



The Department of Defense S&T Program

***Innovation, Speed, and Agility
and the Impact on MANPRINT***

March 17, 2010

***Mr. Al Shaffer
Principal Deputy
Defense Research and Engineering***



Connecting Researchers to the Warfighter



President Obama, Speech at the National Academies of Science April 27, 2009



“At such a difficult moment, there are those who say we cannot afford to invest in science, that support for research is somehow a luxury at moments defined by necessities. I fundamentally disagree. Science is more essential for our prosperity, our security, our health, our environment, and our quality of life than it has ever been before.”

Continuing the Reform Agenda

This budget provides the resources to sustain a military at war. It takes care of our people, rebalances military capabilities, reforms what and how we buy, and supports our troops in the field.

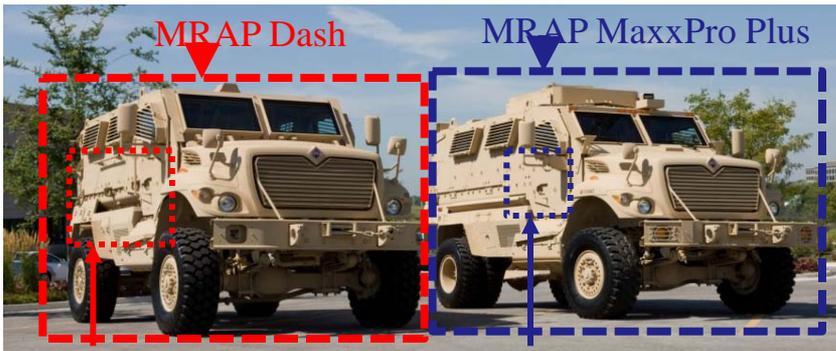
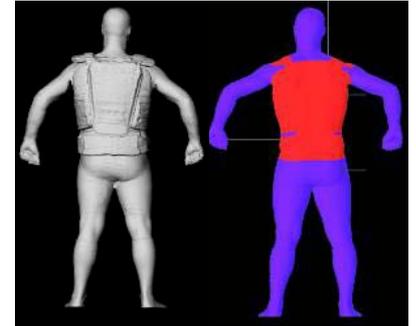




Key Themes

From Under Secretary Robert Hale 1 Feb 2010 Budget Rollout Brief and Secretary Gates 2010 Budget Rollout Brief

- *Taking Care of People*
- *Rebalancing the Military*
- *Reforming What and How We Buy*
- *Supporting our Troops in the Field*



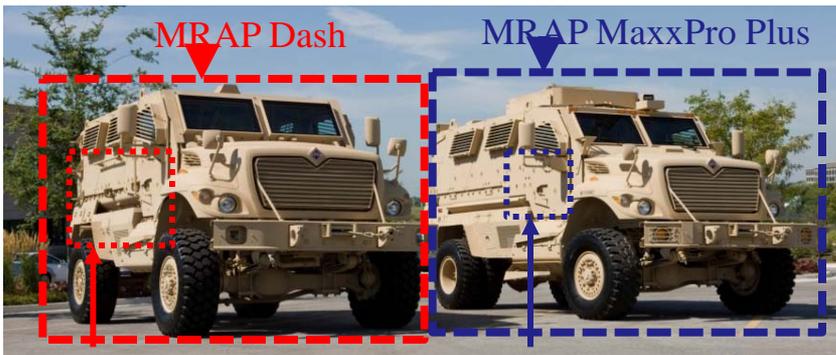
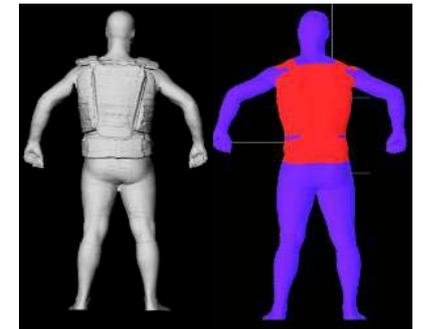


Key Themes

From Under Secretary Robert Hale 1 Feb 2010 Budget Rollout Brief and Secretary Gates 2010 Budget Rollout Brief

Why S&T and MANPRINT Matter

- *Taking Care of People*
- *Rebalancing the Military*
- *Reforming What and How We Buy*
- *Supporting our Troops in the Field*





Director, Defense Research and Engineering Imperatives

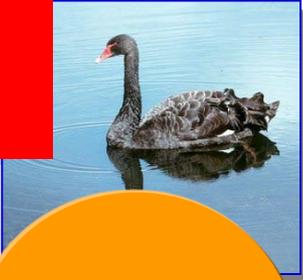


- 1. Accelerate delivery of technical capabilities to win the current fight.**
- 2. Prepare for an uncertain future.**
- 3. Reduce the cost, acquisition time and risk of our major defense acquisition programs.**
- 4. Develop world class science, technology, engineering, and mathematics capabilities for the DoD and the Nation.**

