12th Annual Science & Engineering Technology Conference/DoD TECH Exposition

"Linking the DoD S&T Program to Key Mission Areas"

NORTH CHARLESTON, SC

21 – 23 June 2011

Agenda

TUESDAY, JUNE 21, 2011

Keynote Address
- The Honorable Zachary J. Lemnios, Assistant Secretary of Defense for Research & Engineering

FY 2012 President’s Budget Request for DoD S&T Program
- Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)

DoD Basic Research Program with a Focus on Academia
- Dr. Randy Avent, Chief Scientist, Basic Science Office, OASD(R&E)

Rapid Fielding Directorate's Portfolio of Opportunities
- Mr. Earl Wyatt, Deputy Assistant Secretary of Defense, Rapid Fielding, OASD(R&E)

The DoD T&E/S&T Program
- Mr. George Rumford, T&E/S&T Program Manager, Defense Test Resource Management Center

Process Used to Develop the DoD Science & Technology Priorities
- Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)

Data to Decisions
- Dr. Randy Avent, Chief Scientist, Basic Science Office, OASD(R&E)

Autonomy
- Dr. Bobby Junker, Head, C4ISR Department, Office of Naval Research

Human Systems
- Dr. John F. Tangney, Director, Human & Bioengineered Systems Division, Office of Naval Research

Engineered Resilient Systems
- Dr. Randy Avent, Chief Scientist, Basic Science Office, OASD(R&E)

WEDNESDAY, JUNE 22, 2011

Providing Technology Enabled Capabilities
- Mr. Jeff Singleton, Director for Basic Research, Office of the Deputy Assistant Secretary of the Army (Research & Technology)

Overview of Naval Science, Technology, and Engineering
Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

Discussion on Navy and Marine Corps Technology Needs
Moderator: Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
- Mr. Michael Bosworth, Acting Chief Technology Officer, Naval Sea Systems Command
- Ms. Rebecca Ahne, Deputy Chief Technology Officer, Naval Aviation Enterprise
- Mr. James H. Smerchansky, Deputy Commander Systems Engineering, Interoperability, Architectures, & Technology, Marine Corps Systems Command

Overview of Air Force Science, Technology, and Engineering
- Colonel Mark Koch, USAF, Associate Deputy Assistant Secretary of the Air Force (Science, Technology & Engineering)

High Velocity Penetrating Weapon (HVPW)
- Mr. Leo Rose, U.S. Air Force Research Laboratory/RW, Program Manager

Responsive Reusable Booster for Space Access
- Mr. Bruce Thieman, Air Vehicles Directorate, U.S. Air Force Research Laboratory

Precision Airdrop
- Dr. Keith Bowman, Air Vehicles Directorate, U.S. Air Force Research Laboratory

THURSDAY, JUNE 23, 2011

How Capabilities are Developed and Delivered to the Combatant Commanders
- Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)

USCENTCOM
- Mr. Eric A. Follstad, Chief, Transformation & Concept Development, USCENTCOM

USSOCOM
- Ms. Lisa Sanders, Deputy Director Science & Technology, USSOCOM

USPACOM
- Mr. Ken Bruner, Science Advisor, USPACOM

USSOUTHCOM
- Mr. Ricky Stuart, Technology Manager, USSOUTHCOM

USTRANSCOM
- Mr. Lou Bernstein, Chief, Future Capabilities & Technology, USTRANSCOM

USSTRATCOM
- Mr. Dave Tyner, Science & Technology Advisor, USSTRATCOM

USNORTHCOM
- Dr. Susanne Wirwille, Director, Science & Technology, NORAD and USNORTHCOM

USEUCOM
- Mr. Stephen L. Spehn, Deputy Science Advisor, USEUCOM
12TH ANNUAL SCIENCE & ENGINEERING TECHNOLOGY CONFERENCE / DoD TECH EXPOSITION

Linking the DoD S&T Program to the DoD S&T Priorities

CONFERENCE AGENDA
EXHIBITOR PROFILES
ATTENDEE ROSTER

Event #1720
June 21 – 23, 2011
Charleston Convention Center ➔ North Charleston, SC
The 12th Annual S&ET Conference / DoD Tech Exposition will occur on June 21 - 23, 2011, at the Charleston Convention Center, North Charleston, SC. This year's conference is dedicated to the memory of Dr. A. Louis Medin, the founding Chairman of the NDIA S&ET Division.

The 2010 Quadrennial Defense Review (QDR) identified the need for the DoD to “rebalance its policy, doctrine, and capabilities to better support 6 key missions.” Success in the QDR’s key mission areas is dependent on the development, integration, and timely deployment of critical core capabilities. These capabilities must align to the dynamic threat environment, evolving mission architectures, and are enabled by critical investments in science and technology.

The ASD(R&E), with the support of the Services, Agencies and Joint Staff, led studies to identify the core capabilities and enabling technologies for each of the six QDR key mission areas. These studies were completed and identified near and long-term technology investments that will be required to contribute to success in these mission areas. The DoD Science & Technology (S&T) Executive Committee considered the results of these studies, along with Service S&T priorities, and the recommendations of DoD S&T Communities of Interest and DoD Technology Focus Teams, to develop a list of 7 DoD S&T Priorities. These 7 DoD S&T Priorities were documented in a memorandum signed by the Secretary of Defense on April 19, 2011. In this memorandum, the Secretary directed that implementation roadmaps be developed for each S&T Priority to coordinate the Department’s “investments in the priority areas to accelerate the development and delivery of capabilities consistent with these priorities.”

Speakers from the DoD will present background information, a status update, and the technology challenges associated with each of the 7 S&T Priorities, plus technology investments the Services are making to achieve success in each of the 7 S&T Priority areas. Briefers will highlight opportunities for industry collaboration with Services and Agencies and identify technology areas in which industry may want to consider making independent (IR&D) investments. Speakers will be available in the “Speakers Corner” after each session. The conference will again, this year feature poster paper sessions with authors available for discussion and interaction on emerging concepts and technology. There will also be opportunities for industry and academia to present ideas to Service representatives in One-On-One Sessions. Sign-up sheets will be available at the Conference Registration Desk. The DoD Speakers will also be available to discuss new business opportunities.

S&ET Division Chair:
Mr. James Chew, Director, Advanced Technologies & Concepts, L-3 Communications

S&ET Division Vice Chair:
Dr. Jocelyn Seng, Research Staff, Institute for Defense Analyses, (Brigadier General, USAFR)

S&ET Division Secretary:
Mr. Michael Liggett, Director Technology Programs, Raytheon Company

S&ET Conference Co-Chairs:
- Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)
- Dr. Preston W. “Chip” Grounds, Director Electronics, Sensors, & Networks Research Division, Office of Naval Research
- Mr. Chris Miller, Executive Director SES, SPAWAR
TUESDAY, JUNE 21, 2011

7:00 AM – 6:30 PM  Conference Registration
                Ballroom A & B Foyer

7:00 AM – 8:00 AM  Continental Breakfast
                Ballroom A & B Foyer

8:00 AM – 8:15 AM  Welcome Remarks
                General Session - Ballroom A & B
        ▶ Major General Barry D. Bates, USA (Ret),
          Vice President of Operations, National Defense
          Industrial Association
        ▶ Mr. James Chew, Director, Advanced
          Technologies & Concepts, L-3 Communications;
          S&ET Division Chair

8:15 AM – 9:15 AM  Keynote Address
                General Session - Ballroom A & B
        The Honorable Zachary J. Lemnios, Assistant
        Secretary of Defense for Research & Engineering

9:15 AM – 12:15 PM  FY 2012 President's Budget Request and
                    Opportunities for Collaboration Session
                General Session - Ballroom A & B
In this session, we will present the Fiscal Year 2012
President’s Budget Request for the DoD S&T program. Specific programs that provide conference
Attendees opportunities to engage in collaborative
efforts with the DoD S&T community will also
be highlighted. Presentations will provide information
on technology areas of high interest to the DoD,
time lines, and points of contact for the submission of
proposals. Opportunities for both industry and
academia will be covered. A wide range of programs,
from the larger technology demonstrations funded by
the Joint Capability Technology Demonstration
program, that lead to the evaluation of military utility
of advanced technology by a Combatant Commander;
to the more focused technology development efforts
that are funded by the Test & Evaluation/Science
& Technology (T&E/S&T) program will be covered.
Opportunities for proposing commercial off-the-shelf
technology to meet current military needs will be
addressed by “The Rapid Fielding Directorate’s
Portfolio of Opportunities” presentation. The session
will be rounded out with brief presentations by poster
paper Authors, highlighting the topics of poster papers
that will be on display.
Co-Chairs:
        ▶ Dr. Raj K. Aggarwal, Managing Director,
          Advanced Research & Technology, College of
          Engineering, Iowa State University
        ▶ Mr. Michael Liggett, Director Technology
          Programs, Raytheon Corporation

ONE-ON-ONE SESSIONS
There will be the opportunity to meet with a USA, USN or USAF
Representative in One-On-One Sessions. You may sign-up for your private, 15
minute One-On-One Session on-site at the Conference Registration Desk.
Reservations will be on a first-come, first-served basis, and will be limited to
one session with each Service.

ONE-ON-ONE REPRESENTATIVES
Army:
    ▶ Mr. Thomas Haduch, Chief, Cross
       Command Integration, Programs &
       Engineering U.S. Army Research,
       Development and Engineering
       Command
    ▶ Ms. Lucy Priddy, Engineer Research
       & Deveoplpment Center, CoE
    ▶ Mr. Jeff Singleton, Director for Basic
       Research, Office of the Deputy Assistant
       Secretary of the U.S. Army Research &
       Technology

Navy:
    ▶ Mr. Craig Hughes, Deputy Director
       of Innovation, Office of Naval Research
    ▶ Dr. Joseph Lawrence, Director of
       Transition, Office of Naval Research
    ▶ Dr. Kam Ng, Deputy Director of
       Research, Office of Naval Research
    ▶ Mr. Bob Smith, Director, Technology
       Transition Initiatives, Office of Naval
       Research
    ▶ Mr. Eric Wilson, Deputy Director of
       Transition, Office of Naval Research

Air Force:
    ▶ Mr. Chris Clay, Deputy Division
       Chief, Science and Technology Division,
       Office of the Deputy Assistant Secretary
       of the U.S. Air Force for Science,
       Technology, and Engineering

SPEAKER DONATION
In lieu of Speaker Gifts, a donation has been made to the Wounded Warrior
Project. For additional information, please visit:
www.woundedwarriorproject.org

SURVEY
A survey will be e-mailed to you after the event. NDIA would appreciate your
time in completing the survey to help make our event even more successful in
the future.
The ASD(R&E), with the support of the Services, Agencies and Joint Staff, led studies to identify the core capabilities and enabling technologies for each of the 6 QDR key mission areas. These studies were completed and identified near and long-term technology investments that will be required to contribute to success in these mission areas. The DoD Science & Technology (S&T) Executive Committee considered the results of these studies, along with Service S&T priorities, and the recommendations of DoD S&T Communities of Interest and DoD Technology Focus Teams, to develop a list of 7 DoD S&T Priorities. These 7 DoD S&T Priorities were documented in a memorandum signed by the Secretary of Defense on April 19, 2011. In this memorandum, the Secretary directed that implementation roadmaps be developed for each S&T Priority to coordinate the Department’s investments in these priority areas. In this session, team leaders responsible for developing the implementation roadmaps will provide an update on the background, status, and the identification of the technology challenges associated with 4 of the 7 DoD S&T Priorities. The remaining 3 DoD S&T Priorities (Cyber Science and Technology, Counter Weapons of Mass Destruction, and Electronic Warfare/Electronic Protection) will be presented in the Classified Session on Thursday afternoon.

Co-Chairs:
- Dr. Jim Wasson, Vice President, Business Development, Bennett Aerospace
- Dr. Al Emondi, Deputy Chief Technology Officer, SPAWAR, Atlantic

Process Used to Develop the DoD Science & Technology Priorities
Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)
## TUESDAY, JUNE 21, 2011

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<th>Time</th>
<th>Session</th>
<th>Speaker/Role</th>
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<tr>
<td>2:30 PM – 2:45 PM</td>
<td>A Message to Industry</td>
<td>Ms. Matice Wright, Principal Director, Manufacturing and Industrial Base Policy, OUSD(AT&amp;L)</td>
</tr>
<tr>
<td>2:45 PM – 3:15 PM</td>
<td>Data to Decisions</td>
<td>Dr. Randy Avent, Chief Scientist, Basic Science Office, OASD(R&amp;E)</td>
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<tr>
<td>3:15 PM – 3:45 PM</td>
<td>Networking Break</td>
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<td>3:45 PM – 4:15 PM</td>
<td>Autonomy</td>
<td>Dr. Bobby Junker, Head, C4ISR Department, Office of Naval Research</td>
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<tr>
<td>4:15 PM – 4:45 PM</td>
<td>Human Systems</td>
<td>Dr. John F. Tangney, Director, Human &amp; Bioengineered Systems Division, Office of Naval Research</td>
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<tr>
<td>4:45 PM – 5:15 PM</td>
<td>Engineered Resilient Systems</td>
<td>Dr. Randy Avent, Chief Scientist, Basic Science Office, OASD(R&amp;E)</td>
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<tr>
<td>5:15 PM – 6:30 PM</td>
<td>Networking Reception</td>
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## WEDNESDAY, JUNE 22, 2011

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<tr>
<td>7:00 AM – 5:00 PM</td>
<td>Conference Registration</td>
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<td>7:00 AM – 7:55 AM</td>
<td>Continental Breakfast</td>
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<tr>
<td>7:55 AM – 8:00 AM</td>
<td>Opening Remarks</td>
<td>Mr. James Chew, Director, Advanced Technologies &amp; Concepts, L-3 Communications; S&amp;ET Division Chair</td>
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<tr>
<td>8:00 AM – 5:00 PM</td>
<td>Services Sessions</td>
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<tr>
<td>8:00 AM – 10:00 AM</td>
<td>Army Science &amp; Technology Program Session</td>
<td>Co-Chairs: Dr. Walter F. (Rick) Morrison, Principal, Booz Allen Hamilton; Mr. Jeff Singleton, Director for Basic Research, Office of the Deputy Assistant Secretary of the Army (Research &amp; Technology)</td>
</tr>
<tr>
<td>8:00 AM – 9:00 AM</td>
<td>Providing Technology Enabled Capabilities</td>
<td>Mr. Jeff Singleton, Director for Basic Research, Office of the Deputy Assistant Secretary of the Army (Research &amp; Technology)</td>
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WEDNESDAY, JUNE 22, 2011

9:00 AM – 9:45 AM
Providing Soldiers Strategic Technology Enablers
Dr. David Pittman, Director of the Geotechnical and Structures Laboratory, U.S. Army Engineer Research & Development Center, U.S. Army Corps of Engineers

9:45 AM – 10:00 AM
Question and Answer Session
Moderator: Dr. Walter F. (Rick) Morrison, Principal, Booz Allen Hamilton
  ➤ Dr. Marilyn M. Freeman, Deputy Assistant Secretary of the Army (Research & Technology)
  ➤ Dr. David Pittman, Director of the Geotechnical and Structures Laboratory, U.S. Army Engineer Research & Development Center, U.S. Army Corps of Engineers

10:00 AM – 12:00 PM
MRAP Integration Facility Tour*
(Optional MRAP Tour)
Off-site Location (See left column for details)

10:00 AM – 10:30 AM
Networking Break
Exhibit Hall - Exhibition Hall A

10:30 AM – 12:30 PM
The Naval Science & Technology Program Session
General Session - Ballroom A & B
Co-Chairs:
  ➤ Mr. Dennis L. Ryan, III, Science & Technology Planning Director, Johns Hopkins University, Applied Physics Laboratory
  ➤ Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
  ➤ Mr. E. Terrence Dailey, Director for Transition, Carnegie Mellon University, Software Engineering Institute

10:30 AM – 11:15 AM
Overview of Naval Science, Technology, and Engineering
Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

11:15 AM – 12:30 PM
Discussion on Navy and Marine Corps Technology Needs
Moderator: Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
  ➤ Mr. Rob Wolborsky, Chief Technology Officer (CTO), SPAWAR
  ➤ Mr. Michael Bosworth, Acting Chief Technology Officer, Naval Sea Systems Command
  ➤ Ms. Rebecca Ahne, Deputy Chief Technology Officer, Naval Aviation Enterprise
  ➤ Mr. James H. Smerchansky, Deputy Commander Systems Engineering, Interoperability, Architectures, & Technology, Marine Corps Systems Command

12:30 PM – 1:30 PM
Networking Buffet Lunch
Exhibit Hall - Exhibition Hall A

MRAP INTEGRATION FACILITY TOUR*
During the conference, there will be an optional MRAP Integration Facility Tour. The tour will take place on Wednesday, June 22 from 10:00 AM until 12:00 PM. The tour will walk through the MRAP Integration Facility with storyboards describing their processes and success stories. There are 50 vehicles in the facility for integration of electronic systems. To attend the tour, one must have already submitted a visit request. If you submitted a visit request for the Classified Session, you do not need to send another visit request. Tour attendance will be awarded on a first-come, first-served basis. To sign-up, please see the Conference Registration Desk.

➤ The Tour is limited to the first 50 Attendees who sign-up at the Conference Registration Desk
➤ Prior submittal of visit request required to participate
➤ Transportation will be provided

QUESTIONS
Please contact Mr. James Polk at: james.polk@navy.mil or (843)218-5699 with questions or concerns regarding the MRAP Integration Facility Tour.
WEDNESDAY, JUNE 22, 2011

1:30 PM – 5:00 PM  
**Air Force Science & Technology Program Session**  
*General Session - Ballroom A & B*  
**Co-Chairs:**  
- Mr. Michael C. Dudzik, Vice President, Science & Technology, Lockheed Martin  
- Mr. Chris Clay, Deputy Division Chief, Science & Technology Division, Office of the Deputy Assistant Secretary of the U.S. Air Force for Science, Technology, and Engineering

1:30 PM – 2:15 PM  
**Overview of Air Force Science, Technology, and Engineering**  
Colonel Mark Koch, USAF, Associate Deputy Assistant Secretary of the Air Force (Science, Technology & Engineering)

2:15 PM – 2:45 PM  
**High Velocity Penetrating Weapon (HVPW)**  
Mr. Ron Taylor, Munitions Directorate, U.S. Air Force Research Laboratory

2:45 PM – 3:30 PM  
**Networking Break - Last Chance to Observe Exhibits and Poster Papers**  
*Exhibit Hall - Exhibition Hall A*

3:30 PM – 4:00 PM  
**Responsive Reusable Booster for Space Access**  
Mr. Bruce Thieman, Air Vehicles Directorate, U.S. Air Force Research Laboratory

4:00 PM – 4:30 PM  
**Precision Airdrop**  
Dr. Keith Bowman, Air Vehicles Directorate, U.S. Air Force Research Laboratory

4:30 PM – 5:00 PM  
**IR&D Linkage to Service Core Functions**  
Dr. James Malas, Plans & Programs Directorate, U.S. Air Force Research Laboratory

5:00 PM  
**Adjourn for the Day**

THURSDAY, JUNE 23, 2011

7:00 AM – 12:00 PM  
**Conference Registration**  
*Ballroom A & B Foyer*

7:00 AM – 7:55 AM  
**Continental Breakfast**  
*Ballroom A & B Foyer*

7:55 AM – 8:00 AM  
**Opening Remarks**  
*General Session - Ballroom A & B*  
Mr. James Chew, Director, Advanced Technologies & Concepts, L-3 Communications; S&ET Division Chair

8:00 AM – 12:00 PM  
**Capabilities Needed by the Combatant Commanders Session**  
*General Session - Ballroom A & B*  
Meeting the capability needs of the warfighter is the most important goal of the DoD Science & Technology program. Establishing strong communications between the warfighter and the researcher is essential for understanding these capability needs. Warfighters traditionally communicate their needs in terms of capability gaps. The DoD S&T community must be able to address those gaps in S&T projects and demonstrate how enabling technology can effectively fill these capability gaps. In this session, representatives of U.S. Combatant Commanders will describe what new operational capabilities would make a big difference in their ability to conduct military operations in their areas of responsibility.

**Co-Chairs:**  
- Mr. James Chew, Director, Advanced Technologies & Concepts, L-3 Communications  
- Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
THURSDAY, JUNE 23, 2011

8:00 AM – 8:20 AM  How Capabilities are Developed and Delivered to the Combatant Commanders
Mr. Robert W. Baker, Deputy Director, Plans & Programs, OASD(R&E)

8:20 AM – 8:40 AM  USCENTCOM
Mr. Eric A. Follstad, Chief, Transformation & Concept Development, USCENTCOM

8:40 AM – 9:00 AM  USSOCOM
Ms. Lisa Sanders, Deputy Director Science & Technology, USSOCOM

9:00 AM – 9:20 AM  USPACOM
Mr. Ken Bruner, Science Advisor, USPACOM

9:20 AM – 9:40 AM  USSOUTHCOM
Mr. Ricky Stuart, Technology Manager, USSOUTHCOM

9:40 AM – 10:00 AM  Networking Break
Ballroom A & B Foyer

10:00 AM – 10:20 AM  USTRANSCOM
Mr. Lou Bernstein, Chief, Future Capabilities & Technology, USTRANSCOM

10:20 AM – 10:40 AM  USSTRATCOM
Mr. Dave Tyner, Science & Technology Advisor, USSTRATCOM

10:40 AM – 11:00 AM  USAFRICOM
Mr. Mike Owens, Science & Technology Advisor, USAFRICOM

11:00 AM – 11:20 AM  USNORTHCOM
Dr. Susanne Wirwille, Director, Science & Technology, NORAD and USNORTHCOM

11:20 AM – 11:40 AM  USEUCOM
Mr. Stephen L. Spehn, Deputy Science Advisor, USEUCOM

11:40 AM – 12:00 PM  Best Poster Winner Announcement and Closing Remarks
▷ Mr. James Chew, Director, Advanced Technologies & Concepts, L-3 Communications; S&ET Division Chair
▷ Mr. Michael Liggett, Director Technology Programs, Raytheon Company

12:00 PM  Conference Adjourned and Boxed Lunch Served

Classified Session Badge Pick-Up Desk Hours

Do not forget to pick-up your Classified Session Badge! All Classified Session Attendees must have a conference badge, a classified badge and a valid photo ID to attend the session.

TUESDAY, JUNE 21, 2011
7:00 AM – 8:00 AM
9:45 AM – 10:15 AM
2:45 PM – 3:30 PM

WEDNESDAY, JUNE 22, 2011
7:00 AM – 8:00 AM
10:00 AM – 10:30 AM
3:30 PM – 4:00 PM

THURSDAY, JUNE 23, 2011
7:00 AM – 8:00 AM
9:30 AM – 10:10 AM
12:10 PM – 12:45 PM
THURSDAY, JUNE 23, 2011

1:00 PM – 5:15 PM

**Classified Session**

*Off-site Location: SPAWAR's facility on Base*

Registered NDIA S&ET Conference Attendees are invited by OASD(R&E) and SPAWAR to attend a Classified Session held off-site. Classified Session Attendees must hold a Secret Level Classification and must have previously submitted and verified their clearance acceptance with the SPAWAR security office by Friday, June 10, 2011. **Classified Session Attendees must have a valid ID and a Classified Issued Badge to attend this Session.**

**Co-Chairs:**
- Dr. Al Emondi, Deputy Chief Technology Officer, SPAWAR, Atlantic
- Mr. James Chew, Director, Advanced Technologies & Concepts, L-3 Communications; S&ET Division Chair

1:00 PM – 1:30 PM

**Classified Session Attendees Proceed to Off-Site Location**

Bus Transportation to the Classified Session Provided; **WILL START AT 1:00 PM SHARP**

Front Drive

1:30 PM – 2:00 PM

**Operate Effectively in Cyberspace**

Dr. Steven King, Deputy Director for Cyber Security Technology, OASD(R&E)

2:00 PM – 2:30 PM

**Counter Weapons of Mass Destruction (WMD)**

Dr. Carol Kuntz, Senior Advisor, Office of the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs

2:30 PM – 3:00 PM

**Electronic Warfare/Electronic Protection**

Dr. Peter Craig, Electronic Warfare Program Manager, Office of Naval Research

3:00 PM – 3:15 PM

**Networking Break (Refreshments not provided)**

3:15 PM – 3:35 PM

**USSTRATCOM**

Mr. Dave Tyner, Science & Technology Advisor, USSTRATCOM

3:35 PM – 3:55 PM

**USSOCOM**

Ms. Lisa Sanders, Deputy Director Science & Technology, USSOCOM

3:55 PM – 4:15 PM

**USCENTCOM**

Mr. Eric A. Follstad, Chief, Transformation & Concept Development, USCENTCOM

4:15 PM – 4:35 PM

**USPACOM**

Mr. Ken Bruner, Science Advisor, USPACOM

4:35 PM – 4:55 PM

**USNORTHCOM**

Dr. Susanne Wirwille, Director, Science & Technology, NORAD and USNORTHCOM

4:55 PM – 5:15 PM

**USSOUTHCOM**

Mr. Ricky Stuart, Technology Manager, USSOUTHCOM

5:15 PM

**Classified Session Adjourned and Return Bus Service**
Booth # - 218
Aeros Aeronautical Systems
Aeros is the world’s leading lighter-than-air, FAA-certified aircraft manufacturing company. The company’s operations involve the research, development, production, operation and marketing of a complete family of Aeros-branded air vehicles used in government and commercial applications. These include non-rigid FAA Type Certified Aeros 40D Sky Dragon Airships, Advanced Tethered Aerostatic Systems and New Type Rigid Air Vehicle - Aeroscraft.

Booth # - 220
Bennett Aerospace, Inc.
Bennett Aerospace is a small business and a high-end, highly technical, engineering and development company based in Cary, North Carolina. The company’s core capabilities are in:
 • Optics and Lasers: Holographic Visualization; Tunable Lasers; Fiber Lasers • Sensor and Instrumentation Development: Lidar Systems; Phased Array Radar • Space Hardware: Communications; Navigation; Strategic Assessments • Robotics: System Design and Build; Shipboard Robotics • Communications: System and Component Design; Terrestrial and Space • Materials and Manufacturing: Additive Manufacturing; Nano-Scale High-Strength Fiber; Advanced Materials; Nano-scale Piezoelectrics

Booth # - 107
Biometrics Identity Management Agency
The Biometrics Identity Management Agency (BIMA) leads Department of Defense activities to program, integrate, and synchronize biometric technologies and capabilities. BIMA collaborates with stakeholders and the biometric community to lead in the development of biometric capabilities that empower the warfighter.

Booth # - 109
Center for Organic Photonics and Electronics
The Georgia Tech Center for Organic Photonics and Electronics (COPE) is a leading research and educational resource center that creates flexible organic photonic and electronic materials and devices that serve the information technology, telecommunications, energy, and defense sectors.

Booth # - 306
Dassault Systemes Americas Corp.
As a world leader in 3D and Product Lifecycle Management (PLM) solutions, Dassault Systèmes develops and markets PLM application software and services that support the defense industry's industrial processes and provide a 3D vision of the entire lifecycle of products. Solutions include: Integrated product design, realistic simulation, virtual production, global collaborative innovation and 3D lifelike experience.

Booth # - 317
Aurora Flight Sciences
As a leader in the unmanned aircraft systems technology for over 20 years, Aurora Flight Sciences is engaged in the design, development, production, and support of unmanned aircraft. Aurora works closely with academia, the Service laboratories, DARPA, and NASA to demonstrate innovative solutions for our warfighter. As an example, the 5-day endurance Orion UAS was selected for the CENTCOM sponsored MAGIC JCTD in August 2010.

Booth # - 217
Defense Microelectronics Activity-DMEA
DMEA is a vital national asset as the joint DoD Center for microelectronics acquisition, adaptive operations and support--advancing future microelectronics research, development, technologies and applications to achieve the DoD’s strategic and national security objectives.

Booth # - 318
DHS Science and Technology Directorate
DHS Science and Technology Directorate’s mission is to provide our customers, DHS operating components, and their customers who secure our borders, ports and skies, with advanced capabilities to protect and serve the public. The S&T Directorate manages an integrated research and development program that enables technology for a safer nation.

Booth # - 414
Edgewood Chemical Biological Center
The U.S. Army Edgewood Chemical Biological Center is the nation’s principal R&D resource for non-medical chemical biological defense. ECBC supports all phases of the acquisition lifecycle from basic and applied research through technology development, engineering design, equipment evaluation, product support, sustainment, field operations and demilitarization to address unique customer requirements.

Booth # - 405
Global Staffing and Consulting, LLC
GSAC, Global Staffing and Consulting, LLC, services clients in government and commercial organizations with contract, permanent and consulting professionals and executives. GSAC’s areas of expertise include: Accounting, Aerospace, Audit, Capture, Compliance, Contracts, Government Relations, Engineering, Financial, Healthcare, Information Technology, Legal, Logistics, Proposals, Capture, and Procurement professionals.. Visit GSAC at www.gsacgroup.com or call 301-760-6802. Bethesda, MD & Washington, DC

(As of 6/09/2011)
**Booth # - 208**

**U.S. Air Force Research Lab**

AFRL displays the latest Air Force technologies in directed energy, human systems, information management, materials and manufacturing, munitions, propulsion, sensors, air vehicles, space vehicles, and basic research. AFRL executes the Air Force’s entire science and technology budget. We partner with government, industry and academia to accomplish this mission.

**Booth # - 417**

**U.S. Army Corp of Engineers, ERDC**

The U.S. Army Engineer Research and Development Center (ERDC) is one of the most diverse engineering and scientific research organizations in the world. The ERDC conducts R&D in support of the Soldier, military installations, and the Corps of Engineers civil works mission, as well as for other federal agencies, state and municipal authorities, and with U.S. industry through innovative work agreements. ERDC’s unique research capabilities and facilities have earned it distinction as the “Army Large Research Laboratory of the Year” for 10 of the last 19 years. As the world’s premier engineering and environmental sciences organization, ERDC’s cutting-edge technology is solving problems that others are not attempting to tackle in an effort to make our world safer and better.

