Intelligence Community Forum

November 5, 2008

Washington, DC

Onsite Agenda

National Intelligence Perspective

Dr. Pete Rustan, Director, Ground Enterprise Integration Office, NRO

USD(I) DOD Perspective

Mr. Bob Arbetter, Director for Collection Concepts and Strategies, OUSD(I)

IARPA Vision and Focus

Dr. Lisa Porter, Director, Intelligence Advanced Research Project Agency, ODNI

Operational Neuroscience

Dr. Amy Kruse, Program Manager, Cognitive Science, DARPA Defense Sciences Office

Warfighter Perspective

Mr. James “Snake” Clark, SES, Director ISR Innovations and UAS Task Force, HQ USAF A2

Chief Scientist Panel: S&T Solutions of Interest

Panelists:

- Dr. Eric Kaufman, Chief Scientist, National Counter Terrorism Center
- Mr. Michael Gilbert, Technical Executive, Innovision Directorate, NGA

Acquisition and Intelligence Community Collaboration

Ms. Kristen Baldwin, Acting Director, Systems and Software Engineering, ODUSD(A&T)

NDIA
NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

PROMOTING NATIONAL SECURITY SINCE 1919

INTELLIGENCE COMMUNITY FORUM

IC Interest Areas to Focus Industry's IRAD

SESSIONS INCLUDE:

- National Intelligence Perspective
- USD(I) DoD Perspective
- IARPA Vision and Focus
- Defense Science Board Task Force: Operations Research in Support of ISR
- Warfighter Perspective
- Chief Scientist Panel: S&T Needs and Solutions of Interest
- Acquisition and Intelligence Community Collaboration

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THE C4ISR DIVISION OF NDIA & USGIF

UNITED STATES GEOSPATIAL INTELLIGENCE FOUNDATION

NOVEMBER 5, 2008

WWW.NDIA.ORG/MEETINGS/9760

BOLLING AIR FORCE BASE ▸ WASHINGTON, DC

EVENT #9760

INTELLIGENCE COMMUNITY FORUM

NOVEMBER 5, 2008 ▶ BOLLING AIR FORCE BASE

Background:
Recent cross-agency intelligence organization initiatives have advanced and challenged the capability gaps in collecting intelligence, analyzing it and sharing it. Incremental improvements while notable cause chaos in reaching agreement as well as consensus as to the proficient leveraging of government investment initiatives along with industry's IRAD focus areas. To be sure, the goal of understanding the areas of IC capability needs is the first step towards the maturation of technology essential for the enhancement of system solutions for fusion into the intelligence community family of professional tools and products.

Conference Objectives:
This forum will enable the interchange of ideas amongst government and industry Program Analysts, Portfolio Managers, Systems Engineers, Chief Scientists, Researchers and Product Engineers who are subject matter experts in specific areas of intelligence related science, technology and application domains. Historically the US Industrial Base has responded to the clarion call when called upon. In the period of constrained and limited discretionary resources, it is imperative that the industrial community deliver solutions whose capability not only satisfy the IC operational capability needs but also effect the operational tactics, techniques and methods of employment essential to the mission.

6:30 a.m.	**Registration and Continental Breakfast**
7:45 a.m.	**Welcome Remarks and Introductions** Mr. Sam Campagna, Director, Operations, NDIA; Dr. Steve Kimmel, NDIA C4ISR Division Chairman; Senior Vice President for Corporate Development
8:00 a.m.	**National Intelligence Perspective** Dr. Pete Rustan Director, Ground Enterprise Integration Office, NRO
8:30 a.m.	**USD(I) DOD Perspective** Mr. Bob Arbetter Director for Collection Concepts and Strategies, OUSD(I)

9:00 a.m. **IARPA Vision and Focus**
Dr. Lisa Porter
Director, Intelligence Advanced Research Project Agency, ODNI

9:30 a.m. **Break**

10:00 a.m. **Operational Neuroscience**
Dr. Amy Kruse
Program Manager, Cognitive Science, DARPA Defense Sciences Office

10:30 a.m. **Warfighter Perspective**
Mr. James "Snake" Clark
SES, Director ISR Innovations and UAS Task Force, HQ USAF A2

11:00 a.m. **Lunch**

12:00 p.m. **Chief Scientist Panel: S&T Solutions of Interest**
Moderator: Mr. Keith Masback
President, United States Geospatial Intelligence Foundation

Panelists:
Dr. Pete Bythrow, Chief Scientist, MASINT Management Office, DIA
Dr. Eric Kaufman, Chief Scientist, National Counter Terrorism Center
Mr. Michael Gilbert, Technical Executive, Innovision Directorate, NGA

1:30 p.m. **Acquisition and Intelligence Community Collaboration**
Ms. Kristen Baldwin, Acting Director,
Systems and Software Engineering, ODUSD(A&T)

1:50 p.m. **Forum Summary**

2:00 p.m. **Networking Roundtable**

3:30 p.m. **Adjourn**

Notes

Office of the Under Secretary of Defense (Intelligence)

Mr. Bob Arbetter
OUSD(I)

IC S&T Forum November 5, 2008

The overall classification of this brief is Unclassified

Persistent ISR

- **Must:**
  - **Employ** multi-INT, multi-domain **collection**
  - **Provide** relevant and timely **analysis** to address the threat
  - **Result in actionable information** for operators
  - **Take advantage of** key enabling **technologies**

Things have changed…

Key Collection Issues

- Multi-INT, multi-domain persistence – responsive to dynamic, tech-savvy adversaries
  - Speed of light and thought
- Integrated Tasking, Collection and Analysis Management
  - Sensor location and awareness
  - Smart tasking – include collecting on transactions and social networks
  - Analysis Gap awareness
  - Automated feed back loop to multi-discipline tasking recommendations
- Unattended Sensors
  - Integrated tasking and data access
- Operations-based collection management process – analogous to an effects based ATO
  - Collection plans must allow for long-term activities based ISR
- Non-traditional ISR (e.g. OSINT) feeding spatially and temporally searchable ISR data bases
- Collections should be able to support various timelines, from real time operator support to forensics and longer term situational awareness

Key Analysis Issues

- **Integrated Intelligence Architecture**
  - Easy data access
    - Non-traditional data queries – not necessarily temporal or spatial
  - Automated tipping and cueing up and down echelon
  - COP available down to lowest tactical level; including both Red and Blue forces.
  - Robust, responsive, and tested information transfer layer
  - Integrated Data Centers and storage solutions for rapidly increasing volumes of data
  - Predictive and forensic analysis – must understand metrics, and they are different

Key Analysis Issues (cont.)

- **Maritime and Air Domain Awareness**
  - Connect the vertical dots into a horizontal theme
  - Build and support COPs
- **Nuclear Forensics**
  - Post Detonation Attribution
- **Biometrics and Social Network Analysis Integration**
- **Reduced analyst workload and footprint**
  - Better tools and Automated analysis optimized for their particular problem
  - Make volume our friend
  - Treat IMINT like SIGINT

“Last Tactical Mile” Issues

- **Multi-level security vice “Multiple levels of security”**
  - Sensitive but releasable data at the lowest possible levels without separate networks
  - Common message and email systems
- **COP and supporting analysis down to lowest tactical level**
- **Ensure Intel drives Ops**

Enabling Key Technologies

- **Bridge the technology provider-end user gap**
- **Streamline technology-to-operations cycle**
- **Select most promising technologies and rapidly transition to operations**
- **Reduce barriers that hinder discovery of cutting-edge technology**

Stretch today's technologies and invest wisely in future technologies

Questions?

Mr. Bob Arbetter
Director
Collection Concepts and Strategies
DUSD Technical Collection and Analysis
Undersecretary of Defense for Intelligence
(703) 692-2888

ACQUISITION & TECHNOLOGY

THE WILL TO CHANGE

Acquisition and Intelligence Community Collaboration

Kristen Baldwin

Deputy Director, Software Engineering and System Assurance
Office of the Deputy Under Secretary of Defense
(Acquisition and Technology)

Outline

- Discuss two examples of the growing collaboration between Acquisition and Intelligence communities:
  - DoD Systems Engineering Research University Affiliated Research Center
  - DoD Acquisition Cyber Security and Program Protection
- Describe opportunities to engage