The need for MANPRINT is interwoven throughout the imperatives



New Global Dimensions Affecting S&T



Pace of Technology

Black Swan Syndrome

Information Agility



Economic Mega Trends

Rise of The Commons



Technology Commercialization

Expanding Global Knowledge Base



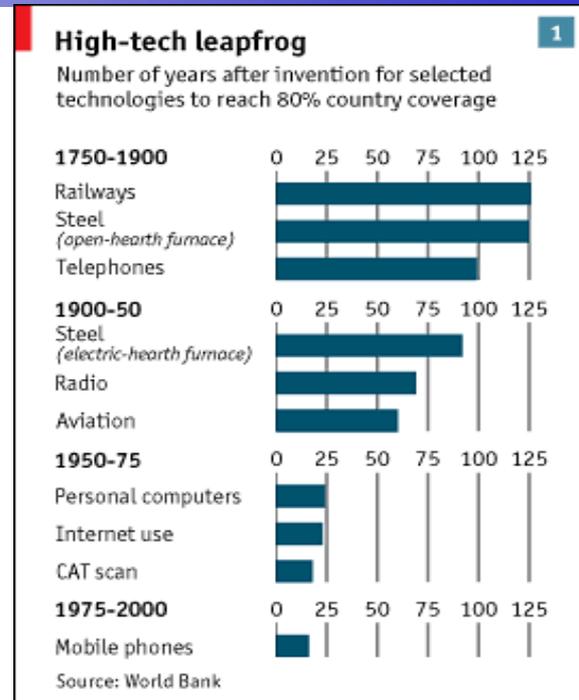
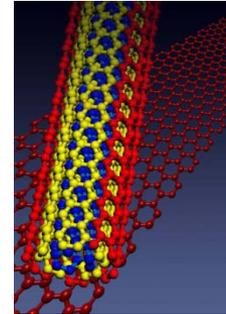
When the rate of change outside your organization exceeds that within your organization, the end is near. - Jack Welch, former CEO, General Electric



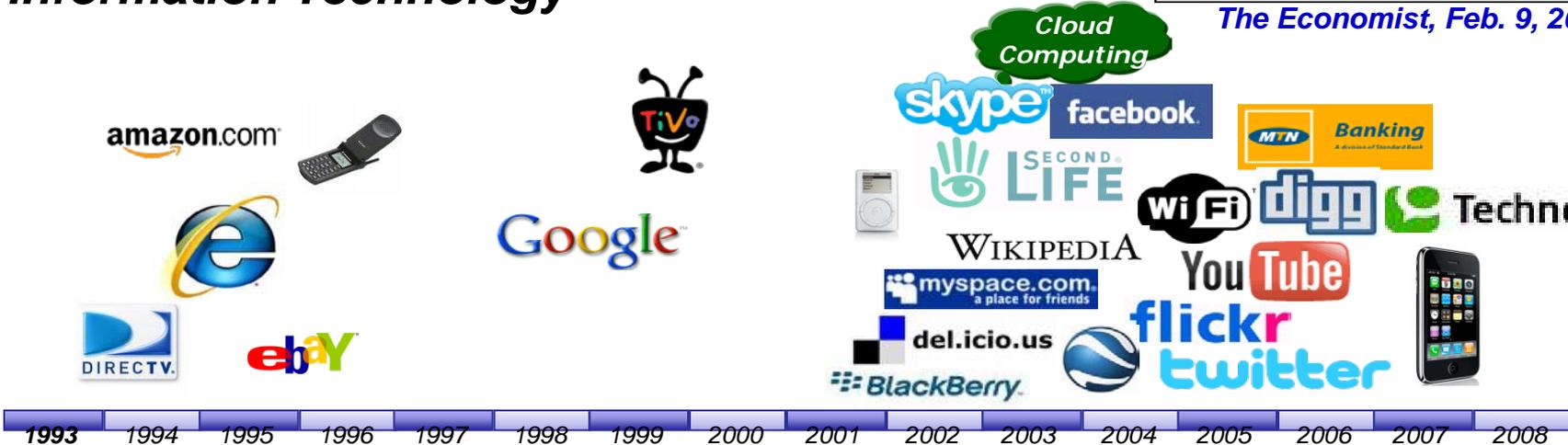
Pace of Technology Continues to Increase



- *Time between modeling of semiconducting properties of germanium in 1931 and first commercial product (transistor radio) was 23 years*
- **Carbon nanotube**
 - *Discovered by Japan (1991)*
 - *Researchers recognized carbon nanotubes were excellent sources of field-emitted electrons (1995)*
 - *“Jumbotron lamp” - nanotube-based light source available as commercial product (2000)*
- **Information Technology**



The Economist, Feb. 9, 2008





The Timeline has Collapsed (For Military Systems)!



Conventional Warfare

USAF Capability

High Altitude Aircraft



Electronic Countermeasures



Endgame Countermeasure



Engage SAM



Adversary Capability

High Altitude SAM



Monopulse SAM



SAM with ECCM



Response loop measured in years

Counter-Insurgency Warfare

US Capability

Jammers



Mine Resistant Ambush Protected (MRAP)



Adversary Capability



Advanced Technology

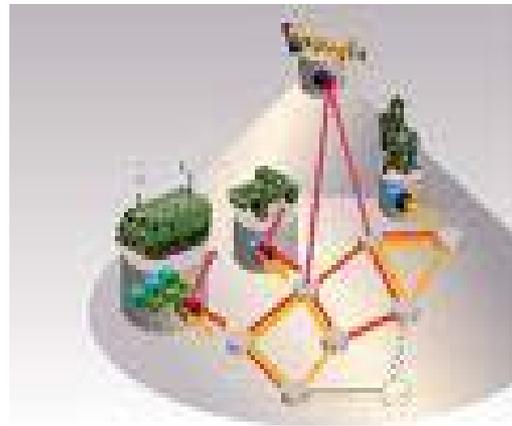
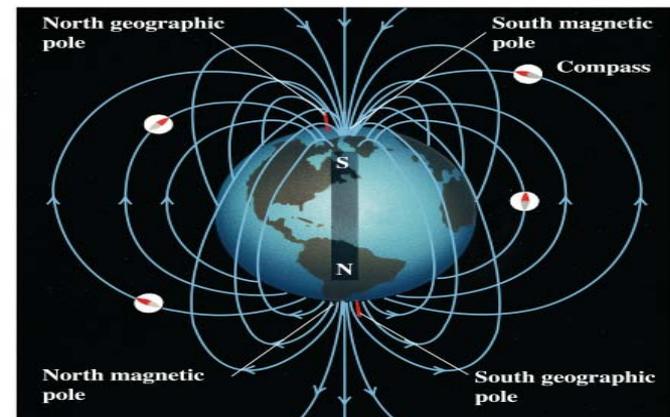
Response loop measured in months or weeks