**Booth # - 402**

**U.S. Army RDEC ARL**

The U.S. Army Research, Development and Engineering Command (RDECOM) is the Army's technology leader and largest technology developer. RDECOM ensures the dominance of Army capabilities by creating, integrating and delivering technology-enabled solutions to our Soldiers. To meet this commitment to the Army, RDECOM develops technologies in its eight major laboratories and research, development and engineering centers. The U.S. Army Research Laboratory is the Army's corporate, or central, laboratory. Its diverse assortment of unique facilities and its workforce of government engineers and scientists comprise the largest source of world class integrated research and analysis in the Army. ARL's programs consist of basic and applied research and survivability/lethality analysis. One of the centers, the Armaments Research, Development & Engineering Center has the mission to develop and maintain a world-class workforce to execute and manage integrated life cycle engineering processes required for the research, development, production, field support and demilitarization of munitions, weapons, fire control and associated items.

**Booth # - 410**

**U.S. Army RDECOM ARDEC**

ARDEC is an internationally acknowledged hub for the advancement of armaments technology and engineering innovation. Our mission is to develop, maintain, execute and manage integrated life cycle engineering processes required for the research, development, production, field support and demilitarization of munitions, weapons, fire control and associated items.

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**EXHIBITOR PROFILES**

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**Booth # - 219**

L-3 Communications - Interstate Electronics Corp.

L-3’s Precision Engagement Sector consists of the following divisions; Interstate Electronics Corporation, Fusing and Ordnance Systems, Unmanned Systems and Airborne Technologies, Inc. These businesses provide a broad range of products, including components, subsystems and systems, to military and commercial customers. Offerings include Unmanned Aircraft, Guidance & Navigation, Command & Control, Situational Awareness, Fuzing and Ordnance, and Systems Integration.

**Booth # - 108**

NDIA - STEM

NDIA's Science, Technology, Engineering and Mathematics (STEM) Workforce Division provides a forum for effective interaction between government, industry, academia, and the public at large for the strengthening of the national security STEM workforce. The Broad goals of the Division are to:

- Increase NDIA's participation in exciting and attracting K-12 students into STEM careers.
- Maximize cooperation between federal departments, agencies, and industry on STEM workforce development initiatives.
- Support the development of integrated policies around the STEM workforce.
- Establish partnerships to collect and disseminate information and coordinate resources to build a robust STEM workforce of the future.

**Booth # - 314**

Scientific Research Corporation

The T&E/S&T Program continues to develop test technologies for transition into future test capabilities that will verify and support to optimization of the warfighting performance of our most advanced warfighting systems. These systems include advanced propulsion systems, directed energy weapons, multi-spectral sensors, net-centric systems, and unmanned systems.

**Booth # - 101**

Space and Naval Warfare Systems Center Atlantic

SPAWAR Systems Center Atlantic is a Department of the Navy engineering laboratory focused on rapidly developing and delivering secure, integrated and innovative solutions for our naval, joint, national and coalition warfighters. Aligned with the CNO's vision of adding cyber power to the already proven arsenal of sea and air power, SPAWAR Systems Center Atlantic provides end-users with a critical edge, elevating Information Dominance as a core warfighting capability.

**Booth # - 407**

Test Resource Management Center

The T&E/S&T Program continues to develop test technologies for transition into future test capabilities that will verify and support to optimization of the warfighting performance of our most advanced warfighting systems. These systems include advanced propulsion systems, directed energy weapons, multi-spectral sensors, net-centric systems, and unmanned systems.

**Booth # - 308**

Torrey Pines Logic

Torrey Pines Logic provides research, design, development and custom solutions using visible and IR sensors, lasers, image processing and analysis, wireless and IR-based communications, computer graphics and video.

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GKN Land Systems

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L-3 Fuzing and Ordnance Systems

Mr. Frank Cooper
Concurrent Technologies Corporation

Mr. Francis Corbett
Textron Defense Systems

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<td>OSD (AT&amp;L) OASD (R&amp;E) Research Directorate</td>
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<td>Mr. Robert Heaton</td>
<td>SPAWAR</td>
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<thead>
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<th>Lockheed Martin Corporation</th>
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<td>CDR Will Hesse, USN (Ret)</td>
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<td>AAI Corporation (Textron)</td>
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<td>Dr. Julia Medin</td>
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# ATTENDEE ROSTER

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<th>Role/Position</th>
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<tr>
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<td>Barling Bay, LLC</td>
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Thank You for Attending!
We’ll See You in 2012!

SAVE THE DATE

13th Annual S&ET Conference DoD / Tech Exposition
April 17 - 19, 2012
Charleston Convention Center, North Charleston, SC

http://www.ndia.org/meetings/2720
Naval Aviation Enterprise
Chief Technology Officer (CTO)
Organization

Ms. Rebecca Ahne, NAE Deputy CTO
The Naval Aviation Enterprise (NAE) is a warfighting partnership in which interdependent Naval Aviation issues affecting multiple stakeholders are resolved on an enterprise-wide basis. Between the Navy and Marine Corps, our Enterprise includes over 183,000 people, 3,700 aircraft, 11 aircraft carriers and executes a budget in excess of $40 billion. Focusing these resources to provide our country with the necessary warfighting readiness expected to meet national policy and priorities is a shared responsibility of each member of the Enterprise.

NAE CTO also serves as the CTO for
- Naval Air Systems Command (NAVAIR) and PEOs
- Naval Air Warfare Centers (NAWC)
NAE Science & Technology Objectives

- Provides guidance for the NAE to facilitate the alignment of available science and technology development investments with the technology requirements of Naval aviation.

- Represents the goals of the NAE S&T program
  - Used as the baseline for identifying, prioritizing, aligning and synchronizing S&T investment efforts throughout the Enterprise.

- Represents a broad strategy that provides focused direction for the future while retaining sufficient flexibility to allow the S&T community to meet emerging challenges.

- Identifies 11 Capability Gaps supported by 34 NAE S&T Objectives (STOs)
  - USMC Aviation STOs included

- Document signed by
  - Commander, Naval Air Forces
  - Deputy Commandant for Aviation
  - Commander, Naval Air Systems Command
  - Director, Air Warfare

- Updated biennially; next edition available April 2012

S&T Objective Road Mapping

4 Levels of Road mapping

- Acquisition* – Defines capability needs specific to each platform and maps/aligns with POM cycles
- Platform S&T – Identifies where S&T can contribute to the needs identified on the Acquisition roadmap, identifies and maps current workload/projects to those needs
- S&T Objectives – Defines the critical capability gaps for each S&T Objective, decomposes capabilities needs into technology investment areas, identifies & maps current workload/projects, and identifies where future work may be required to achieve required capability
- Laboratory Core Capabilities – Defines those technologies considered core to the NAWC laboratory research and engineering workforce and facilities, maps current workload/projects and identifies where future work is required

* Acquisition Road maps are being developed by Program Offices
- **STO Number:** DEF STO 3
- **Title:** Improved Vertical Delivery - Systems enhancements

**Statement of Need:** Vertical delivery systems enhancements that improve ability to operate in the intended environment are required to increase tactical effectiveness, safety and survivability. Includes aerial delivery and internal/external cargo handling systems.

**Why Required:** Military success is often dependent on a commander’s ability to effectively maneuver and mass forces, to support and reinforce deployed or embarked units, and to quickly react to changes in the tactical situation. Additionally, Naval forces rely heavily on efficient, effective vertical lift for resupply and sustainment.

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<td>Redistribution of Downwash</td>
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DEF STO 3 - Systems Enhancements

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<td>3</td>
<td>IMPROVE SITUATIONAL AWARENESS (Brownout/Whiteout/Fog/Rain)</td>
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<td>4</td>
<td>Redistribution of Rotorwash/Flow Field Modification</td>
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<td>11</td>
<td>Develop &quot;See Thru&quot; Technologies</td>
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<td>Develop Tactile Cueing Systems</td>
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<td>Develop Terrain/Obstacle/Traffic Warning Systems</td>
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DEF STO 3: See “Thru” Solution for Degraded Visual Environment

H-53 Upgrades

Acquisition

Technology Maturation (TRL 4-6)

Science & Technology (TRL 1-4)

Future Naval Capability #1

DARPA Project

AF/NAVAIR Joint Development

Army Project

Future Naval Capability #2

AFRL Project

SBIR for Sensors #2

SBIR for Sensors #1

SBIR for Data Fusion/Manage

SBIR for Displays/Symbology
GOAL: Combined S&T/Acquisition

Rotary Wing Acquisition Roadmap (Example)

Combined S&T/Acquisition Roadmap

EXAMPE S&T PLATFORM ROADMAP: H-1

Legend:

- [ ] S&T Work
- [ ] 2-Year
- [ ] Software
- [ ] Update
- [ ] Cycle
Summary

- NAE Chief Technology Officer (CTO) is responsible for providing oversight and strategic management of the NAE S&T investment portfolio

- NAE CTO monitors health of S&T portfolio and progress toward delivery of capability through the use of S&T Objective Roadmaps

- Goal is to integrate/link S&T Objective Roadmaps into Acquisition Roadmaps
  - Allows insight into our programs and provides a strategic framework for all stakeholders

Rebecca Ahne
NAE Deputy CTO
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Thank you for your support and celebration of the United States Sea Services!
DoD’s Engineered Resilient Systems (ERS) S&T Priority

PoC: Dr. Robert Neches
Director, Advanced Engineering Initiatives
ODASD - SE
Robert.Neches@osd.mil

Presenter: Dr. Randy Avent
Presentation to NDIA/DoD Annual S&T Conference
20-23 June 2011
A Quote from the former Secretary of Defense, Dr. Robert Gates

...our record of predicting where we will use military force since Vietnam is perfect. We have never once gotten it right.

There isn't a single instance ... where we knew and planned for such a conflict six months in advance, or knew that we would be involved as early as six months ahead of time.

So my mantra actually has been for the last several years in the department that, as we train and as we equip, we need to have in mind the greatest possible flexibility and versatility for the broadest range of conflict....

The Honorable Dr. Robert M. Gates, 22nd Secretary of Defense, interview at The American Enterprise Institute, carried on CSPAN, 24 May 2011
Engineered Resilient Systems
Problem Statement

Uncertain futures & threats outpace our ability to create & field affordable, effective systems

**Change happens – we need to design for it.**
But, today, instead...

- **Adaptability, trustability and affordability are not sufficiently considered** when making tradeoffs
  - ...and are also not maintained when modifications occur during design, manufacturing, and fielding

- **Effective design is hobbled:** engineers hear too little about warfighters’ / stakeholders’ needs; and too little information about design feasibilities and opportunities gets fed back

- **Cost/schedule slip is highly likely when problems arise, requirements change, or adaption is needed:** Too few alternative designs are considered in depth, nor are they kept active very long

- **Uncertainties compound when planning horizons grow:** long design-test-build-field-adapt lead-times exacerbate uncertain futures problems, overload designs, and lock out new technologies
21st Century Dynamics Require New Design Constraints

Trustability
Adaptability (Modifiability)
Adaptability (Fit)
Capability
Feasibility
Manufacturability

Rapidly Adapting to User Needs

Leveraging the Global Supply Chain
Facing Uncertain Futures
ERS: Tools and Technologies to Facilitate Adaptability & Trustability

**ERS Technology Toolbox**

1. Trustability: design patterns, analytic tools
2. Platform-Based analysis & architecting
3. Model-Based tools: analysis and simulation
4. Tying design, physical and computational testing
5. Tradespace exploration
6. Instrumented virtual and live environments

Accelerated Design-to-Build: Capability Engineering

Accelerated needs exploration: Conceptual Design

ERS Environment
Goals / End States
Engineering of Defense Systems Capable of Supporting Rapidly Changing Warfighter Needs

R&D in ERS enables agile and cost effective design, development, testing, manufacturing, and fielding of trusted, assured, easily modified defense systems

ERS delivers science, engineering concepts, processes, and design tools to:

- Continuously coordinate design, testing, and production with warfighter review to facilitate earliest possible safe field use of needed capabilities
- Generate an efficient set of design points spanning the design space
- Ensure that tradeoffs among alternative designs are better understood, and that tradeoffs bearing on time, cost, trust and adaptability get appropriate consideration
- Facilitate adaptability via both reconfigurable product families and design diversity
- Consider a wide range of conditions and ConOps during design and testing
- Protect against unintentional or malicious compromise of weapon systems through the supply chain
- Reduce the time needed to reconfigure, substitute or otherwise adapt systems to rapidly changing conditions or operational concepts
- Provide a distributed collaborative engineering environment with seamless two-way transfer of data between tools enabling design, engineering, production/manufacturing, and operational evaluation
Enabling Technologies for Making Informed Decisions about Systems Designed for Trustability and Adaptability – with Timely and Affordable Results

Efficient, sufficiently veridical Physical & Engineering (product, environmental) Models (System Centric Design Support)

Cross-level consistency / interoperability of models (scale, physics)

Synthetic Environments for Assessment (Mission Centric Design Support)

Early Warning Systems for Downstream Issues:
- Tradespaces
- Testing sufficiency
- Computational Test and Validation of Process Plans (e.g., Manufacturability, Supply Chain Risk,...)

(Distributed Infrastructure Support)

Configurable Collaborative Engineering Environments and Processes Human-provided Guidance and Coordination Mechanisms
Emerging Technical Opportunities

1. **Trustability: design patterns and tools**
   *Adapt/extend reliability-inspired methods*
   - Integrating reliability and cost approaches
   - Reasoning about risk and uncertainty
   - New sensitivity localization algorithms

2. **Platform-Based analysis & architecting:**
   *New analysis tools for designing platforms, rapidly adapting systems*
   - Identifying high-impact variables, and likelihoods of emergent interactions
   - Algorithms for measuring adaptability
   - Risk-based cost-benefit analysis tools for platforms and designs, “uncertainty bars”

3. **Model-based tools: analysis & simulation**
   *New products / product line options*
   - On-demand composition of models and simulation/analysis workflows
   - Maintaining consistency across hybrid models (not unintelligible monolithic models)
   - Using semantic features to create and repair mappings between modeling systems

4. **Tying design, physical/computer tests**
   *Linked temporal & physical models*
   - Simulations combining live and virtual elements
   - Acquisition and cross-integration of physics-based vs. statistical models
   - Critical new models: e.g., deformable and moving objects

5. **Tradespace exploration:**
   *Collaborative options exploration*
   - Guiding automated searches
   - Advanced algorithms and massive computing for exploring alternative options
   - Envisionment of multi-dimensional tradespaces

6. **Instrumented live and virtual environments for ConOps Exploration**
   - Game and scenario writing tools
   - Discussion, annotation, collaboration in augmented reality environments
   - Visualization and explanation tools to assist in prioritizing tradeoffs, explaining decisions
Basic Science Issues

- **Scale and Complexity mean that humans cannot do the job unassisted**
  - Algorithms for selective search of intractably large spaces are needed to manage the combinatorial explosion
  - Human-guided search, and social networking techniques will also play a role

- **New challenges for large distributed architectures**
  - Efficient execution and coordination of large processing that is widely distributed and highly stochastic but partly parallel

- **New technology of interchange between discrete event, process and mathematical models will be needed to further manage tractability**
  - Models will need to be learned and refined from instrumenting physical tests and live systems

- **New human interface tools and approaches for decision support**
  - How do we help people understand the extent of coverage of mission possibilities?
  - How do we help people understand impact of requested design features/properties/capabilities and their interactions on affordability, delivery time, cost, and mission range?

- **New mathematical and statistical approaches to testing complexity and model validation**
  - Uncertainty representation and analysis (risk and confidence intervals)
  - Game theoretic approaches to finding design tradeoff win-wins

- **Physics and engineering disciplines**
  - Understanding the actual phenomena we want to capture in multi-scale, multi-physics models
  - Validating multi-scale, multi-physics models
Novel Elements of Approach

- Focus on re-design: retrofit/upgrade/adapt faster and cheaper
- Selectively explore feasible variations, reconfigurations, extensions
- Three lines of defense against change and uncertainty:
  - Mission-oriented design for adaptability, with testing against broad range of missions and environments, prepares for the “known unknowns”
  - Diversity from longer retention of multiple designs avoids fragility of monoculture
    - Increases chances of having options that will address any “unknown unknowns”
    - Forcing the entire process to be open to alternatives, architects the engineering process to facilitate as rapid and agile a response as possible -- even in the worst case
  - Reduced engineering times enable tighter (therefore less uncertain) planning horizons
- Focus on design and testing in context, with stakeholders
  - Model more of the operating environment
  - Explore and evaluate current and future scenarios, jointly with associated CONOPS
  - Design and evaluate for mission capability rather than disjoint technical parameters
The Path to Achieving, “Agile and cost effective design, development, testing, manufacturing, and fielding of trusted, assured, easily modified defense systems”

Better conceptual design
Better deep design

Better coordination between them

Informed Decisions via larger tradespaces (designs, constraints)

Timely & Affordable via selective search, design-driven testing

Advanced Design & Engineering Capability

Adaptable & Trustworthy via longer-lived options, contextual analysis and testing

Better conceptual design

Engineered Resilient Systems, NDIA 20-23 June 2011
Page-11

Unclassified
Informed Decisionmaking
• Increasing the availability of engineering choices and the ability to assess consequences of those choices

Trustworthy and Adaptable Design
• Encouraging design for reliability, testing designs across many contexts (including degraded functioning), keeping options open, and learning from inspecting alternatives

Affordable and Timely
• As fast as possible for the problem addressed – minimizing unnecessary effort both reduces time and the cost of standing armies of engineers

Key ERS Goals, Concepts and Notional Roadmaps

Informed Decisionmaking

Trustworthy and Adaptable Design

Affordable and Timely

Cost-justified systems fielded in 50-75% time taken for today’s high-cost systems

Choices made, options preserved, based on millions of mission-driven tests on hundreds of alternatives

Systems designed, tested, and rated based on thousands of variations on hundreds of mission cases

Informed Decisionmaking

Metrics (distance from a single design):
# options developed, # of “-ilities” assessed for each option, # of mission use cases tested, # of participants in the process

Single design, aimed at individual reqmts -- trust and adaptability quality not considered

No designing for trust and adaption, no testing for it, no metrics of quality

Ten-year time frames, tens of billions of $ regarded as ill-spent

Engineering Efficiency

Metrics: reduced time to conceive-design-build-test-adapt, increased ratio of design-to-development, reduced ratio of rework to design/test

Distance from “Point Designs”

2013 2016 2018 2020 2023

2013 2016 2018 2020 2023
DoD Basic Research Program with a Focus on Academia

Dr. Randy K. Avent
21 June 2011
Key Challenges and Trends

• **Demographics**
  – Aging population in developed world
  – Growing youth population in developing world

• **Globalization**
  – World wide access to knowledge

• **Economics**
  – New wealth in Brazil, Russia, India & China
  – Large debts and deficits in developed nations

• **Energy**
  – High on every nation’s priority list

• **Climate change & natural disasters**

• **Challenges to existing state structures**
  – Radical ideologies
  – Internet communities

A robust S&T program is necessary to address today’s complex and changing defense environment
Outline

• Introduction

• By the numbers

• Science initiatives

• Summary
Federal Research Spending

Recent R&D Appropriations for Key Federal Departments and Agencies

Source: Battelle/R&D Magazine with data from OSTP, AAAS
Basic Research Portfolios

• Defense Investments

- Defense Investments:
  - BA7: 39%
  - BA6: 21%
  - BA5: 18%
  - BA4: 6%
  - OSD: 6%
  - BA3: 7%
  - BA2: 6%
  - BA1: 2%

• Defense Recipients

- Defense Recipients:
  - Universities: 51%
  - Intramural: 25%
  - Industry: 13%
  - FFRDCs: 6%
  - Nonprofits: 5%
Basic Research Funding

PBR Funding (FY11 $B)

Year


White House Senate House
Outline

• Introduction

• By the numbers

• **Science initiatives**

• Summary
Basic Research Definitions

Basic Research should pursue fundamental understanding to provide a foundation for future work.
Priority Basic Research Areas

Normalized Number of Publications

Year

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

Superconductivity
Synthetic Biology
Quantum Systems
Human Behavior
Cognitive Neuroscience
Metamaterials
Nanotechnology
Nanoscience and Nanotechnology

- **Discover and exploit unique phenomena at nanometer dimensions to enable novel applications**

- **Enabled capabilities**
  - Electronics and Sensing: Multispectral focal plane arrays
  - Power and Energy: Fuel-cells, portable electronics, thermoelectrics
  - Coatings: Photactive, self-cleaning films

- **Select breakthroughs**
  - Nano-particle coating & functionalization
  - Catalysts for energy-harvesting
  - Graphene and carbon nanotubes

- **Key research challenges**
  - Low defect density graphene over large areas
  - Production and reproducibility of chirality nanotubes and bilayers of graphene
Synthetic Biology/Panomics

• The promise of engineered biology for a multitude of applications

• Enabled capabilities
  – Bio-production including bio-fuels, food production
  – Bio-sensors
  – Tissue regeneration, broad-source vaccinations
  – Clean water as a bio-based capability

• Key research challenges
  – Modeling and simulation to address complexity of pathways
  – Automation of trials
  – Selection of appropriate host cell compatible with synthetic genome
  – Regulation and societal acceptance
Quantum Information Science

- Manipulate and control nature down to the precision of a single quantum

- Enabled capabilities
  - Quantum computing, Quantum communication
  - Quantum simulation
  - Quantum sensing, metrology and imaging

- Select breakthroughs
  - Quantum factorization algorithm
  - Quantum gas microscope

- Key research challenges
  - Maintaining quantum coherence over time
  - Discovering new algorithms that fully exploit QIS for additional new capabilities
  - New techniques to control quantum systems
  - New materials, fabrication for long coherence time
Metamaterials and Plasmonics

- **Engineered design of basic properties and transport of energy/information in materials and structures**

- **Enabled capabilities**
  - Nanoscale subsurface spectroscopy
  - Plasmon-enhanced detectors and imagers, Phased arrays
  - Novel coatings; Microvascular autonomic composites

- **Select breakthroughs**
  - Sub-wavelength elements, plasmonics, photonic crystals, metamaterials
  - Self-sensing and self-healing materials
  - Biologically-inspired structures

- **Key research challenges**
  - Efficiently convert optical radiation into localized energy
  - Enhanced local photophysical processes; 3-D photonic structures
  - Integrated plasmonics with nanostructured semiconductor devices
Cognitive Neuroscience

- More deeply understand and more fully exploit the fundamental mechanisms of the brain

- Enabled capabilities
  - Deeper understanding of human information processing, learning and decision making
  - Ameliorate/prevent PTSD and TBI

- Select breakthroughs
  - Advances in brain imaging, e.g., fMRI, Diffusion Tensor Imaging, digital EEG
  - Advances in correlation of brain-structure to function
  - Massively parallel computation enabling brain signal analysis

- Key research challenges
  - Solving the inverse problem of predicting human behavior from brain signals
  - Translating clinical measurements & analyses to uninjured personnel
  - Developing models incorporating individual brain variability
Computational Models of Human Behavior

• A fundamental understanding and predictive capability of human behavior dynamics from individuals to societies

• Enabled capabilities
  – Predictive models supporting strategic, operational and tactical decision making
  – Real-time cultural situational awareness; Immersive training

• Select breakthroughs
  – Early success of simple models
  – Success of social network analysis
  – Prediction of crowd tipping points

• Key research challenges
  – Conflicting theories
  – Data management and fusion
  – Mathematical complexity; validation of models
Summary

• Future operations capabilities depend on the basic research achievements of today

• Five goals for DDR&E to strengthen the defense basic research program:
  – Provide scientific leadership for the DoD basic research enterprise
  – Attract the Nation’s best S&Es to contribute to and lead DoD research
  – Ensure the coherence and balance of the DoD basic research portfolio
  – Foster connections between DoD performers and the DoD community
  – Maximize the discovery potential of the defense research business environment

• Achieving these goals results in a coherent, forward-thinking basic research program supported by the Nation’s top researchers and paving the way for tomorrow’s revolutionary breakthroughs
Data-to-Decisions

Dr. Randy K. Avent

21 June 2011
Data-to-Decision Systems

Tactical Operations
- Low Latency
- Narrow Field-of-View
- Limited Fusion
- Automatic Target Recognition
- Data: ~MB-GB

Operations Intelligence
- Medium Latency
- Wide Field-of-View
- Hard Sensor Fusion
- Assisted Target Recognition
- Data: ~GB-TB

Strategic Intelligence
- Long Latency
- Synoptic Field-of-View
- Hard/Soft Sensor Fusion
- Multiple Hypotheses
- Data: ~PB-EB

The complexity and adaptability of threats has surpassed our ability to find them in large data volumes within mission timelines.
D2D Technology Assessment

- Moderately Mature
  - Driven by IT Industry

- Immature
  - Driven by Defense

- Moderately Mature
  - Driven by IT Industry

Current assessment is that unstructured data analytics is the most challenging and critical component of D2D
Outline

• Introduction

• Technology Thrusts

• Summary
Data Management Layer

• **Problem Statement:** Increasing data volumes and modalities have diminished our ability to communicate, store, retrieve and process sources within mission critical timelines

• **3-to-5 year timeframe objective**
  – Computational infrastructure to support capturing, processing, marking, retrieval, and management of millions of information objects per second
  – Network architecture with embedded information management on existing networks to support both real-time and discovery mission data requirements

• **7-to-10 year timeframe objective**
  – Anticipatory autonomous control of sensors and compute resources to simultaneously support hundreds of consumer requests for analysis products
Hardware Infrastructure

- **Embedded System**
  - On-board storage
  - Tightly coupled data and algorithms
  - Low-latency, low-bandwidth operations

- **Grid Cluster**
  - Centralized storage
  - Data moved to compute nodes
  - Tightly coupled algorithms
  - Parallel file system limits large data use

- **Cloud Computing**
  - Distributed storage
  - Applications moved to compute nodes
  - Order-independence through map/reduce
Analytic Layer

• **Problem Statement:** Existing automation tools do not aid users in finding today’s complex and adaptable threats within mission timelines

• **3-to-5 year timeframe objective**
  – Robust classification to accurately detect, geo-register and identify surface objects despite difficult environments, configurations and emplacements
  – Robust automation tools to identify relationships, patterns of life and activities of ground vehicles
  – Robust tools to capture, store and retrieve HUMINT-based information to identify and leverage popular support against insurgents

• **7-to-10 year timeframe objective**
  – Robust classification to accurately detect, geo-register and identify all surface objects despite difficult environments, configurations and emplacements
  – Robust automation tools to identify relationships, patterns of life and activities of dismounts
  – Robust tools to search, mine and exploit open-source data to identify all aspects of insurgent networks
Generalized Tracking

Data Preparation
- Time sequencing
- Registration
- Bias correction

Track Prediction
- Time sequencing
- Registration
- Bias correction
- Extrapolate
- Context (road, terrain)
- Behavior/Doctrine
- Motion models

Association Matrix
- Hypothesis generation
- Hypothesis evaluation
- Breadth reduction
- Clustering
- Score pairings
- Assignment Matrices

Track Assignment
- Hypothesis pruning
- Track initiation
- Coasting

Updated Track List
- Updated tracks
- Track initiation
- Coasting

Track Update
- Kalman update
- Multi-lateration

Hypothesis Management
Tracking Analysis

Area Rate (km²/hr) vs. Object Density (obj/km²)

- Shipping Lanes
- Vehicular Traffic
- Pedestrian Traffic

- LACOSTE
- MASIVS
- ARGUS-IS
- Constant Hawk

Baseline Tracking
“TIVO” Enabled
Context Aware Tracking
Multi-Source Tracking
Performance-Based
Advanced Trackers
Imagery Processing Chain

Objects of Interest

Confusers

Sensing Platform

Detection & Classification

Image Analyst

Clutter False Alarms

Terrain and Foliage Masking

Missed Declarations

Missed Objects
Detection/Classification Analysis

![Graph showing the relationship between Analysts Hours and Image Rate (km²/hr) for different detection methods.]

- **Image Analyst**
- **Baseline ATR**
- **Multi-Sensor Detection**
- **Geometric Features**
- **Advanced Learning**
- **Performance Models**
# Text Analysis

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<tr>
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<th>Advanced Machine Translation</th>
<th>HSCB Analysis</th>
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* This refers to operational Document Exploitation (DOCEX); when Special Ops Forces (SOF) finds hard copy documents at a site and we need to process for intel info.

**Acronyms & Abbreviations**
- A&V = Analysis & Visualization
- HSCB = Human Social Cultural Behavioral
- MT = Machine Translation
- OCR = Optical Character Recognition

**Distribution Statement A: Approved for public release, distribution is unlimited**
User Interface Layer

• Analysts (Single Source)
  - Data
  - Metadata
  - Workflows
  - Templates
  - User Interface
  - Analytics

• Aggregators (All-Source)
  - Data
  - Metadata+
  - Tags
  - Provenance
  - Ontologies
  - User Interface†
  - Queries
  - Reports
  - Usage Statistics
  - Ontologies
  - Workflows
  - Provenance
  - Ontologies
  - Workflows
  - Tags
  - Templates

†End User Programmable
User Interaction Layer

• **Problem Statement:** Existing interface tools do not support the user’s need to collaborate, visualize, adapt and manage knowledge gained from sensing assets

• **3-to-5 year timeframe objective**
  – User tools that aid data discovery, link communities, support aggregation and provide natural user interfaces

• **7-to-10 year timeframe objective**
  – Never-ending learning systems that maintain and reason over millions of facts to identify new knowledge
  – Workflow tools that capture and teach analysts’ best practices
The Data-to-Decisions program develops technology for the rapid development of flexible new Decision Support Systems.

Program consists of a series of relevant challenge problems that advance the underlying technology in data management, analytics and user interfaces.

Execution is through a consortium that addresses the challenge problems in a coherent and integrated team approach.

