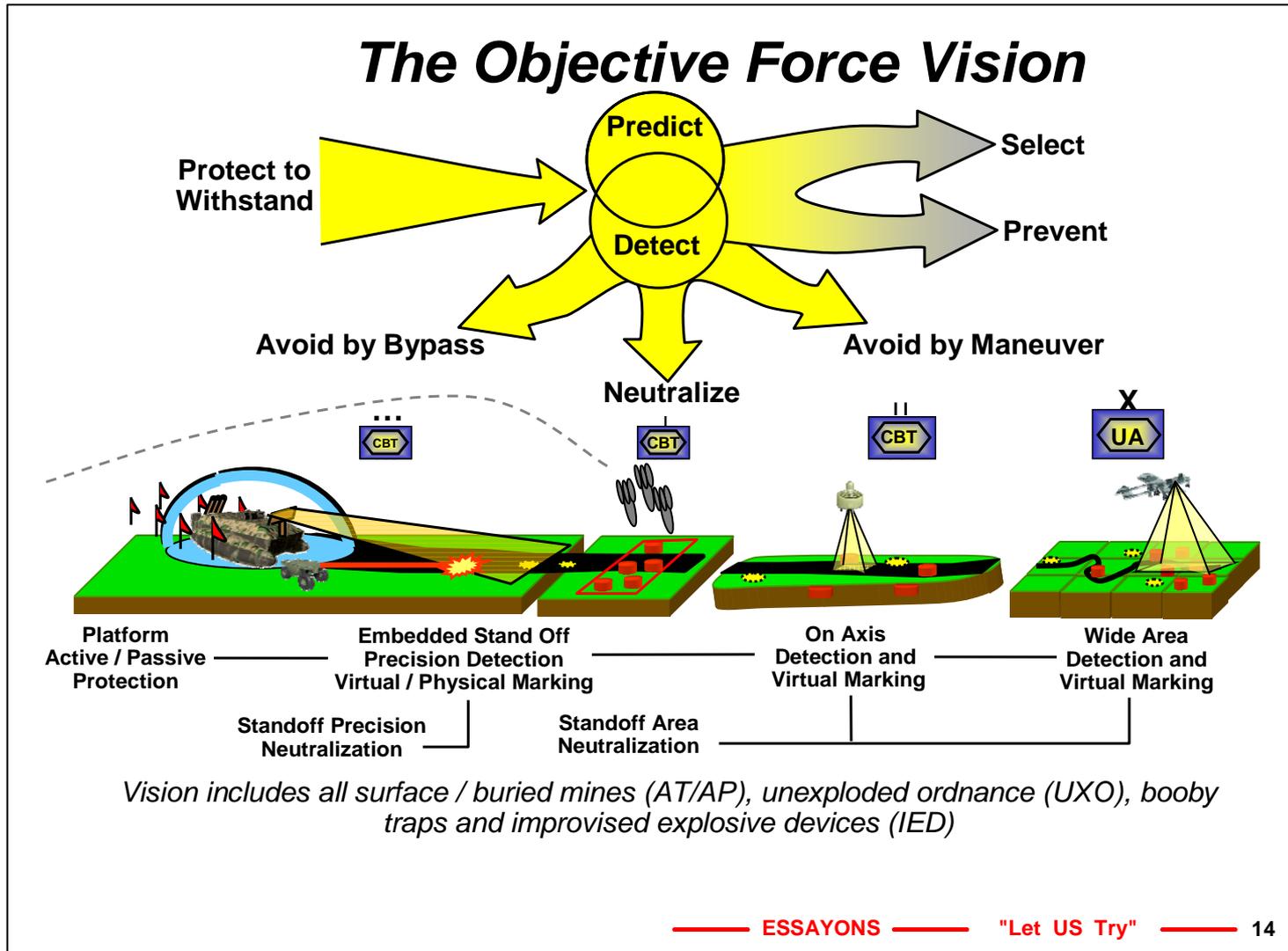
- ### ➤ University Research Initiative (university teams conducting research involving more than one science and engineering discipline)