The Challenge:
Maintain focus on MANPRINT as the cycle time decreases



Rise of the Commons

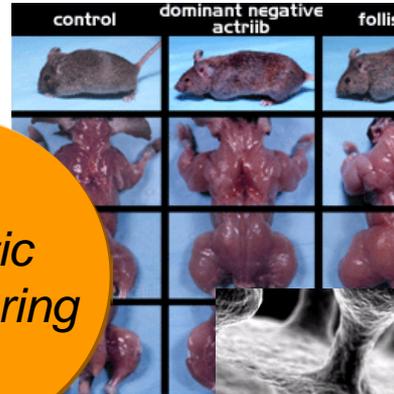
- ***Military operations increasingly depend on being able to operate in places “no one owns” – The Commons***
- ***U.S. DoD science and technology is increasing to assure capability to operate in the commons.***





Commercial / Military Hybrids

- Fundamentally can have global impact & change the balance and approach to force expression
- Drives and fuels the need for & new innovative concepts
- Includes how new capabilities are built on emerging technology
- Appearing increasingly from the global commercial marketplace



Genetic Engineering



Future Processors



Proliferant Lasers



Unmanned Vehicles



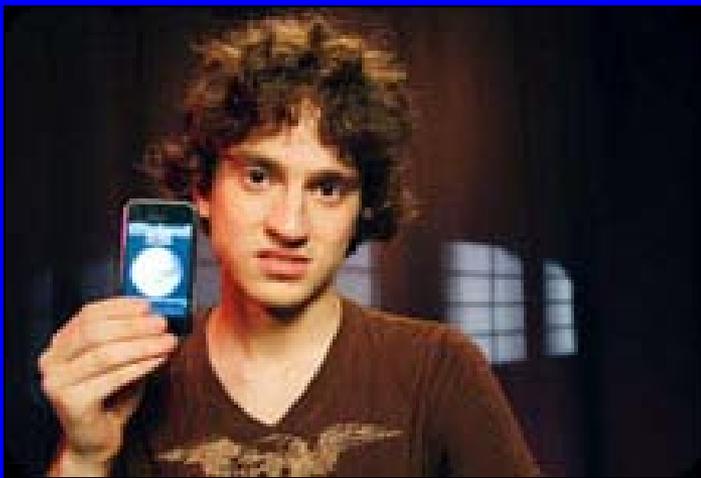
Wireless Devices





Information Agility

In 2007



George Hotz, 17, of Glen Rock, New Jersey holding the iPhone® that he separated from the AT&T network and used on the T-Mobile Network. Career goal: hack the human brain

- ❑ **Apple and AT&T released the iPhone on 29 June**
- ❑ **An exclusive agreement guaranteed the iPhone could only be used on AT&T's mobile network**
- ❑ **Hotz spent approximately 500 hours working on his “summer project”**
- ❑ **The hack was announced on 24 August.**
 - ❑ **AT&T - market cap: \$245B**
- annual revenue: \$90B
 - ❑ **Apple - market cap: \$117B**
- annual revenue: \$23B
 - ❑ **Hotz - PRICELESS**