Major research initiatives focus on developing extendable analytic approaches and advanced user-interface modules.
Fiscal Year 2012
President’s Budget Request
for the
DoD Science & Technology Program
June 21, 2011

Mr. Bob Baker
Deputy Director, Plans & Programs,
Assistant Secretary of Defense (Research & Engineering)
Outline

• Guidance from the Chain of Command
• FY2012 S&T President’s Budget Request
• Historical Context
• Strategic Planning & Budget Changes
President Obama, State of the Union, January 25, 2011

“The first step in winning the future is encouraging American innovation. Our free enterprise system is what drives innovation. But because it’s not always profitable for companies to invest in basic research, throughout our history, our government has provided cutting-edge scientists and inventors with the support they need.

Two years ago, I said that we needed to reach a level of research and development, we haven’t seen since the Space Race. And in a few weeks I’ll be sending a budget to Congress that helps us meet that goal. We’ll invest in biomedical research, information technology, and especially clean energy technology -- an investment that will strengthen our security, protect our planet, and create countless new jobs for our people.

Maintaining our leadership in research and technology is crucial to America’s success. But if we want to win the future -- if we want innovation to produce jobs in America and not overseas -- then we also have to win the race to educate our kids.

Over the next 10 years, with so many baby boomers retiring from our classrooms, we want to prepare 100,000 new teachers in the fields of science and technology and engineering and math.”

Investment in Basic and Applied Research is a commitment to the future warfighter
“These budget decisions took place in the context of a nearly two year effort by the DoD to reform the way the Pentagon does business – to change how and what we buy…We have protected programs that support military people, readiness, and modernization…We still live in a very dangerous and often unstable world. Our military must remain strong and agile enough to face a diverse range of threats – from non-state actors attempting to acquire and use weapons of mass destruction and sophisticated missiles, to the more traditional threats of other states…”

“Directed DoD to fund 2% real growth in Basic Research and to maintain stable funding in the rest of S&T for FY12-FY16. In real terms, the FY12 S&T budget request is almost 29% greater than the request in FY 2000.” OSD/PA News Release, 2/14/11
Continuing the Reform Agenda

“Budget represents a reasonable, responsible, and sustainable level of funding” - Secretary Gates, Budget Rollout Brief (2/14/2011)

• Taking Care of People
• Rebalancing Military Capabilities
• Reforming What and How We Buy
• Supporting our Troops in the Field
ASD(R&E) Imperatives

• Accelerate delivery of technical capabilities to win the current fight.
  – Solve the most difficult near term problems and transition compelling concepts to the warfighter.

• Prepare for an uncertain future.
  – Shape the Department’s science and technology investments to open options that counter (and create) strategic surprise.

• Reduce the cost, acquisition time and risk of our major defense acquisition programs.
  – Provide systems engineering leadership, deep system analysis, and technical assessments across the Department.

• Develop world class science, technology, engineering, and mathematics capabilities for the DoD and the Nation.
Outline

- Guidance from the Chain of Command
- FY2012 S&T President’s Budget Request
- Historical Context
- Strategic Planning & Budget Changes
Total FY12 S&T request = $12.25B

Total FY11 S&T Request = $11.82B
Army = 1,945  Navy = 1,961  AF = 2,191  DARPA = 3,026  ChemBio = 396  DTRA = 555  OSD = 1,356  Other DA = 389

FY12 DoD S&T Budget Request
## FY12 President’s Budget Request

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</tr>
<tr>
<td>Army</td>
<td>BA 1</td>
<td>406,873</td>
<td>436,920</td>
<td>440,492</td>
<td>456,268</td>
<td>470,582</td>
<td>487,449</td>
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<tr>
<td>Army</td>
<td>BA 2</td>
<td>841,364</td>
<td>869,332</td>
<td>860,648</td>
<td>856,203</td>
<td>840,534</td>
<td>832,660</td>
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<tr>
<td>Army</td>
<td>BA 3</td>
<td>696,592</td>
<td>976,812</td>
<td>949,153</td>
<td>983,936</td>
<td>966,542</td>
<td>983,685</td>
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<tr>
<td>Army S&amp;T</td>
<td>1,944,829</td>
<td>2,283,064</td>
<td>2,250,293</td>
<td>2,296,407</td>
<td>2,277,658</td>
<td>2,303,794</td>
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<tr>
<td>Navy</td>
<td>BA 1</td>
<td>556,425</td>
<td>577,372</td>
<td>599,398</td>
<td>622,310</td>
<td>646,079</td>
<td>670,756</td>
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<tr>
<td>Navy</td>
<td>BA 2</td>
<td>678,680</td>
<td>783,794</td>
<td>782,973</td>
<td>772,408</td>
<td>809,831</td>
<td>821,744</td>
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<tr>
<td>Navy</td>
<td>BA 3</td>
<td>725,599</td>
<td>648,217</td>
<td>606,260</td>
<td>641,203</td>
<td>629,779</td>
<td>641,636</td>
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<tr>
<td>Navy S&amp;T</td>
<td>1,960,704</td>
<td>2,009,383</td>
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<td>2,035,921</td>
<td>2,085,689</td>
<td>2,134,136</td>
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<tr>
<td>AIR FORCE</td>
<td>BA 1</td>
<td>500,473</td>
<td>518,859</td>
<td>538,233</td>
<td>558,331</td>
<td>579,179</td>
<td>600,805</td>
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<tr>
<td>AIR FORCE</td>
<td>BA 2</td>
<td>1,181,420</td>
<td>1,181,874</td>
<td>1,187,232</td>
<td>1,203,560</td>
<td>1,227,057</td>
<td>1,250,541</td>
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<tr>
<td>AIR FORCE</td>
<td>BA 3</td>
<td>509,305</td>
<td>585,404</td>
<td>562,607</td>
<td>579,470</td>
<td>590,288</td>
<td>600,329</td>
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<td>Air Force S&amp;T</td>
<td>2,191,198</td>
<td>2,286,137</td>
<td>2,288,072</td>
<td>2,341,361</td>
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<td>2,451,675</td>
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<tr>
<td>Def-Agencies</td>
<td>BA 1</td>
<td>535,026</td>
<td>545,319</td>
<td>559,794</td>
<td>584,297</td>
<td>609,848</td>
<td>645,202</td>
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<tr>
<td>Def-Agencies</td>
<td>BA 2</td>
<td>1,774,358</td>
<td>1,852,273</td>
<td>1,849,602</td>
<td>1,880,356</td>
<td>1,880,715</td>
<td>1,949,184</td>
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<td>Def-Agencies</td>
<td>BA 3</td>
<td>3,412,934</td>
<td>3,270,792</td>
<td>3,647,857</td>
<td>3,670,149</td>
<td>3,842,117</td>
<td>3,900,533</td>
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<td>Def-Agencies S&amp;T</td>
<td>5,722,318</td>
<td>5,668,384</td>
<td>6,057,253</td>
<td>6,134,802</td>
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</tbody>
</table>
FY11 and FY12 RDT&E Budget Request Comparison
- in Then Year Dollars -

**FY11 RDT&E request = $76.13B**
(Budget Activities 1-7)

<table>
<thead>
<tr>
<th>Budget Activity</th>
<th>S&amp;T</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA1 Basic Research</td>
<td>$1.99B</td>
<td>$1.99B</td>
</tr>
<tr>
<td>BA2 Applied Research</td>
<td>$4.48B</td>
<td>$6.47B</td>
</tr>
<tr>
<td>BA3 Advanced Technology Development</td>
<td>$5.34B</td>
<td>$11.82B</td>
</tr>
<tr>
<td><strong>Total S&amp;T</strong></td>
<td>$11.82B</td>
<td><strong>$11.82B</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$30.33B</td>
<td><strong>$42.15B</strong></td>
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</table>

**Technology Base (BA1 + BA2) = $6.47B**

**FY12 RDT&E request = $75.33B**
(Budget Activities 1-7)

<table>
<thead>
<tr>
<th>Budget Activity</th>
<th>S&amp;T</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA1 Basic Research</td>
<td>$2.08B</td>
<td>$2.08B</td>
</tr>
<tr>
<td>BA2 Applied Research</td>
<td>$4.69B</td>
<td>$6.77B</td>
</tr>
<tr>
<td>BA3 Advanced Technology Development</td>
<td>$5.48B</td>
<td>$12.25B</td>
</tr>
<tr>
<td><strong>Total S&amp;T</strong></td>
<td>$12.25B</td>
<td><strong>$12.25B</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$33.69B</td>
<td><strong>$45.94B</strong></td>
</tr>
</tbody>
</table>

**Technology Base (BA1 + BA2) = $6.77B**

**PBR11 S&T is 15.5% of RDT&E**

**PBR12 S&T is 16.2% of RDT&E**
RDT&E Budget Request Overview - FY11 and FY12 Comparison -
## FY12 DoD R&E Budget Request Comparison

<table>
<thead>
<tr>
<th></th>
<th>PBR 2010</th>
<th>PBR 2011 (CY FY11 $)</th>
<th>PBR 2012 (CY FY11 $)</th>
<th>Real Change from PBR11 to PBR12 (CY FY11 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Research (BA 1)</td>
<td>1,798</td>
<td>1,999</td>
<td>2,078 (2,043)</td>
<td>+2.2%</td>
</tr>
<tr>
<td>Applied Research (BA 2)</td>
<td>4,247</td>
<td>4,476</td>
<td>4,687 (4,608)</td>
<td>+2.9%</td>
</tr>
<tr>
<td>Advanced Technology Development (BA 3)</td>
<td>5,605</td>
<td>5,344</td>
<td>5,481 (5,388)</td>
<td>0.8%</td>
</tr>
<tr>
<td>DoD S&amp;T</td>
<td>11,649</td>
<td>11,819</td>
<td>12,247 (12,039)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Advanced Component Development and Prototypes (BA 4)</td>
<td>14,306</td>
<td>13,877</td>
<td>13,733 (13,401)</td>
<td>-3.4%</td>
</tr>
<tr>
<td>DoD R&amp;E (BAs 1 – 4)</td>
<td>25,956</td>
<td>25,696</td>
<td>25,880 (25,440)</td>
<td>-1.0%</td>
</tr>
<tr>
<td>DoD Topline</td>
<td>533,813</td>
<td>549,093</td>
<td>566,341 (556,710)</td>
<td>+1.4%</td>
</tr>
</tbody>
</table>
FY12 Technology Investment Compared to Other DoD Categories

DoD Can Not “Fix” Today's Problems by Reducing S&T

FY 2012 Budget Request

<table>
<thead>
<tr>
<th>Category</th>
<th>FY12 Budget Request ($ in Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O&amp;M &amp; Mil Pers</td>
<td></td>
</tr>
<tr>
<td>Proc</td>
<td></td>
</tr>
<tr>
<td>RDTE - (S&amp;T)</td>
<td></td>
</tr>
<tr>
<td>S&amp;T</td>
<td></td>
</tr>
</tbody>
</table>

Today

Next Force

Force After Next

Readiness Modernization Future
*Includes non-profit institutions, State & local govt., & foreign institutions

Source: National Science Foundation Report (PBR08)
Outline

- Guidance from the Chain of Command
- FY2012 S&T President’s Budget Request
- Historical Context
- Strategic Planning & Budget Changes
DoD S&T FUNDING: FY1962-2016
(Constant FY12 Dollars)
DoD Basic Research
(TY Dollars in Millions)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PBR-12</td>
<td>2,078</td>
<td>2,138</td>
<td>2,221</td>
<td>2,306</td>
<td>2,404</td>
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<tr>
<td>PBR-11</td>
<td>1,999</td>
<td>1,963</td>
<td>2,054</td>
<td>2,115</td>
<td>2,193</td>
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<tr>
<td>2% RPG</td>
<td>1,999</td>
<td>2,069</td>
<td>2,145</td>
<td>2,225</td>
<td>2,307</td>
<td>2,392</td>
</tr>
<tr>
<td>Δ - PBR11 versus PBR12</td>
<td>116</td>
<td>84</td>
<td>106</td>
<td>113</td>
<td></td>
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</tr>
</tbody>
</table>
DoD Science & Technology
(TY Dollars in Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>PBR-12</th>
<th>PBR-11</th>
<th>0% RPG</th>
<th>∆ PBR12 versus PBR11</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2011</td>
<td>11,819</td>
<td>11,819</td>
<td>11,819</td>
<td>138</td>
</tr>
<tr>
<td>FY2012</td>
<td>12,247</td>
<td>12,109</td>
<td>12,055</td>
<td>194</td>
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<tr>
<td>FY2013</td>
<td>12,584</td>
<td>12,390</td>
<td>12,297</td>
<td>145</td>
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<tr>
<td>FY2014</td>
<td>12,808</td>
<td>12,663</td>
<td>12,542</td>
<td>-33</td>
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<tr>
<td>FY2015</td>
<td>13,093</td>
<td>13,125</td>
<td>12,793</td>
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<tr>
<td>FY2016</td>
<td>13,385</td>
<td>13,049</td>
<td>13,049</td>
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S&T Breakout
- Services and Defense Agencies (Wide) as % of Total S&T -

President's Budget Requests

Services as % of S&T

Defense Agencies (Wide) as % of S&T

Percent of Funding

FY90 FY92 FY94 FY96 FY98 FY00 FY02 FY04 FY06 FY08 FY10 FY12 FY14 FY16

Services
Defense Agencies
Outline

- Guidance from the Chain of Command
- FY2012 S&T President’s Budget Request
- Historical Context
- Strategic Planning & Budget Changes
Quadrennial Defense Review
Key Mission Areas (KMAs)

1. Defend the United States and Support Civil Authorities at Home

2. Succeed in Counterinsurgency, Stability, and Counterterrorist Operations

3. Build the Security Capacity of Partner States

4. Deter and Defeat Aggression in Anti-Access Environments

5. Prevent Proliferation and Counter Weapons of Mass Destruction

6. Operate Effectively in Cyberspace.
QDR 2006 vs. QDR 2010

**QDR 2006 Strategic Outcomes**

1. Defend the Homeland in Depth
2. Defeat Terrorist Networks
3. Shape the Choices of Countries at Strategic Crossroads
4. Prevent the Acquisition or use of Weapons of Mass Destruction

**QDR 2010 Key Mission Areas**

1. Defend the United States and Support Civil Authorities at Home
2. Succeed in Counterinsurgency, Stability, and Counterterrorism Operations
3. Build the Security Capacity of Partner States
4. Deter and Defeat Aggression in Anti-Access Environments
5. Prevent Proliferation and Counter Weapons of Mass Destruction
6. Operate Effectively in Cyberspace

QDR 2010 Builds on QDR 2006

- Anti-Access and Cyberspace are New -
Priority S&T Investment Areas for FY 2013-2017

- **Data-to-Decisions**
  - Science and applications to reduce the cycle time and manpower requirements for analyses and use of large data sets.

- **Engineered Resilient Systems**
  - Engineering concepts, science, and design tools to protect against malicious compromise of weapon systems, and to develop agile manufacturing for trusted and assured defense systems.

- **Cyber Science and Technology**
  - Science and technology for efficient, effective cyber capabilities across the spectrum of joint operations.

- **Electronic warfare / Electronic protection**
  - New concepts and technology to protect systems and extend capabilities across the electromagnetic spectrum.

- **Counter Weapons of Mass Destruction (WMD)**
  - Advances in DoD’s ability to locate, secure, monitor, tag, track, interdict, eliminate, and attribute WMD weapons and materials.

- **Autonomy**
  - Science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks in all environments.

- **Human Systems**
  - Science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.
## Big Moves DoD Wide

### FY2012

<table>
<thead>
<tr>
<th>Program</th>
<th>Funding (Increase from FY11PBR-FY12PBR)</th>
<th>Agency</th>
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<tbody>
<tr>
<td><strong>Taking Care of People</strong></td>
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<td></td>
</tr>
<tr>
<td>1 Defense Health</td>
<td>~ $ 125 M</td>
<td>DHP; Services</td>
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<tr>
<td><strong>Force Protection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Chemical Bio-Defense Program</td>
<td>~ $ 100 M</td>
<td>NCB</td>
</tr>
<tr>
<td>3 Cyber S&amp;T</td>
<td>~ $ 76 M</td>
<td>DARPA</td>
</tr>
<tr>
<td>4 Force Protection</td>
<td>~ $ 49 M</td>
<td>Navy &amp; Army</td>
</tr>
<tr>
<td>5 RF Systems</td>
<td>~ $ 45 M</td>
<td>Navy</td>
</tr>
<tr>
<td><strong>Prepare for Uncertain Future</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Info &amp; Communications Technology</td>
<td>~ $ 120 M</td>
<td>DARPA; AF</td>
</tr>
<tr>
<td>7 Weapons Technology</td>
<td>~ $ 62 M</td>
<td>Services</td>
</tr>
<tr>
<td>8 Undersea Warfare</td>
<td>~ $ 30 M</td>
<td>Navy</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td>~ $ 607 M</td>
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</table>
## Big S&T Moves, Last Three Budgets

<table>
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<tr>
<th>FY2010 (~$1.8B across the FYDP)</th>
<th>FY2011 (~$1.6B across the FYDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical S&amp;T (Wounded Warrior) (~$2.5B total; ~$1B in S&amp;T, remainder DHP)</td>
<td>7% increase in FY11 Basic (6.1) and Applied Research (6.2) from FY10 base (~$544M)</td>
</tr>
<tr>
<td>Large Data Handling (ISR Cap) ~ $100M</td>
<td>Deployable Force Protection (~$238M)</td>
</tr>
<tr>
<td>Cyber Protection (~ $100 M)</td>
<td>Cyber Security Research (~$200M)</td>
</tr>
<tr>
<td>Anti-Tamper (~$33M)</td>
<td>Night Vision Technology-Advanced Focal Plane Array ($94M)</td>
</tr>
<tr>
<td>High Temperature Materials (~$70M)</td>
<td>High Energy Laser Advanced Technology ($512M)</td>
</tr>
<tr>
<td>Stand-off Detection of Fissile Materials (~$300)</td>
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</tr>
<tr>
<td>High Performance Computing (~$100M)</td>
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</tr>
<tr>
<td>Minerva (Sociology Research) (~$100M)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>FY2012 (~$0.6B; $3.0 B across the FYDP)</th>
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</thead>
<tbody>
<tr>
<td>Protection of Defense Health ($125 M)</td>
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<tr>
<td>Information and Communication Technology ($120 M)</td>
</tr>
<tr>
<td>Force Protection Technology ($49 M)</td>
</tr>
<tr>
<td>Chemical and Biological Defense Technology ($100 M)</td>
</tr>
<tr>
<td>Cyber Security ($76 M)</td>
</tr>
<tr>
<td>Advanced Undersea Warfare Applied Research ($30 M)</td>
</tr>
</tbody>
</table>

### Key
- Joint Programs
- Multiple Executors
- Army
- Navy
- Air Force
Summary

- Overall S&T up 1.9% (in real terms) from FY11 PBR
  - Grew at a faster rate than DoD top line (1.4%)
  - All three categories (6.1, 6.2, 6.3) had real growth
  - RDT&E is down, but S&T is up

- Met SECDEF Guidance

- Big Moves Included:
  - Protection of Defense Health Program
  - Information and Communications Technology
  - Cyber S&T
  - Force Protection
  - Chemical and Biological Research
  - Weapons Technology
How Capabilities are Developed and Delivered to the Combatant Commanders
June 23, 2011

Mr. Bob Baker
Deputy Director, Plans & Programs
Assistant Secretary of Defense (Research & Engineering)
Service vs. COCOM Responsibilities

Military Services / Departments
Organize, Train & Equip

Combatant Commanders
Operationally Employ
How Capabilities are Developed and Delivered to the Combatant Commanders

- Adaptive Response to Urgent Needs
  - Rapid Acquisition / Procurement / Rapid Fielding

- Transition to Procurement & Sustainment
  - Joint Training / Global Force Allocation

- Readiness & Suitability Confirmation
  - Test & Evaluation
  - Military assessment of utility

- Functional Validation; Tailored Form/Fit/Function
  - Demonstration

- Technical Concept Design & Development
  - Prototyping

- Alternatives Development & Assessment
  - Experimentation
  - Red Teaming Analysis

- Conceptualization
  - Needs identification / lessons learned / assessment
  - Tech push exploitation
Defense Acquisition Process
### ASD(R&E) Key Demonstration & Fielding Programs

#### Research, Development, Test & Evaluation

<table>
<thead>
<tr>
<th>Funds</th>
<th>Pre-Concept</th>
<th>Mtrl. Solution Analysis</th>
<th>Technology Development</th>
<th>Engineering &amp; Manufacturing Development</th>
<th>Production &amp; Deployment</th>
<th>Sustainment &amp; Maintenance</th>
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<tbody>
<tr>
<td>TRL 1 - 3</td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
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</tbody>
</table>

#### Operational Experiments & Tech Integration for COCOMs & Interagency

- **Emerging Capabilities (EC)**  
  - PE 0603699D8Z

#### Joint Capabilities Technology Demonstrations (JCTDs)

- **Quick Reaction Funds (QRF)**  
  - PE 0603826D8Z

#### New Breakthrough Capabilities to Operations

- **Biometrics & Forensics S&T**  
  - PE 0603665D8Z

#### Tech Demos for Irregular Warfare

- **Rapid Reaction Fund (RRF)**  
  - PE 0603826D8Z

#### Assess Mature Technology from Coalition Industry

- **Foreign Comparative Testing (FCT)**  
  - PE 0605130D8Z

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**Tech Demos for Irregular Warfare**

**New Breakthrough Capabilities to Operations**

**Operational Experiments & Tech Integration for COCOMs & Interagency**

**COCOM, Joint, Coalition & Interagency Capability Needs**

**“Gap-Filling” Technologies for OCO**

**Quick Reaction Funds (QRF)**

**Foreign Comparative Testing (FCT)**

---

OCO: Overseas Contingency Operations

TRL: Technology Readiness Level
Rapid Reaction Fund (RRF)

• Description
  – Identify & develop near-term capabilities to support irregular warfare needs within 6-18 months

• Focus Areas
  – Unmanned autonomous systems and behaviors
  – Evaluation of emerging commercial technologies for blue/red applications
  – Addressing and responding to enhanced enemy capabilities
  – ISR RDT&E architecture and integration venues
  – Countering violent extremism
  – Force Protection against advanced asymmetric threats

• Participants: COCOMs, Intel Community, Interagency, Services & Defense Agencies
Joint Capability Technology Demonstrations (JCTDs)

**Description**
- Provide technology capability solutions through rapid prototyping to solve urgent joint, coalition, and inter-agency gaps
- Validated by Joint Staff and independent Military Utility Assessment

**Focus Areas**
- Most pressing military needs as identified by COCOM’s capability gaps, including Joint Urgent Operational Needs (JUONs) & Integrated Priority Lists (IPLs)
- Multiple new start opportunities annually to address emerging capability gaps within the budget period

**Participants:** COCOMs, Coalition Partners, Services & Defense Agencies, Industry

**Persistent Ground Surveillance Systems**
Supports urgent need for persistent surveillance at forward operation bases in Afghanistan

**Focused Lethality Munition**
Demonstrate low collateral damage weapon - warhead with specialized fill to reduce frag & increase blast effects
Quick Reaction Fund (QRF)

**Description**
- Funds high priority, short duration technology demos during execution year responding to new adversary threats
- Identify and develop near term capabilities to support conventional forces warfare urgent needs
- Efforts completed within 12 months

**Focus Areas**
- Anti-Access Area Denial (FY 2012)

**Participants**
- Project Sponsors & Execution: Services & Defense Agencies
- Efforts coordinated with Combatant Commanders / Joint Staff

---

**Gunslinger**
Modular, vehicle based, on-the-move hostile fire detection and counter-fire capability

**Deployable Satellite Communication System**
Inflatable satellite antenna, designed to provide high-bandwidth SATCOM capability in a smaller, lighter package than conventional systems
Worldwide Responsibilities

- USSOCOM
- USTRANSCOM
- USSTRATCOM
- USCYBERCOM
Process Used to Develop the DoD Science & Technology Priorities
June 21, 2011

Mr. Bob Baker
Deputy Director, Plans & Programs
Assistant Secretary of Defense (Research & Engineering)
Process Began With the 2010 QDR

- The 2010 QDR identified 6 Key Mission Areas (KMAs) that DoD should build capability capacity to be successful in the future global security environment
  - Defend the United States and Support Civil Authorities at Home
  - Succeed in Counterinsurgency, Stability, and Counterterrorist Operations
  - Build the Security Capacity of Partner States
  - Deter and Defeat Aggression in Anti-Access Environments
  - Prevent Proliferation and Counter Weapons of Mass Destruction
  - Operate Effectively in Cyberspace.
### QDR Key Mission Areas

and Department Planning and Programming Guidance (DPPG) Tasking

<table>
<thead>
<tr>
<th>Key Mission Areas</th>
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<tbody>
<tr>
<td>Defend U.S. and Support Civil Authorities at Home</td>
</tr>
<tr>
<td>Succeed in COIN/Stability/CT Ops</td>
</tr>
<tr>
<td>Build Partner Security Capacity</td>
</tr>
<tr>
<td>Deter and Defeat Aggression in Anti-Access Environments</td>
</tr>
<tr>
<td>Prevent Proliferation and Counter WMD</td>
</tr>
<tr>
<td>Operate Effectively in Cyberspace</td>
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</tbody>
</table>

**DPPG Task:** “The DDR&E, with the support of the Secretaries of the Military Departments, Directors of the Defense Agencies, and CJCS will lead an effort across the Department to identify the core capabilities and enabling technologies for each of the six QDR key mission areas.”
QDR KMA Study Approach

Mission 1
Defend the United States and Support Civil Authorities at Home

Mission 2

Mission 6

Objective Architecture

Critical Capabilities

Enabling Technologies

FY 2012/2013 S&T President’s Budget Request
# QDR KMA Study Timeline

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<td>Kickoff</td>
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<tr>
<td>Working Groups</td>
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<td>Working Groups</td>
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<td>Working Groups</td>
<td>DoD S&amp;T Priorities Development Process</td>
</tr>
<tr>
<td>Strawman Mission Area</td>
<td></td>
<td>OV-1 Architectures</td>
<td></td>
<td>Integration and Recommendations</td>
<td>October</td>
</tr>
<tr>
<td>OV-1 Architecture Definition</td>
<td></td>
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<tr>
<td>Enterprise Working Meeting</td>
<td>Enterprise Working Meeting</td>
<td>Enterprise Working Meeting</td>
<td>Industry Day Enabling Technology Identification Working Sessions</td>
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<tr>
<td>(S&amp;T, CAPE, Policy, COCOM)</td>
<td>(S&amp;T, CAPE, Policy, COCOM)</td>
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<td>2 June</td>
<td>7 June</td>
<td>29 July</td>
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<tr>
<td>2 June</td>
<td>7 July</td>
<td>29 July</td>
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</tbody>
</table>

**Timeline Events:**
- **Apr 2010:** Kickoff
- **May 2010:** Working Groups
  - Strawman Mission Area
  - OV-1 Architectures
- **Jun 2010:** Working Groups
  - OV-1 Architecture Definition
- **Jul 2010:** Enterprise Working Meeting
  - (S&T, CAPE, Policy, COCOM)
- **Aug 2010:** Integration and Recommendations
- **Sep 2010:** DoD S&T Priorities Development Process
- **Oct 2010:** Industry Day Enabling Technology Identification Working Sessions
Single-Service Led S&T Priorities

- **Army**
  - Immersive Training

- **Navy**
  - Undersea Warfare

- **Air Force**
  - Long Range Strike
  - Affordable Space Access

*Note: The QDR KMAs are additive to core military missions and competencies assigned to the armed forces*
Initial S&T Priorities - 54 Total - Reduced to 7 -

• QDR KMA DPPG Study:
  – Data to Decisions
  – Systems 2020
  – Immersive Training
  – Autonomy for Standoff, Speed & Scale
  – Human Terrain Preparation
  – CBRN Standoff Detection, Locate, Monitor & Track
  – Cyber Mission Assurance/Dominance -Includes Trust & Attribution
  – Rapidly Tailored Effects
  – EM Spectrum Management
  – Knowledge and Information Management / Architecture
  – Ubiquitous Observation
  – Access and Sharing of DoD Information/Databases
  – Alternatives to GPS for providing PNT
  – Contextual Exploitation

• TFTs and COIs:
  – High Speed / Hypersonics
Initial S&T Priorities - 54 Total - Reduced to 7 (contd.) -

• TFTs and COIs (contd.)
  – Highly Adaptive Turbine Engines
  – Multi Role Vertical Lift
  – Reasoning Machines
  – Teaming Large Numbers of Autonomous Hetero. Systems
  – Developing Materials Underpinning Electronics Technologies
  – Force Protection
  – Mobility
  – Integrated Computational Materials Science and Engineering (ICMSE)
  – Complex Engineered Materials
  – Improved Kinetic Weapons

• Service and Agency Priorities
  – Autonomy
  – Power & Energy
  – Total Ownership Cost
  – Directed Energy
  – Educational Outreach/STEM
Service and Agency Priorities (contd.)
- Irregular Warfare/Counter IED
- Undersea Warfare
- Electronic Warfare/Electronic Protection
- Improved Situation Awareness, Persistent ISR
- Climate Change and the Arctic
- Long-Range Strike
- Medical PTSD/TBI, Blast/Trauma
- Enhanced Cognitive Performance
- Software Assurance
- Rare Earth Element Technologies
- Small Engines/Alternate Propulsion
- Military-Unique Fixed-Wing and Rotary-Wing Technologies
- Human System
- Affordable Space Access
- Precision lethality
- Counter-WMD Technologies (9 total that were consolidated to 1)
Implementation Forum:
S&T Executive Committee

ASD(R&E) (Chair)
J8
Navy
Army
Air Force
EXCOM

Policy
DARPA
ASD(NCB)

Deputies Council

Technology Focus Teams
Communities of Interest
Strategic Drivers
CoCom Needs

6 TFTs
12 COIs
QDR, NSS...
JUONs, IPLs ...

Leadership Commitment
High-Priority Objectives
Tightly-Focused Agendas
Structured Decision Packages
S&T Executive Committee (EXCOM)

Lt Gen Larry Spencer  
J8

Ms. Kathleen Hicks  
DUSD(SPF)

Mr. Zach Lemnios  
ASD(R&E)

Mr. Andrew Weber  
ASD(NCB)

Mr. Brett Lambert  
DASD(MIBP)

Dr. Regina Dugan  
DARPA

Dr. Steven Walker  
DASA(S STE)

Dr. Marilyn Freeman  
SAAL-ZT

RADM Nevin Carr  
CNR
Process for Developing S&T Priorities

S&T Investment Drivers

- **Warfighters**
  - IPLs/STIPLs
  - RDA Task Force

- **Strategic Guidance**
  - QDR KMA Studies
  - DPPG Studies
  - OSTP Priorities

- **Technology Push**
  - TFT Priorities
  - COI Priorities

- **Service Priorities**
  - Immersive Training
  - Undersea Warfare
  - Affordable Space Access

**Comprehensive List of Needs**

- (54 Total)

**Identify Cross-cutting & Single Service Priorities**

**S&T EXCOM Review**

High Level Review of Existing Priorities

(7 Identified)

**SECDEF S&T Priorities Memo**

Apr 19, 2011
## FY 2013 S&T Priorities Timeline

<table>
<thead>
<tr>
<th>Date</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov 8-12</td>
<td>S&amp;T Deputies Council Meeting - Priorities spreadsheet discussion</td>
</tr>
<tr>
<td>Nov 15-19</td>
<td>S&amp;T Deputies Council Meeting - Gather Inputs and organize data</td>
</tr>
<tr>
<td>Nov 22-26</td>
<td>S&amp;T Deputies Council Meeting - Discuss which priorities make it into DDR&amp;E Guidance Memo - QDR KMA Study Team 1 Brief)</td>
</tr>
<tr>
<td>Nov 29-Dec 3</td>
<td>S&amp;T Deputies Council Working Group</td>
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<tr>
<td>Dec 6-10</td>
<td>S&amp;T Deputies Council Meeting - Review DDR&amp;E Guidance Memo</td>
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<tr>
<td>Dec 13-17</td>
<td>S&amp;T Deputies Council Meeting - S&amp;T Priorities Briefing</td>
</tr>
<tr>
<td>17 Nov</td>
<td>S&amp;T Deputies Council Meeting - Reviewed voting on top 6-8 S&amp;T Priorities</td>
</tr>
<tr>
<td>23 Nov</td>
<td>S&amp;T Deputies Council Meeting - POC briefings on S&amp;T Priorities</td>
</tr>
<tr>
<td>30 Nov</td>
<td>Roadmap Development</td>
</tr>
<tr>
<td>10 Nov</td>
<td>Service Priorities</td>
</tr>
<tr>
<td>3 Nov</td>
<td>QDR KMA Study</td>
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<td></td>
<td>DPPG Studies</td>
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<td></td>
<td>OSTP Priorities</td>
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<tr>
<td></td>
<td>TFT/COI Priorities</td>
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<tr>
<td>15 Dec</td>
<td>S&amp;T EXCOM - S&amp;T Priorities Briefing</td>
</tr>
</tbody>
</table>

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**Service Priorities**
- QDR KMA Study
- DPPG Studies
- OSTP Priorities
- TFT/COI Priorities
S&T Priorities

- Data-to-Decisions
- Engineered Resilient Systems
- Cyber Science and Technology
- Electronic Warfare / Electronic Protection
- Counter Weapons of Mass Destruction
- Autonomy
- Human Systems

“The Assistant Secretary of Defense for Research and Engineering, with the Department’s S&T Executive Committee and other stakeholders, will oversee the development of implementation roadmaps for each priority. These roadmaps will coordinate Component investments in the priority areas to accelerate the development and delivery of capabilities consistent with these priorities.”
Priority S&T Investment Areas for FY 2013-2017

• Data-to-Decisions
  – Science and applications to reduce the cycle time and manpower requirements for analyses and use of large data sets.