Systems Engineering Research

University Affiliated Research Center

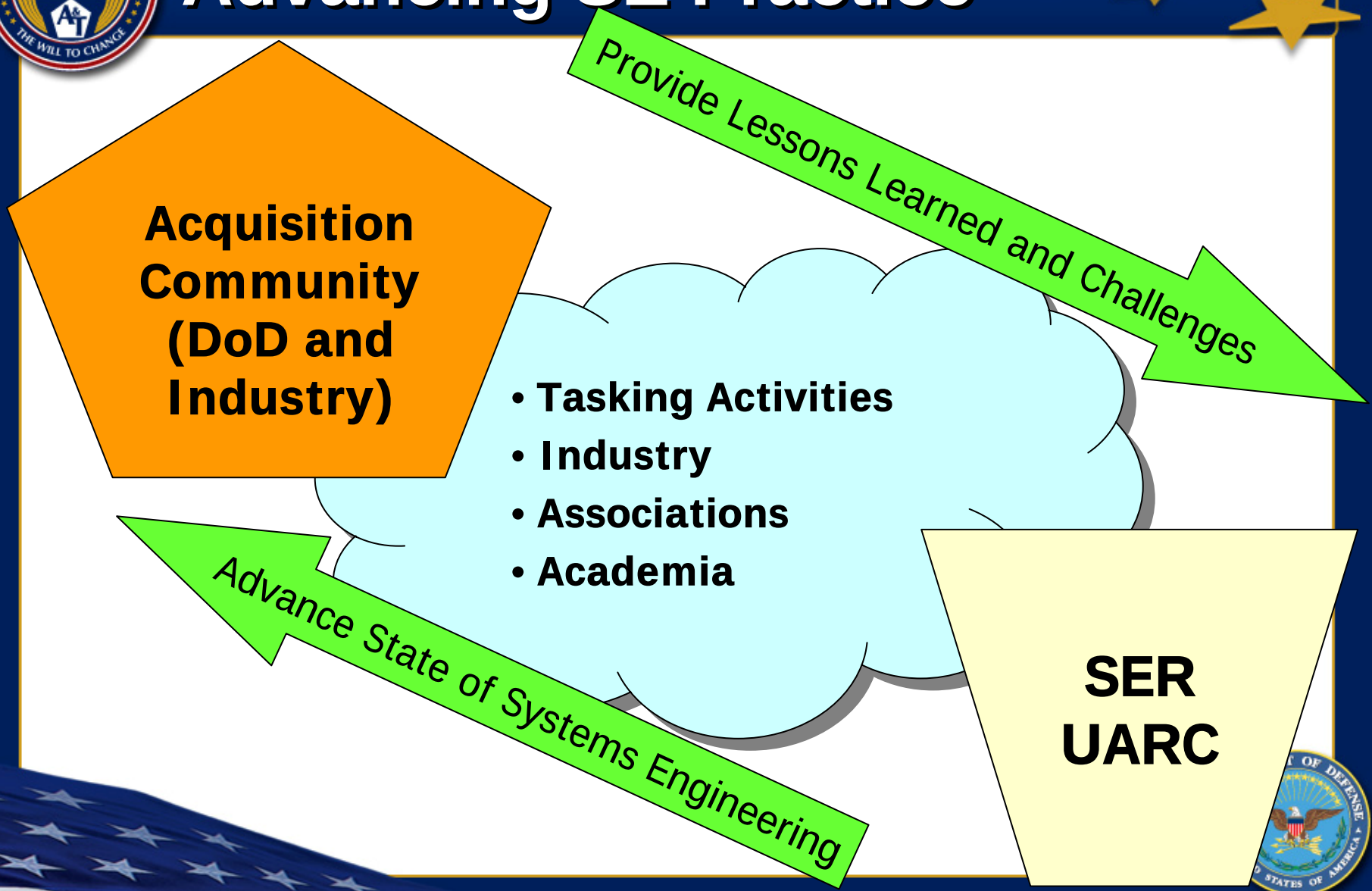
The Need

- Current SE methods, processes, tools do not address the breadth, complexity, and tempo of today's development environment.
- Although systems engineering is recognized as key to delivering weapon systems, there is no single body leading the effort to advance SE methods, processes, and tools (MPTs) to support DoD challenges…nor funding line.
- There is an inadequate supply of systems engineers experienced with the breadth and complexity of DoD's current development environment.

The Solution

- **Provide funding for a center to lead, coordinate, and harmonize research focused on delivering improved SE MPTs that support DoD challenges**
  - **Establishes and maintains essential systems engineering research and analysis capabilities**
  - **Nurtures and grows graduate-level systems engineering academic and research programs that support DoD acquisition program needs**

Advancing SE Practice



SER UARC Mission

To research and analyze advanced and emerging systems engineering practices and relevant technologies to address the full spectrum of DoD and Intelligence systems across the Department

Goal: Ensuring consistency and systems engineering excellence throughout the acquisition cycle

SER UARC Team

UARC Lead Organizations

STEVENS Institute of Technology

USC UNIVERSITY OF SOUTHERN CALIFORNIA

Members

- Auburn University
- Air Force Institute of Technology
- Carnegie Mellon University
- Fraunhofer Center at UMD
- Massachusetts Institute of Technology
- Missouri University of Science and Technology (S&T)
- Pennsylvania State University
- Southern Methodist University
- Texas A&M University
- Texas Tech University
- University of Alabama in Huntsville
- University of California at San Diego
- University of Maryland
- University of Massachusetts
- University of Virginia
- Wayne State University

Summary

- UARC will address SE research challenges across DoD and the Federal Government
- Research results (new/improved MPTs) will be shared across Government and industry to improve SE practice.
- Opportunity for DoD and Industry investment
  - Advance the state of Systems Engineering
  - Nurture and grow graduate-level systems engineering academic and research programs

UARC Program Manager
Dennis Barnabe
drbarnab@nsa.gov

UARC Deputy PM
Sharon Vannucci
sharon.vannucci@osd.mil

DoD
Cyber Security
And
Program Protection

Increased Priority for Program Protection

- ***Threats*: Nation-state, terrorist, criminal, rogue developer who:**
  - **Gain control of IT/NSS/Weapons through supply chain opportunities**
  - **Exploit vulnerabilities remotely**
- ***Vulnerabilities*: All IT/NSS/Weapons (incl. systems, networks, applications)**
  - **Intentionally implanted logic (e.g., back doors, logic bombs, spyware)**
  - **Unintentional vulnerabilities maliciously exploited (e.g., poor quality or fragile code)**
- ***Consequences*: Stolen critical data & technology; corruption, denial of critical warfighting functionality**

System Assurance is the confidence that the system functions as intended and is free of exploitable vulnerabilities, either intentionally or unintentionally designed or inserted during the lifecycle

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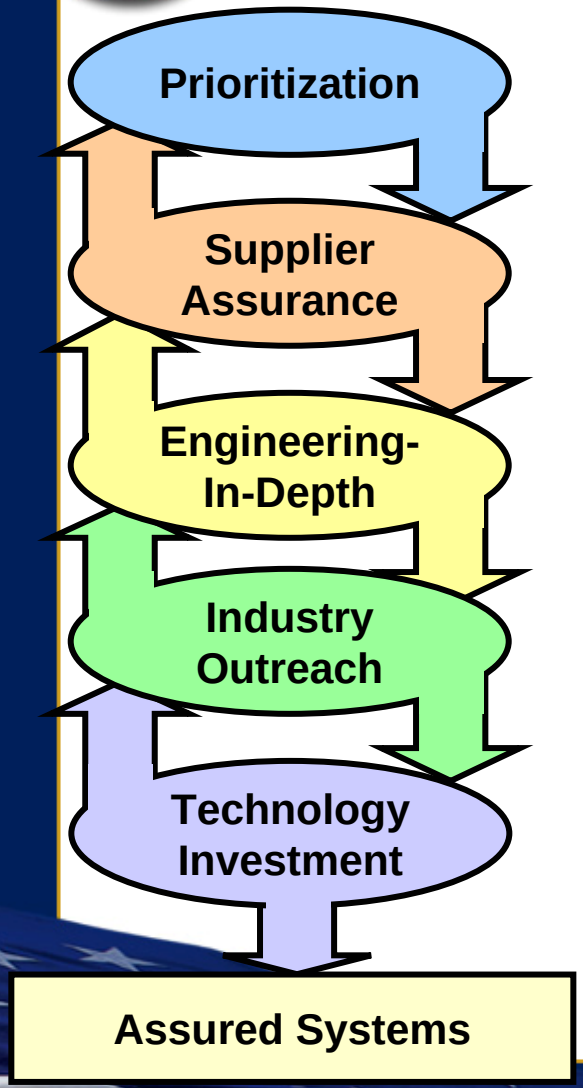
The Solution Components



Vision of Success

- The requirement for assurance is allocated among the right systems and their critical components
- DoD understands its supply chain risks
- DoD systems are designed and sustained at a known level of assurance
- Commercial sector shares ownership and builds assured products
- Technology investment transforms the ability to detect and mitigate system vulnerabilities

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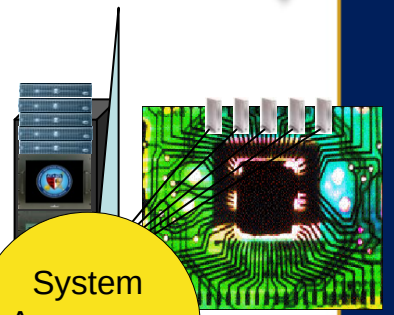
Numerous Defensive Protection Strategies and Related Engineering Disciplines



Program Protection (USD(I))

Trusted Micro-electronics (DTICS (DDRE, NII, IP))

Trusted Foundry (DDRE)

Center For Assured Software (NSA)

Quality Engineer

Configuration Manager

Anti-Tamper (AF)

System Assurance (AT&L/NII)

Program Manager

Software Protection Initiative (DDRE)

Reliability Engineer

Systems Engineer

Safety Engineer

Information Assurance (NII)

Protection implemented via multiple initiatives with multiple owners

Several Assurance Efforts in Acquisition

- Defense Industrial Base Cyber Security
  - DIB Information Sharing
  - Implementing Cyber Security on Contracts
  - Interim Policy and Near Term Pilots with Programs and Industry
- Program Protection Planning
  - Policy requiring all programs identify Critical Program Information (CPI) at MS A and submit PPP at MS B
  - Guidance and Procedures in development
- Engineering for System Assurance Guidebook
  - Systems Engineering and Acquisition Life-Cycle Overlay for Assurance
  - Joint Industry and Government effort, released 1 Oct 08

Critical Program Information

- **"CPI. Elements or components of an RDA program that, if compromised, could cause significant degradation in mission effectiveness;**
  - **Includes information about applications, capabilities, processes, and end-items.**
  - **Includes elements or components critical to a military system or network mission effectiveness.**
  - **Includes technology that would reduce the US technological advantage if it came under foreign control…"**

DoDI 5200.39

Program Protection Envisioned Benefit

Program Benefit

- Coherent direction and integrated policy framework to respond to security requirements
- Risk-based approach to implementing security
- Provision of expert engineering and intelligence support to our programs
- Streamline process to remove redundancy; focus on protection countermeasures

DoD Benefit

- Reduced risk exposure to gaps/seams in policy and protection activity
- Improved oversight and focus on system assurance throughout the lifecycle
- Ability to capitalize on common methods, instruction and technology transition opportunities
- Cost effective approach to "building security in" where most appropriate

Expanding DoD Industry Partnership

- **Acquisition Cyber Security is a long term interest for DoD**
  - **Fully anticipating Cyber Security is expected to be a ongoing priority for the new administration**
- **DoD will continue to take advantage of the global marketplace and COTS solutions**
  - **Engineering for System Assurance seeks to identify and fortify critical components allowing incorporation of COTS**
  - **Industry outreach must explore strategy for commercially reasonable assurance for globally sourced products**
- **Industry is part of the solution**
  - **NDIA System Assurance Committee will continue to focus on the solution strategy**
  - **ITAA, GEIA, INCOSE, others all participate on this committee**