This is the new asymmetry—victory goes to the agile and innovative

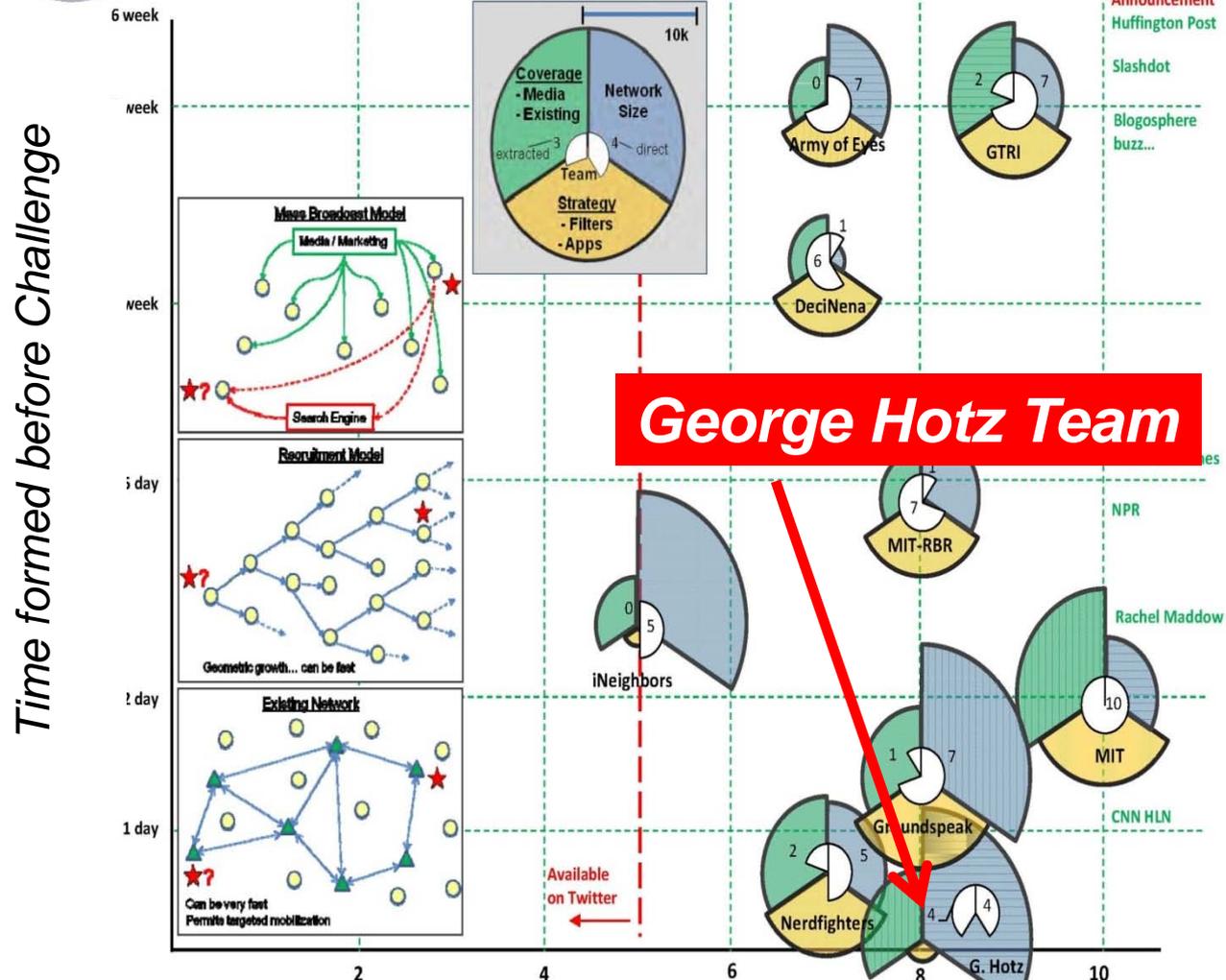


2010 DARPA "Balloon" Challenge

- In Dec 2009 – DARPA set out 10 red weather balloons
- First team to find all 10 won \$40K
- Teams self assembled using Internet
- Hotz formed a team the morning of the competition....and almost won
- The power of the network enables the individual



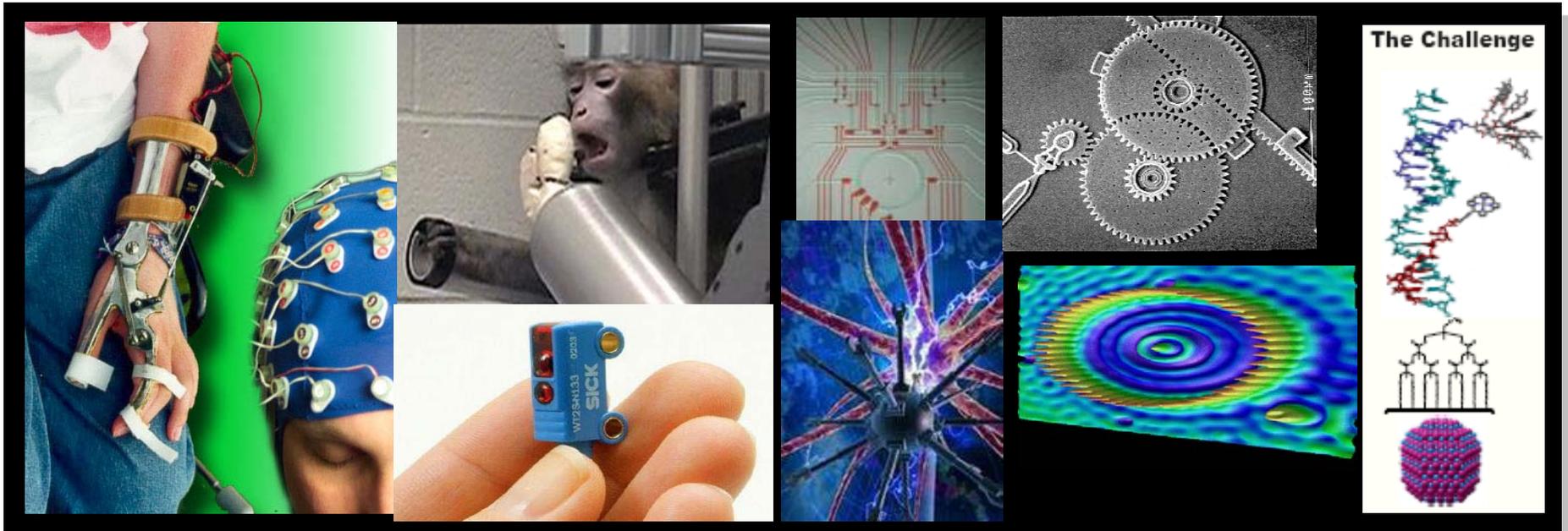
Network Challenge Team Performance





Implications

- Greater base of technology development, agility
- Probability of technology surprise increasing
- Technology increasingly hybrid, commercial/military