• Engineered Resilient Systems
  – Engineering concepts, science, and design tools to protect against malicious compromise of weapon systems, and to develop agile manufacturing for trusted and assured defense systems.

• Cyber Science and Technology
  – Science and technology for efficient, effective cyber capabilities across the spectrum of joint operations.

• Electronic warfare / Electronic protection
  – New concepts and technology to protect systems and extend capabilities across the electromagnetic spectrum.

• Counter Weapons of Mass Destruction (WMD)
  – Advances in DoD’s ability to locate, secure, monitor, tag, track, interdict, eliminate, and attribute WMD weapons and materials.

• Autonomy
  – Science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks in all environments.

• Human Systems
  – Science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.
USTRANSCOM
Operational and Technology Challenges Brief to
Science & Engineering Technology Conference/DOD Tech Expo
Mr. Lou Bernstein

Approved for Public Release
Purpose

• Role/Mission

• Logistics Transformation Imperative

• Top Operational/Technology Challenges

• RDT&E Program Overview/Project Highlights
USTRANSCOM Transformation

1986 – Goldwater/Nichols Act

1987 – US Transportation Command Established

1990 – DESERT SHIELD/STORM

1993 – US Transportation Command Charter (Peacetime/Wartime Strategic Mobility)

2003 – Distribution Process Owner Established

2005 – Full Time US Transportation Command Commander

2007 – DPO lead for DOD Supply Chain RFID/AIT implementation

2011 – Global Distribution Synchronizer
USTRANSCOM’s End-to-End Mission

The optimized schedule is ready for execution.

Will my force in the AOR be ready for the fight on D-Day?

Where is my equipment now & when will it get here?

Leveraging S&T to Transform Logistics Support to the Warfighter and Ensure the Development of Affordable Solutions
Operating in a Global Environment...

Combatant Commander Plans...
- Rely on Austere Infrastructure
- Demand Rapid Force Projection
- Require Early Diplomatic Coordination
- Incorporate Civil-Military Support
- Pose Force Protection Threat

...that places a premium on Collaboration
DOD’s Logistics Strategic Vision

• DOD Logistics Goals
  – *Effective logistics support to current ops*
  – Effective management of contractors on the battlefield
  – Integrate life cycle management principles
  – *Integrate supply chain to point of consumption*
• **Deliver integrated joint logistics capabilities**
• **Network/Optimize the Joint Logistics Enterprise**
• **Ensure Rapid, Precise Response**

Note: USTRANSCOM RDT&E program affects italicized areas
Top Operational/Technical Challenges

• Improve Point of Need Delivery
  - High Speed Container Delivery
  - Helicopter Sling Load - JPADS
  - JPADS-Guidance/Navigation/Control

• Ability to Sustain from the Joint Seabase
  - Joint Universal Causeway Interface Module
  - Com’l Roll-on/Roll-off Interface Platform
  - Sea Base Enablers

• Command & Control/Decision Support
  - Situational Awareness & Collaboration
  - Computing Environment
  - AT21/Decision Support

• Operate in Any Environment/Energy Conservation
  - Unmanned Air Systems/Hybrid
  - Cyberspace/Security
  - Support Planning for Aerial Refueling

See USTCH60-2 for complete list
www.transcom.mil/rdte
Program Summary

<table>
<thead>
<tr>
<th></th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16</th>
<th>FY17</th>
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<tr>
<td>Current Top Line</td>
<td>$43M</td>
<td>$34.2M</td>
<td>$38M</td>
<td>$38.3M</td>
<td>$39.2M</td>
<td>$43.1M</td>
</tr>
</tbody>
</table>

Leveraged over $285M in Service/OSD/Defense Agency
RDT&E contributions (FY06-11) – 7:1 ROI
Future Focus Areas

- Force Protection/Security
- Humanitarian Airdrop Over Populated Areas
- Sense and Respond Logistics
- Improved Accuracy at Point of Need
- Optimization
- Rapid/Automated Landing Site Detection
- Collaboration and Integration
- Port Efficiency Enhancements
- Sea Based Enablers
Knowledge Management--Service-Oriented Architectures

Airships and Hybrid Airships

Satellite RFID

Advanced Decision-making Tools for the Supply Chain

Cloud Computing and Data Quality

Wind Farm Effects on Radar Performance

Science, Technology Engineering & Mathematics

Over $7.5M of Industry Investment

Remotely Piloted Vehicles For Cargo Transport
We Measure Success Through the Eyes of the Warfighter & the Taxpayer!
Backups
Selected Benefits (completed efforts)

- **End to End Distribution Model**
  - Halved MCRS-16 simulation run-times; simulate all portions of deployment & distribution
  - Provided the data to support USAF decision to retire 22 C-5A

- **Joint Modular Intermodal Container: $16M/yr savings w/cardboard uni-pack**

- **Defense Distribution Expeditionary Depot**
  - Significant reduction in military inter-theater airlift for DLA managed items
  - Customer Wait Time reduced from 19.8 days to 10.8 days

- **Coalition Mobility System: 100% ROI within 2 years and $2.3M/yr thereafter**

- **Common Operating Picture (Deployment and Distribution)**
  - ID of top 100 heaviest airlifted items saving $54M annually in transportation costs
  - Delivered initial iDistribute.mil capabilities (i.e., workspace mgmt, collaboration, etc.)

- **En Route Patient Care Module**
  - Less people managing more patients/continued intervention in absence of skilled caregiver
  - Closed loop system provides ~40% reduction in O2 use over current manual methods

- **JPADS – Mission Planner: 80% reduction in recovery ops/cost & saves lives**

- **JPADS Next Generation Guidance, Navigation & Control**
  - Enhanced accuracy (< 50 meters) integrated into 2K JPADS assets; Reduce DZ by 20%
  - Reduce IED exposed convoys, safer recovery ops, increased personnel survivability

- **Low Cost Low Altitude: Reduce airdrop asset recovery/improves safety (less grnd convoys)**
Selected Benefits (completed efforts)

- **Wireless Gate Release System**
  - Doubles C-130 delivery capacity (FOC 4QFY11) (saving fuel/acft wear & tear/assoc costs)
  - Eliminates bundle damage due leap frogging (effects 20% of airdropped bundles)

- **Joint Recovery and Distribution System**
  - 101st Sustainment Brigade employing three 40T vehicles - completed < dozen missions in Afghanistan to date
  - USMC to deploy four 34T vehicles (per HQMC current trailer is unsuited for Afghan rugged off road conditions-- looking to purchase another 10 to fill Urgent Universal Needs Statement)

- **Seabasing**
  - Joint Universal Causeway Interface Module: Universal connector (vice spending $246M to replace Army Modular Causeway System and Improved Navy Lighterage System)
  - Commercial Roll-on/Roll-off Interface Platform: Provide non-existent capability to off-load commercial RO/ROs at sea – enhanced operational flexibility/could reduce sealift recap bill
  - Shipboard Selective Access and Retrieval System
    - 67% reduction in manpower required to move vehicles and containers (typically 6 to 2)
    - Improved storage (omni-directional access/movement) of mission assets
    - MHE fuel usage is cut by 67% for RO/RO operations and 100% eliminated for flat-deck operations (due use of battery/hybrid diesel/electro-hydraulic drives)

- **Next Generation Autonomic Logistics/Predictive Analysis**: Will improve sustainment forecasting and enable best cost transportation solutions
Selected Benefits (ongoing efforts)

- **Cyber**
  - Computer Adaptive Network Defense-in-Depth: Provided DOD the ability to continue critical network operations in a contested NIPR/SIPR network environments via secure enclaves
  - Cross Domain Collaborative Information Exchange: Provide bi-directional transfer across NIPR/SIPR domain for the Joint Deployment & Distribution Enterprise

- **Humanitarian Assistance Visibility Experiment/Humanitarian Expeditionary Log Project**
  - Qualified ROI is a cost savings of $147,000 ($15.00/hr x 35 hours x 70 operating days x 4 sites) and a twelvefold improvement in data visibility (from once every 12 hours to once every hour)
  - Historical example from 2008 Hurricane Ike - capability would have resulted in a cost avoidance of $5M to the taxpayer in one incident in which 450 truckloads of ice were procured and destroyed because resource visibility was nil

- **Next Generation Wireless Communications:** Army G4 draft BCA determined break even point in 2 years and ~33% out-year lower costs over current $619M-10 yr aRFID solution

- **Support Planning for Air Refueling:** Potential $265M/yr savings at $3/gal
Selected Benefits (ongoing efforts)

- **AT21/Living Plan: Combined (TWCF/RDT&E) $884M (FY07-26) cost savings**
  - Movement Requirements Visibility-Theater: Better utilization of common user movement assets in theater is expected to provide at least a $16.7M annual cost avoidance
  - Distribution Process Nodal Model: Improve Time Definite Delivery by 10 – 15%
  - End to End Distribution Modeling: Reduce model setup and runtime by 20%; Economic Analysis states breakeven year to be FY17 (AT21 enabler)
  - Global Mission Scheduling: TACC tool to dynamically re-plan (est. cost avoidance of $6.38M/yr due more efficient use of assets/fuel savings/reduced mission support requirements/etc.)
  - Cognitive Visualization, Alerting and Optimization: Reduces time to generate multiple COAs and develop optimized solution among multiple stakeholders
  - Situational Awareness & Collaboration: Better warfighter support via improved organizational unity of effort and efficiencies thru common operational SA and networked collaborative capabilities for JDDE stakeholders
  - Enterprise Integration Lab: Mitigate technical risk and accelerated capability fielding via comprehensive functional and certification/accreditation testing
  - Dynamic Re-planning Nodal Management Air
    - Provide standard, objective, repeatable method to assess airport capacity and flow requirements
    - $0.9M/yr savings/cost avoidance (conservative estimate)
    - Could realize similar savings from seaport – providing additional $400K in FY13 to explore/assess
Selected Benefits (ongoing efforts)

- **Point of Need Delivery:** No costs savings/just better warfighting capability
  - JPADS Helicopter Sling Load: Increased operational flexibility/agility – enhanced safety (crew/helo as well as reduction in ground convoys)
  - High Speed Container Delivery System: Enhanced aircrew/aircraft survivability (70% reduction in exposure to ground threat due fast ingress/egress) while increasing accuracy of resupply (due delivery at lower altitude and higher airspeed) as well as volume (from < 2200 lbs to > 16,000 lbs)
  - Autonomous Technologies for Unmanned Air Systems: Ability to provide precision delivery (via sling load) in anti-access/austere/urban environments (minimizes risk to ground troops, eliminates pilot/aircrew from resupply equation, provides field retrograde capability). Hand-held beacon to eliminate need for forward air controllers/ground stations.

**Minimum 7:1 ROI – Program Pays for Itself**
Michael L. Bosworth  
SEA 05T, Chief Technology Officer (acting)  
Michael.bosworth@navy.mil
NAVSEA Organization (made simple)

NAVSEA Commander VADM McCoy
Vice Cdr Executive Director Staff

Program Executive Offices (PEOs)
- Ships
- Submarines
- Aircraft Carriers
- Integrated Warfare Systems
- Littoral and Mine Warfare >>> to Littoral Combat Ship (soon)

Headquarters Directorates
- Most notably for this venue
  SEA 04 (with naval shipyards, supships)
  SEA 05 (Naval Systems Engineering)
  with a dozen tech groups of which one is 05T (Technology ie R&D)

Naval Labs
- NSWC (surface)
- NUWC (undersea)

Fuller & official org chart at http://www.navsea.navy.mil/Organization/HQ.aspx
• Serve as Primary SEA 05 R&D and Technology Transition Staff
• Focus on transitioning technology from S&T to the Acquisition Programs and Fleet
• Manage assigned R&D Programs
• Develop a workforce that can effectively lead and transition technology into the fleet
• Partner with S&T Community, Industry, Acquisition Community, and the Fleet to produce technology development strategies and transition technology into the fleet
Naval Technology Needs for Today’s Fleet

• Technologies promoting the ability to affordably modernize to meet evolving threats
  – Open Architecture
  – Modularity
  – Increased Distributed System Capacity (electrical power, chill water, etc.)
  – Ability to interface with new aircraft (MV-22, JSF, etc.)
  – Ability to interface with off-board unmanned systems.
• Technologies that improve material condition of ships
  – Corrosion Control
  – Reliability improvements
• Technologies that reduce the Total Ownership Cost of Today’s Fleet
  – Energy Efficiency
  – Reduced Manning
  – Improved training methods
• Analytical Methods to enable calculating Return on Investment of Open Architecture and Modularity
  – “Real Options”
Naval Technology Needs for the Future Fleet

- Architecture driven Product Lines
  - Next Generation Integrated Power Systems
  - HVAC 21st Century
  - Open Architecture Combat Systems
- Affordable incorporation of evolving technologies
  - Railguns and Directed Energy Weapons
  - Unmanned Vehicles and Autonomy
  - New Aircraft (shipboard integration of…)
- Improved Design methods and tools
  - Ship Design Process Modeling
  - Properly Pricing Risk
  - Properly Valuing Flexibility
  - Design, Costing & Analysis Tools
- Total Ownership Cost Reduction Technologies
- Mission Effectiveness Technologies
- Improved Technology Transition Model

Need affordable robustness in a changing world
• The transition opportunities are in the acquisition shops (PEOs).

• FOR SHIPS: Look at annual 30 year Shipbuilding Plan.

• Backup from the first of class ‘award date’ to early design.

• Have a new capability/technology ‘ready for transition’ as design concepts are being developed, competed, selected.

• Less centralized data for warfare systems, HM&E & logistics systems, boats/craft/unmanned vehicles.
**30yr Ship-Building Plan**

**SHIPS:**
- DDG51
- DDG(X)
- LHD(X)
- LSD(X)
- T-AO
- T-ARS(X)
- T-AGOS(X)
- AS(X)
- SSC
- LCS
- LCS(X)

*POC: Glen Sturtevant*
*Glen.Sturtevant@navy.mil*

**SUBS:**
- SSBN(X)
  - Ohio Replacement
- SSN - Virginia
*POC: Regan Campbell*
*Regan.Campbell@navy.mil*

**CARRIERs:**
- CVN21
*POC: Eric Pitt*
*Eric.Pitt@navy.mil*

**Near Term Technology For Today’s Fleet**

**Pacing Evolving Threats:**
- Open Architecture
- Modularity
- Distributed Systems
- UV Interfaces

**Operating Cost Reduction:**
- Energy Efficiency
- Automation
- Improved Crew Training

**Lifecycle Cost Reduction:**
- Low Maintenance Materials
- Remote CBM
- Reduce/Eliminate Corrosion
- Software Reconfigurability

**Far Term Technology For The Future Fleet**

**Architecture Driven Product Lines:**
- NGIPS
- HVAC 21st Century
- Open Architecture

**Disruptive Technology:**
- Directed Energy Weapons
- EM Railgun
- UVs

**New Design & Analysis Tools:**
- Ship Design Process Modeling
- Pricing Risk
- Quantifying/Valuing Flexibility
- CREATE

**Disruptive Technology:**
- Large Diameter Tube Payloads

**Lifecycle Cost Reduction**: *additional to ones listed above*
- In Water Repairable Systems

**Pacing Evolving Threats**: *additional to ones listed above*
- New Aircraft Interfaces

**Life Cycle Cost Reduction**: *additional to ones listed above*

**Pacing Evolving Threats**: *additional to ones listed above*
- New Aircraft
Summary

- Technology & Innovation for Ships, Boats, Unmanned Vehicles & the systems that integrate into them….for warfighting mission payoff.
- Affordable (crisis of cost).
- Transitionable (crisis of productization).
- Utilize existing in new configurations (to be affordable & transitionable)

April 2011
**Contact Info:**

<table>
<thead>
<tr>
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<th>Jerome Dunn</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
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</tr>
</tbody>
</table>

**NAVSEA 05 - Naval Systems Engineering Directorate**

| SEA 05C - Cost Engineering & Industrial Analysis |
| SEA 05D - Surface Ship Design & Systems Engineering |
| SEA 05H - Integrated Warfare Systems Engineering |
| SEA 05L - Littoral and Mine Warfare Design & Systems Engineering |
| SEA 05P - Ship Integrity & Performance Engineering |
| SEA 05S – Command Standards |
| **SEA 05T - Technology** |
| SEA 05U - Submarine/Submersible Design & Systems Engineering |
| SEA 05V - Aircraft Carrier Design & Systems Engineering |
| SEA 05X – University Affiliated Research Center |
| SEA 05Z - Marine Engineering |
| SEA 04 – Logistics, Maintenance, and Independent Operations |
| SEA 07 – Undersea Warfare |
| SEA 08 – Nuclear Propulsion |
| SEA 21 – Surface Warfare |

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AFRL Precision Air Drop

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Air Force Research Laboratory
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Air Drop by the Numbers

60,400,000
Pounds dropped in 2010, 99+% CDS ($2.5K/bundle)

<100,000
Pounds dropped in 2010, guided systems ($30+K/bundle)

250
Distance to impact point (in meters) considered an “acceptable” drop

<50
Desired distance to impact point (in meters)
Air Drop Focus Areas

“AMC has a need to provide aerial delivery of a broad range of assets with superb accuracy from extended airdrop offset distances and higher altitudes. Single pass capability solutions should be considered…” Gen Raymond Johns, Commander AMC, 2011

• “Precision” was the original intent of the AFRL Air Drop focus
• AMC’s desire was for AFRL to address urgent needs with:
  – Critical resupply
  – Humanitarian airdrop
• AMC’s urgent needs shaped the definition of precision
• The AFRL Air Drop scope addresses precision as:
  – Single pass
  – Dispersion predictability
  – Situational awareness of bundles
  – Impact point accuracy
SINGLE PASS AIR DROP & PRECISION AIR DROP
Single Pass Airdrop (SPAiD)

**Technology**

- AFRL proposed UAV-based weather drop sonde-release solution; Ready to demo in 2Q11
- Integrate into C-17, C-130 Joint Precision Air Drop System Mission Planning (JPADS-MP) Computer

**Description**

Rapidly find technical solution for AFCENT UON to eliminate need for 2 passes over drop zones during high altitude airdrop ops

**Benefits to the War Fighter**

- Eliminates multiple aircraft passes over drop zone
  - Reduces potential for enemy fire
  - Prevents tip-off of drop event
- Allows precision delivery of packages with lower-cost Improved Container Delivery System (ICDS)
- Simplifies mission profiles and time aloft for air delivery missions
- Solves AFCENT UON/Requirement

**Technology Investment Schedule (FY10)**

<table>
<thead>
<tr>
<th>Problem Scoping</th>
<th>Solution Concept Development</th>
<th>Project Approval</th>
<th>Prototype Dev'lp/Fabrication</th>
<th>Demonstration/Testing</th>
<th>Transition</th>
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<tbody>
<tr>
<td>1Q10</td>
<td>2Q10</td>
<td>3Q10</td>
<td>4Q10</td>
<td>1Q11</td>
<td></td>
</tr>
</tbody>
</table>

Funding (6.3 – CP3 Project): $1M

Tor: Note: Sonde transmits weather data to Pod, VR data from Pod to inbound A/C.
Single Pass Air Drop (SPAiD) FY10 Accomplishments

**Objective:** Collect current, drop zone (DZ) weather data, which will enable mobility aircraft to perform accurate air drop to the target DZ in a single pass.

**Challenges**
- Coordination Efforts
  - AMC/AFMC/ACC/AFCENT
  - In-theater
- Reduce drop sonde size; increase reception range
- Pod attachment to RPA (Predator)
- Pod design/flight worthiness approval
- Surrogate flight approval/Pod components flight test
- UON priority—compressed schedule
- RPA (Predator) asset availability
  - We need a Predator for 1-week test in CONUS

**Accomplishments**
- Smaller drop sonde – 87% reduction in weight
- Predator availability in-theater; support from 62 ERS (Kandahar)
- Data Storage/Forwarding
  - increased reception from 6nm to 100nm
- Pod slide-on attachment to Hellfire rail system
- Successful Pod components flight test, Dec 2010
- AMC/AFCENT G.O. level coordination and endorsement
- Transition to part of FCC from CP-3

M34 Dummy Hellfire Interim pod
- ~99 lbs
- Quick Seek Eagle Approval

Lightweight TMS pod
- ~15 lbs
- Transition 3Q11
## Precision Airdrop

### Description

Develop technologies that improve the accuracy and lowers the cost of Container Delivery System (CDS), humanitarian, and guided airdrops.

### Technology Challenges
- Real-time wind sensing
- Automated green light release technology integration
- Error budget analyses and improved modeling approaches
- Low cost highly accurate guided drop systems
- Humanitarian relief delivery concepts

### Benefits to Warfighter
- Improves accuracy of CDS drops
- Lowers the cost of precision drops
- Lowers the risk of unintended consequences
- Improves pre/post drop SA
- Improves bundle SA
AFRL REQUIREMENTS DERIVATION
Systems Engineering (SE) Process

- **Step 1: IPT**
  - Generate Technology Alternatives and Conceptual Designs

- **Step 2: Requirements**
  - Develop Requirements and Metrics
    - Solicit input from all stakeholders
    - Define measurands, desirability functions, and relative importance
    - Repeat as knowledge advances

- **Step 3: Alternatives**
  - Perform Value Analysis to Evaluate Alternatives
    - Evaluate alternatives against requirements
    - Compute desirability and risk for each concept
    - Explore trade space
    - Generate or refine alternative approaches
    - Select most promising approach

- **Step 4: Evaluation**
  - Deliver Results: Recommend Alternatives

- **Step 5: Documentation**
  - Solicit input from all stakeholders
  - Define measurands, desirability functions, and relative importance
  - Repeat as knowledge advances
Desirements Development

P01: Impact Point Accuracy

**Critical Resupply**

**Description:** Accuracy of impact point, measured as the difference between planned and actual (x,y,z) location of center of the dispersion pattern on impact, based on a 3,000 ft AGL drop.

**Clarification:** This is not a CEP number; it is more a 90% probability number. The expectation for greater accuracy increases at lower altitude.

**Unit of Measure:** meters

**Priority:** Very High

**Weight:** 5

**Objective:** 50

**Risk Limit:** 200

**Objective Rationale:** 50 m 90% of the time is the objective requirement from the JPADS CDD.

**Risk Limit Rationale:** Current level of performance. Must improve upon this.

---

Desirements Breakout:

Performance – 20

Human Factors – 7

Cost – 5

Security - 2
Functional Work Breakdown Structure

36 alternatives (notional solutions) identified to address high error-prone functional areas
### Alternatives Analysis & Tradeoffs

**Tradespace Refinement**

<table>
<thead>
<tr>
<th>Des #</th>
<th>Desirement Name</th>
<th>Units</th>
<th>Current</th>
<th>I-Skid</th>
<th>I-SkidAdv</th>
<th>I-Dun</th>
<th>I-DunAdv</th>
<th>I-Release</th>
<th>Active Shaping</th>
<th>ForceEx</th>
<th>Air Bags</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
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<td></td>
<td>meters</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>P01</td>
<td>Impact Point Accuracy</td>
<td></td>
<td>400</td>
<td>800</td>
<td>325</td>
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<td>300</td>
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<td>400</td>
<td>800</td>
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<tr>
<td>P02</td>
<td>Predictability of Dispersion Pattern</td>
<td></td>
<td>200</td>
<td>400</td>
<td>162.5</td>
<td>362.5</td>
<td>150</td>
<td>337.5</td>
<td>200</td>
<td>400</td>
<td>125</td>
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<tr>
<td>P03</td>
<td>Accuracy of CARP Execution</td>
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<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
<td>100</td>
<td>200</td>
<td>100</td>
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<tr>
<td>P04</td>
<td>Predictability in the Event of Malfunction</td>
<td>Confidence</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
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<tr>
<td>P05</td>
<td>Platform Agnostic</td>
<td>Scale: 1–5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
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<tr>
<td>P06</td>
<td>Likelihood of Avoiding Collateral Damage</td>
<td>Probability</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
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<td>Expected</td>
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<td>P07</td>
<td>Communication Capability</td>
<td>Scale: 1–5</td>
<td>2</td>
<td>1</td>
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<td>Expected</td>
<td></td>
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<td>Expected</td>
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<tr>
<td>P08</td>
<td>Agility / Flexibility</td>
<td>Minutes</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td>Expected</td>
<td></td>
<td></td>
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<td>Expected</td>
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<td>P09c</td>
<td>Number of Passes</td>
<td>Count</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>P09h</td>
<td>Load Deliverable in a Single Pass</td>
<td>%</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>Survivability of the Load</td>
<td>Confidence</td>
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<td></td>
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<td></td>
<td></td>
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<td>Expected</td>
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<td>Bundle-Awareness Capability</td>
<td>Scale: 1–5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>P13</td>
<td>Mass Capability (Max)</td>
<td>lb</td>
<td>2200</td>
<td>2200</td>
<td>10000</td>
<td>15000</td>
<td>10000</td>
<td>15000</td>
<td>10000</td>
<td>15000</td>
<td>10000</td>
</tr>
</tbody>
</table>

**36 alternatives were given a sanity check and scored against the desirements by time frame…0-5 yrs and 5+yrs**
Findings and Way Forward

• The SE process educated AFRL on air drop and the associated trouble spots
• The process became less effective with the scoring of the alternatives against the desirements
  – Lack of real data prevented an understanding of how the alternative would affect the air drop outcome
  – There was no robust error budget model or analyses available
  – Outcome set the stage for a multi-phase AFRL approach

• The AFRL Air Drop way-forward is evolving
• AFRL is proposing a Phase I discovery period where AFRL/Army Natick/AMC work to collect data from air drop flights
Way Forward – cont’d

• AFRL has teams addressing:
  – On-board WX sensing integrated with sniper pod technology
  – Automated Green Light Release
  – Payload Exit/Release Improvement
  – Air Drop for Humanitarian Relief
  – Low Cost Guided Air Drop

• Each team lead has emphasized the need to capture:
  – Aircraft dynamics at release point
  – Bundle dynamics at release point and during descent
  – Weather situation and affects
  – Parachute specifics (type, material, extraction/opening times)

• A complete picture of the problem is needed to drive our S&T efforts to the highest payoff solution
Summary

• AFRL is fully engaged in the air drop problem
• The problem is challenging and needs further deep-dive understanding
• AFRL is planning on FYDP solutions that can be transitioned to AMC to address CDS and humanitarian drops
• AFRL is also working plans with the Army to make guided air drop systems more attractive
• The AFRL S&T process needs to be thorough to yield high payoff solutions
Soft Power and its use in the Asia Pacific Region

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HQ U. S. Pacific Command

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June 2011
How is the US viewed by the international community?
What is “Soft Power”?  