NDIA Conference
November 4th, 2008

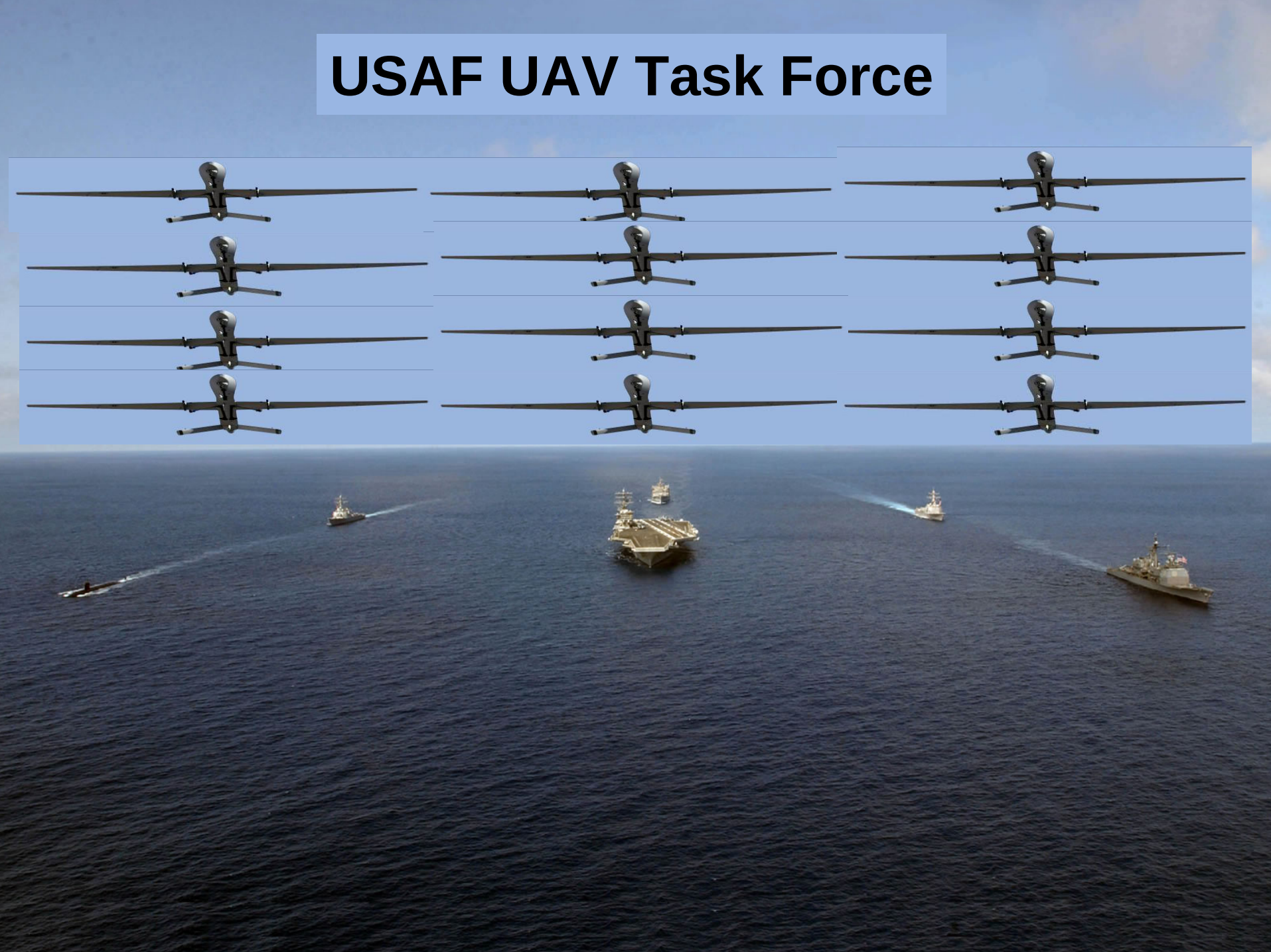
ISR Innovations and UAV Task Force Directorate

November 2008

He's armed and dangerous

And now he's an actual "Intel Guy"

USAF UAV Task Force



Yoda of Predator

Tazar AB Hungary 1996

Kandahar AB Afghanistan 2008

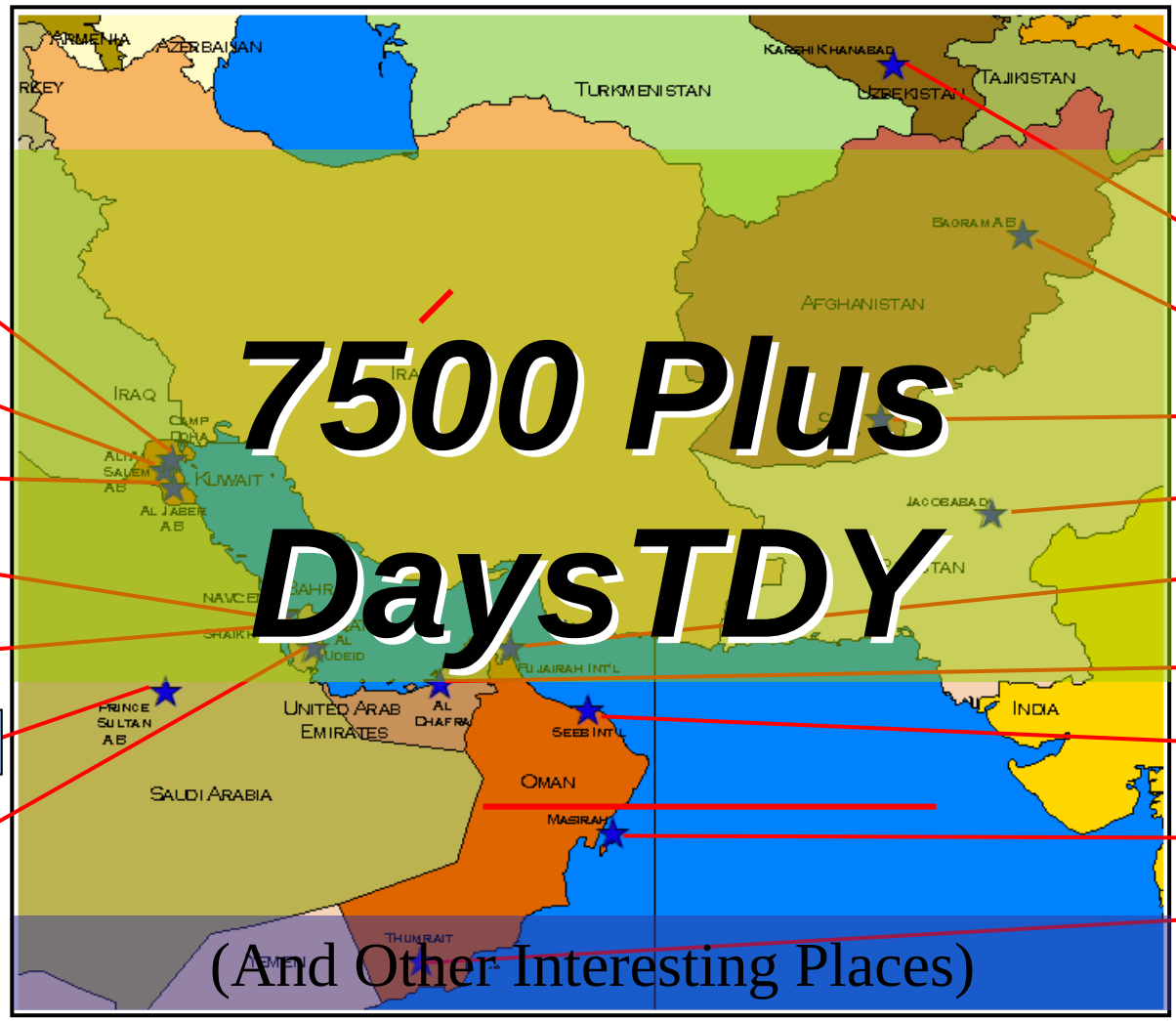
A2-U's Expertise:
We've done it longer than anyone else.
We built many of the capabilities.
Our personnel are flying it today.

***And Snake can still fit into a Flight Suit

A2-U in the AOR

June 2001 – August 2008

- Balad
- Baghdad
- Tallil
- Camp Doha
- Ali Al Salem
- Al Jaber
- NAVCENT
- Shaikh Isa
- PSAB
- Al Udeid



- Manas Kyrgyzstan
- Karshi Khanabad
- Bagram
- Camp Rhino
- Jacobabad
- Fujahra
- Al Dhafra
- Seeb
- Masirah
- Thumrait