All factors drive to enhanced agility / speed



Take Care of Our People Wounded Warrior



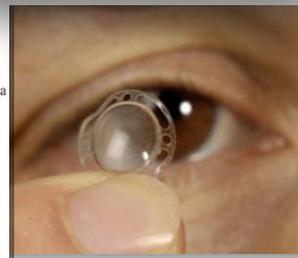
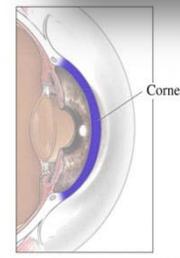
"...Beyond the recent one-time increase by the Congress for this specific purpose, I request the development of a tailored plan to provide R&D investments that advance state of the art solutions for world class medical care with an emphasis on Post Traumatic Stress Disorder, Traumatic Brain Injury, Prosthetics, Restoration of Sight and Eye-Care, and other conditions directly relevant to the injuries our soldiers are currently receiving on the battlefield."

Robert M. Gates, Secretary of Defense, 26 June, 2008

Secretary Gates "Big 5"

Funding increased
By
\$200M + in FY11

- **Post Traumatic Stress Disorder**
- **Traumatic Brain Injury**
- **Prosthetics**
- **Restoration of Sight and Eye-Care**
- **Other conditions directly relevant to injuries on the battlefield**





Forces of Change...



**Changing
International
Factors**

**Defense S&T for
Persistent Conflict**

**Changing
Warfare
Factors**

**NEW TECHNOLOGY NEEDED:
2 Strategic Initiatives:
Data to Decisions and Systems 2020**



Data to Decisions Emergent Technical Agenda



- **Intelligent Information Management at Scale**

- Intelligent data storage and retrieval
- New methods for data consistency and provenance

- **Data Manipulation**

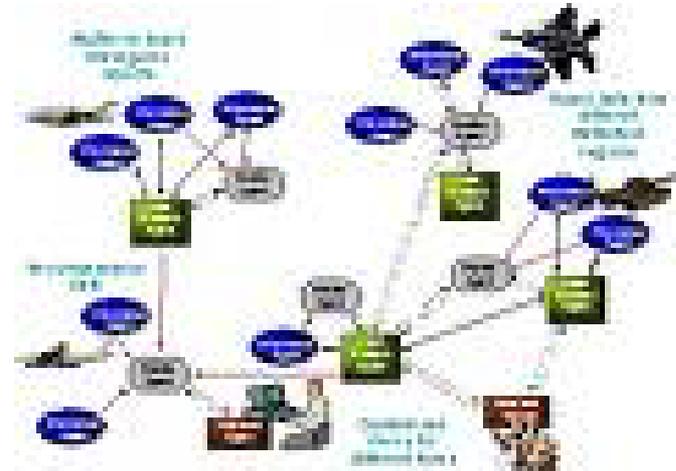
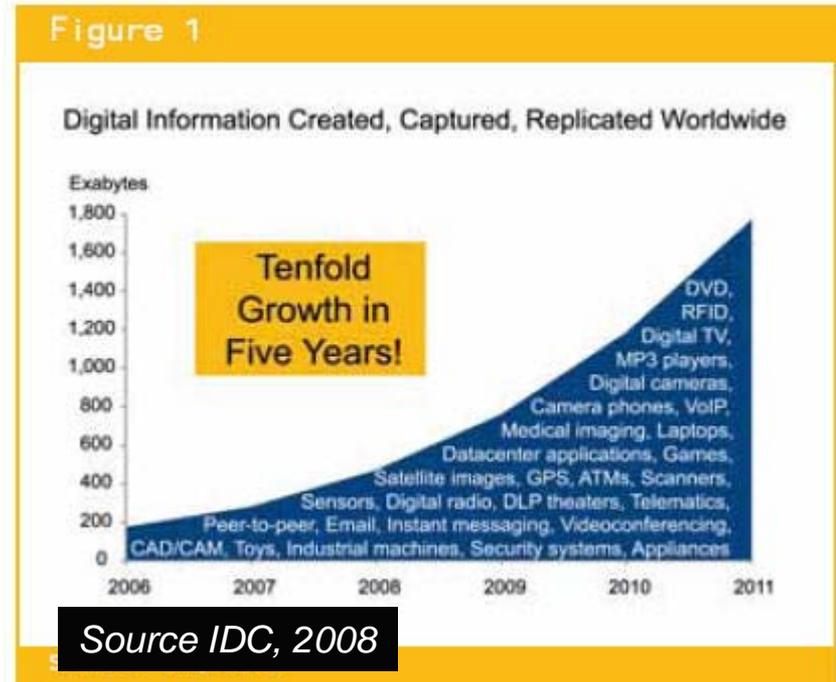
- Multi-INT representation
- Automated multi-source all-source registration

- **Machine Intelligence**

- Data mining tools for link and target discovery
- New techniques to automate exploration and detection of unknown threats and targets
- Fusion of physical and soft targets

- **Human-Computer Interface**

- Consequence-modeled decision aids
- Shared mental models for effective human-machine interactions





Systems 2020 Emergent Technical Agenda



- **Complex systems**
- **Multidisciplinary development – autonomy, software,**
- **Performance Optimization**
- **Trusted / Assured Performance**
- **Rapid Manufacture**
- **Human Systems Interface**