Posit a definition: 

* “Soft power is influencing others to act in mutual interest by appealing to shared values”

Culture, political values, and foreign policies

Compared to “Smart Power” and “Hard Power”

* Joseph Nye, Dean of Harvard’s Kennedy School of Government
Which “Power” is Best?

Choosing which power(s) to use depends upon what effect(s) we’re trying to achieve

Soft power is more about winning the peace

- Longer-term effects
- Moral high ground

_Borrowing Brilliance_, David Kord Murray

Root cause analysis: “Why is a problem a problem?”

Root problems for warfighting seem to point to higher level problems best addressed by soft power
What Role Does S&T Play in Soft Power?

Most nations value the development and prosperity that scientific and technological advances bring.

First, how do we equip our PACOM ambassadors to engage across the theater?

Second, how do we use S&T to initiate and improve broader military-to-military engagement and interoperability with our allies and strategic partners?

There is so much more we can do, and at PACOM we are open to any and all S&T partnership opportunities that we can tie to our most pressing challenges across our strategic and operational portfolios.

Be cautious of unintended effects/consequences.
Common Challenges and Mutual Opportunities

- POW/MIAs
- Humanitarian Assistance
- Disaster Relief
- Terrorism / Extremism
- Maritime Security
- Weapons Proliferation

Disaster Relief

Humanitarian Assistance

POW/MIAs

Terrorism / Extremism

Maritime Security

Weapons Proliferation
Two focus areas for S&T

- Humanitarian Assistance/Disaster Relief
  - Resilient Communities
    - Energy (Renewable energy sources)
    - Water (Long term, safe water supplies)
    - Education (Distance learning, Mobile Learning Environments)

- Maritime Security
  - Anti-piracy
  - Illegal fishing
  - Smuggling
Energy Efficient Water Purification focused on USPACOM HADR

- ID HADR capabilities with respect to small unit and local populace water purification.
- Ten systems assessed in a limited objective experiment as part of Crimson Viper Field Experiment 2010 (CV10) in Sattahip, Thailand.
  - Thai military operators and lab technicians operated the systems and provided subjective feedback
  - Water quality analysis was both subjective (by operators) and objective (lab analysis of samples)
- Telemedicine with Mongolia
- Discussion of use of distance learning with Indonesia
Maritime Awareness

Senator John McCain said on Monday,

“the United States should help members of the Association of Southeast Asian Nations to develop and deploy an early warning system and coastal vessels in contested waters”

Tensions between China and other rival claimants to the strategically vital waters -- home to two potentially oil-rich archipelagoes, the Paracels and Spratlys -- have escalated in recent weeks.

The Philippines and Vietnam in particular have expressed alarm at what they say are increasingly aggressive actions by China in the disputed waters.

Source: Energy Daily June 20, 2011
Small, low-cost Autonomous UAS

- Heavy Fuel
- Beyond Line of Sight
- Loiter 33 hours
- Power 2.1 kw
- Range > 2000nm
- Usable payload – 76 pounds
- ITAR being worked
- Payloads
  - AIS
  - FMV EO/IR
  - SAR
  - SATCOM

Technology for affordable Maritime Awareness

Low Cost Dual Use HF OTH Radar

Commercial RADARSAT
"Tell him we haven't got time for any of his bright ideas - we've got a battle on our hands"
Science and Technology Development

From the Combatant Command Perspective
Where we fit in with the rest of the COCOMs
Central Region
Crossroads of Three Continents
Strategic Interests & Mission

- Security of the U.S. citizens & the U.S. Homeland
- Regional stability
- International access to strategic resources, critical infrastructure, & global markets
- Promotion of human rights, rule of law, responsible & effective governance, & broad-based economic growth & opportunity

With our national & international partners CENTCOM will:
- Promote security & cooperation among nations
- Respond to crisis
- Deter & defeat state and non-state aggression
- Support development & reconstruction to establish conditions for regional security, stability, & prosperity
CENTCOM - Area of Responsibility

Complex
- 20 Countries, 4.5 million square miles
- 1.1 Million square miles of ocean
- 531 Million people, 16 major ethnic groups
- 7 Major languages, hundreds of dialects
- 4 Major religions

Global Economic Impact
- Arabian Gulf produces ~ 31% of world crude oil
- Region exports ~ 26% of global LNG supply
- 3 x Strategic Choke Points
  - Appx 40% internationally traded oil transits SoH
  - 21% of LNG goes through Strait of Hormuz
Vision – We seek a region:

• At peace with itself & its neighbors
• Focused on common security & cooperation
• With stable governments responsive to the needs of the people
• With economic development that advances the population’s well being
• Free of nuclear weapons & where nuclear energy use is verifiable & for peaceful purposes
• With unhindered international access to strategic resources, critical infrastructure, & global markets
• Which does not allow the safe haven of extremists which threaten Americans or our friends & allies
Challenges

- Lack of progress in the Middle East Peace Process
- Extremist ideological movements & militant groups
- Proliferation of WMD
- Ungoverned, poorly governed, & alternatively governed spaces
- Terrorist & insurgent financing & facilitation
- Piracy
- Ethnic, tribal, & sectarian rivalries
- Disputed territories & access to vital resources
- Criminal activities: weapons smuggling, narcotics, human trafficking
- Uneven economic & employment opportunities
- Lack of regional & global economic integration
Priority Tasks for CENTCOM

- Reversing the momentum of the insurgency in Afghanistan
  - Regain the initiative
  - Restore public confidence in the GoA
- Maintain kinetic / non-kinetic pressure against threats to National security and our Allies
- Expand our partnership with Pakistan
  - Support their operations against militants
  - Assist in developing their counterinsurgency capability
- Counter malign Iranian activities & policies
- Counter proliferation of WMD & build partner capacity to prevent and/or respond to WMD events
- Bolster military & security capability of our regional partners
- With our partners counter piracy, illegal narcotics, & arms smuggling
- Ensure responsible expenditure of funds
- Reduce strain on the force & the cost of our operations
Major Activities

- Defeat al-Qaeda & associated movements
- Deny sanctuary & support for violent extremist groups
- Counter proliferation of WMD & associated technologies
- Deter & counter state-based aggression & proxy activities
- Support peaceful resolution to long-standing conflicts
- Build bi-/multi-lateral partnerships
- Develop partner nation capacity
- Assist nations in their ability to protect their critical infrastructure & support robust infrastructure development
- Bolster at-risk states
- Respond to humanitarian crisis
- Counter arms smuggling
- Protect freedom of navigation
The Nature of the Enemy

• A network guided by ideology
• Amorphous worldwide network which operates as a web of cells
• Fueled by militant Islamic zeal
• Anti-Zionist
• No state boundaries
• Powerful virtual element
• “Virtual Caliphate” - All directed toward the eventual establishment of a pan-Islamic state - the “Physical Caliphate”
• Seek safe-havens, physical footholds for recruitment, training, financing, and propaganda initiatives which complement its virtual element
• Well financed and has a simplified acquisition/training/fielding strategy
Al Qa"da and Associated Movements (AQAM)
AQAM: A Threat in All Realms

- Recruitment and Education
- Internet and Proselytizing
- Media and Propaganda
- Ideologically Sympathetic NGO’s
- Financiers
- Facilitators, Smugglers
- Technical Expertise, Weapons Suppliers
- Human Capital, Fighters and Leaders
- Training Camps
- Safe Havens
- Front Companies
- Sympathetic Members of Legitimate Govt’s

Virtual
Geographic

AQAM Extremist Ideology
It Takes a Network … To Defeat a Network
The Role of Science & Technology
Charter

Conduct *discovery, research, analysis*, and *sponsor development* of new and emerging technologies which have the *potential to provide material solutions* to Headquarters and Component validated Joint needs.

*Review* USCENTCOM and Component *plans, operations*, programs, policies and activities for areas where technology will improve efficiency and effectiveness.

*Integrate* across USCENTCOM headquarters and Component staffs for transformational, integrating, and experimentation activities.
What we do

• Technology discovery, research & analysis, and inform the staff & OSD on promising initiatives
  • Attend technology symposiums / reviews
    – Service Labs, DARPA, FFRDCs
    – Private industry & Academia
  • Conduct global market research
  • Provide initial feasibility / technical merit on proposals

• Needs pull
  • Conduct HQ USCENTCOM Leadership, Directorate, & Component outreach
  • Participate in planning, operations, & exercises
  • Review submissions from the requirements generation processes for technology needs to support the Warfighter

• Operationally Manage technologies we sponsor
• Participate in limited objective experiments
Director
Resources and Analysis

Analysis and Requirements
- Integrated Priority List (IPL), JQRR, Warfighting Challenges (WFCs), etc.
- Joint Urgent Operational Need (JUON)

Financial Management

Science and Technology
- Quick Reaction Branch
- Science & Advanced Concepts
- Transformation & Integration

Needs

Solution

Tech Search
How we connect
U.S. Central Command Tech Focus

• We focus on the **JOINT** solution that has the potential to satisfy a **JOINT validated** need

• Separate from the many technology needs of our customer(s) those technology challenges which:
  
  – *Do not have a readily available solution*

  – For high-impact needs there is *insufficient activity pursuing a solution*

• Seek out game-changing technologies which our customer(s) don’t know they need
Some technology areas we “pursue”:

- Detection of CBRNE at tactically significant distances; with emphasis on the “E”
- Pre-shot counter-sniper, counter-mortar, counter-RPG technologies; with emphasis on automated systems

- Technologies which enable the transfer of information more securely, more quickly, to a wider set of users, to include the warfighter when it makes sense, with less bandwidth and dedicated support resources, e.g.:
  - Multi-level Security over single architectures
  - Bandwidth compression / reduction techniques
  - Data reduction [data=>info=>knowledge=>understanding=>wisdom]

- Through automation, remote action, new and novel techniques, technologies which reduce risk and/or stress on the force and/or improve the efficiency and effectiveness of our action(s)

- Technologies which allow for greater persistence over the battlespace with fewer platforms; employing improved sensor technology providing greater fidelity of information
Common thematic areas of concern
(not in priority order)

• Detect / Defeat:
  – IED initiators / initiator systems
  – Buried / concealed IEDs
  – Production and assembly of IEDs
• HME production standoff detection
• Culvert access denial / alerting
• Persistence in surveillance
• Biometrics
  – Identity dominance
  – Force protection / access
• Non-lethal vehicle / vessel stop
• Reduce stress on the force:
  – Force Protection requirements
  – Increased automation
• Anti-swarm lethal / non-lethal
• More efficient / effective / timely trng
• Predictive analysis techniques
• Voice to text technologies

• C4ISR systems:
  – Info sharing between system
  – Multi-level security
  – Cross domain solutions
  – Faster … Better sorting / retrieval
  – On the move w/ GIG access to tactical edge
    • SATCOM, WiFi, WiMax, etc.
• Tagging, Tracking, and Locating (TTL)
• Lightweight “x” with greater “y”
• More power per unit of weight
• Scalable effects – non-lethal to lethal
  – Directed Energy
  – Kinetics
• True SA for Blue … Fused Red
• Sustaining the force – reduced size, weight, amount, and retrograde
• Holding all targets at risk
• Any sensor … any shooter; the Soldier as a sensor; any adversary … any battlespace … anytime
What would the battlespace be like if …

• Bandwidth could be made irrelevant
• Concealed / buried explosive material could be detected at significant distances
• Tagants in dual-use items used to make homemade explosives when combined cause the mixture to inert
• Intent could be pre-determined
• A two-way certified cross-domain exchange was available
• Warfighter equipment drew its power from the environment (day or night); making power storage devices optional
• Aural simultaneous two-way translation into any language was available in a miniature form-factor
When proposing a solution …
*The Heilmeier Questions … adapted*

- What are you trying to do?
  - Articulate your objectives using absolutely no jargon
- Who should care?
- How is it accomplished today?
- What are the limits of the current practice?
- What is new in your approach?
- Why do you think you will be successful?
  - How do you define / measure success?
  - What is your strategy to get there?
- How long will it take and at what cost?
- What are the risks?
- What is your risk reduction / mitigation strategy?
- What are the payoffs / return on investment?
For Technology Developers Some Points to Consider

• Seek to understand how your solution fits in the overall DoD system of systems
  – Integrate with legacy systems vice replace them
  – Open architectures receive higher interest / support

• Consider partnering with others to bring a "greater" solution to the table - system best-of-breed vice at the component level

• Determine your relative impact to a program of record
  – Training
  – Initial fielding
  – Sustainment

• Substantiate your position with data
  – Testing
  – Cost-benefit analysis
We are Venture Capitalists without any Capital. When a promising technology is discovered, we:

• Seek OSD / Joint Staff / Service support for funding *
  • Service programs of record (PORs)
  • Joint Rapid Acquisition Cell (JRAC)
  • Joint IED Defeat Organization (JIEDDO)
  • Quick Reaction Funds (QRF)
  • Rapid Reaction / New Solutions (RR/NS)
  • Force Transformation / Operational Experimentation (FT/OE)
  • Operational Test and Evaluation (Joint Tests & Quick Reaction Tests)
  • JFCOM Limited Acquisition Authority (LAA)
  • Defense Acquisition Challenge (DAC)
  • Technology Transition Initiative (TTI)
  • Foreign Comparative Testing (FCT)
  • Combatant Commander Initiatives Fund (CCIF)
  • Defense Venture Catalyst Initiative (DeVenCI)

• For those technologies we desire to “sponsor”
  • Assist the Headquarters and Components in the development of technical proposals to satisfied identified needs
  • Provide oversight management to get the technology into the hands of the Warfighter

* Not an all-inclusive list
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  Division Chief & Command Science Advisor

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  SMDC LNO
Raise your Hand
Autonomy
S&T Priority Steering Council

Team members/Affiliation:

Dr. Bobby Junker
Autonomy PSC Lead
Division Director
ONR/
Presentation to S&T EXCOM
14 June 2011
Two Human-Machine Relationships

**Human is Supported**

**Goal**
Minimize human control to defining mission

**Optimum Level**
System understands human intent

**Human is Supporting**

**Goal**
Minimize supporting humans

**Optimum Level**
Zero

Complexity
(Environment, Context, Mission, System)
UxV and Autonomy

Now:
• Uninhabited UxVs are an intermediate step towards autonomy

Mid-Term:
• Current UxV systems are rule-based and can support relatively simple missions, but do not operate well in complex, uncertain dynamic environments

Long-Term:
• Level of reasoning capable of comprehending the battlespace
• Automated, coordinated, distributed, adaptive planning

We are here

The Future

Persistent Littoral Undersea System
Distributed EW

Autonomy PSC Roadmap
14 Jun 11 Page-3
Levels of Autonomy

Ability to Alter Actions
- Enhance World Model and Adapt
- Adapt to Achieve Goals
- No Adaptation

Ability to Reason
- Rational
- Deliberative
- Cognitive
- Reactive

World Model
- Platform Behavior
  - Vehicle control / Navigation / Sensor control / Group behavior / …
- Mission Performance
  - Comprehend Commander’s intent / objectives
  - Perceive Battlespace
  - Assess Battlespace re: Commander’s intent / objectives
  - Dynamic replanning
  - Survivability
  - Appropriate human engagement for support / awareness; Understanding task / mission accomplishment or abort
  - Weapons release analysis
  - …

Increasing Capability
- Path clear: crash into obstacle
- Path blocked; note obstacle: take alternate route
- All paths blocked; explore uncharted territory and make new map

Physical / Cyber World

Autonomy PSC Roadmap
14 Jun 11 Page-4
Operational and Tactical Pictures Development

Common, Distributed Information Storage (Data and Battlespace Context)

Operational and High-level Tactical (eg MOC)

Analysis

Collection Tasking

Sensors-Based ISR

Non-Sensors-Based ISR

Decision Making (C2)

Weapons Release / Countermeasures / Responsive Actions

Tactical (eg Combat System, mission execution)

Real-time Analysis

Sensor Tasking

Sensors

Update

Context

Objectives and Constraints

Toward Non-Real-Time Toward Real-Time
Autonomy Problem Statements

- **Problem:** Insufficient manpower to support command and control of persistent, pervasive surveillance assets across relevant battlespace
  - Desire for, at most, single operator control of unmanned teams
  - Increasing quantity and scope of ISR data pushing analysis “beyond human scale”
  - Expanding domains and time-criticality pushing decision-making “beyond human scale”

- **Problem:** Operators/decision-makers don’t have appropriate level of trust in autonomy, ie too low or too high.
  - Lack technologies for adaptive autonomous control of vehicle systems in the face of extremely harsh, unpredictable and mathematically intractable environments
  - Lack technologies to enable safe manned and unmanned operation in a mixed battlespace (civilian and military AORs)
  - V&V and C&A address only part of trust
    - Ramifications of over-reliance on autonomy in contested, complex battlespaces

- **Problem:** Environments so harsh as to not reasonably permit humans to enter and sustain activity
  - Examples include
    - High radiation, High biological, High chemical environments
  - Mission areas where one may not return
# Desired End States

<table>
<thead>
<tr>
<th>3 year (2016)</th>
<th>5 Year (2018)</th>
<th>7 Year and beyond (2020+)</th>
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<tbody>
<tr>
<td>• Develop highly flexible, interoperable environment for common control and computations</td>
<td>• No increase in supporting manpower requirements for C2 of 1,000 sq mile area</td>
<td>• Continue evolving technologies</td>
</tr>
<tr>
<td>• 50% staff reduction for C2 for a notional 100 sq mile area</td>
<td>• Integrated wide area – classification / ID sensor resource for autonomous cooperation</td>
<td>• Complete Phase 2 advanced autonomous tech development</td>
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<tr>
<td>• Autonomously update battlespace context using available sources</td>
<td>• Expand mixed manned/unmanned operations to non-cooperative, but not contested battlespace</td>
<td>• Initiate Phase 3 advanced autonomous tech development</td>
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<tr>
<td>• Enable timely operational decision making based on commander’s intent</td>
<td>• Enhanced SIGINT input to include signal internals</td>
<td>Beyond</td>
</tr>
<tr>
<td>• Enable mixed manned/unmanned operations within common battlespace</td>
<td>• Continue 2nd generation prototyping</td>
<td>• Fully autonomous operations with periodic need for update</td>
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<tr>
<td>• Complete Phase 1 advanced autonomous tech development</td>
<td>• Continue Phase 2 advanced autonomous tech development</td>
<td>• &gt;75% prob of success in contested battlespace</td>
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<td>– Tailored pattern recognition</td>
<td>– Tailored swarming tech-subterranean</td>
<td>• Training/experience (warfighter culture) support inclusion of autonomous capabilities</td>
</tr>
<tr>
<td>– Decision making</td>
<td>– Coordinated multi-unit search</td>
<td>• Complete Phase 3 advanced autonomous tech development</td>
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<tr>
<td>– Miniaturization of autonomous control sensors, power supplies, etc</td>
<td>– Obstacle negotiation, task restructure</td>
<td>• Complete 3rd generation prototype</td>
</tr>
<tr>
<td>– Autonomous Protective system defeat</td>
<td>– Threat recognition &amp; adaptive response</td>
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</table>

Autonomy PSC Roadmap
14 Jun 11 Page-7
Overview of Autonomy Roadmap *

2011
Realistic Scenario Capabilities

2013
Regional (notional 100 Miles \(^2\)) Persistent ISR

2016
Integrated Wide Area and High Resolution Surv. Regional (notional 1000 Miles \(^2\)) Persistent ISR

2018
Regional (notional 100 Miles \(^2\)) Persistent ISR

2020
Robust, Adaptive Autonomous Capability in Dynamic, Contested Battlespace

2023

Activities

- FOB Area Protection
- Integrated Wide Area and High Resolution Surv. Regional (notional 1000 Miles \(^2\)) Persistent ISR
- Regional (notional 100 Miles \(^2\)) Persistent ISR
- Common / Interoperable Control / Computational Environment
- Evaluate Services’ Approaches
- Distributed, Networked Architecture
- Integrated wide-area surveillance with classification / ID sensor resources
- Operations in Mixed Environment
- Netted Platform Behavior Control
- Mission / Task Specific Resource Optimization (Priority, Time, Resource Readiness, etc)
- Contested battlespace operations
- Non-cooperative operations in battlespace
- Cooperative operations in battlespace
- Operations in a Mixed Battle Space with Manned and Unmanned Entities
- Operations in Mixed Environment
- Netted Platform Behavior Control
- Common / Interoperable Control / Computational Environment
- Evaluate Services’ Approaches
- Distributed, Networked Architecture
- Integrated wide-area surveillance with classification / ID sensor resources
- Contested battlespace operations
- Non-cooperative operations in battlespace
- Cooperative operations in battlespace
- Operations in a Mixed Battle Space with Manned and Unmanned Entities
- Realistic Scenario Capabilities

* Comms and networking assumed available or adaptation
Notional Autonomy Roadmap *

2011  2013  2016  2018  2020  > 2023

Semi-autonomous and Autonomous Analysis and Assessment (information integration and assessment in real-time and non-real-time)

- Broad Area Entity Tracking
  - Identification of normal, new, and abnormal activity
  - Robust multi-platform tracking

Autonomous Image and Video Understanding / Comprehension and Assessment

- Traditional analysis
- Object classification and identification
- Extraction of motions and actions in the context of the environment
- Identification and assessment of activities
- Assessment of group activities
- Bio-inspired Image and Video analysis

**SIGNET**

- Externals
- Internals

Cultural / Behavior Algorithms and Social Network Analysis

- Relationships and Pattern Recognition

*Comms and networking assumed available or adaptation*
AF Science, Technology, and Engineering Overview

Col Mark D. Koch
Associate Deputy Assistant Secretary
(Science, Technology, and Engineering)
Agenda

- AF S&T Organization
- AF S&T Vision
- SAF/AQR
- S&T Program Tenets
- S&T Program Priorities
- Strategy Development
- Summary
AF S&T Vision

Create compelling air, space, and cyber capabilities for precise and reliable Global Vigilance, Reach and Power for our Nation
Deputy Assistant Secretary for Science, Technology and Engineering
Dr. Steven Walker

Associate Deputy Assistant Secretary
Col Mark D. Koch

- Congressional
- Budget

Engineering & Technical Mgt Division (AQRE)
Strategy Division (AQRS)
Science & Technology Division (AQRT)
SAF/AQR Portfolio

Technical Advice to SAE

S&T Program Oversight

Support to Existing Reviews

AF Program Support Reviews

Enterprise Integration

“Functional Directorate” & “Capability Directorate”

Life Cycle Systems Engr & Tech Policy

S&E Career Field

Technology Transition

Air Force Science & Technology Strategy

S&T Strategy

Distribution A (SAF/PA Case 2011-265)  Integrity - Service - Excellence
S&T Program Tenets

- Prepare for an Uncertain Future and Investigate Game-Changers to Shape the Art-of-the Possible into Military Capabilities

- Create Technology Options that Address Urgent Warfighter Needs and Provide New AF Service Core Function Capabilities in Support of the Joint Mission

- Maintain In-House Expertise to Support the Acquisition and Operational Communities and Modernize and Improve the Sustainability of Unique Research Facilities and Infrastructure

- Develop Future Air Force Leaders with an Appreciation for the Value of Technology as a Force-Multiplier

- Remain Vigilant Over and Leverage Global S&T Developments and Emerging Capabilities
S&T Program Priorities

- **Priority 1**: Support the current fight while advancing breakthrough S&T for tomorrow’s dominant warfighting capabilities
  - Enable the AF to operate effectively and achieve desired effects in all domains and all operations
  - Improve the agility, mobility, affordability and survivability of AF assets
Support the Current Fight While Advancing Breakthrough Capabilities

IED Detection

Electric Laser on a Large A/C (ELLA)

Support the Current Fight…. Advancing Tomorrow's Capabilities
**S&T Program Priorities**

**Priority 2:** Execute a balanced, integrated S&T Program that is responsive to AF Service Core Functions; Increase emphasis in S&T that will:

- Improve the sustainment, affordability and availability of legacy systems
- Reduce cyber vulnerabilities while emphasizing mission assurance
- Support the needs of the nuclear enterprise
- Deliver autonomous systems and human performance augmentation technologies envisioned in Technology Horizons
- Provide robust situation awareness to enhance decision-makers’ understanding and knowledge by improving ISR capabilities and data PED
- Enable long-range precision strike
- Reduce energy dependency

**Where Do We Invest the Next Dollar**
Delivering Human Performance Augmentation and Autonomy

- **Intruder**
- **Evasive Avoidance**
- **Re-Form & Continue Mission**

- **UAS Formation Flight**
- **Mimic Aerial Refueling**
- **Faulted Vehicle**
- **Maneuver to Protect Fleet**
- **Disengage & Maneuver to Protect Assets**

**Experiments:**
- Experiment 3
- Experiment 4
- Experiment 5

**Experiment 3:**
- Maneuver to Protect Fleet

**Experiment 4:**
- Faulted Vehicle

**Experiment 5:**
- Intruder Sensed

**UAS Formation Flight**

**Mimic Aerial Refueling**

**Disengage & Maneuver to Protect Assets**

**Intruder Sensed**
Reduce Energy Dependence

Increase Supply

Reduce Demand

High Performance...

Seed Crops

Fuel Efficiency...

Change the Culture

Make Energy A Consideration In All We Do
**Priority 3:** Retain and shape the critical competencies needed to address the full range of S&T product and support capabilities

- Increase level of in-house basic research
- Enhance critical competencies of the organic cyber workforce
- Support AF STEM initiatives to develop and optimally manage the future S&E workforce

**Shaping the Current and Future Workforce**
Retain and Shape Critical Competencies Internal to AFRL

Provide Organic Basic Research and Advanced Development Opportunities in Critical Areas
Industrial Base

- Greater consideration given to non-domestic sources
- Greater need for acquisition and sustainment decision makers to be provided with usable, current IB information
- Greater need for the AF to provide clear guidance in terms of shaping the IB
  - Critical domestic capabilities – technologies and skill sets
  - Sufficient competition – supply chain management
  - Risk mitigation tools
- S&T community has an important role to play here
Priority 4: Ensure the AF S&T program is integrated into the AF Corporate requirements and programming processes

- Be a trusted partner of the acquisition/sustainment community – assess tech maturity/enhance and accelerate tech transition
- Leverage R&D efforts within industry – including small businesses
- Develop and demonstrate technology solutions that decrease manufacturing risks

Bridge the Valley of Death
**Flagship Capability Concept**

- **Definition:** An integrated technology project collaboratively developed by MAJCOM(s), Center(s), and AFRL that:
  - Addresses a documented and prioritized MAJCOM capability need
  - Is commissioned via AF S&T Governance structure
  - Is traced to a CRRA Gap, linked to a Service Core Function Master Plan

- **Attributes:**
  - Initial systems engineering and development planning (DP) initiated
  - Somewhere between a leading DP concept and a prototype
  - Assigned to lead Center for transition
  - MAJCOM transition manager identified
    - Transition funding (6.4) committed two years prior to S&T completion
  - Defined S&T baseline/exit criteria
  - S&T project ideally completed during current FYDP
Initial Set of Flagships

1. High Velocity Penetrating Weapon (HVPW)
2. Responsive Reusable Boost for Space Access (RBS)
3. Selective Cyber Operations Tech Integration (SCOTI)

Flagships Helping Bridge the Valley of Death
Strategy Development Efforts

- Energy
- Cyber
- Hypersonics
- Space Situational Awareness
- Sustainment
Flight test the AF Hypersonic Technology (HyTech) scramjet engine, using endothermic hydrocarbon fuel, by accelerating a vehicle from boost (~M=4.5) to Mach 6+

- Acquire ground and flight data on an actively cooled, self-controlled operating scramjet engine (rules and tools development)
- Demonstrate viability of an endothermically fueled scramjet in flight
- Prove viability of a free-flying, scramjet powered, vehicle (Thrust > Drag)
Hypersonic Air Vehicle and Propulsion Technologies Enable Long Range at High Speed with Effective Payload

- Precision Strike
- Variable Warhead Effects
- Long Range
- High Speed

Aircraft Systems
- Internal bombers
- External fighters

Net Enabled In-Flight Targetable

Rapid, Responsive Strike in Anti-Access/Access Denied (A2/AD) Environments
Operation in A2/AD Environments

Penetrate Denied Areas (Survivable)

- Large ground coverage area
- High utility in space-denied areas
- Mach 4+ Cruise
- Runway Takeoff and Landing

Turbine Based Combined Cycle
Reuable, Long-Life Airframe

On-Demand Flight in A2/AD Environments
Air Force Depends on the S&T Program to discover, develop, and demonstrate high-payoff technologies across all domains – **Tech Push**

S&T Program Priorities, Program Tenets, and Processes aligned to turn science and knowledge into militarily relevant capabilities – **Tech Pull**

Flagships linking S&T, Development Planning, and MAJCOM transition funding into HAF-commissioned AF Capabilities – **The Bridge Over The Valley of Death**

Industrial Base, Engineering, and Technical Management – **Improving Acquisition Outcomes**
BACKUPS
## High Speed Weapon Roadmap

### Fiscal Year TOTAL

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<tr>
<th>Fiscal Year</th>
<th>FY10</th>
<th>FY11</th>
<th>FY12</th>
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</table>

- **Warhead Integration**
- **Configuration and Trade Study**
- **Tactical Propulsion**
- **Advanced Guidance for Surface Targets**

### Demo Tasks
- Platform integration
- X-51A+ (scramjet)
- Warhead integration
- Terminal Guidance

### Technology Readiness Level

<table>
<thead>
<tr>
<th>Transition Point (TAD)</th>
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<th>Strike up to 100s of miles</th>
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### TECHNOLOGY GAPS

- High Speed Multimode Seekers
- Anti Jam GPS
- Alternative high speed guidance (GPS denied environment)
- Compact energetic booster
- Aeroconfiguration, structures and materials, control surfaces, TPS
- Compatibility with current and emerging fighters and bombers
- Compatibility with Navy/VLS
## High Speed Aircraft Roadmap

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<td>System Testing</td>
<td>Flight Design Power Development/Test</td>
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<td>CMC Structures</td>
<td>Low Cost/Light Wt Hi Speed Structures</td>
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<td>Prior Robust Scramjet</td>
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<tr>
<td>Enabling Technologies for Operational Vehicle</td>
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**Technology Readiness Level**

**Transition Point (TAD)**
Weapon Systems Acquisition Reform Act (WSARA) of 2009 requires:

Director, Systems Engineering to “Review the organizations & capabilities of the military departments with respect to...development planning ...and identify needed changes or improvements”

SAE to “develop & implement plans to ensure the military dept has provided appropriate resources for: Development planning and systems engineering organizations with adequate numbers of trained personnel”
What is Development Planning?