MQ-1 Predator Reaches 440,000 hours

4000 + Weekly Combat Hours

28 Combat CAPS

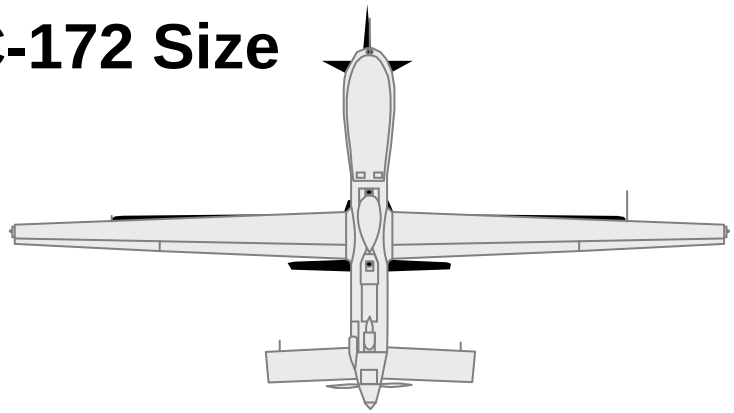
MQ-9 Reaper 30,000 hours

Over 400 Combat hours a week

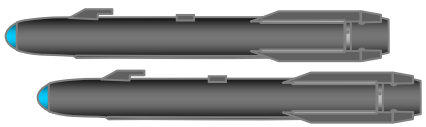
MQ-1/MQ-9 Comparison

MQ-1

C-172 Size

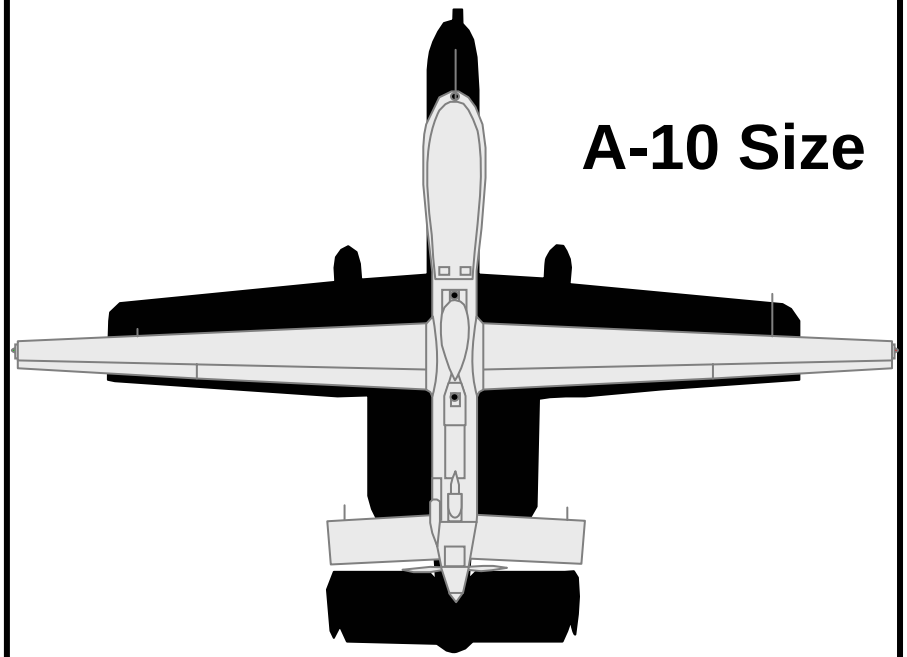


2 x Hellfire

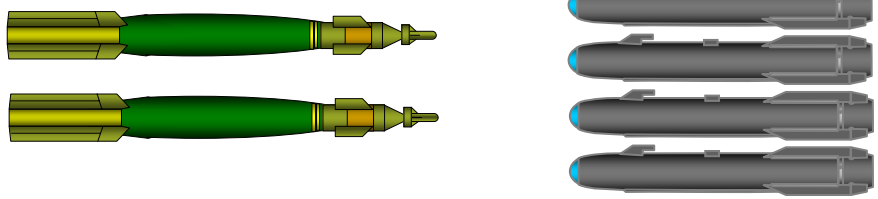


MQ-9

A-10 Size



2 X 500 lb bombs & 4 x Hellfire



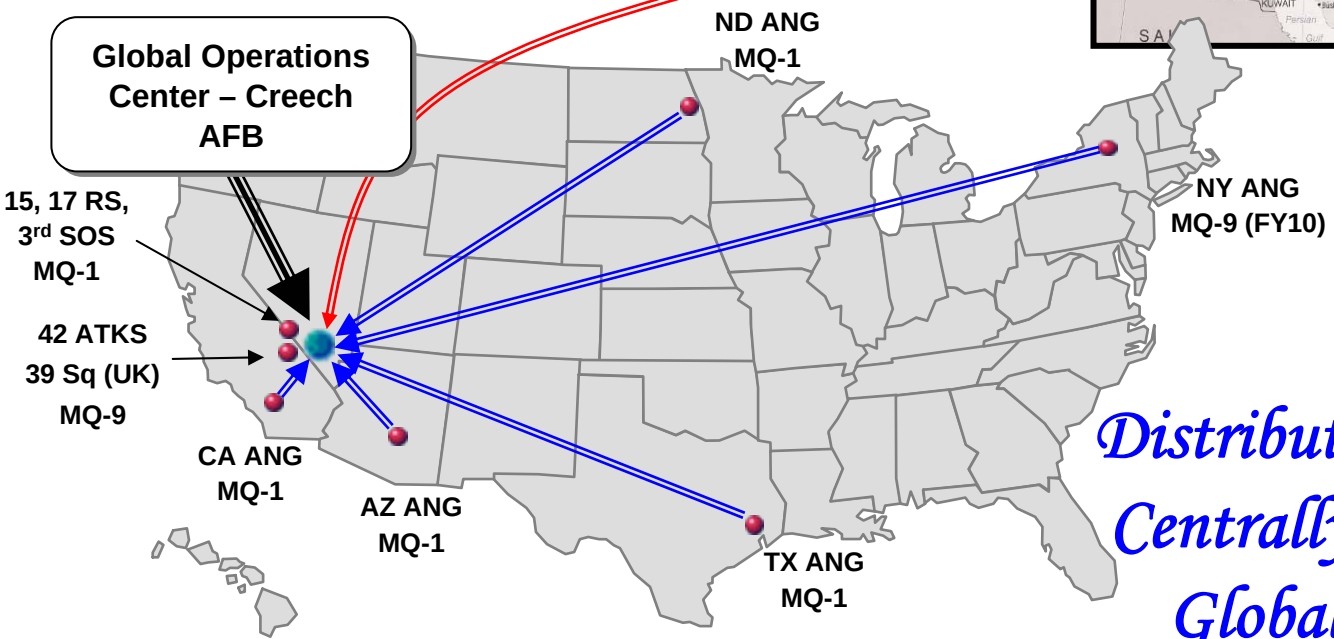
Smart reach back UAV Operations

Total Force Operations

Active Duty, Reserve, National Guard, Special Operations, United Kingdom

6 - Stateside operations centers

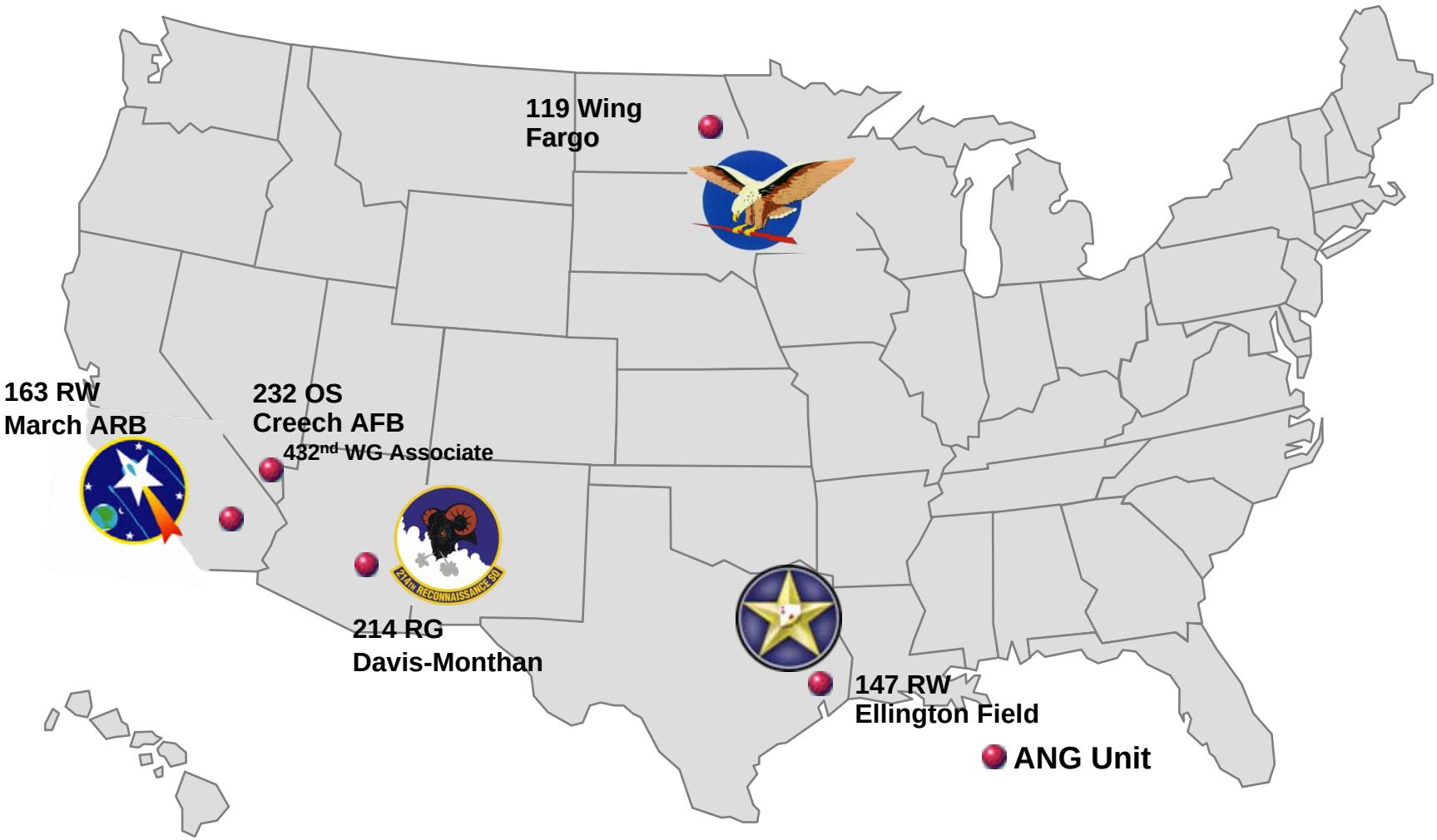
5 - Launch and recovery units in theater



Distributed Operations
Centrally Coordinated
Globally Applied

Over 1000 personnel flying Combat Operations not in harms way

ANG MQ-1 Organization



Air National Guard Total Force Transformation

- **Convert BRAC units to new UAVs Mission**
- **Maintaining years of Aircrew experience**

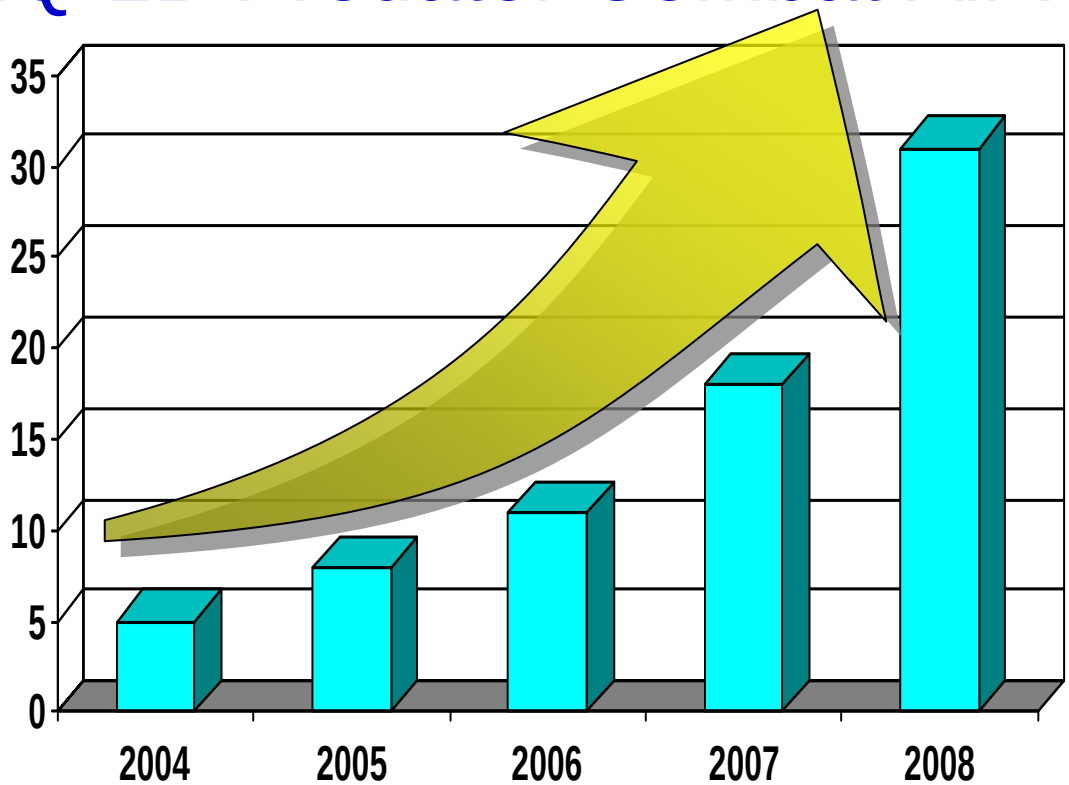
  (F-4, F-15, F-16, F-117, A-10, B-52, C-5, C-17, C-21, C-130, KC-135, & AH-64)
- **From a high time of 5000+ hours to an average of over 1500 hours**
- **Minimum training for High Combat Experience**
- **Maintaining extensive Maintenance, Logistics, Training, Intel Support, and Facilities to the new mission at a minimum cost**