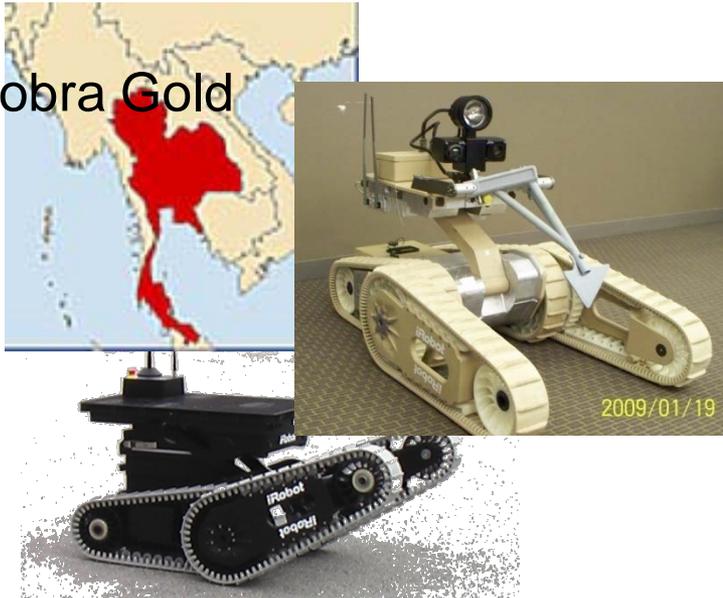




Systems 2020 – The Precursor DoD Robotics



Cobra Gold



Fixes to WARRIOR resulting from Warfighter Experimentation

@ Cobra Gold 2008

2 to 4 hours MTBF

5 kph Top Speed

10 – 15 hours Track Reliability

Line-of-sight teleoperation

@ Cobra Gold 2009

>24 hours

10 kph (soon >15 kph)

>100 hours

Heads-up video display

**2X – 6X Performance
Enhancement in one year**

Greater Autonomy & Manipulation Dexterity for EOD Technicians' robots:

- 80%+ increase in accuracy
- 35% decrease in time to complete task
- 25% decrease in overall workload





Reform Now What We Buy

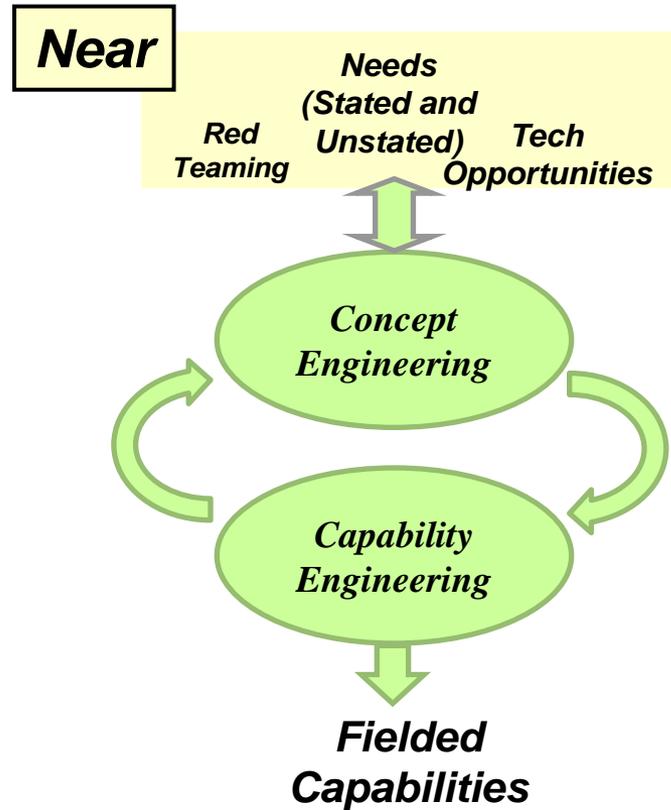
--Thoughts from the Secretary of Defense--



"I believe the Department should seek increasing competition, use of prototypes, and ensure technology maturity so that our programs are ready for the next phases of development..."

Secretary Gates before the SASC,
January 27, 2009

Systems Engineering Development Planning



Early Systems Engineering = Early application of MANPRINT



Support our Troops in the Field



Rapid Development and Fielding of Technology Solutions A Must for the S&T Community

- ***Joint Rapid Acquisition Cell***
- ***Fast Teams***
- ***MRAPs***



<http://www.amc-fast.army.mil/>



Next Big Thing

Forward Operating Base (FOB) Protection Helicopter Protection

Issue: Extended Lines Of Communication (LOCs) Terrain and Enemy Tactics increase vulnerability of Forward Operating Bases

- At least 7 currently open JUONS seeking enhanced FOB Protection
- Current Systems tend to be “Ad-Hoc”



Goal – Networked, Integrated Base Protection System



Goal – Helicopters with integrated sense and react capability

Issue: MANPADs/AAA threat to low flying OIF/OEF aircraft remains high; specter of newer seekers/missiles being introduced have potential to increase threat

- **Large size/weight/power attributes of current IR Counter Measures not suited to helicopters**
- **Reliability of current systems makes them unsuitable for OEF**