Basic Research

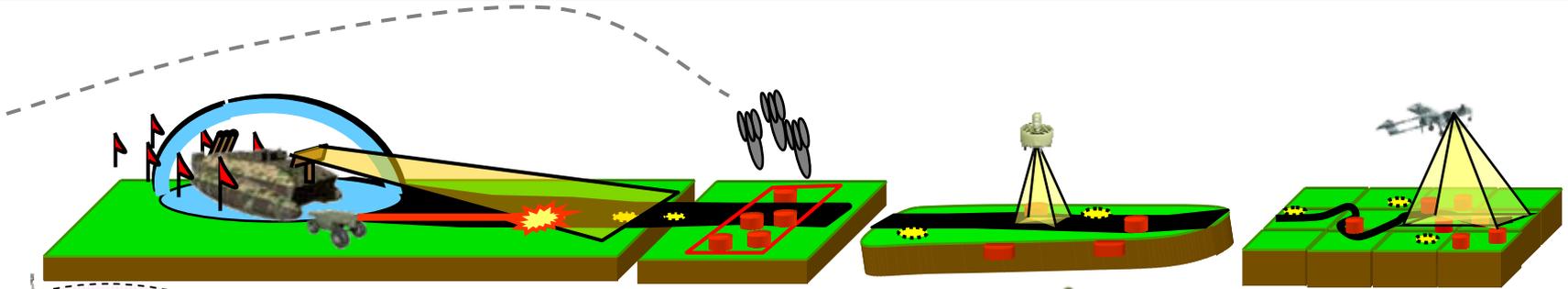


Maneuver Support – What we wanted in 2003





Where are we on providing capabilities desired in 2003



Class I Unmanned Aerial Vehicle



Class IV Unmanned Aerial Vehicle

- Detects enemy activity
- Detects and confirms location of mined area
- Terrain change detection

Husky Modified Mine Detecting Ground Penetration Radar (GPR)

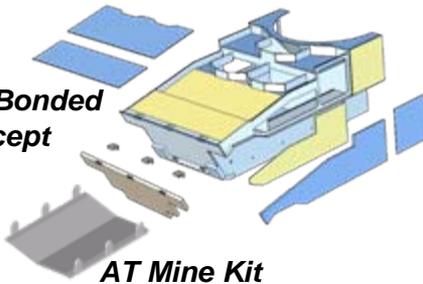


Multifunction Utility/Logistics and Equipment Countermine and Transport

Packbot
- Detects explosives



A+B & A/B Bonded Armor Concept



AT Mine Kit

Manned Ground Vehicle

- Protection
- Jam with CREW
- Sensors and Soldiers



Future Combat Systems— Spinouts to the Current Force

PROGRAM MANAGER
FCS
BRIGADE COMBAT TEAM
One Team-The Army/Defense/Industry

Manned Ground Vehicles (MGV)

Infantry Carrier Vehicle (ICV)

Command and Control Vehicle (C2V)

Mounted Combat System (MCS)



Unmanned Aerial Systems (UAS)

Class I UAV

Class IV UAV



Reconnaissance And Surveillance Vehicle (RSV)

Unattended Ground Systems (UGS)



T-UGS

U-UGS



Tactical and Urban Unattended Ground Sensors

Non-Line of Sight Launch System (NLOS-LS)

Common Chassis

Advanced Lightweight Armor
Engine



Non-Line of Sight Mortar (NLOS-M)



Non-Line of Sight Cannon (NLOS-C)



Medical Vehicle Treatment (MV-T)

Medical Vehicle Evacuation (MV-E)

FCS Recovery and Maintenance Vehicle (FRMV)



Unmanned Ground Vehicles (UGV)

MULE-C

Multifunction Utility/ Logistics and Equipment Countermine and Transport

MULE-T



Armed Robotic Vehicle – Assault (Light) (ARV-A-L)