Bottom line: Flying, armed UAV's is not simple
13 ½ years and 450 K hours lesson learned

Predator Combat Growth

Air Force MQ-1B Predator Combat Air Patrols

- 2004 = 5
- 2005 = 8
- 2006 = 11
- 2007 = 18
- 2008 = 31 (Planned)



520% Increase in 4 years!

Predator Innovations

Laser Designator	*Kosovo*	*38 Days*
Hellfire	*2001*	*61 Days*
Remote Split Ops	*2001*	*5 Days*
Stinger	*2002*	*91 Days*
ROVER	*2002*	*4 Days*
Hellfire Sleeve	*2002*	*21 Days*
GBU-12	*2003*	*9 Months*
Link-16/SADL	*2004*	*8 Months*

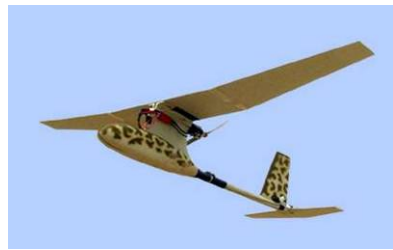
FalconView Multi-Predator Tool, Super Splitter, Cursor on Target, UAS Mission Information System, Blue Force Tracking, Civil Air Tracks, ISR Information Services, Wing/Squadron C2, Predictive Control Displays, Predator FalconView enhancements . . .

ROVER
Full Motion Video directly to the Warfighter

- Predator
- SNIPER Pod
- Litening Pod
- P3
- Raven
- Pioneer
- Pointer
- AC-130
- Shadow
- Hunter
- Fire Scout
- Scathe View

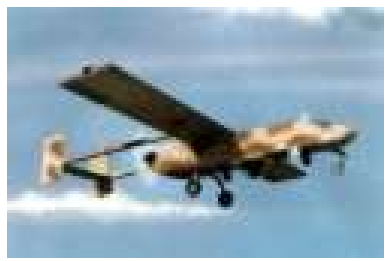




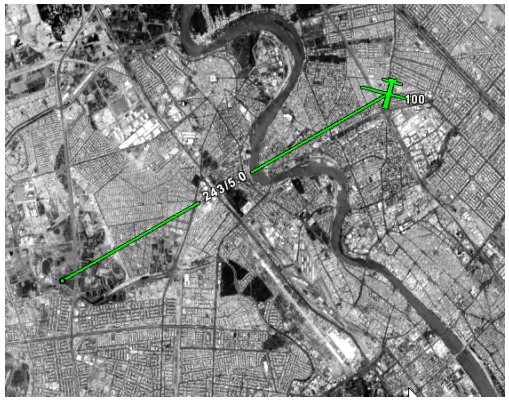



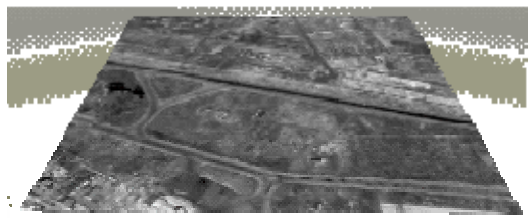






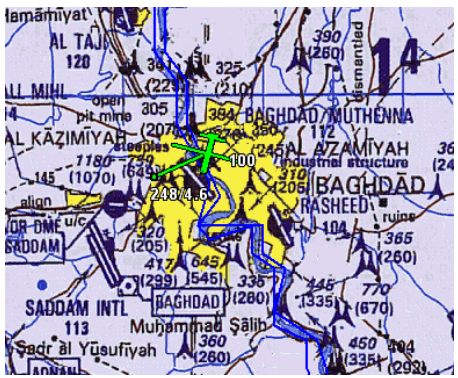

ROVER Big Picture





PSS-SOF Precision Targeting

FalconView
Maps
+
Imagery



ROVER

ROVER
Revolutionizes the Battlefield

Over 14 NATO and ISAF countries use ROVER

– *UK*	*France*	*Australia*	*Germany*
– *Norway*	*New Zealand*	*Canada*	*Portugal*
– *Italy*	*Spain*	*Sweden*	*Belgium Netherlands*

85% of CAS mission done with ROVER in OIF

Fielded ROVERs

ROVER I: (Pred to AC-130)
Total Delivery – 20

ROVER II: (Aircraft to JTAC)
Total Delivery 147

ROVER III – Multi-band receiver C/L/KU
Total Delivery 2331

ROVER IV
Total Delivered 1169

ROVER V
On Order 9

ROVER 4200

OSRVT 1083

ROVER Recycling Program Upgrade
ROVER 3's to ROVER 4's only $7K

ROVER 5 Test Sep 08

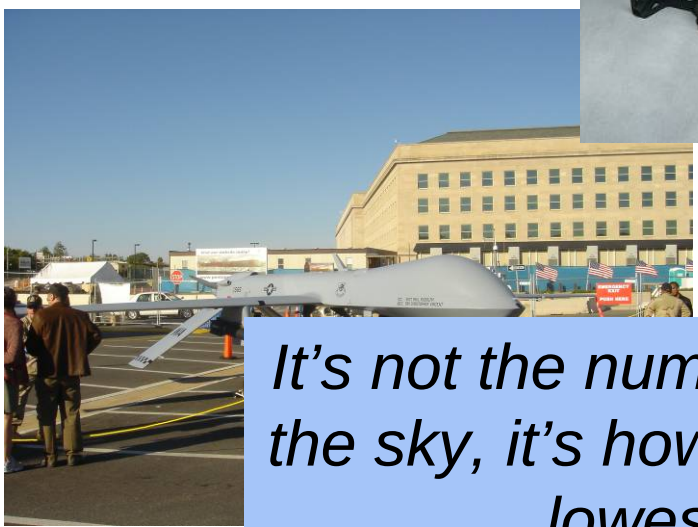
- Full Encryption
- 4 pounds
- John Madden
- Full production Nov 08

OEF Coalition Warfare
38 Nations in ISAF
All members must have the same maps and imagery

A2-U Afghanistan
Eagle Express

- *145 Laptops computers with NATO releasable maps and imagery on FalconView*
  - *Six Regional Commands*
  - *Provided FV training*