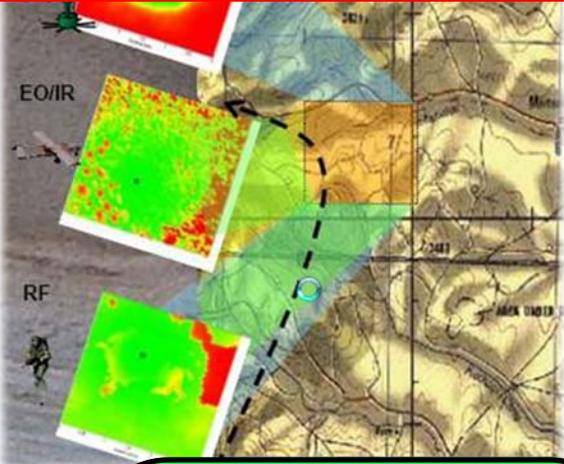


Base Protection: Gap Filler

Target: to USFOR-A by April



**Small-Base Leader Mission Planning/
Training CD for Sensor Employment**

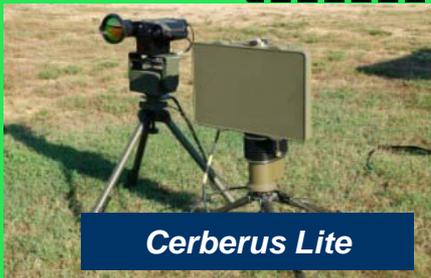


**Modular Protective Systems
for Side Cover**



**RECON III
Thermal Imaging
System**

**Ground
Surveillance
Radar**



Cerberus Lite

**Systems Engineering
Testbed**

**UTAMS
(Unattended
Transient
Acoustic
MASINT
System)**



**Unattended
Ground Sensors**



Helicopter Survivability Task Force (HSTF)



- ***Established by DDR&E 24 Jul 09 to address hostile fire threats to rotorcraft in Afghanistan***
- ***HSTF reconvened by DDR&E 1 Oct 2009 per SECDEF direction***
 - ***“What can we do to cut losses in helo incidents not involving hostile fires?”***
 - ***Hostile fires incidents are only 20% of all helo losses (36% of OEF losses)***
- ***Several safety & survivability enhancements identified for OEF helos***
 - ***Gapfiller technologies: Fieldable in 6 months***
 - ***Block 1 technologies: Fieldable in 12 months***
 - ***Block 2 technologies: Fieldable in 18 months***



HSTF Technologies

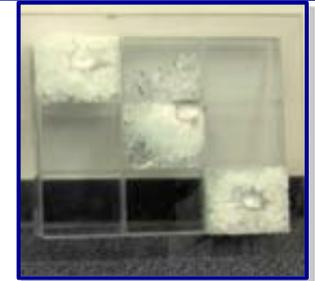


Aircraft Self-Protect Optimization



TAWS Surrogate

AAR-54 HFI



Transparent Armor



Firetrace Fire Suppression



Gen3 ECU



Existing sensors and displays



CMWS Gen 3 HFI



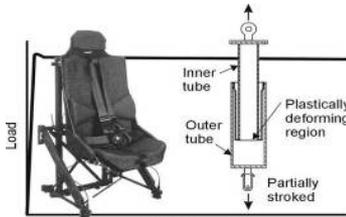
Defensive Systems Data Recorder



Engineering & Intelligence Ops



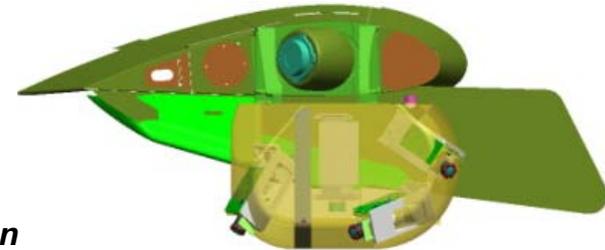
Helo Autonomous Landing System



Stroking Seating



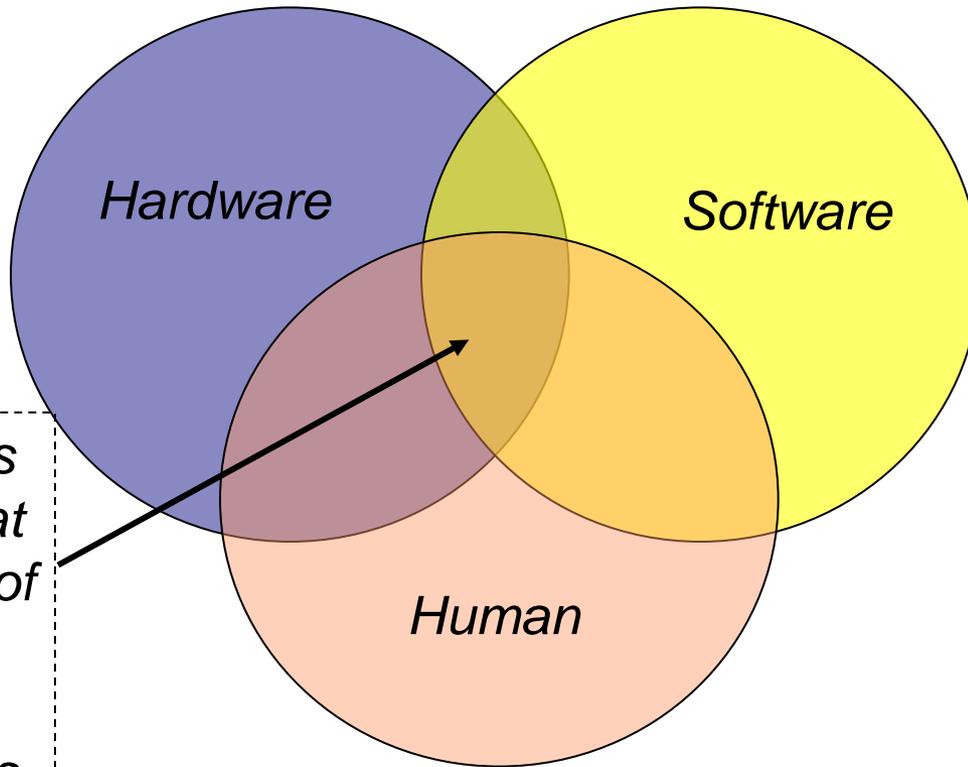
Open Architecture Display



WeaponWatch™ HFI for Apache



System Development Challenge



HSI performs its technical work at the intersection of Hardware, Software and Human elements.