BARPA



Small UGV (SUGV)



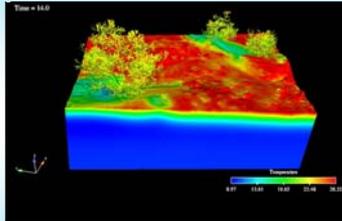
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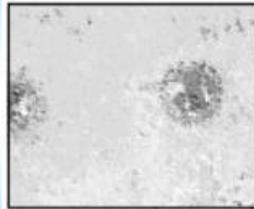
Future Maneuver Support Technologies

Predict

Tactical sensor optimization

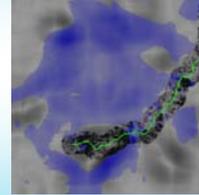


Simulated geo-environment



Initial disturbed soil simulation

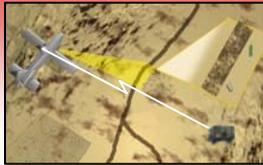
Autonomous planning / replanning tools



Advanced Crew Stations



Detect



IED and Minefield Detection Payload for Shadow Tactical UAV



Wichmann Down Looking Ground Penetrating Radar



Magnetometer & Electro Magnetic

Forward looking Radar



Avoid / Neutralize



Operator planning tools



Dynamic planning for manned/unmanned operations

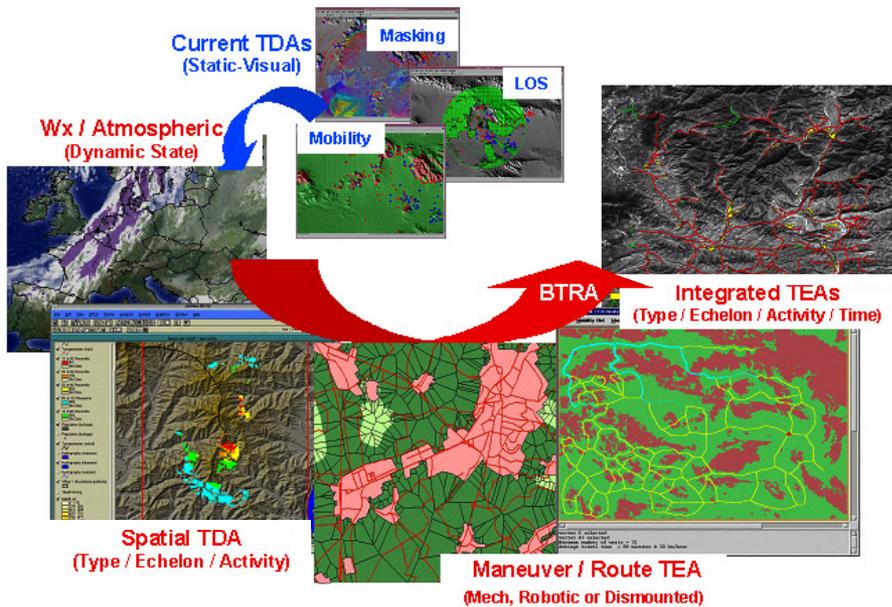
Low Cost Radio Frequency / High Power Microwave Neutralizer Capability





Recent Accomplishments

Battlespace Terrain Reasoning and Awareness (BTRA)



Modeled complex terrain and weather effects on vehicle mobility and developed Tactical Decision Aids

Joint Rapid Airfield Construction (JRAC)

Provide Future Force the ability to create contingency airfield

Remote / Expedient Site Assessment



Rapid Stabilization & Lightweight Mats



Enhanced Construction Technologies



In-Theater Contingency Airfield





Basic Research Thrusts

Revolutionize military training and mission rehearsal through the development of technology and art for simulation experiences and the development of virtual human technology



Research in human-engineered and biologically-evolved networks to improve performance, increase reliability and enhance network-centric mission effectiveness



Research to understand biological construction of novel materials, structures and processes to develop biologically-derived materials, sensing systems, information processing and power and energy