- Acquisition contribution to AF-level capability planning
- Early analyses of technical issues, risks, and resources
  - Inform sponsors and decision makers on realm of the possible
  - Greatest leverage prior to Materiel Development Decision
- Systems engineering efforts define the trade space of concepts
- DP activities foundation for new system development
- Results in high-confidence estimates of cost, schedule, and technical performance
Naval S&T Overview

Dr. Joseph Lawrence
Director of Transition
Office of Naval Research
June 22, 2011
Global R&D Trends

- 2010: $1.15T
- 1996: $0.5T

Growth in Global S&T Investment

* UIS S&T database; World Bank - PPP

** OECD 2010 PPP; 2010 Global R&D Report (Battelle)
R&D Investment Trends

Source: National Science Foundation, Division of Science Resource Statistics, 
Science and Engineering Indicators 2010
RDT&E 6.1 – 6.7

Then Year $ Billions

DON PBR RDT&E,N

DON PBR S&T

FY02 FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11
88 Years of Naval Research
Looking Back ......

Naval S&T Milestones
ACCOMPLISHMENTS ACROSS ALL DOMAINS

80s
- Multistatic Radar Tested at NRL
- Sound Navigation and Ranging (SONAR)
- Uranium 235 Production
- Gamma-ray Radiography
- NRL Commissioned

90s
- Plan-Position Indicator
- Principles of Modern Fracture Mechanics
- Synthetic Lubricants
- First Concept for a Nuclear Submarine
- First U.S. Radar Patents

1900s
- First Detection of X Rays from the Sun
- First Far-Ultraviolet Spectrum of the Sun
- Ranger I Launched
- Project Whirlwind
- Vertical Take-Off and Landing
- Bathyscaphe Frigate reaches 35,800 ft.
..... And Looking Ahead

- Power & Energy
- Directed Energy & Hypersonics
- Information Dominance
- Autonomous Systems
- Total Ownership Cost Reduction
- Naval Warfighter Performance
Power & Energy

1. Sail a “Green Strike Group” by 2016
2. 50% of Navy energy from alternative sources by 2020,

- Fuels
- Power Generation
- Energy Storage
- Efficient Distribution
- Energy Usage
Directed Energy & Hypersonics

- Fight at Hypervelocity & Speed of Light
- Deepen the Magazines
- Increase Depth of Fire
- Broad Range of Missions
Dominating the Electromagnetic Spectrum

Integrated Topside Innovative Naval Prototype Program (INTOP)

RF Onboard Countermeasures

Integrated Distributed EW

Wide-Area MOSA CM Technologies
• Changes everything
  – Tactics to strategy
• Hybrid force with manned systems
• Power & Energy implications
• Mission CONOPS development
Naval Warfighter Performance

**Human Systems Integration**
- Manpower & Personnel Management
- Training & Digital Tutors
- User-Centered Design
- C2 Decision Support
- Human, Social, Cultural Sciences
- Safety / Hearing

**Bio-Engineered Systems**
- Marine Mammal Health
- Bio-Sensors / Materials
- Microbial Fuel Cells
- Bio Robotics
- Human-Autonomy Systems

**Undersea & Expeditionary Medicine**
- Undersea Medicine (NNR)
- Point of Injury Care
  - “Lighten the Load”
  - Treat hemorrhagic shock
- Automated Medical Care
  - CASEVAC / Patient Movement

- Combat Gauze
- Spray-Dried Plasma
Naval S&T Strategic Plan

Focus Areas

- Power and Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric & Irregular Warfare
- Information Superiority and Communication
- Power Projection
- Assure Access and Hold at Risk
- Distributed Operations
- Naval Warfighter Performance
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Total Ownership Cost

Discovery & Invention (Basic and Applied Science)
≈40%

Leap Ahead Innovations (Innovative Naval Prototypes)
≈10%

Acquisition Enablers (FNCs, etc)
≈30%

Quick Reaction & Other S&T
≈10%

Near
Mid
Long

Tech Solutions
FNCs
INPs
D&I
How We Execute

- 70 Countries
- 50 States
- 1,078 Companies
  - 859 small businesses
- 1,035 Universities & Nonprofit Entities
  - 3,340 principal investigators
  - 3,000 grad students
6.1: Basic Research
- Naval Labs and Centers: 31%
- University & Nonprofit: 62%
- Industry: 7%

6.2: Applied Research
- Naval Labs and Centers: 62%
- University & Nonprofit: 30%
- Industry: 23%

6.3: Advanced Tech Development
- Naval Labs and Centers: 14%
- University & Nonprofit: 21%
- Industry: 65%
First university degrees in natural sciences and engineering, selected countries

- **China**
- **US**
- **Japan**
- **S Korea**
- **UK**

Non-Minority Women
- **15%**
- **14%**
- **34%**
- **37%**

Minority Men
- **11%**
- **13%**
- **41%**
- **35%**

High School Graduates
- **Total: 3,115,220**

First-time Freshmen
- **Total: 1,903,400**

First-time Freshman Interested in S&E
- **Total: 928,000**

S&E Bachelor's Awarded
- **Total: 455,441**

BS Natural Science & Engineering
- **Total: 225,660**

MS Natural Science & Engineering
- **Total: 43,104**

PhD Natural Science & Engineering
- **Total: 11,189**

PhD Engineering
- **Total: 2,380**

S&M Engineering
- **Total: 2,380**

www.STEM2Stern.org
Speed to Fleet

Industry

Academia

R&D
6.4-6.8
$$

S&T
6.1-6.3
$$

Acquisition
P.O.R.

6.4
$$
Why it Matters

“I never, ever, want to see a Sailor or a Marine in a fair fight!

-Adm. Gary Roughead
Chief of Naval Operations
We Want To Hear From You!

- **ONR Website:**
  [www.onr.navy.mil](http://www.onr.navy.mil)

- **ONR Central Phone Number:**
  703-696-5031
Back-up
Transitions

Successfully delivered 83% of the FNCs to Acquisition

<table>
<thead>
<tr>
<th>FNC Delivery Year</th>
<th>Products Planned to Deliver</th>
<th>Products Delivered to Acquisition</th>
<th>Deployed</th>
<th>On-Track for Deployment</th>
<th>Still With Acquisition Program</th>
<th>Did Not Transition</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY10</td>
<td>19</td>
<td>15</td>
<td>1</td>
<td>7</td>
<td>5</td>
<td>2 (13%)</td>
</tr>
<tr>
<td>FY09</td>
<td>35</td>
<td>32</td>
<td>2</td>
<td>12</td>
<td>11</td>
<td>7 (22%)</td>
</tr>
<tr>
<td>FY08</td>
<td>47</td>
<td>35</td>
<td>8</td>
<td>12</td>
<td>3</td>
<td>12 (34%)</td>
</tr>
<tr>
<td>FY07</td>
<td>32</td>
<td>26</td>
<td>7</td>
<td>8</td>
<td>1</td>
<td>10 (38%)</td>
</tr>
<tr>
<td>FY06</td>
<td>34</td>
<td>30</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>17 (57%)</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>138</td>
<td>25</td>
<td>43</td>
<td>22</td>
<td>48 (35%)</td>
</tr>
</tbody>
</table>

Forensics

- Did Not Transition
- Still With Acquisition Program
- Deployed or On-Track for Deployment

Technology Lost in Acquisition Competition
- 22.9%

PMO Lost Interest
- 12.5%

Acquisition Strategy Significantly Modified
- 20.8%

Technology did not meet TTA Requirements
- 27.1%

Requirements Changed or not Adequately Specified
- 16.7%
ONR Global

- Develop partnerships
- Leverage global S&T advances
- Avoid technology surprise
A Great Place to Work

• #1 “Best Place to Work” in the Navy
  ▪ Partnership for Public Service

• “Most Admired Employer”
  ▪ Black Engineer magazine
  ▪ Hispanic Engineer magazine
  ▪ Women of Color magazine

• #1 Patent Portfolio worldwide among government agencies from IEEE Patent Power Scorecard
  ▪ 232 patents in 2009

• Popular Science Magazine’s 2010 Best of What's New Winner
  ▪ NEAH Power Systems' Infinity Fuel Cells

• TIME Magazine’s “Best Inventions of the Year”
  ▪ 2009: Microbial Fuel Cell
  ▪ 2008: NEXI, MEMRISTOR
The Office of Naval Research

Naval Research Laboratory (Appropriations Act, 1916)
“[Conduct] exploratory and research work...necessary ...for the benefit of Government service, including the construction, equipment, and operation of a laboratory....”

Office of Naval Research (Public Law 588, 1946)
“...plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future of naval power, and the preservation of national security...”

Transitioning S&T (Defense Authorization Act, 2001)
“...manage the Navy’s basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation.”
Uncertain Future

- Unanticipated Futures
- Predicted Future Threats
- New development/Undiscovered technologies (disruptive)
- New development/Known technologies
- Spiral developments/Incremental improvements
- Evolved current systems
- Existing Systems & CONOPS

Time

Complexity...Uncertainty...Warfighting Capability
Uncertain Future

- Unanticipated Futures
- Predicted Future Threats
- Discovery & Invention (Basic and Applied Research)
- Leap Ahead Innovations (Innovative Naval Prototypes)
- Acquisition Enablers (FNCs, etc.)
- New development/Undiscovered technologies (disruptive)
- New developments/Innovations
- Spiral developments/Improvements

Time

Complexity...Uncertainty...Warfighting Capability

- Existing Systems & CONOPS
- Quick Reaction & Other S&T
Quick Reaction S&T
(1-2 Year) Off-The-Shelf Technologies

- Rapid solutions to problems identified by deckplate Sailors and Marines
- 1 year turnaround time
- Video: www.youtube.com/usnavyresearch
- Requests submitted online
  www.onr.navy.mil/techsolutions
Future Naval Capabilities
(3-5 Year) Component Technologies
Innovative Naval Prototypes
(5-10 Year) Disruptive Technologies

- High Risk / High Payoff
- Innovative and game-changing
- Approved by Corporate Board
- Delivers prototype

Tactical Satellite
EM Railgun
Persistent Littoral Undersea Surveillance
Sea Base Enablers

Free Electron Laser
Integrated Topside
Large Displacement UUV
AACUS
Basic Research
(1-25 Year) Undiscovered & Emerging Technologies

- Diverse portfolio
- Fosters innovation
- Long-term
- Investment in people
  * 56 Nobel laureates

1st U.S. Intel satellite
GRAB

Semiconductors
GaAs, GaN, SiC

Spintronics

GPS

Arctic Research

Weather Modeling

EWF

Laser Cooling

\[ \varepsilon \int E \cdot dA = \sum q \]
The Challenge: “Speed to Fleet”

“I never, ever, want to see a Sailor or a Marine in a fair fight! … We have to get technology to the Fleet faster.”

- Adm. Gary Roughead, Chief of Naval Operations
Shaping the Department’s S&T Strategy

21 June 2011

The Honorable Zachary J. Lemnios
Assistant Secretary of Defense for Research and Engineering
Global Challenges and Trends

- Shifting Global Demographics
- Globalization shifts
- Energy
- Climate change & natural disasters
- Cyber as a new domain
- Challenges to existing state structures
- WMD proliferation
Globalization of R&D

WORLD TOTAL $1,192B

Source: www.rdmag.com “2011 Global R&D Funding Forecast” - Battelle
World R&D Trends: A Global Shift
Guidance Roadmap

**Target Affordability and Control Cost Growth**
- Mandate affordability as a requirement
  - At Milestone A set affordability target as a Key Performance Parameter

**Improve Tradecraft in Services Acquisition**
- Create a senior manager for acquisition of services in each component, following the Air Force’s example
- Adopt uniform taxonomy for different types of services

**Incentivize Productivity & Innovation in Industry**
- Reward contractors for successful supply chain and indirect expense management
- Increase the use of FPIF contract type where appropriate using a 50/50 share line and 120 percent ceiling as a point of departure
- Limit the use of time and materials and award fee contracts for services
- Require that services contracts exceeding $1B contain cost efficiency objectives
- Increase small business participation in providing services

**Promote Real Competition**
- Present a competitive strategy at each program milestone
- Remove obstacles to competition
  - Allow reasonable time to bid
  - Require non-certified cost and pricing data on single offers

**Reduce Non-Productive Processes and Bureaucracy**
- Reduce the number of OSD-level reviews to those necessary to support major investment decisions or to uncover and respond to significant program execution issues
- Eliminate low-value-added statutory processes
- Reduce by half the volume and cost of internal and congressional reports

**Promote Real Competition**
- Eliminate redundant within warfighter portfolios
- Make production rates economical and hold them stable
- Set shorter program timelines and manage to them
- Drive productivity growth through Will Cost/Should Cost management

**Improve Tradecraft in Services Acquisition**
- Address causes of poor tradecraft in services acquisition
  - Assist users of services to define requirements and prevent creep via requirements templates
  - Assist users of services to conduct market research to support competition and pricing
  - Enhance competition by requiring more frequent re-compete of knowledge-based services

**Reduce Non-Productive Processes and Bureaucracy**
- Reduce non-value-added overhead imposed on industry
- Align DCMA and DCAA processes to ensure work is complementary
- Increase use of Forward Pricing Rate Recommendations (FPRRs) to contain cost

**Improve Tradecraft in Service Acquisition**
- Address causes of poor tradecraft in services acquisition
  - Assist users of services to define requirements and prevent creep via requirements templates
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**Reduce Non-Productive Processes and Bureaucracy**
- Reduce non-value-added overhead imposed on industry
- Align DCMA and DCAA processes to ensure work is complementary
- Increase use of Forward Pricing Rate Recommendations (FPRRs) to contain cost
Support to Combatant Commanders

Arctic Awareness & Capable Presence

Ballistic Missile Defense

Counter Extremist Ideology & Propaganda

Persistent Surveillance

Collection Processing Exploitation All Sources

Ensuring Domain Awareness

Comprehensive Signal Management

Cyberspace Enabling Tools

Transportation Worldwide Command & Control
Continuing the Push for Capabilities to the Fight

**FY 11**

- Force Directed Layout
- Operational 3D JCTD
- Rapid Reaction Tunnel Detect JCTD
- SCAR Fire Control System
- Sea Tracker JCTD

**FY 12**

- RF Combat ID Patches
- RIO JCTD
- Robotic Moving Targeting System
- Pyrolysis Solid Waste Disposal
- SOF Sensor Fusion Night Vision
- SOF Sinuous Spiral Antenna
- Submarine Survivor Locator Device
- Precision Sniper Rifle
- Submersible Multi-Fuel Outboard Engines
- XFC Submerged Launch UAV
- Nat’l Tech Nuclear Forensics JCTD
- Hostile Fire Detection System

NDIA S&T
06/21/2011 Page-7

Distribution Statement A: Approved for public release; distribution is unlimited.
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.
Quadrennial Defense Review
Missions Require New Capabilities

1. Defend the United States and Support Civil Authorities at Home

2. Succeed in Counterinsurgency, Stability, and Counterterrorist Operations

3. Build the Security Capacity of Partner States

4. Deter and Defeat Aggression in Anti-Access Environments

5. Prevent Proliferation and Counter Weapons of Mass Destruction

6. Operate Effectively in Cyberspace.
Capability Priorities for FY13-17

Complex Threats

- Electronic Warfare / Electronic Protection
- Cyber Science and Technology
- Counter Weapons of Mass Destruction

Force Multipliers

- Data-to-Decisions
- Autonomy
- Engineered Resilient Systems
- Human Systems
High Interest Basic Science Areas

- Synthetic Biology
- Human Behavior Modeling
- Novel Engineered Materials
- Cognitive Neuroscience
- Quantum Information Science
- Nanoscience
DoD S&T Funding By Budget Activity
- President’s Budget Requests – in Constant FY11 Dollars -

Total FY12 S&T request = $12.25B

6.1 Basic Research
$2.08B

6.2 Applied Research
$4.69B

6.3 Advanced Technology Development
$5.48B

FY98 FY99 FY00 FY01 FY02 FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15

Constant FY11 Dollars (in Millions)
0 1,000,000 2,000,000 3,000,000 4,000,000 5,000,000 6,000,000 7,000,000
Integrated S&T Enterprise

Missions

• National Defense Strategy
• Quadrennial Defense Review
• Space Posture Review
• Nuclear Posture Review

Operational Challenge

JUONs, UONs, COCOM, IPL

Objective Architectures

Critical Capabilities

Enabling Technologies

Laboratory Program

Basic Research Program

STEM Program

Industry IR&D
Conference Summary

• FY2012 President’s Budget Request
• ASD(R&E) Programs
  – Basic Research
  – Rapid Fielding
  – Test & Evaluation
  – Trusted Foundry
• Department S&T Emphasis Areas
• Components’ S&T Program Overviews
• Combatant Command Briefs
High Velocity Penetrating Weapon Program Overview

13 Apr 2011

Leo Rose, AFRL/RW
Program Manager
850-883-2188

Distribution A: Approved for public release; distribution unlimited
High Velocity Penetrating Weapon (HVPW)

Description
Provides improved penetration capability of hard, deep targets with boosted impact

Benefits to the War Fighter
• Defeats emerging hard targets
• 2000 lb weapon
• Internal carriage on F-35
• Increased loadout for other bomber/fighters

Technology
• Survivable ordnance package
• GN&C (precision navigation, terminal flight control)
• Propulsion (performance, GN&C interactions, IM)
High Velocity Penetrating Weapon Team

HVPW Senior Steering Group (SSG)

Program Manager Leo Rose

Chief Engineer Ron Taylor

Deputy Program Manager Mike Kostelny

ACC/A8M

AAC/XR

Guidance and Control Tom Grady, Deputy

Ordnance John Bailey, Deputy

Systems Engineering & Integration Dr Mike Valentino, Deputy

Propulsion Drew DeGeorge, Deputy

Capability Planning and Transition Pam Pitchford, Deputy
High Velocity Penetrating Weapon
Sys Engineering & Flight Vehicle Integration
Systems Engineering & Flight Vehicle Integration

- **Flight Vehicle Integration**
  - Subsystem requirements, specs, models for subsystem trades, M&S
  - System trades of GN&C, warhead/fuze, and airframe/propulsion
  - Initial Technology Demonstration flight test vehicle concept development

- **Aircraft Integration, Carriage & Release**
  - F-35 internal carriage
  - Platform electrical and physical constraints
Flight Vehicle Integration
Major Technical Challenges

• Focus on integration issues associated with terminal accuracy and vehicle orientation
  • Airframe / control surfaces
  • GN&C algorithms
  • Booster misalignment, shock & vibration

• Scope of effort varies dramatically depending on desired TRL
  • AFRL/RW effort will end at subcomponent demonstrations not integrated flight test
  • AAC/XR CCTDs will provide initial trade space
HVPM Integration with F-35

• F-35 physical fit requirement
  • F-35 physical fit requirement will be validated to a “stay within volume”

• Bay Acoustics and Temperature Issues
  • Goal is to use standard design practices as those of current systems

• Bomb Rack, Launcher
  • Goal is to use current F-35 equipment (e.g. BRU-68)
  • 1760 / 1553 Weapon-Store Interface/Data Bus
  • Some electrical and message content changes as typical with new weapons

• Ground Handling Equipment (e.g. loaders)
  • Goal is to design to current systems; minimize use of adaptors
High Velocity Penetrating Weapon Ordnance Package
Conventional Survivable Ordnance Package (CSOP)

**Technology Investment Schedule (FY)**

- High Velocity Penetration Anly/Testing
- Kick Off/New Start Planning Review
- Requirements/Concept Dev-Systems Analysis
- Warhead Case/Fuze/Explosive R&D
- Ordnance Package Integration
- Sled Testing
- Technology Availability/TRL

<table>
<thead>
<tr>
<th>Description</th>
<th>Benefits to the Warfighter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warhead that survives and functions after a boosted impact into hard target</td>
<td>• Penetrating weapon capability for F-35 in a 2000 lb class weapon</td>
</tr>
<tr>
<td>Technology</td>
<td>• Increased reliability with innovative fuze design which allows for redundancy</td>
</tr>
<tr>
<td>• Survivable intelligent-fuze technology</td>
<td>• Safer munitions through improved high explosive development</td>
</tr>
<tr>
<td>• Survivable energetic explosive</td>
<td></td>
</tr>
<tr>
<td>• Survivable warhead case</td>
<td></td>
</tr>
<tr>
<td>• Modeling &amp; Simulation Tools – Penetration mechanics, lethality &amp; material characterization</td>
<td></td>
</tr>
<tr>
<td>• Leverage ongoing R&amp;D</td>
<td></td>
</tr>
</tbody>
</table>
Fuze Technology

- Hardened Miniature Fuze Technology (HMFT) Post Impact Module
  - Successfully demonstrated survivability and post impact burst point system functionality
  - Very High G (VHG) and airgun shock test environments

- Task added to existing HMFT Contract for FY11 HMFT Feasibility Study for CSOP
  - Conduct contractor laboratory testing
  - Mechanical design updates
  - Assess and document HMFT axial/lateral shock survivability in cannon tests

- HMFT Feasibility study & analysis
  - Requirements evaluation (signal, power, communications, arming)
  - Interfaces
  - Mechanical packaging & mounting
Explosive
New Development

Approach

• Map out the formulation design space via systematic “Mixture Design” methodology
  • A type of statistical, “Design of Experiments”

• Quantify the tradeoff in design parameters
  • Airblast, sensitivity – survivability, & mechanical properties

• Apply residual knowledge
  • Validation data for theory and M&S
  • Reduce formulation time for future application requirements
  • Identify the range of possibilities for current ingredients

Progress

• Ingredients selected, all existing with MIL-SPEC’s

• Composition limit inputs found – 45 run matrix generated
  • Mixture viscosity was primary constraint

• Gathered extensive laboratory-scale safety test data
High Velocity Penetrating Weapon Guidance Research S&T Plan
Control

- Boosting with a rocket adds some issues:
  - Motor/thrust misalignment
  - Control authority, especially with oblique trajectories (e.g. slant targets)
  - Vibration / acceleration effects

- HVPW could have significant problems during boost
  - Angle of Obliquity (AoO) – could be unknown
  - Angle of Attack (AoA) – interacts with AoO

- Must control closely to ensure:
  - Maximum penetration
  - Fuze survives impact
Risk Assessment

Largest risk / least maturity in following component areas:

- CEP control
- Angle of Attack (AoA) sensing & control
- Trajectory shaping for optimized rocket firing
- Rocket integrated control

Philosophy: methodical modeling and tool-up to:
1. Show maturity of guidance subsystem
2. Prepare for more than one MS-A contractor conceptual design
High Velocity Penetrating Weapon
Propulsion
HVPW Propulsion

- HVPW derived operational systems will require a new rocket motor
- HVPW propulsion potential design/technology challenges include
  - Thrust alignment/alignment control
  - Energy management
  - Tight propellant burn rate specification
  - Increased performance
  - Wrap-around motor
  - Service life through extreme environments
Questions

Leo Rose, GS-15
AFRL/RW
HVPW Program Manager
ROSEL@EGLIN.AF.MIL
850-883-2188
The DoD T&E/S&T Program

George Rumford
Program Manager

Test Resource Management Center
Test & Evaluation / Science & Technology Program
(TRMC, T&E/S&T)

NDIA 12TH Annual Science & Engineering Technology Conference
Test Resource Management Center (TRMC)

- DoD Field Activity
- Direct Report to USD(AT&L)
  ⭐⭐⭐ SES Director

Oversee Test Infrastructure
Major Range & Test Facility Base (MRTFB)
Other T&E Facilities Within & Outside DoD

Develop T&E Strategic Plan
Biennial 10-Year Strategic Plan for DoD T&E Resources

Administer Corporate T&E Investment Programs
Centrally-Funded T&E Investment Programs (T&E/S&T, CTEIP, JMETC)

Certify T&E Budgets
Annual Certification of Military Departments & Defense Agencies T&E Budgets
The STEWARD of the DoD Test Infrastructure

Major Range and Test Facility Base (MRTFB): The “Critical Core”

24 Sites: Army-9; Navy-6; Air Force-7; Defense Agency-2

30,000 personnel
Military, Gov, Contractor

18,000 sq. mi. of land
180,000 sq. mi. of air space
( > ½ of all DoD land)

Replacement Value = $25B

Keyport
China Lake
30th Space Wing
Point Mugu
Air Force Flight Test Center
Yuma
Tropic Region Test Center, HI & Puerto Rico
PMRF
U.S Army Kwajalein Atoll

NDIA 12th Annual Science & Engineering Technology Conference, 21-23 June 2011
Synergy through Aligned Investment

Quadrennial Defense Review
Strategic Planning Guidance

Annual T&E Budget Certification*

DoD Strategic Plan for T&E Resources

TRMC Joint Investment Programs (FY10: $254M)

Risk mitigation needs
Technology shortfalls

Risk mitigation solutions
Advanced development

Service T&E Needs and Solutions Process

Requirements
Capabilities

(6.3 Funding)
(6.4 Funding)
(6.5 Funding)

Transition

Service Modernization and Improvement Programs

Acquisition Programs and Advanced Concept Technology Demonstrations

T&E Multi-Service/Agency Capabilities

DoD Corporate Distributed Test Capability

NDIA 12th Annual Science & Engineering Technology Conference, 21-23 June 2011
T&E Capability Development Cycle

Challenge: T&E Capabilities are available in time to provide useful insight to decision-makers and warfighters

A
Materiel Solution Analysis
Begin System T&E Planning

B
Technology Development
Articulate T&E Requirements

C
Engineering and Manufacturing Development
Use T&E Capabilities

Operations and Support
IOT&E uses capabilities

T&E/S&T Program
CTEIP and Services I&M

Cycle for Test Capability Development Must Begin Early

NDIA 12th Annual Science & Engineering Technology Conference, 21-23 June 2011
**T&E/S&T Program Overview**

**Mission:** Develop Technologies Required to Test Future Warfighting Capabilities

- Established in FY02
  - Joint DDR&E / DOT&E Initiative
  - Transitioned to TRMC in FY05
- RDT&E Budget Activity 3 funds
- Purpose
  - High Risk / High Payoff R&D for Testing
  - Foster technology transition to major DoD test ranges
  - Risk reduction for test capabilities developments

- Annual Broad Agency Announcements (BAAs)
  - Academia
  - Industry
  - Government Laboratories
- Tri-Service working groups
  - Validate requirements
  - Evaluate proposals
  - Facilitate technology transition
- Central Oversight – Distributed Execution

**Seven Test Technology Areas**

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Propulsion</td>
<td>18 Active Projects</td>
</tr>
<tr>
<td>Unmanned &amp; Autonomous Systems</td>
<td>13 Active Projects</td>
</tr>
<tr>
<td>Directed Energy</td>
<td>22 Active Projects</td>
</tr>
<tr>
<td>Spectrum Efficiencies</td>
<td>6 Active Projects</td>
</tr>
<tr>
<td>Multi-Spectral Sensors</td>
<td>16 Active Projects</td>
</tr>
<tr>
<td>Net-Centric Systems</td>
<td>12 Active Projects</td>
</tr>
</tbody>
</table>

**As of 15 April 2011**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Funding</th>
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<tr>
<td>FY 2010</td>
<td>$95.7M</td>
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<tr>
<td>FY 2011</td>
<td>$97.6M</td>
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<tr>
<td>FY 2012</td>
<td>$99.6M</td>
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<tr>
<td>FY 2013</td>
<td>$102.2M</td>
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<tr>
<td>FY 2014</td>
<td>$103.7M</td>
</tr>
<tr>
<td>FY 2015</td>
<td>$105.4M</td>
</tr>
<tr>
<td>FY 2016</td>
<td>$108.4M</td>
</tr>
</tbody>
</table>

**Shaping Technology into Tomorrow’s T&E Capabilities**
T&E/S&T Program Annual Budget
Historical (FY02) to Future Projection (FY16)
Top DoD S&T Priorities

- SECDEF memo dated 19 April 2011
- Seven priority DoD S&T investment areas
  1) Data to Decisions
  2) Engineered Resilient Systems
  3) Cyber Science and Technology
  4) Electronic Warfare / Electronic Protection
  5) Counter Weapons of Mass Destruction
  6) Autonomy
  7) Human Systems

What will we need to TEST these technologies?
Mission: Develop Technologies Required to Test Future Warfighting Capabilities

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  - 112 Active Projects

- Annual Broad Agency Announcements (BAAs)
  - Academia
  - Industry
  - Government Laboratories
- Tri-Service working groups
  - Validate requirements
  - Evaluate proposals
  - Facilitate technology transition
- Central Oversight – Distributed Execution

Nine Test Technology Areas

- Advanced Propulsion
  - 18 Active Projects
- Unmanned & Autonomous Systems
  - 8 Active Projects +3
- Advanced Instrumentation
  - 11 Active Projects +5
- Multi-Spectral Sensors
  - 17 Active Projects +1
- Directed Energy
  - 26 Active Projects +5
- Spectrum Efficiency
  - 19 Active Projects +6
- Net-Centric Systems
  - 13 Active Projects +1
- Electronic Warfare
  - Re-aligning 6 projects from Multi-Spectral
- Cyber Test
  - Re-aligning 2 projects from Net-Centric

As of 6 June 2011

FY 2010 $95.7M
FY 2011 $97.6M
FY 2012 $99.6M
FY 2013 $102.2M
FY 2014 $103.7M
FY 2015 $105.4M
FY 2016 $108.4M

Shaping Technology into Tomorrow’s T&E Capabilities
T&E/S&T Program
Test Technology Areas

Test Technologies for:

• Enhanced Test Capabilities
  – Advanced Instrumentation Systems
  – Spectrum Efficient Technology

• Emerging Warfighting Capabilities
  – Directed Energy Weapons
  – Hypersonic Vehicles
  – Multi-Spectral/Hyperspectral Sensors
  – Net-Centric Warfare Systems
  – Unmanned and Autonomous Systems
  – Electronic Warfare Systems
  – Cyber Operations

112 Active Projects

Each Test Technology Area has a Tri-Service Working Group with T&E and S&T participants
Technology Maturity by TTA
(Current T&E/S&T Portfolio of 112 Active Projects)
Central Oversight – Distributed Execution
T&E/S&T Executing Agents

**Army**
- Minh Vuong, Army PEO-STRI
  - Directed Energy Test (DET)
  - Electronic Warfare Test (EWT)
- Frank Carlen, Army Aberdeen Test Center
  - Multi-Spectral Test (MST)

**Air Force**
- Ed Tucker, Air Force AEDC
  - Advanced Propulsion Test (APTT)
- Tom Young, Air Force AFFTC
  - Spectrum Efficiency Technology (SET)
- Gil Torres, Navy NAVAIR (Pt. Mugu)
  - Net-Centric Systems Test (NST)
  - Cyber Test Technologies (CTT)

**Navy**
- George Shoemaker, Navy NUWC (Newport)
  - Advanced Instrumentation Systems (AIST)
- Steve Koepenick, Navy SPAWAR
  - Unmanned and Autonomous Systems Test (UAST)
T&E/S&T Program
Industry / Academia Days 2011

- 18-20 October 2011 in Atlanta, GA
  - Overview of the T&E/S&T Program
  - Overview of all Nine (9) Test Technology Areas
  - Preview of the T&E/S&T Broad Agency Announcement topics
  - Contracting and proposal requirements
  - Individual meetings with the T&E/S&T Program Manager and Test Technology Area Executing Agents

To request future announcements:
www.trmc-test.org/i-a_days
Determining Position of a System Under Test without Using GPS

• Emerging challenges for Time-Space-Position Information (TSPI) instrumentation
  – Test operations in GPS-denied environments (urban, caves, dense foliage, undersea)
  – Hypersonic vehicles in a plasma field
  – Micro autonomous systems
  – Large-scale System-of-Systems environments
  – Low Observable (LO) Systems that can not mount external instrumentation
Improving Testing of Undersea Systems in a Realistic Operational Environment

Needs: Provide submarine undersea tracking during test events - without sub needing to ping!