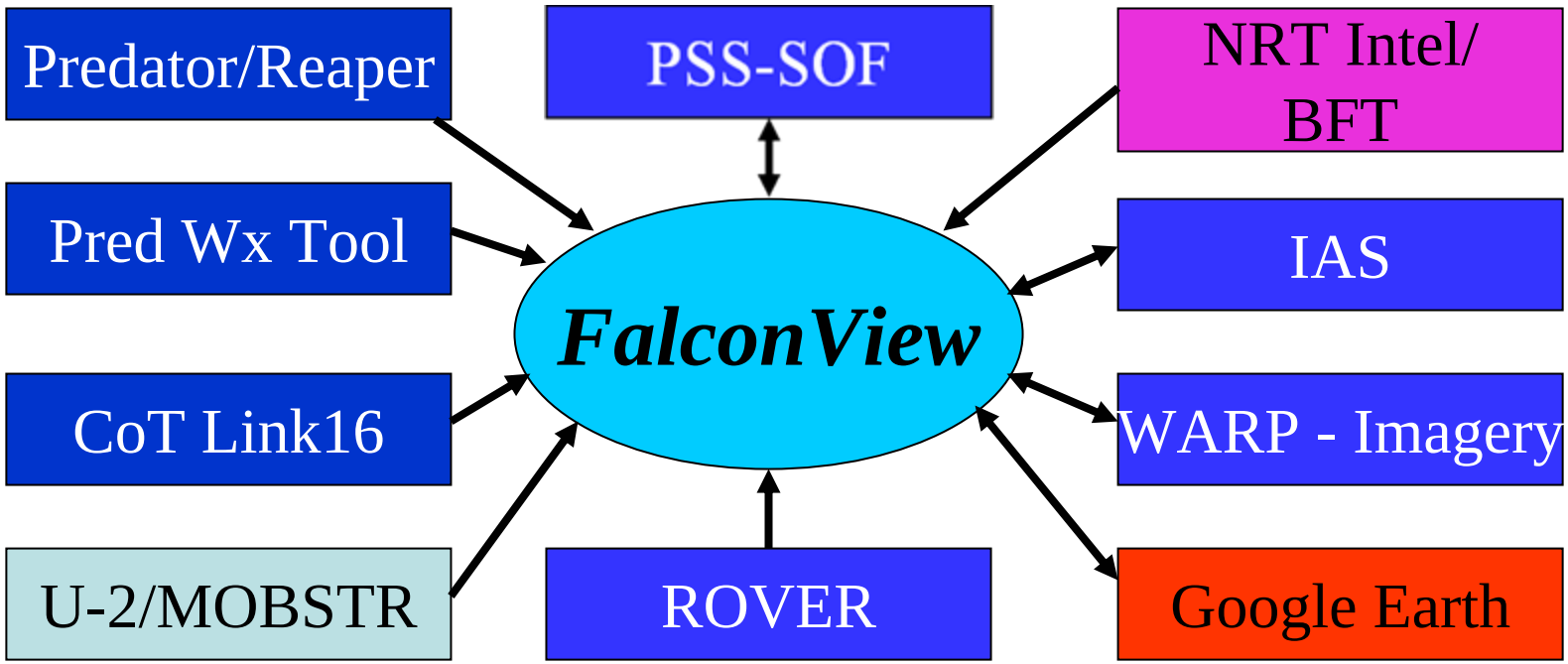
Enhanced Combat Situational Awareness



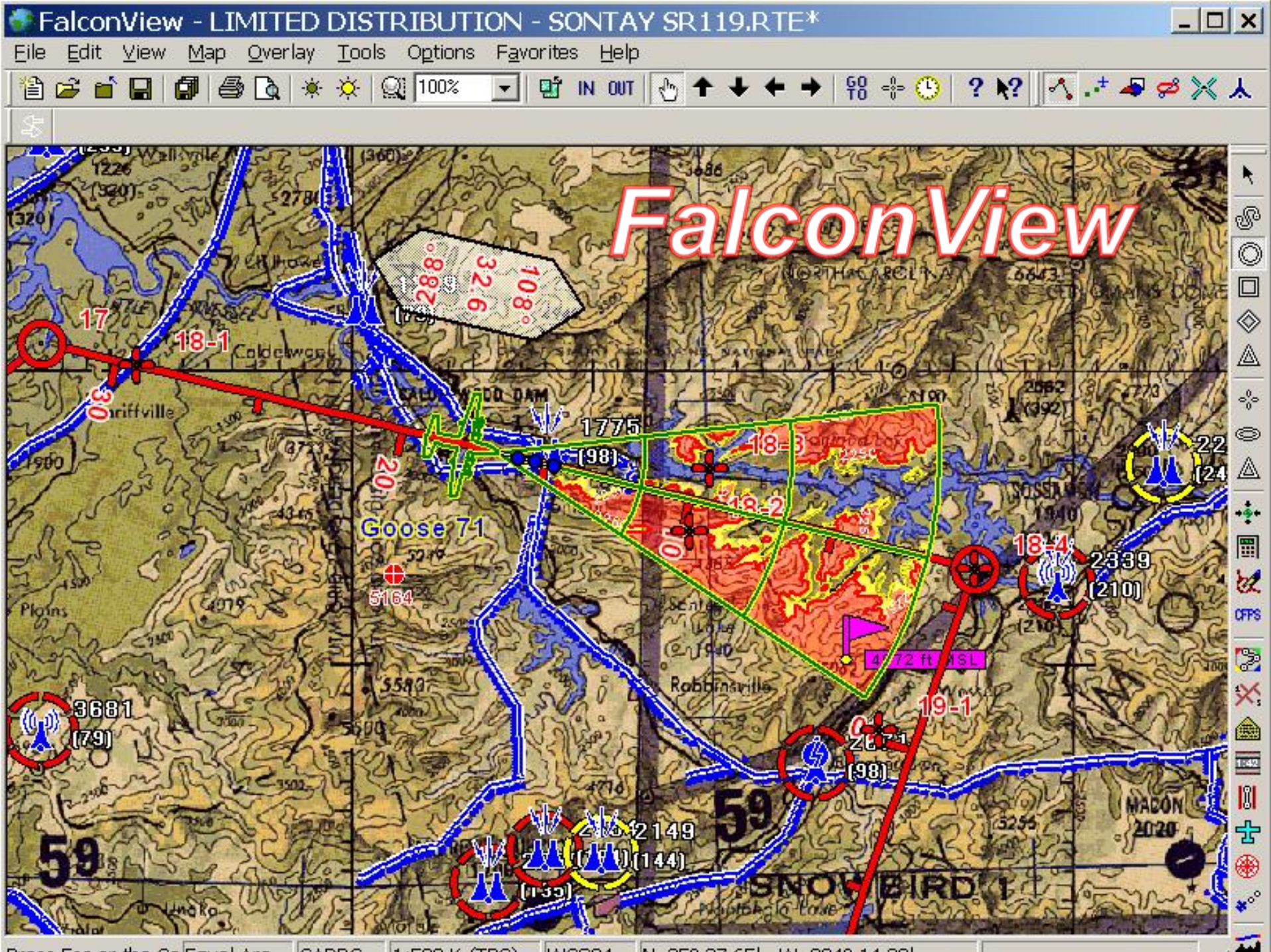
It's not the number of UAV's that are in the sky, it's how you get the data to the lowest tactical level

FalconView Technology

Increasing Connectivity – the “glue” that provides SA to the operator



Even used on Air Force One!


FalconView - LIMITED DISTRIBUTION - SONTAY SR119.RTE*
File Edit View Map Overlay Tools Options Favorites Help
100%
IN OUT
GO TO
FalconView
17
18-1
30
20
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5164
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(144)
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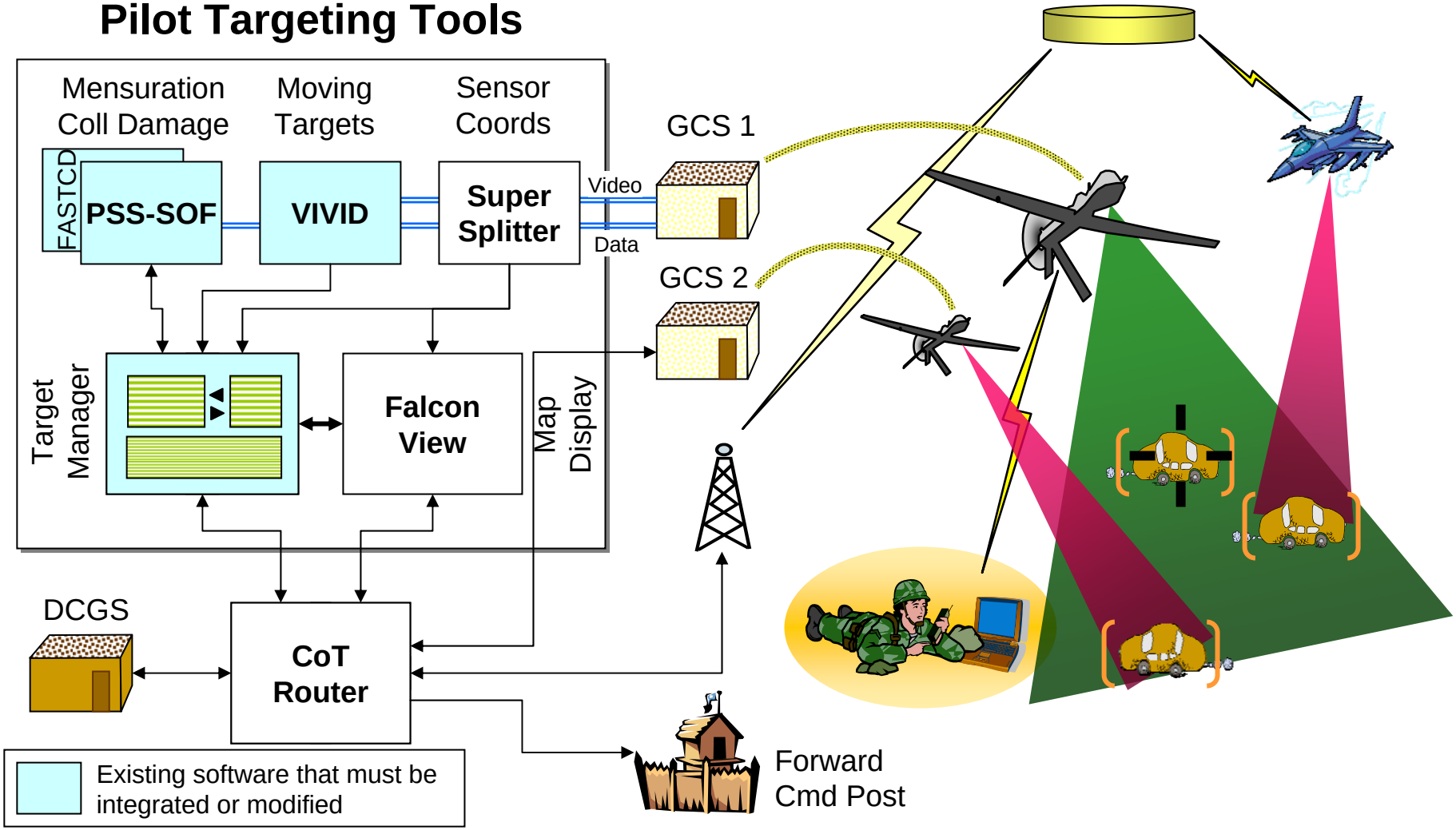
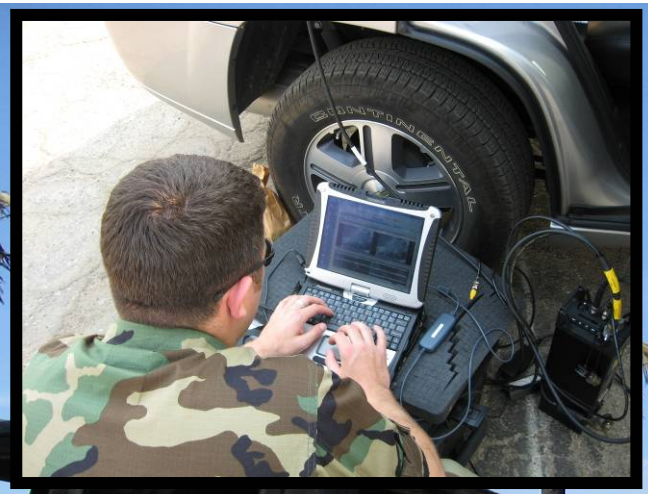
59
SNOW BIRD 1
MADON
2020
Griffville
Caldwell
Plains
Robbinsville
CFPS

Predator Reaper Integrated Targeting

Pilot Targeting Tools



ROVER & FalconView Support



A2-U ROVER Team

ROVER Video posted NORTHCOM website

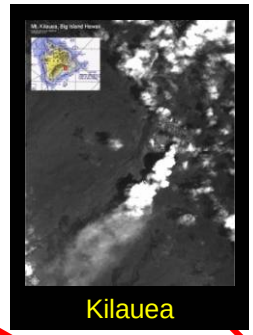
Fire Fighter (Don Green) embedded with

FalconView Training for

EV5 Worldwide Support

- Hurricane Katrina
- San Diego Fires
- Northern CA
- Fire Lines
- Big Island Fires
- Tsunami Assistance
- RP Flooding
- RP Mudslide
- US Natural Disasters
- Burma Cyclone
- Volcano