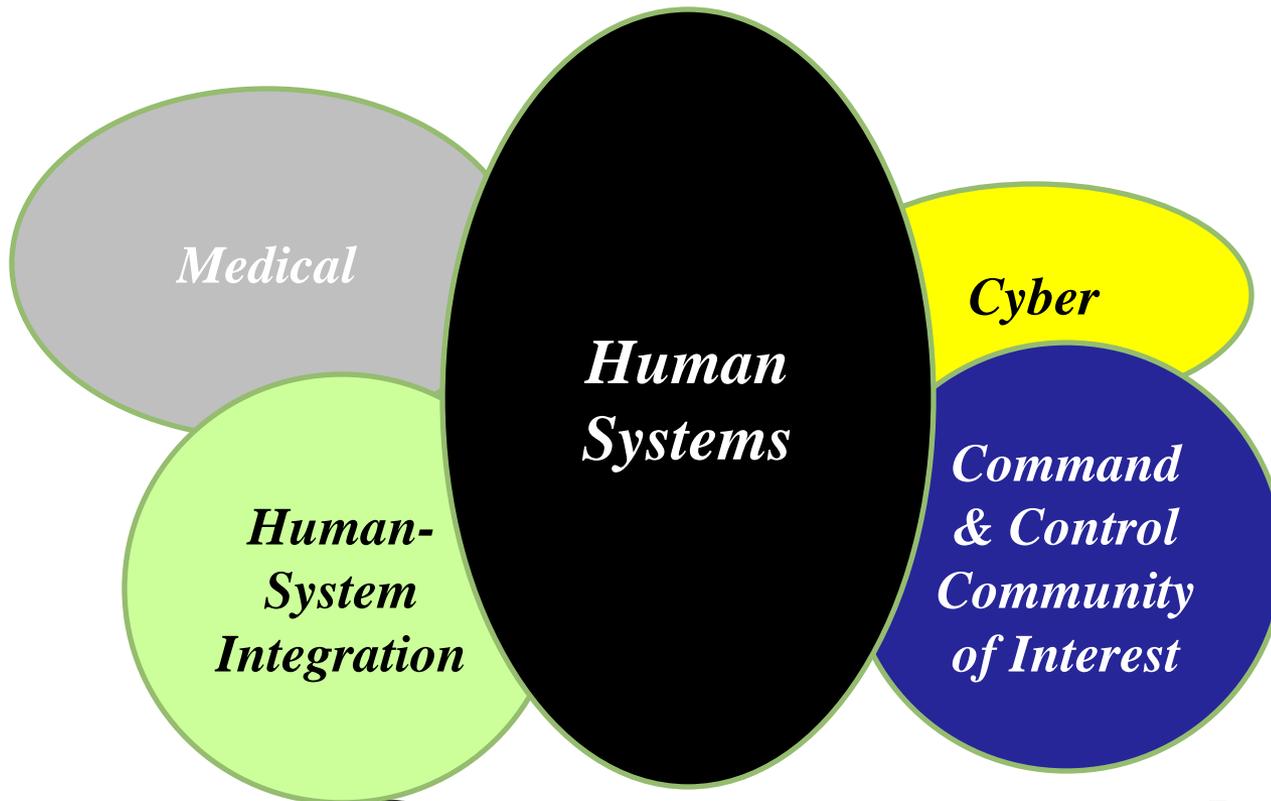
HSI Domains

- Human Factors
- Personnel
- Habitability
- Manpower
- Training
- Safety and Occupational Health
- Survivability

The key is to strike the right balance between the hardware, software and human in achieving the best possible system performance.



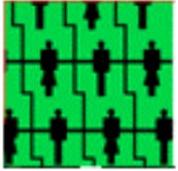
Human Systems are pervasive!!



Human Systems are critical!!



HSI DOMAINS



MANPOWER - number of military and civilian personnel required and potentially available to operate, maintain, sustain and provide training for systems



SURVIVABILITY - characteristics of system that can reduce fratricide, detectability, and probability of attack, as well as minimizing system damage, personal injury, and cognitive and physical fatigue



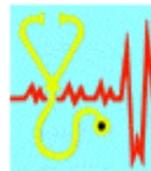
PERSONNEL - cognitive and physical capabilities require to train, operate, maintain and sustain material and information systems



SAFETY - design and operating characteristics of a system that minimize the human or machine errors or failures that cause accidents



TRAINING - instruction, education, and OJT required to provide personnel and units with their essential job skills, knowledge, values and attitudes.



OCCUPATIONAL HEALTH - design and operating characteristics of a system that create significant risks of bodily injury or death; sources of health hazards include: loud noise, chemical and biological substances, extreme temperatures, and radiation energy.



HUMAN FACTORS ENGINEERING - integration of characteristics into system definition, design, development and evaluation to optimize human-machine performance



HABITABILITY – establish requirements for physical environment (e.g. , adequate space and temperature control) and, if appropriate, requirements for personnel services (e.g., medical and mess) living conditions that have a direct impact on meeting or sustaining system performance.