DARPA-developed chip scale atomic clock

Key issues: Maintain clock accuracy, operate week+ without update

Highly accurate track is displayed in real-time on board the tracked submarine

T&E/S&T – CTEIP transfer: Providing critical test needs, validate crucial warfighting systems

Insertion into undersea pingers

OT for Common Broadband Advanced Sonar System (CBASS) Torpedo
Improving Testing of IRCM Systems

Both Units Delivered Directly to Test
- Eglin AFB (DoN LAIRCM Testing on Navy CH-46)
- China Lake (LAIRCM Testing on AFSOC CV-22)

Included in Navy TEMPs
- DoN LAIRCM, JATAS, Assault & Strike DIRCM
  (for MH-60, MV-22, JSF, F/A-18E/F, CH-53)

Included in Air Force TEMP
- LAIRCM NexGen
  (For C-17, C-130J, C-5, CV-22)

JMITS “paints” UV & IR signatures on IRCM systems and characterizes laser and flare countermeasures

Required T&E/S&T Development for Higher Power Continuous Wave Infrared Sources
- To simulate long range shots within MANPAD operational envelopes
- To simulate longer range RF SAMs during multi-spectral testing (RF & IR)
- Two Colors (IR-Red & IR-Blue)
Improving Real-time Data Throughput Across the Test Environment
T&E/S&T Program
Project Selection Process

Drivers

Tri-Service Test Technology Area Working Groups
- Executing Agent
- T&E Community Reps
- S&T Community Reps
- Subject Matter Experts

http://www.fedbizopps.gov/ → Search for —TRMC”

Solicitations are issued through http://www.fedbizopps.gov

Solicitations
Dec – Jan

White Papers
Feb – March

Proposals
May – June

Executing Agent

Final Selections
September

Recommendaions

Source Selection Evaluation Team
- Working Group
- Subject Matter Expert
- Contracting Reps

Program Manager

Funding Decision

NDIA 12th Annual Science & Engineering Technology Conference, 21-23 June 2011
The Proposal — Key Criteria

• Meets a T&E Need

• Requires S&T work

• High Payoff

• Broad application (more than one DoD test activity)

• High potential for transition to development of a test capability
T&E/S&T Program
Summary

• T&E/S&T Program initiated to address critical T&E needs tied to S&T drivers
  – Advancing the state of the art in T&E technologies

• The only DoD S&T program dedicated to T&E

• Annual Call to Industry, Academia, and Government Laboratories to address test capability needs

• Competitive technology developments to get the best technologies possible to the test community

• Focused on transition into needed test capabilities

Looking Ahead, Responsive, and Agile
Questions?

Please stop by our booth in the exhibit hall

Contact Information:

Mr. George Rumford

Test Resource Management Center
T&E / S&T Program

George.Rumford@osd.mil
Science and Technology Capabilities to the SOF Operator

Ms. Lisa Sanders
Deputy Director,
Science and Technology
Directorate (SORDAC-ST)
June 2011
“Our strategic focus has shifted largely to the south... certainly within the special operations community, as we deal with the emerging threats from the places where the lights aren't....”

ADM Eric T. Olson
Commander’s Guidance & Direction for USSOCOM S&T / S&T Vision

- Develop a coherent capability-based research and development effort focused on placing new capabilities in the hands of SOF operators
- Conduct technology discovery, coordinate research and development activities, rapidly integrate technology developments, and rapidly insert new capabilities for equipment and techniques across the force

A Special Operations force, empowered with the newest technologies and capabilities, able to operate in any environment, work effectively with partners, and defeat all adversaries
STIPLs focus on SOCOM S&T needs while complementing the SOCOM IPL

FY13-17 S&T Priorities (Not in Order)
- Extended duration incapacitation
- Comprehensive signature management across electromagnetic spectrum
- Understand and Exploit the Battlefield
- “Own the Night”
S&T Funding Sources

- Two Traditional Sources:
  - BA2 (Special Operations Technology Development)
    - TRL 3-5
    - Studies, early lab hardware, software development models
  - BA3 (Special Operations Special Technology)
    - TRL 5-7
    - Prototypes, Demonstrations

- Rapid Exploitation of Innovative Technologies for SOF (REITS)
  - Developmental Effort with potential to transition to field in 6-12 months (no more than 18 months)
  - High Risk, High Payoff Projects
Funding Sources (Cont)

- **Small Business Innovative Research**
  - Phase 1: Competitively Awarded Topics, $100k for feasibility studies
  - Phase 2: Sole Source to Phase 1 contractors, approx $1M per contractor
  - Phase 3: Sole Source, Requires Program Funds, no $ limit

- **Leveraging**
  - OSD, Service Research Labs, DARPA, Dept of Energy, OGA
FY2011 S&T Funding ($M)

- Core: 33.1
- JCTD: 5.4
- REITS: 5
- Office: 2

Total: 45.5
USSOCOM
S&T Commodity Alignment

- **Four Primary Commodities**
  - Soldier Systems
  - Mobility & Classified
  - RF & Antennas
  - Power & Energy

- **Two Cross-Commodities Focus Areas**
  - Experimentation & JCTDs
  - SBIR Management
S&T Capabilities to the SOF Operator

Component Commands
Theater Special Operations Commands

USSOCOM HQs

Other Government Labs/Agencies & Industry

Needs & Requirements

Science & Technology

REITS & Other Tech Inserts

Special Operations Research, Development, and Acquisition Center (SORDAC)
- Joint Acquisition Task Force (JATF)
- SOF Warrior (PEO-SW)
- Special Reconnaissance, Surveillance & Exploitation (PEO-SRSE)
- Maritime (PEO-M)
- Rotary Wing (PEO-RW)
- Fixed Wing (PEO-FW)
- Command, Control, Computers, and Communications (PEO-C4)
- SOF Support Activity (PEO-SOFSA)

Acquire & Deliver

Fund & Leverage
SOCOM Unique Authorities

A Unified Combatant Command…
- Command of All U.S. Based SOF
- Plan and Synchronize DoD Activities in the Global War on Terrorism
- Deploy SOF to Support Geographic Combatant Commanders
- As Directed, Conduct Operations Globally
- Plan and Execute Pre-Crisis Activities

...With Service & Military Dept-like Responsibilities
- Organize, Train, Equip SOF
- Develop Strategy/Doctrine/Tactics
- Program and Budget
- Procure SOF-peculiar Equipment
- Monitor SOF Personnel
- Ensure Interoperability
The TILO provides USSOCOM and Industry a means to rapidly identify, track, and assist with the efficient transition of emerging and needed technologies and capabilities to the SOF warfighter.

Mr. Chris Harrington (USSOCOM Director, Office of Small Business Programs and TILO)

tilo@socom.mil

TILO Hotline (813) 826-3200
Questions?
Army Science & Technology

12th Annual Science & Engineering Technology Conference / DoD Tech Exposition

Providing Technology Enabled Capabilities

Dr. Marilyn M. Freeman
Deputy Assistant Secretary of the Army for Research and Technology

June 22, 2011
We have been at War for 10 Years…

What have we Learned?
It’s all about the Soldier – Basic Human Needs

Sleep

Shelter & protection

Basic hygiene

Food & water
It’s all about the Soldier – Expeditionary Maneuver / Tactical Force Projection

Unrestricted maneuver

Physical / Physiological

Access & Tactical resupply

Cognitive & Affective
It’s all about the Soldier – Force Protection

In Action - Collective

On the move

In Action - Individual

At “rest”
It’s all about the Soldier – Expeditionary Basing

Easy set up

Performance focused

Operationalized effectiveness

Adequate Reset & Recovery
It’s all about the Soldier – Cognitive, Physical & Social Performance
It’s all about the Soldier – Spiritual, Cultural, Social Needs
It’s all about the Soldier – Cultural, Spiritual & Social Connectedness
It’s all about the Soldier
“In the past the small unit was built around the fighting system. Today and for the future, the fighting system must be built around the small combat unit.”

— MG(R) Robert Scales*

*Ground Combat Vehicle CONOPS - Concept paper dated Dec 2, 2010
Foster invention, innovation, maturation, and demonstration of technologies to enable Future Force capabilities while exploiting opportunities to transition technology enabled capabilities to the Current Force.

Current Force:
1. Modular Protective Systems
2. IED/Mine Detection Ground Penetrating Radar
3. MRAP Expedient Armor Program
4. Unattended Transient Acoustic MASINT System

Future Force:
1. Immersive Training
2. Virus-based Self-Assembling Electrodes
3. Regenerative Medicine
4. Autonomous Materiel Handling System
DASA (R&T) Responsibilities

• Advise Army Leadership and the Acquisition Community on scientific and technical matters

• Maintain balanced S&T portfolio responsive to Warfighter needs—advocate and defend Army S&T investments

• Provide policy and guidance to the S&T Enterprise

• Promote technological innovation throughout the acquisition process

• Laboratory Management—improve/maintain health of Army labs/centers

• Assess technology readiness and facilitate transition to systems

Principal Proponent and Accountable Senior Official for Army Science, Technology and Engineering
The Army S&T Workforce

Total Civilian Manpower: 18,640
- 10,949 Scientists & Engineers
- 1,443 S&E’s are supervisors
- Approximately 9% new hires in FY10

Level of Education
- 37% of new hires from Tier 1 schools
- 35% of S&E have MS
- 14% of S&E are PhD

Expertise Across Lifecycle
- Deployable Employees:
  – field-deployable scientists, engineers, technicians and operators
- Matrixed support to JPEO/PEO offices
- Military personnel

Critical and Unique Research Competencies and Facilities:
- Sensors, Electronics, and Materials
- Human Performance and Behavioral Science
- Clothing and combat feeding
- Medicine and clinical research
- Infectious diseases and battlefield medicine
- Munitions and warheads
- Threat agent chemistry and biochemistry
- Biology and environmental sciences
- Geospatial
- Sensor technology for space applications
- Network, cybersecurity, and information fusion

Degrees Held by Civilian S&E Workforce

<table>
<thead>
<tr>
<th>Degree</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelors</td>
<td>5,500</td>
</tr>
<tr>
<td>Masters</td>
<td>4,000</td>
</tr>
<tr>
<td>PhD</td>
<td>1,400</td>
</tr>
</tbody>
</table>

Approximately 9% new hires in FY10
DASA(R&T)’s Problem & Challenge

• The Problem
  – It takes too long to get technology enabled capabilities to the field
  – Army S&T is perceived as irrelevant

• Fixing the Problem requires:
  – New comprehensive strategy
  – Changing the culture
  – Restoring confidence in Army S&T
  – Building a strong Partnership with Leadership
  – Motivating the workforce towards results

We have been working on this for a year – and we are on the path to fixing it!
New Metrics for Value of Army S&T:

- The technical capabilities we provide to Warfighters
- The data and information we provide to decision makers
- The quality of the research, development, and engineering conducted in our laboratories and centers
- The contributions of our subject matter experts who participate in decision making activities
- The number of times we are called upon to provide innovative solutions to big Army/DoD problems
- Our ability to effect positive change
New Strategic Goals for Army S&T

“World Class” Science & Technology

Timely Transition of the Right Technologies

Recognized Leader in Defense Development and Engineering

Strong Internal & External Partnerships

High Quality, Relevant Facilities and Capabilities

A Balanced Investment Portfolio

Highly Skilled, Motivated Workforce that Exemplifies our Core Values

Effective, Efficient, & Adaptable Processes

Government and Public Understanding of Our Value

Overarching Goal: To be the Army Senior Leadership’s “Go-To” place for all Science & Technology and Engineering issues
Building Partnerships Across the Enterprise

**Army Leadership**
- CSA
- VCSA
- SECARMY
- AAE
- MILDEP
- G-8
- G-4
- G-3
- G-1
- MACOM Commanders
- ASAs
- OGC

**Congress**
- Staffers
- Members

**International**
- OSD
  - DAE
  - ASD(R&E)
  - AT&L
  - DOT&E
  - DSB
- OGA
  - DARPA
  - DTRA
  - DLA
  - DHS
  - DoE
  - DoJ
  - NASA
  - FFRDCs
  - IC

**Army Labs and Centers**
- RDECOM
- ERDC
- MRMC
- ARI
- SMDC

**Requirements**
- TRADOC HQ
- ARCIC
- Centers & Schools

**Other Service S&T**
- Navy/Marine Corps
- Air Force
- Coast Guard

**Academia**
- Universities/Colleges
- Study Institutes
- National Academies
- DAU, ASB
- USMA, USNA, USAFA

**Industry**
- OEMs
- Small Businesses
- Defense Contractors
- Support Contractors
Army S&T Alignment—Soldier Systems
6.2 and 6.3 FY12

Human Dimension:
- **Soldier** Leader Training
- **Equipment** designs which reduce physical and cognitive burden during training, operations and reset
- **Cultural** Awareness

Soldier Load & Protection:
- **Offloading** technologies
- **Lightweight**, threat tailored, ballistic and blast components for Soldier mobility & survivability
- High density and efficient energy sources
- **Decision** aids for mission equipment planning
- **Lethality** assets that are lighter & environmental friendly
- **Low-cognitive** user interface technologies

Mission Command:
- **Dismounted** Mission Command Technologies
- **NSA** approved wireless protocol & novel Soldier personal area network architectures
- Technologies with allow freedom of maneuver across battlespace
- **Distributed** information & situational awareness

Health Promotion:
- PTSD and TBI treatments
- Suicide Prevention Study
- Psychological Resetting After Combat Deployment
- Nutrition Sustainment
- Fatigue Interventions

Combat Casualty Care:
- Regeneration of Damaged Tissue
- Ocular and Maxillofacial Trauma
- Musculoskeletal Injury
- Regenerative Medicine to Reduce and Repair Burn Injury
- Blood Products Research
- Wound Infection Countermeasures
Army S&T Alignment—Ground Systems
6.2 and 6.3 FY12

1. Data to Decisions
2. Engineered Resilient Solutions
3. Cyber Science & Technology
4. Electronic Warfare/Electronic Protection
5. Counter Weapons of Mass Destruction
6. Autonomy
7. Human Systems

Ground Vehicle Power and Mobility:
• High temperature power electronics
• Fuel cell for silent watch
• Prime Propulsion

Intelligent Ground Systems:
• Fully autonomous leader/followers
• Tactical formation
• Human Machine Interface

Survivability:
• Occupant Centric protection systems
• Light-weight, multi-hit and multi-functional integrated armors
• More effective and compact KE defeat APS

Deployable Force Protection:
• Integrated, lightweight protection technologies for small bases (<300 people)
• Line-of-sight and non-line-of-sight detection
• Organic active and passive defense
• Robust and resilient systems

Unmanned Ground:
• Virtual testing of UMS
• Autonomous mobility performance in complex environments
• Soldier/robot and robot/robot teaming
• Autonomous Robotics Systems
• Indirect Vision Technologies
• Unmanned Systems Technology Development
• 360°Situational Awareness Technologies
• Soldier Machine Interfaces
Army S&T Alignment—Air Systems
6.2 and 6.3 FY12

Platform Technologies:
- Joint Multi-Role Technology Demonstrators
- Rotorcraft Airframe Technology
- Platform Durability & Damage Tolerance
- Air Vehicle Structures & Dynamics Technology
- Aviation Weapons Integration

Survivability:
- Integrated ASE Architecture
- EO/IR Countermeasures
- Hostile Fire Warning & Visual Cueing
- Affordable Directional IR Jamming
- Increase Survivable Crash Envelope

Operations and Support:
- Propulsion and Drive Trains
- Increased Fuel Efficiency
- Lighter Weight Components
- Small Heavy Fuel Engine
- Improved Reliability and Durability
- Reduced Weight/Vibration

Rotors & Flight Controls:
- Active Rotors and Controls
- Future Rotary Wing Concepts
- Advanced Rotor System Development
- Reconfigurable Vehicle Technology
- Reconfigurable Rotors

Unmanned Air:
- Autonomous Behaviors
- Unmanned Cargo Resupply
- Manned-Unmanned Teaming
- Video from Unmanned Aerial Systems for Interoperability Teaming (VUIT)
- Bi-Directional Remote Video Terminal (BDRVT)
Army S&T Alignment—Command, Control, and Communications Systems
6.2 and 6.3 FY12

1. Data to Decisions
2. Engineered Resilient Solutions
3. Cyber Science & Technology
4. Electronic Warfare/Electronic Protection
5. Counter Weapons of Mass Destruction
6. Autonomy
7. Human Systems

Intelligence & Electronic Warfare:

- **Fusion** for timely, accurate SA
- **Networked** EW assets for simultaneous and autonomous detection, classification, and geolocation of modern emitters/threats in all terrains
- Surgical disruption and/or neutralization of C4ISR nodes and RCIEDs

Communications:

- **GIG** voice/data connectivity for dismounted Soldiers
- **Tactical** access to military Smartphone applications
- **Intrusion** Detection Systems to detect/protect and reduce network downtime from cyber threats
- **Cross Domain** Solution for bi-directional info sharing
- Affordable phased-array antennas for OTM Satcom

Sensors:

- New growth methods and structures enabling lower cost, large format IR FPAs:
  - Superlattice & Barrier (“nBn”) detectors
  - Novel digital readout integrated circuit (ROIC) technology
- Radar technologies for 360 Degree Hemispherical Coverage
- Standoff capability to characterize urban structures

Mission Command:

- **Mission-aware** data mining and reasoning software agents for decision making and communications utilization
- Custom C2 applications from existing software components and services
- **Mission** Command software services – able to plan, deploy and manage unmanned missions
- Software for Collaboration Services and Decision Support Software Products
University Initiatives:
- Single Investigators
- MURI
- DURIP
- PECASE

Collaborative Technology Alliances:
- Micro Autonomous Systems Technology
- Robotics
- Cognition & Neuroergonomics
- Network Science

Centers for Enduring Needs:
- Vertical Lift Research
- Materials Research
- Automotive Research
- High Performance Computing
- HBCU/MI

Inhouse Research:
- Core Programs
- ILIR
Army Basic Research Focus Areas

1. Nano Science and Engineering
2. Cognitive Neuroscience
3. Quantum Systems
4. Engineered Materials
5. Modeling of Human Behavior
6. Synthetic Biology

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

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

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

Neuroscience
Research in learning, decision models and the functional brain to improve training techniques, human-machine interface design, and to more fully understand the decision-making process

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

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

Materials Modeling
Research to develop fundamental science principles at & across scales and develop underpinning, cross-cutting, and transferrable physics-based modeling capabilities

Autonomous Systems
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
Army Educational Outreach Program

Strategy: Follow the Path to Become Scientists and Engineers

Science Introduction – Grades K-5
NSC
Competitions and Experiences!

Competition – Grades 6-9
eCybermission, Junior Solar Sprint
Up to $7,500 in savings bonds

Lab Experiences – Grades 6-9
GEMS, Near Peer Mentor
Up to $250 stipend a week!

Competition – Grades 9-12
JSHS, IMO, ISEF
Up to $50,000 in cash & prizes!

Mentor Programs – Grades 9-12
UNITE, REAP, SEAP, HSAP/UAP
Up to $5,000 a summer!

College Programs
SEAP-CQL, WISP, CREST, CRFP, SMART
Full scholarship and up to $45,000 a year!

http://www.usaeop.com
Executing the Strategy

The Current Basis (going in)

**Army S&T Priority Challenges !!!**

**Army FY 2013-17 Priority Areas**
- Data to Decisions
- Engineered Resilient Systems
- Cyber S&T
- Electronic Warfare/Protection

**Army FY 2013-17 Warfighter Outcomes**
- Training
- Mission Command
- Power and Energy
- Counter IED and Mine
- Human Dimension
(156 supporting outcomes)

Operational Experiences from 10 Years of War

**WORKSHOP**

**Army FY 2014-18 Army S&T Challenges to Close High Priority Gaps**

- **What**: Goals, Objectives & Metrics
- **When**: 2-3 year deliverables
- **Why**: Addresses high priority Army needs or new capability
- **Application**: Targeted Mission Areas
- **Defined Capability Gap**: Provides enhanced or new capability

**Guidance to S&T Community**

Planning, vetting, identification of enabling technologies, utility analysis, identification of milestones, timing, and resourcing

**Program Building**

- **5-10 Yr Programs**: 6.1/6.2
- **2-3 Yr Programs**: 6.2/6.3

*For the first time, the Army will have Senior Leadership buy-in to Army S&T priorities*

**Army FY 2013-17 Warfighter Outcomes**

- Counter IED and Mine
- Human Dimension
(156 supporting outcomes)

**PLUS Unified Quest Data**

**Workshop focus**
Big Challenge Action Plan
Balanced S&T Portfolio

Focus

Broad

Narrow

Quick Reaction
- Tech Solutions
- Rapid insertions
- Experimentation
- JUON solutions

Enablers
- Applications research for specific military problems
- Tech insertion, integration & transition
- Components, subsystems, models,

Leap-Ahead Innovations
- Skunkworks, integrated evaluations, concepts & wargaming
- Innovative alternative generation, assessment, demonstration and evaluation

Discovery & Invention
- Basic & Early Applied Research
- Education Outreach
- Knowledge for uncertain future

Time Frame

Near (0-3 yrs)

Mid (3-5 yrs)

Far (5+yrs)

Quick Reaction
& Other S&T

Primary focus here

Workshop

PE: 6.3 6.3 / 6.2 6.2 / 6.1
Technology-Enabled Capability Demonstrations (TECDs)

• Definition: A technology or set of technologies that either measurably enhance performance and effectiveness of an existing capability or enable a new and necessary capability for the Warfighter - focus on solving near term challenges that are priorities for the Army

• TECD Considerations
  – TECDs require collaborative program planning (typically cross-organization)
  – TECDs focus on transitioning a capability to meet an agreed upon goal at an agreed upon time
  – Failure of a component technology within a TECD does not necessarily equate to TECD failure
  – Risk management/mitigation strategies take on a new significance within the S&T community – achieving overall capability goal is key
In Summary...

• We are changing the Army S&T business model to be an enduring, sustainable, successful enterprise model

• We are aligning our strategic planning to the budget processes so that we are more efficient and able to achieve “top-down” S&T leadership investment focus

• We are identifying critical Army problems that we can solve in the near and mid-term, using the best talent and skills wherever they exist

• We are enhancing visibility of Army S&T priorities to provide partnering opportunities to jointly solve problems and enhance our Warfighter capabilities

The better we understand our needs and priorities – the better able our enterprise will be to give us capability solutions
My Challenge to You

- Assist us in providing our Soldiers a decisive edge
- Engage in the discussions at this conference
- Strengthen your partnership with the Army

You can help define the architecture, concepts, components and technology to enable the Soldier and small combat unit to achieve the capabilities needed in an environment of persistent conflict and full spectrum operations.
Army Science & Technology

Providing Soldiers Technology Enabled Capabilities
Science and Engineering
Technology Conference/DoD Technology Expo

Jim Smerchansky
Deputy Commander, Systems Engineering, Interoperability, Architectures and Technology (SIAT)
Our Priorities

Continue to provide the best trained and equipped Marine units in Afghanistan

Rebalance our Corps and posture it for the future
Our Priorities

Better educate and train our Marines to succeed in complex environments

Keep the faith with our Marines, our Sailors, and our families
• Energy
• Vehicles/Protected Mobility
• Lighten the MAGTF
At the Tactical Edge Water is the Problem

Data Source CLB-8 period June 13 – September 11 2009
UNCLASSIFIED
MARINE CORPS SYSTEMS COMMAND
EQUIPPING THE WARFIGHTER TO WIN

Vehicle Mobility
“We will rebalance our Corps, posture it for the future and aggressively experiment with and implement new capabilities and organizations.”

The Challenge

System of Systems

Weight/Cube

Requirements

Affordability / Technology

Create the Middleweight MAGTF within Affordability Constraints

Capability Solutions

Required Capabilities
- Energy
- Efficiency
- Weight/Cube
- Other Req.

Capability Development Integration (EOB)

S & T Initiatives

Legacy System Modification

Procurement (e.g., existing Army system)

New development Program
UNCLASSIFIED

Issue: Increasing Power Consumers

Individual Marine Power Requirements

- AN / PVS-17 AA Battery
- AN / PVS-14 AA Battery
- AN / PAS-13D AA Battery
- AN / PEO-16A DI-123A Battery
- Hand-held flashlight AA Battery
- MIOX Water Purifier AA Battery
- AN / PSC-13 D-DACT Unique or AA Battery
- DAGR AA battery
- Quiet Pro Headset Unique Battery
- Squad Digital Camera Unique Battery
- AN / PRC-148 or 152 Unique Batteries
- AN / PRC-153 Unique Battery
- AN / PRC-117F BA 5590 / BA 5390 / BB 2690 Batteries
- Rugged Laptop Unique Battery
http://www.marcorsyscom.usmc.mil
- POCs
- S&T Strategic Plan
- Technology Needs
What's New at Marine Corps Systems Command:


First M-ATVs deploy to Afghanistan

With unprecedented speed, the first of thousands of Mine Resistant Ambush Protected (MRAP) All Terrain Vehicles (M-ATV) are being deployed to Afghanistan with a highly survivable and off-road-capable vehicle just three months after a delivery order was awarded to protect warfighters.

MRAP vehicles feature a V-shaped hull to deflect roadside bombs and are proven to be lifesavers on the battlefield. The procurement of the M-ATV grew from an urgent requirement to provide troops a smaller and more maneuverable vehicle that can travel off-road and navigate Afghanistan's difficult, mountainous terrain.
Points of Contact

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  - john.h.odonnell@usmc.mil 301-908-1194
- MCTSSA: Mike O’Neil mike.oneil@usmc.mil 760-725-2502
- Counter IED: Maj Brian Stamps brian.stamps@usmc.mil 703-432-3921
“There is little that will sober an enemy more surely than the knowledge that somewhere, just over the horizon, lies a force of well-trained, well-equipped Marines in competently manned ships capable of delivering a stunning amphibious blow at a point and time of their own choosing.”