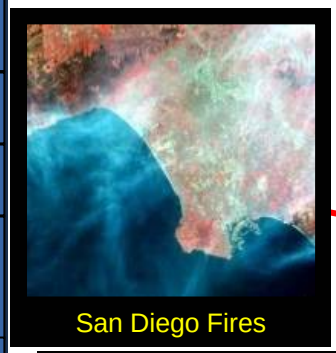

Hurricane Katrina


Kilauea

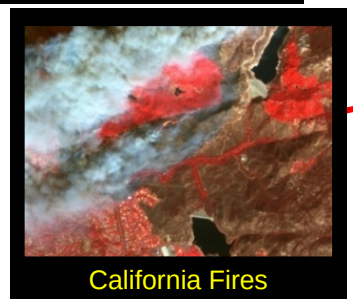

Burma

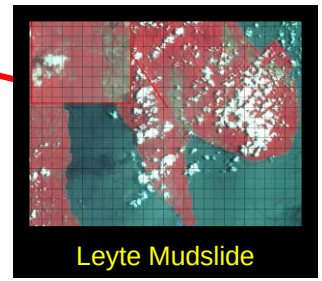

Florida Images

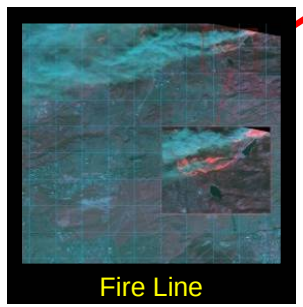

RP Mudslide


San Diego Fires

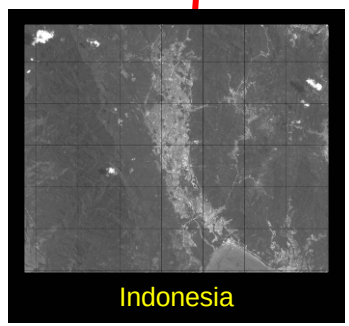
EV5

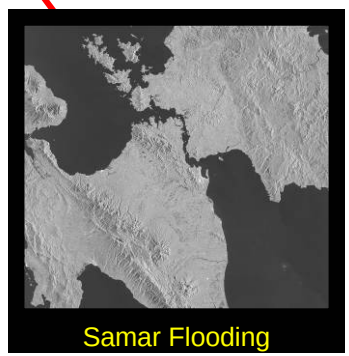

California Fires


Leyte Mudslide


Fire Line


Big Island Fires


Indonesia

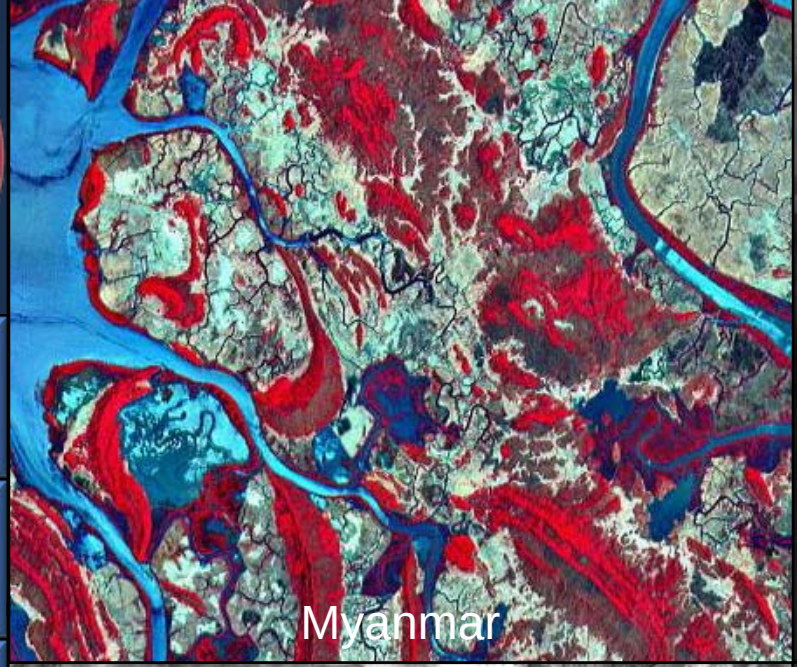

Samar Flooding

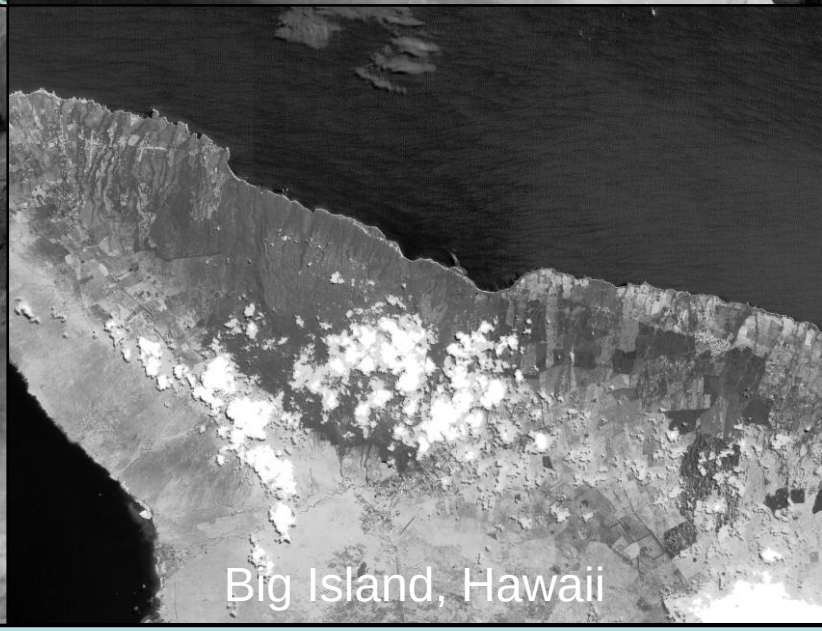
IKONOS

SPOT-5

SPOT-4

SPOT-2





Resolution: 20 meter
Revisit Time: 2-3 Days
Imagery: EO Panchromatic & Multispectral
Times: 1000-1400
License: Title 50

IKONOS

SPOT-5

SPOT-4

SPOT-2

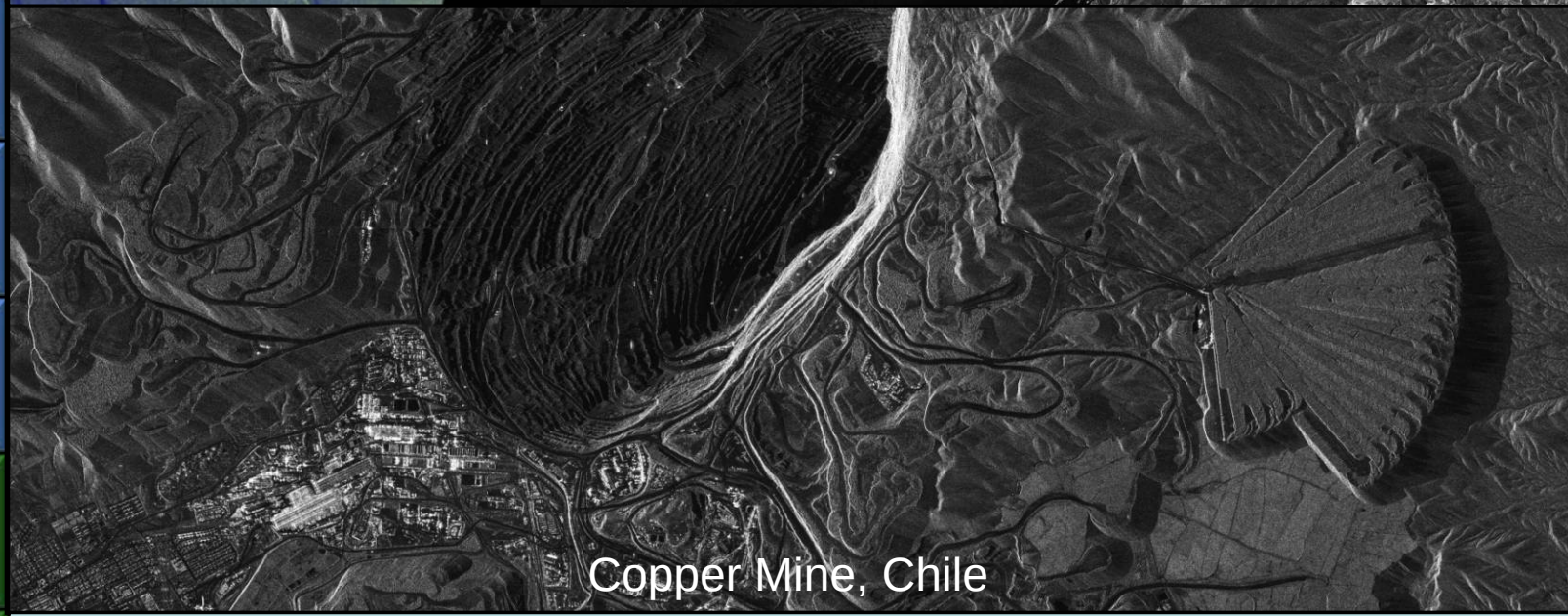
RADARSAT-1

RADARSAT-2

TerraSAR-X

Black Sea Oil Spill

Strait of Gibraltar



Copper Mine, Chile

Resolution: 1, 3, 9, 16 & 32m Imagery: Radar License: Title 50

Revisit Time: 2-3 Days Times: 0530-0730 & 1730-1930

Smithsonian NASM Dedication 23 Apr 2008

16 Sep 01 thru 25 Jul 03
Combat Sorties 196
Combat Hours 2606

1st Hellfire Test 16 Jan 01
1st Hellfire Combat Shot 07 Oct 01

USAF Way Ahead

- Support Today's Fight
  - Increase Combat CAPs
  - Increase MQ-9 Reaper Deployments
- Continue Innovation and Rapid Fielding
- Improve Full Motion Video to the Warfighter
- Improve Interoperability of Multiple Systems
- Next Generation MQ-X

A2U

Questions???