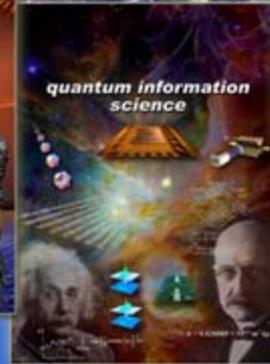
Discover, develop and exploit robotic devices and systems with highly sophisticated sense, response and processing systems approaching that of biological systems to dramatically enhance Soldier survivability



Research in understanding the functional brain to improve training techniques, human-machine interface design, the nature of traumatic brain injuries, and to more fully understand the decision-making process



Discover and create new materials with properties that will revolutionize military technology and make Soldiers less vulnerable to the enemy and environmental threats



Generate advances in quantum sciences that will enable revolutionary approaches to information processing, cryptography, information assurance, and communication

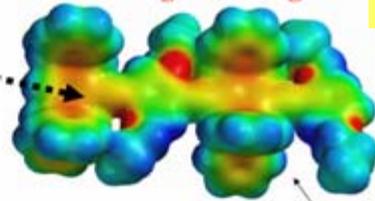
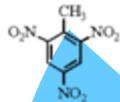
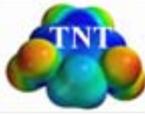


Improved Detection— Robotic Chemical Sniffer

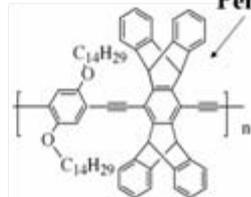
Molecular Engineering

Blue=positive charge

Red=negative charge



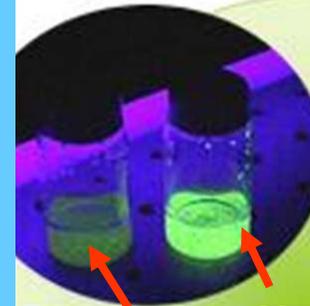
Pentiptycene



Design Attributes:

- Highly selective to only TNT and DNT
- Highly resistant to contamination
- Long-term stability for reuse

Army Top Ten Invention



Amplifying Fluorescent Polymer (AFP) developed by MIT normally glows green, but quenches when TNT is present.

No TNT
TNT Detected

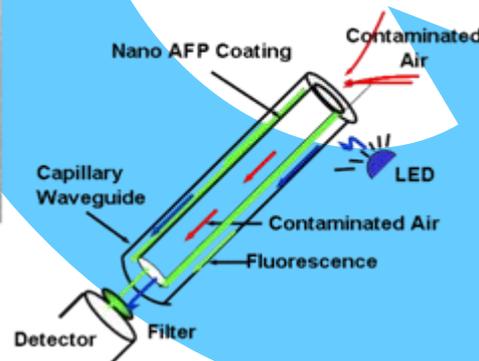
Fido/Packbot unmanned systems and Handheld Fido explosive sensors currently being used in Iraq

Fido X



- Rugged
- Handheld
- Lightweight
- Easy to operate
- Audio and visual indications

Integrated Detector/Sampler





Predicting the Future

It's tough to make predictions, especially about the future. Some famous technology predictions include:

- ***“Heavier-than-air flying machines are impossible.”***
 - ***Lord Kelvin, 1895***
- ***“Airplanes are ...of no military value.”***
 - ***Marshal Ferdinand Foch, 1911***
- ***“Who ... wants to hear actors talk ?”***
 - ***H. M. Warner, 1927***
- ***“... (T)here is world market for maybe five computers.”***
 - ***T. Watson, IBM Chairman, 1943***
- ***“640k (RAM) ought to be enough for anybody.”***
 - ***Bill Gates, 1981***



Army S&T... Engine of Transformation



**U.S. ARMY ARMAMENT RESEARCH,
DEVELOPMENT AND
ENGINEERING CENTER
2007 MALCOLM BALDRIGE
NATIONAL QUALITY AWARD**