Lieutenant General, Victor Krulak, United States Marine Corps
U.S. European Command Technology Requirements

Stephen L. Spehn, Deputy Science Advisor
23 June 2011
Mission

- Defend the Homeland forward and support U.S. strategic interests
  - Maintain ready forces for global operations
  - Secure strategic access and enable global freedom of action
  - Enhance trans-Atlantic security through support of NATO
  - Promote regional stability
  - Counter terrorism

Building Partner Capacity is essential to all our efforts
Technology Solutions

- EUCOM needs innovative technology solutions to emerging and persistent security concerns
- These solutions may involve non-traditional partnerships executing on accelerated schedules
- These partnerships will need to include:
  - Government agencies with equities in the problem
  - Prime contractors with success in DoD acquisition
  - Small technology providers that are adaptive and agile
  - A coordinating entity to bring it all together
Technologies of Interest
(1 of 8)

- Building Partner Capacity
  - Multi-modal collaboration tools using non-proprietary software that adheres to internationally recognized open standards and is free of ITAR restrictions
  - Cross-language tools that support mixed-mode collaboration
  - Portable, renewable power generation, storage, and distribution to self-configuring grids
Technologies of Interest (2 of 8)

- Information Sharing
  - Cross-domain VTC
  - Dynamic language translation for chat and HTML sites
  - Advanced modeling for decision-support of environmental areas of regional interest
- Socio-Cultural and Regional Awareness
  - Large data-volume collection and visualization capability across all classifications and specified taxonomies, with modeling & simulation to project alternative futures
Technologies of Interest (3 of 8)

- Non-Lethal Weapons (NLW)
  - Halt or disable personnel out to 300 meters
  - Halt or disable
    - Ground vehicles up to 500 meters
    - Surface maritime vessels up to 850 meters
  - Enhance high energy lasers and high powered microwaves to provide NLW capability
    - Smaller size
    - Lower weight
    - Less power
Technologies of Interest (4 of 8)

- Biometrics
  - High-volume, multi-national biometrics matching capability providing firewalled query access to participating nations’ biometrics databases with broad category match indications
  - Advanced biometric identification capability to include: facial; voice; iris; and long-distance, high-speed DNA
  - Infrastructure for sharing biometric information
Technologies of Interest
(5 of 8)

- Persistent ISR
  - Low cost
  - Small logistics tail
  - Minimal operational manpower
  - Expendable equipment
  - Day/night and all-weather
  - Automated processing
  - In-theater tasking
Technologies of Interest (6 of 8)

• Enhanced Logistics Capabilities
  • Point of Need Delivery
    • Reduced requirements for supporting infrastructure
    • Reduced dependence on foreign oil
  • Hybrid Airships
    • Green efficiency
    • Heavy Lift
    • Avoid logistics choke points
    • Outsized cargo
    • ISR capabilities
Technologies of Interest (7 of 8)

- Cyberspace Domain Awareness
  - Enhanced ability to monitor and influence network operation
  - Increased cyber intelligence, surveillance, and reconnaissance
  - Greater information assurance
  - Reduced reaction time
Technologies of Interest
(8 of 8)

• Technology Enablers
  • Low-cost, configurable, multi-purpose small satellites
  • Low-cost small satellite launch platforms
  • Long-life, high-density power storage and management at all levels: from individual soldier through theater
  • Precision location and navigation independent of GPS
Contact

- Name: Stephen L. Spehn
- Email: stephen.spehn@eucom.mil
- Phone: +1.256.961.7095
U.S. SOUTHERN COMMAND
Opportunities, Challenges, and Required Capabilities in the Americas

Ricky O. Stuart
Science & Technology Program Manager
23 June 2011
Key Missions – S&T Focus

- Countering Illicit Trafficking
- Humanitarian Assistance and Disaster Relief
- Peace Support Operations
Illicit Trafficking – The Challenge

- Dense Jungle Foliage
- Riverine Basin
- Broad Open Ocean
- Littoral Areas
- Urban Centers
Countering Illicit Trafficking: Source Zone

- Jungle Environment
- Adaptive, Well-funded Adversaries
- Limited Infrastructure
Countering Illicit Trafficking: Transit Zone

- Vast Ocean
- Limited Capacity
- Emerging Targets of Interest
Countering Illicit Trafficking: Transit Zone

- Vast Ocean
- Limited Capacity
- Emerging Targets of Interest
Humanitarian Assistance / Disaster Relief: Supporting Regional First Responders

- Renewable Water and Energy
- Communications
- Situational Awareness
- Logistics
Humanitarian Assistance / Disaster Relief: Supporting Regional First Responders

- Renewable Water and Energy
- Communications
- Situational Awareness
- Logistics
Peace Support Operations

- Information Sharing
- Regional Cooperation
- Interoperability
Next Generation Space Access

Bruce Thieman
Responsive Space Access Capability Lead & Hypersonics Area Planner
Overview

• USAF Vision for Assured Space Access

  – Near Term: Responsive Reusable Booster Stage
  – Far Term: Technology Challenge
AF Responsive Space Access

- **Reusable First Stage**
  - Hybrid Reusable 1st Stage Vertical Takeoff
  - 15K lbs to Low Earth Orbit

- **Fully Reusable**
  - Reusable 2nd Stage
  - Payoff – +40% payload incr.
  - Ex: Reusable Rocket & Rocket-Scramjet Based Combined Cycle

- **Reusable Horizontal Takeoff 1st Stage**
  - Payoff – Flexible Basing
  - 10K lbs to Low Earth Orbit
  - Ex: Turbine-Scramjet Based Combined Cycle

- **Reversible Solids & Liquids**
  - Small Launch Vehicle (SLV)

**Timeline**
- 2010
- 2017 - 2020
- ~2025
- ~2030
- 2035+
RBS: Responsive, Lower Cost Booster Stage – Ops Concept

Concept stretches S&T Gamut of Possible Solutions

~ Mach 3.5 - 7 Separation lowers thermal protection requirement

AFRL S&T Goals
Reusable Booster + Expendable Upper Stage

Potential
- 66% cost reduction
- 24-hr booster turn-around
- 2-8 hr call up
- Flexible basing

Deploy payload
Boost Back

Cleared for Public Release AFRL-WS 07-0586


Cleared for Public Release AFRL-WS 07-0586
### Next Generation Launch System

#### Near Term

<table>
<thead>
<tr>
<th></th>
<th>Small</th>
<th>Small</th>
<th>Med-Lite</th>
<th>Medium</th>
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<td>Lb to LEO</td>
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<td>5,000</td>
<td>16,500</td>
<td>50,000</td>
<td>64,000</td>
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<td>Cost savings</td>
<td>0</td>
<td>~33%</td>
<td>~50%</td>
<td>~50%</td>
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<tr>
<td>Approx IOC</td>
<td>2015-2020</td>
<td>2019</td>
<td>2025</td>
<td>2025</td>
<td>2030</td>
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</table>
What is RBS Flagship?
- Built Upon Small and Affordable Experiments -

<table>
<thead>
<tr>
<th>Point of Departure (PoD) Design</th>
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<tr>
<td>Propulsion</td>
<td>4 Chase-10s</td>
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<tr>
<td>Length</td>
<td>~ 45 ft</td>
</tr>
<tr>
<td>GLOW</td>
<td>~ 60K lbm</td>
</tr>
<tr>
<td>Dry Weight</td>
<td>~ 16K lbm</td>
</tr>
<tr>
<td>Stage PMF Goal</td>
<td>~ 73%</td>
</tr>
</tbody>
</table>

PoD Fuselage Structural Concept

PoD Wing / Tail Arrangement

- **Step 1** – Ground experiments

- **Step 2** – Prove Rocketback

- **Step 3** – Incremental flight test of X-vehicle

Propulsion Options

Airframe Experiment

Subsystems Experiment(s)
RBD Flight Experiment
- Technology for Multiple Future Flight Systems -

- Hybrid Booster
- Flyback & Boostback Boosters
- Weight Optimized TSTO
- Modular TSTO
- Space Maneuver Vehicles
- High Speed Aircraft

- Launch Vehicles
- Aircraft

- High Mass Fraction Airframe
- Highly Operable TPS
- Hi Ops Tempo Propulsion
- Aeromechanics and Flight Control for RLVs
- Subsystems / Processes for Responsiveness

Cleared for Public Release AFRL-WS 07-0586
Broad Spectrum of Technologies for Responsive Space Access

Materials
- Propellant Tanks
- Leading Edges
- Thermal Management

Propulsion
- OMS, RCS
- HC Boost Engine
- Solids
- Upper Stage Engine
- Combined Cycle Engines

Vehicle Concepts

System Trades & Tech Assessment

Thermal Protection System Manhours

Cleared for Public Release AFRL/WS 07-0499
Broad Spectrum of Technologies for Responsive Space Access

Structures

Guidance & Control

Vehicle Health Management

On-Board Health Management

Ground Analysis

Post Mission Analysis

Post Flight Prognostics

Architecture & Hardware

Cleared for Public Release AFRL/WS 07-0499
RBS Operations
RBS Demos

Pathfinder CONOPS and Rockeback flight demo 2014

Rocket Engine Rapid Remove and Replace 2010 & TPS R&R 2011

Ops Control Center, and Autonomous Guidance & Control Ground Experiments 2011

Hydrocarbon Boost 250K lbs thrust Brassboard 2019

FAST Airframe and Health Management Ground Experiments 2013
Overview

- USAF Vision for Assured Space Access
  - Near Term: Responsive Reusable Booster Stage
  - Far Term: Technology Challenge
Airbreathing Two-Stage-to-Orbit (TSTO) Access to Space Vehicles

- Airbreathing systems offer enormous advantages for TSTO access-to-space; reusable space access with aircraft-like operations
- Air Force / NASA conducting joint configuration option assessments using Level 1 & 2 analyses
- Reusable rockets (RR), turbine-based (TBCC) and rocket-based (RBCC) combined cycles
Airbreathing two-stage-to-orbit (TSTO) systems are based on a rocket-based combined-cycle upper stage in which scramjet propulsion eliminates the need to carry a large oxidizer mass, enabling a substantial reduction in the cost per unit mass brought to low Earth orbit.
Supersonic Inlets: Shock-Boundary Layer Interaction (SBLI) Control

- Bleedless mixed-compression inlets need methods to avoid BL separation
- Maximize inlet pressure recovery
- Shock-boundary layer interaction (SBLI) can trigger separation at or after shocks
- AFRL using experiments and numerical simulations to develop suitable control
- Passive sub-boundary layer vortex generator micro-ramps
- Alternative passive control elements
Properly integrated M&S can give large reductions in cost of physical testing

Continued improvements needed in CFD methods (incl. numerics and physics)

E.g., USAF RBS use of CFD to assess payload separation

6-DOF time-accurate trajectory codes using dynamic offset grids

Platform/staging configurations exceed what can be tested directly
HIFiRE flights use sounding rocket descent trajectories to explore fundamental hypersonics technologies

AFRL and Australian DSTO with NASA; rocket flights at Woomera, White Sands, and Pacific Missile Range

Primary focus on aerosciences and propulsion areas; also stability & control and sensors & instrumentation

Propulsion experiments on Flights 2 (US), 3 (AUS), and 6-9 (US/AUS)

Scramjet fueling/combustion, integration, performance
Hypersonic Global ISR Vehicles

- JP-fueled scramjet propulsion system could potentially enable a medium-size rapid-response ISR vehicle having operationally relevant range capability
- Mach 6 limit avoids complex thermal management penalties at higher Mach
- Vertical takeoff / horizontal landing (VTHL) enables single-stage rocket-based combined-cycle (RBCC) system having 5000 nmi range with 2000 lbs payload
- Integral rocket boost to Mach 3.5 with ram-scram acceleration to Mach 6
- Resulting notional vehicle is 80 ft long with 42,000 lbs empty weight

Notional Mach 6 single-stage reusable VTHL ISR vehicle with 5000 nmi range (Astrox)
Scramjet Engine Development

- Hydrocarbon-fueled dual-mode ram/scramjet combustor allows operation over Mach range
- Thermal management, ignition, flameholding
- GDE-1 was flight weight hydrocarbon fuelcooled but with open-loop fuel system
- GDE-2 was closed-loop hydrocarbon fuelcooled system intended for NASA X-43C
- SJX61-1,2 were closed-loop HC fuel-cooled development/clearance engines for X-51A

Ground Demo Engine (GDE-2)  SJX61-1 Development Engine  SJX61-2 Flight Clearance Engine
Supersonic Propulsion Integration: Combined-Cycle Scramjet Systems

AEDC APTU tests under FaCET of common turbo-ramjet/scramjet flowpath
Robust Scramjet Scale-Up Program

X-51A uses small-scale combustor
Possible follow-on flights to test navigation and inert strike on target

AFRL Robust Scramjet program
Scale-up and combustor reconfiguration for 3X, 10X, 100X scales?

Large-scale vehicle

Possible ISR or global strike vehicle

Potential step to a future airbreathing TSTO access-to-space system

Dual flowpaths, mode transitions, cocooning

Combined TBCC nozzle
Vision…

A 21st Century of
Diverse, Routine, Reliable & Affordable Space Access!
BACKUPS
Supporting Technology Directorates for Responsive Space Access

Air Vehicles

Aerothermal Dynamics

Advanced Hypersonics

Propulsion

Nano-tailored Materials

Unmanned Systems

Perpetual Simulation

Micro-Mechatronics

Materials & Manufacturing

Computational Simulation

Man-as-machine systems

Nanostructured Surfaces

AIAA Combined Conferences Keynote Presentation
Cleared for Public Release  AF/ST  28 June 2010
USSTRATCOM Responsibilities

**Plan and Execute**
- Strategic Deterrence & Nuclear Operations
- Space
- Cyberspace
- Global Strike
- Combating WMD

**Plan, Integrate & Synchronize**
- Missile Defense
- Intelligence, Surveillance, & Reconnaissance
- Information Operations
Geographically Distributed Component Commanders

- JFCC IMD
  LTG Formica
  Army SMDC
- JFCC GS
  Brig Gen Wilson
  8th Air Force
- USSTRATCOM
  Gen Kehler
- JFCC ISR
  LTG Burgess
  DIA
- USCYBERCOM
  GEN Alexander
  NSA
- JFCC SPACE
  Lt Gen Helms
  14th Air Force
- JIOWC
  Mr. Johnson
- SCC WMD
  Mr. Myers
  DTRA
Component and Task Force Structure

HQ
USSTRATCOM

Service Components

JFCC GS (Global Strike) Offutt AFB, NE
JFCC SPACE (Space Ops) Vandenberg AFB, CA
USCYBERCOM (Cyber Ops) Fort Meade, MD
JIOWC (Info Ops) Lackland AFB, TX
JFCC ISR (Intel, Surveillance & Recon) Bolling AFB, DC
JFCC IMD (Missile Defense) Schriever AFB, CO
SCC WMD (Combating WMD) Fort Belvoir, VA

Components

Nuclear Task Forces

ICBMs TF 214 E Warren AFB, WY
Bombers TF 204 Barksdale AFB, LA
Tankers TF 294 Scott AFB, IL
TACAMO TF 124 Tinker AFB, OK
PAC SUBS TF 134 Pearl Harbor, HI
LANT SUBS TF 144 Norfolk, VA

How We Are Organized
USSTRATCOM Task Forces

- **Aerial Refueling/Tankers (TF 294)**
  - USAF refueling aircraft enhance Command’s capability to conduct global combat and reconnaissance operations

- **Airborne Communications (TF 124)**
  - Navy E-6B aircraft provide a survivable communications link between national decision makers and the nation’s strategic forces

- **Ballistic Missile Submarines (TFs 134/144)**
  - Navy ballistic missile submarines provide launch capability from around the globe--most survivable leg of US strategic forces

- **Strategic Bomber & Reconnaissance Aircraft (TF 204)**
  - USAF aircraft deploy globally to project air power and support Command’s reconnaissance mission

- **Land-Based ICBMs (TF 214)**
  - USAF ICBMs, dispersed in hardened silos, provide a quick-reacting and highly reliable component of US strategic forces
<table>
<thead>
<tr>
<th>Strategic Deterrence/Nuclear Ops</th>
<th>Space Operations</th>
<th>Cyberspace Operations</th>
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<tr>
<td>24x7 Deterrence Operations</td>
<td>SSA Ops: Tracking 22,000+ Objects</td>
<td>Operation BUCKSHOT YANKEE</td>
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<td>Conjunction Analysis: 1,100 Satellites</td>
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<td>20+ SSA Sharing Agreements</td>
<td>Cyber Ops As Directed</td>
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<td>Monitoring Space Weather</td>
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<td>Missile Defense</td>
<td>Global Force Management of ISR Assets</td>
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<td>Synchronize Global MD Planning</td>
<td>Support to GCCs</td>
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<tr>
<td>Coordinate Global MD Asset Management</td>
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<td>TD-2 Launches: Support GCCs</td>
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<td>Combating WMD</td>
<td>Support to PACOM: Operation TOMODACHI</td>
<td>Exercises &amp; Training</td>
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<tr>
<td>Synchronize Global CWMD Planning (Global Sync Conf)</td>
<td>Support to AFRICOM: Operation ODYSSEY DAWN</td>
<td>GLOBAL THUNDER</td>
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<td>Establishing SJFHQ-E of WMD</td>
<td>Support to CENTCOM: STRATCOM Forward Integration Teams (SFIT)</td>
<td>AUSTERE CHALLENGE (EUCOM)</td>
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<td>GLOBAL LIGHTNING</td>
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<td>Cross Mission Area</td>
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<td>Integral Threat Operations: Supporting &amp; Supported</td>
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<td>Training Support to GCCs</td>
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<td>Support to Other COCOM Ops</td>
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Process to Monitor New & Emerging Technologies
S&T Outreach Process Goals

- Identify relevant new technologies earlier
  - Keep abreast of emerging Blue/Red Team technologies
  - Socialize new technologies throughout Command
- Inform Labs of USSTRATCOM mission needs
  - Current Operations & Projected Capability Gaps
    - “National Labs” → DoD Labs, FFRDCs/DOE Labs, UARCs, Defense Research Agencies (e.g., DARPA)
- Leverage existing Command-Lab relationships; forge new ones
- Implement S&T Battle Rhythm around S&T IPL Process

Become USSTRATCOM’s “One-Stop” S&T Venue
S&T Outreach Process Overview

- S&T Enterprise Management Board (EMB)
  - Chaired by Senior Analytic Advisor, assisted by Secretariat
  - Formalized with a Charter
  - Comprised of Coordinators Aligned With 7 Mission Areas
    - Nuclear, Space, Cyber, CWMD, IMD, IO, ISR
  - Other Members: SAG/Lab LNOs, S&T Reps, Special Advisors

- Coordinators / AOs / LNOs
  - Coordinators act as information brokers between AOs/EMB
  - AOs interface with Labs as requested by EMB or directed by J-Directorates/Components
  - Lab LNOs/Advisors facilitate communication and support EMB
Gap: No formal Command process to monitor relevant new technologies at the Labs

- **Through a Lab Engagement Strategy**, the S&T EMB will:
  - Regularly **collect new technology** developments from the Labs
  - Forge new opportunities to **convey mission needs** to the Labs

- **S&T EMB Deliverables**
  - **Technology Updates** – Disseminated throughout Command
  - **S&T IPL Recommendations** – Input to OSD/AT&L
  - **Annotated Mission Area Interest List (MAIL)** – Feedback to S&T Community

*Link new technologies with Command Mission Needs*
Branch Chief: Mr. Chuck Hutchison (402) 232-5347

- **S&T Team**
  - Dr. Mark Brown (402) 232-4114
  - Mr. Eric Dernovish 294-0447
  - Mr. David Beberwyk 294-5472
  - Mr. Brian Liesveld 232-1422
  - Mr. Tim Fowler 232-1421

- **Experimentation Team**
  - Mr. Bill Delaney (402) 294-7650
  - Mr. Monty Hoskinson 232-9872
  - Mr. Ray Varney 294-7523
  - Mr. Brian Shook 232-8617

**Command-Wide Participation in S&T Process**
United States Strategic Command

Questions?
Operation BURNT FROST: Intercepted inop NRO satellite
Operation BUCKSHOT YANKEE: Response to 2008 cyber attack
Taepo-Dong 2 Launch: Response to N. Korea missile tests

Recurring Events:
GLOBAL THUNDER: Exercise focused on nuclear command and control, mission execution
AUSTERE CHALLENGE: USEUCOM full-spectrum operations exercise, USSTRATCOM supported
BULWARK DEFENDER: Joint cyber defense exercise

Ongoing Support to Overseas Contingency Operations....
NORAD and USNORTHCOM
Science and Technology

Dr. Susanne T. Wirwille
Director, Science and Technology
NORAD & USNORTHCOM Missions

- North American Aerospace Defense Command (NORAD)
  - Bi-national Command established between the Governments of the U.S. and Canada in 1958
  - Three Regions: Alaskan NORAD Region (ANR), Canadian NORAD Region (CANR), and Continental NORAD Region (CONR)
  - Conducts aerospace warning, aerospace control, and maritime warning in the defense of North America

- United States Northern Command (USNORTHCOM)
  - Unified Command established in 2002
  - Subordinate Commands: Joint Force HQ National Capital Region, Joint Task Force (JTF) Alaska, JTF Civil Support, JTF North, Army North, Air Force North
  - Conducts homeland defense, civil support, and security cooperation to defend and secure the United States and its interests

Two Commands ... Working Together
...Across a Range of Operations...

Homelands Defense
- Aerospace Warning
- Aerospace Control
- Maritime Warning

Security Cooperation
- Air
- Missile Defense
- Maritime
- Land
- Canada
- Mexico
- The Bahamas

Civil Support
- Disaster Relief
- CBRN Incident
- Civil Disturbance
- Special Events
...With a Host of Partners...

International

Department of Defense

Interagency

Approximately 60 People Representing More Than 50 Agencies
NORAD and USNORTHCOM Focus Areas

• Counter-Terrorism and Force Protection
• Transnational Criminal Organizations
• Defense Support of Civil Authorities
• Chemical, Biological, Radiological, Nuclear Consequence Management
• Maritime Warning and Control
• Aerospace Warning and Control
• Missile Defense
• The Arctic

Cross-cutting Focus Area: Technical Opportunities
N-NC/S&T Mission and Functions

• Advises CDR, NORAD and USNORTHCOM and Deputy Commanders on all S&T matters
• Creates and executes strategies and supporting plans to exploit and develop innovative processes, technology and prototypes to respond to the needs of NORAD and USNORTHCOM
  • Leads studies, innovation, experimentation, enabling technologies, technology demonstrations, military utility assessments, and Joint Tests
  • Performs US and Canadian outreach efforts to identify, assess and integrate potential solutions for identified capabilities and requirements
  • Articulates needed capabilities with R&D organizations
• Critically reviews and eliminates unpromising programs and projects
• Synchronizes S&T activities across NORAD and USNORTHCOM staffs
• Focus is 6 months out to 15 years with innovation cycles of 6 - 36 months

S&T provides leadership and oversight of science, innovation and future capability initiatives in order to improve homeland defense, defense support of civil authorities, theater security cooperation, and other NORAD and USNORTHCOM mission capabilities
S&T Functional Organization

Air/Missile Portfolio
Maritime Portfolio
Land Portfolio

Scientific Analysis
Experimentation

S&T Programs
Innovation

S&T Customers
Sponsors, OMs, Test Dirs, SMEs...
Components
Directorates
FASTs
Special Staff
Technical Opportunities

**Capability Needs**
ID Capability Needs to Mitigate through Technical Opportunities

**S&T Domain Roadmaps**
Capture Needs / Document Mitigation Plan

**Outreach**
Aggressive Outreach to Services, Agencies, Nat’l Labs, Universities & Industry

**Solution Feedback Loop**

**Solutions**
Delivered to Warfighter

**Technology Development**
Advocate and Facilitate

**Non-Materiel Technical Solutions**
Advocate and Facilitate

**“Tool Box”**
Use Processes in the Technical Opportunities Tool Box
NORAD and USNORTHCOM

Defending our Homelands
Welcome to NORAD Tracks Santa

Santa has completed his flight this year. Come back next December to see him fly again!
Rapid Fielding
Portfolio, Strategies & Opportunities

Earl Wyatt
Deputy Asst Sec of Defense, Rapid Fielding
OASD(R&E)
Topics

- The Need
- An Enduring Response
- A Strategy for Implementation
- Innovation Delivered
- Looking Ahead

Japan’s Fukushima Nuclear Power Plant imaged 16 March 2011 by Cosmo SkyMed satellite, enabled by Rapid Fielding’s Foreign Comparative Testing

Distribution Statement A: Approved for public release; distribution is unlimited
The Need

“We must rapidly react to warfighting needs with new technology from commercial sources, prototyping or accelerated maturation of technology from the Science and Technology base.”
Sec. Gates, Jan 09

“Rapid fielding requires rapid performance from the entire AQ team, including the test and evaluation community … without delaying our response to these urgent requirements …”
Dr. Carter, Mar 09
An Enduring Response

- USD AT&L – Established a senior integration team to prioritize, resource and provide senior-level oversight of urgent operational needs

- ASD(R&E) – Established the ODASD(Rapid Fielding)
  - Accelerate technical capability to win the current fight
    - Support and engage in JUONs resolution

- Build an enduring rapid demonstration, assessment and fielding model for DoD that invests in near horizon concepts and rapidly transitions them for time sensitive operational needs
  - Shape Quick Reaction Special Projects, Joint Capability Technology Demonstration, Foreign Comparative Testing, Biometrics S&T and Emerging Capabilities program elements to achieve the rapid fielding objective
A Strategy for Implementation

- **Identify, Develop and Demonstrate Concepts and Capabilities Providing a Competitive Advantage**
  - Identify existing solutions capable of satisfying new JUONs within 12 months, or
  - Work with the R&E Enterprise (e.g., Services, Labs, etc.) to develop solutions for JUONs that can be resolved within 24 months

- **Ensure Responsive Processes**
  - Resource efforts that support continuous COCOM engagement
  - Conduct continuous review of acquisition related processes (needs validation, acquisition priorities, resourcing, utility assessments)

- **Conduct Anticipatory Efforts to Positively Impact Operational Readiness**
  - Engage stakeholders to help identify technology trends, potential vulnerabilities and disruptive threats
  - Expand problem/solution space to include interagency, non-kinetic, human social culture, and dual use technologies

- **Make Efficient Use of the Instruments at our Disposal**
  - Employing the use of fieldable prototypes (organically / industrially);
  - Providing operationally representative integration venues (JERC, Stiletto, Thunderstorm, etc.); and,
  - Expanding supplier base to include to non-traditional performers
Implementation Partners

- **Identify, Develop and Demonstrate Concepts and Capabilities Providing a Competitive Advantage**
  - Combatant Commands, Services, Defense Agencies (e.g., NSA, DTRA, DISA, DARPA)
  - Other Federal Agencies (e.g., DHS, DoS, NASA)
  - Industry, with particular emphasis on small business, and the OSBP

- **Ensure Responsive Processes**
  - Congressional Defense Committees
  - OSD Policy and OSD OSBP
  - OSD General Counsel
  - OUSD(AT&L)
    - OASD(R&E)
    - Joint Rapid Acquisition Cell (JRAC)
    - Defense Procurement and Acquisition Policy (DPAP)

- **Conduct Anticipatory Efforts to Positively Impact Operational Readiness**
  - Combatant Commands
  - Services
  - Defense Agencies (e.g., NSA, DTRA, DISA, DARPA)
  - Other Federal Agencies (e.g., DHS, DoS, NASA)
  - Industry, with particular emphasis on small and non-traditional businesses, and the OSBP

- **Make Efficient Use of the Instruments at our Disposal**
  - R&E Enterprise (Labs, FFRDCs, Coalition Partners, GIFs, Non-Traditional Suppliers)
Innovation Delivered

Identify, Develop, and Demonstrate Innovative Solution Options for Joint Capability Areas

**Force Protection**
- Airborne Tac Extraction (FCT)
- Enhanced Mortar Tgt Sys (ECTD)
- Nat’l Technical Nuclear Forensics (JCTD)
- Hostile Fire Detection Sys (QRSP)
- Persistent Grnd Surveillance System (JCTD)

**Battlespace Awareness**
- Rapid Reaction Tunnel Detection (JCTD)
- XFC Submerged launch UAV (QRSP)
- Eagle Vision (FCT)
- Project SHIVA (QRSP)
- Thunderstorm Test Venue (ECTD)
- Stiletto Maritime Test Platform (ECTD)

**Command & Control**
- Mobile Modular C2 (QRSP)
- Nat’l Senior Leadership Decision Support Services (JCTD)
- Theater Information Sharing Sharing (JCTD)
- Tactical Edge Data Solution (JCTD)

**Logistics**
- PEAK (JCTD)
- Critical Runway Assessment & Repair (JCTD)
- Submersible Multi-Fuel Outboard Engines (FCT)
- Deployable Rigid Wall Shelters (FCT)
- Project Pelican (ECTD)
Looking Ahead

Identify, Develop, and Demonstrate Innovative Solution Options for ASD R&E Focus Areas

- Human Systems
- EW & Protection
- Autonomy
- Resilient Systems
- Counter WMD
- Cyber

Guidance

Validated joint capability gaps
QDR mission area studies
S&T priorities & investments
Intel Services
COCOMs
Operational context

Building Security Capacity

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Rapid Fielding Points of Contact

- Efficiently Develop/Demonstrate Concepts & Capabilities that Provide Competitive Advantage
  - Shape JCTD, QRSP, FCT, Biometric/Forensics/ECD PEs
    - Points of Contact: Wyatt/Riley (via CAPT Wright – lewin.wright@osd.mil)

- Ensure Responsive Processes
  - Resource efforts that support continuous COCOM engagement
    - Points of Contact: Vogt (chris.vogt@osd.mil)/ Fogg (glenn.fogg@osd.mil)
    - Conduct continuous review of acquisition related processes (needs validation, acquisition priorities, resourcing, utility assessments)
      - Points of Contact: Cundiff (dan.cundiff@osd.mil)/ Purdy (ellen.purdy@osd.mil)

- Conduct Anticipatory Efforts to Positively Impact Operational Readiness
  - Engage stakeholders to help identify technology trends, potential vulnerabilities and disruptive threats
    - Points of Contact: Fogg (glenn.fogg@osd.mil) / Vogt (chris.vogt@osd.mil)
  - Expand problem/solution space to include interagency, non-kinetic, human social culture, and dual use technologies
    - Points of Contact: Riley/Fogg (glenn.fogg@osd.mil)

- Make Efficient Use of the Instruments at our Disposal
  - Employing the use of fieldable prototypes (organically / industrially)
    - Point of Contact: Purdy (ellen.purdy@osd.mil)
  - Providing operationally representative integration venues (JERC, Stiletto, Thunderstorm, etc.)
    - Point of Contact: COL Kelleher (pat.kelleher@osd.mil)
  - Expanding supplier base to include to non-traditional performers
    - Point of Contact: Cundiff (dan.cundiff@osd.mil)
Questions?

US Marines demonstrate water purification system in Honduras in the Pre-positioned Expeditionary Assistance Kits JCTD

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Technology Transition Paths

Deliberative Path

- Joint Capabilities Integration & Development System (JCIDS)
- Initial Capabilities Document (ICD)
- Materiel Development Decision (MDD)

Accelerated Path

- Quick Reaction Special Projects/Emerging Capabilities/Biometrics (QRSP/ECD/Bio)
- Joint Capabilities Tech Demos (JCTDs)
- Foreign Comparative Testing (FCT)

Examples of Accelerating Instruments

- Exchange Information
- Deliveries

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