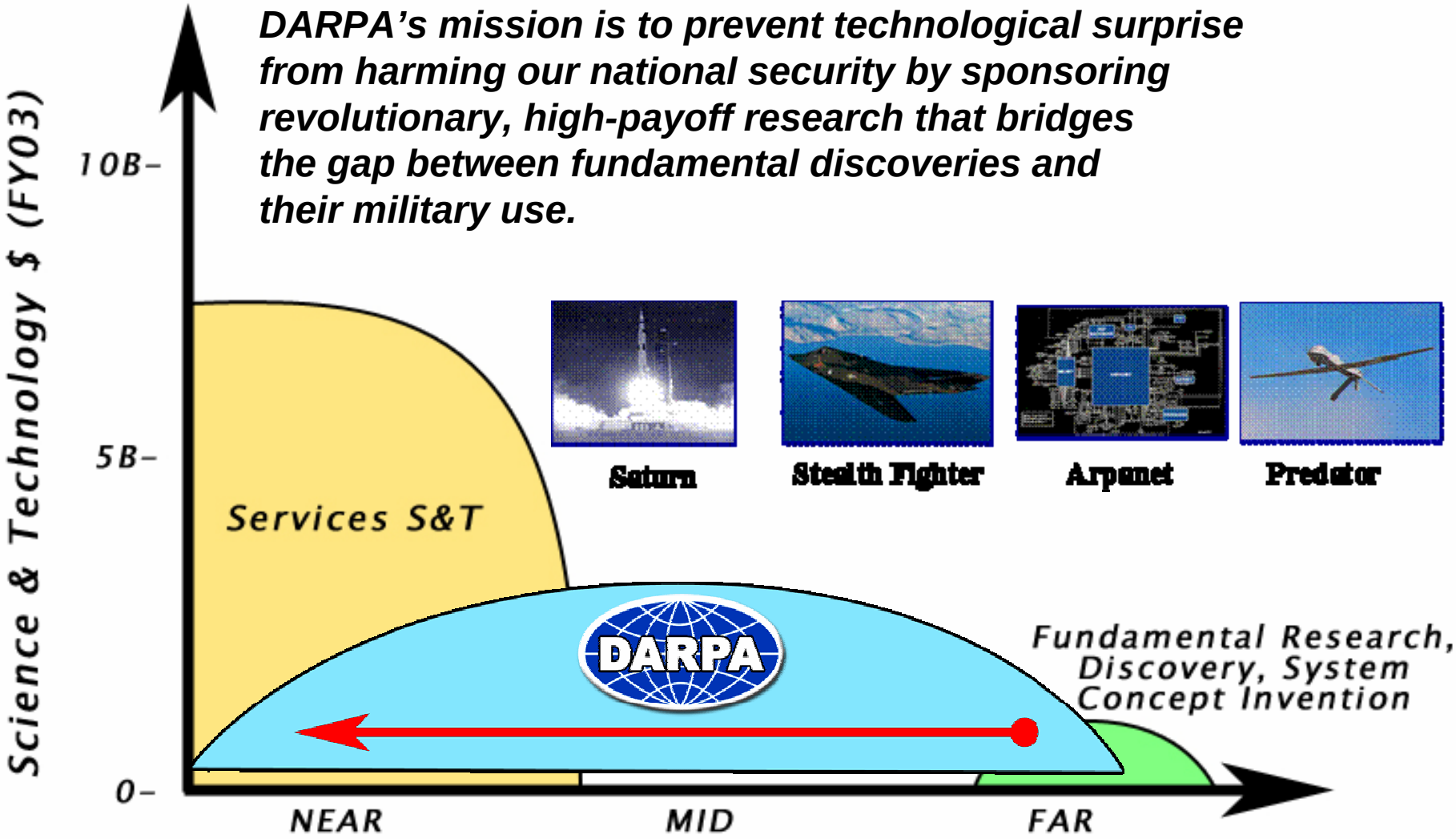
Operational Neuroscience

Intelligence Community Forum

Dr. Amy Kruse
Program Manager
DARPA/DSO
Nov 5, 2008

DARPA's Mission

DARPA's mission is to prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their military use.



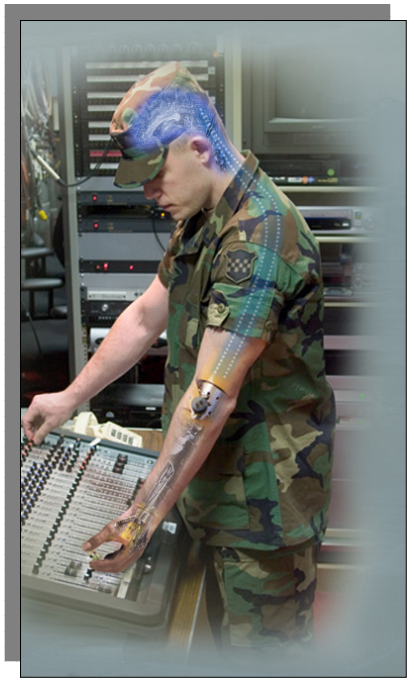
DARPA Strategic Vision

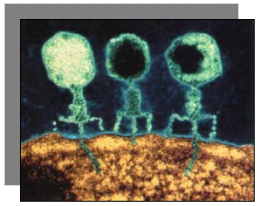
Strategic Thrusts

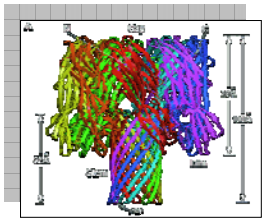
- Precision detection, tracking, and destruction of elusive targets
- Characterization of underground structures
- Urban Operations
- Networked manned & unmanned attack operations
- Assured use of space
- Cognitive systems
- **Bio-Revolution**
- Robust, secure self-forming networks

Bio-Detection

Chlorine Dioxide





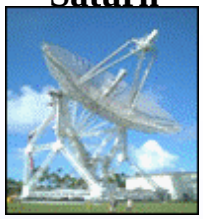


Enduring Foundations

- Materials
- Microsystems
- Information Technologies

DARPA Accomplishments

Saturn



ALTAIR

Ground Surveillance Radar

Stealth Fighter

Sea Shadow

1960

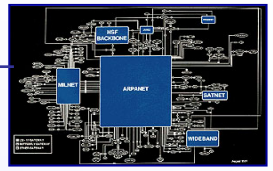
1970

1980

Vela

M-16 Rifle

ATACMS



ARPANET

JSTARS

GPS

X-45

Mobile Robots

JSF Engine

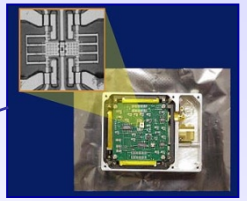
Uncooled IR

Taurus Launch Vehicle

2000

1990

Command Post of the Future



MEMS

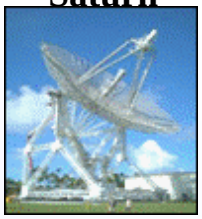
Global Hawk

Predator

BAT

DARPA Accomplishments

Saturn



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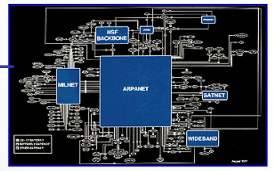

ARPANET

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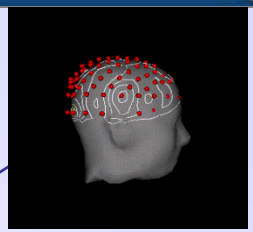
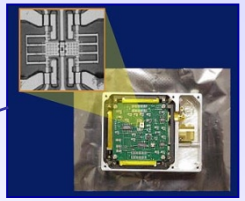


Operational Neuroscience



MEMS

Global Hawk

Predator

BAT

DARPA Technical Offices

Director, Tony Tether
Deputy Director, Bob Leheny

Tactical Technology

Dave Neyland
Steve Walker

- Air/Space/Land/Sea Platforms
- Unmanned Systems
- Space Operations
- Laser Systems
- Precision Strike

Strategic Technology

Barbara McQuiston
Larry Stotts, Brian Pierce

- Space Sensors/Structures
- Strategic & Tactical Networks
- Information Assurance
- Underground Facility Detection & Characterization
- Chem/Bio Defense
- Maritime Operations

Defense Sciences

Bob Leheny (Acting)
Leo Christodoulou

- Physical Sciences
- Materials
- Biology
- Mathematics
- Human Effectiveness
- Bio Warfare Defense

Information Processing Techniques

Chuck Morefield
Charlie Holland

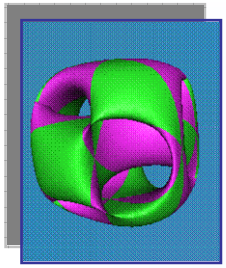
- Cognitive Systems
- Command & Control Systems
- Computer Language Translation
- High Productivity Computing
- Sensors & Processing

Microsystems Technology

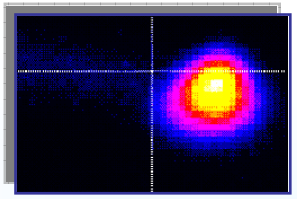
Greg Kovacs
Dean Collins

- Electronics
- Photonics
- MEMS
- Algorithms
- Integrated Microsystems

Defense Sciences Office



Topological Mathematics

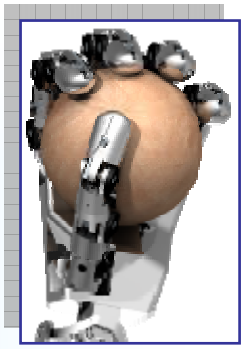


Quantum Mechanics

Zoology

Training and Simulation

Armor Systems



Revolutionizing Prosthetics

Mathematics

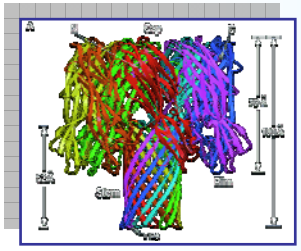
Physical Sciences

Biological Sciences

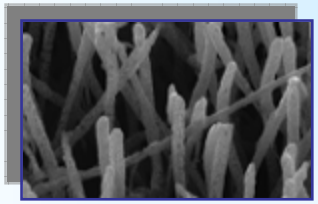
Engineering

Mine the "Far Side of the Far Side"

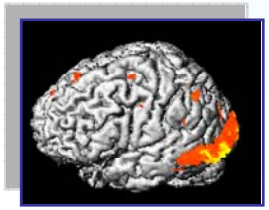
Paradigm shifts in defense capabilities



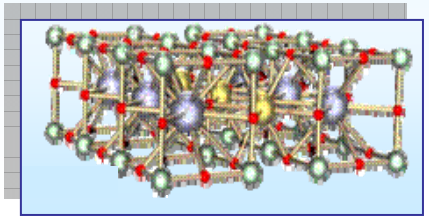
Structural Biology



Nanotechnology



Neuroscience



Solid State Physics

Fuel Cells

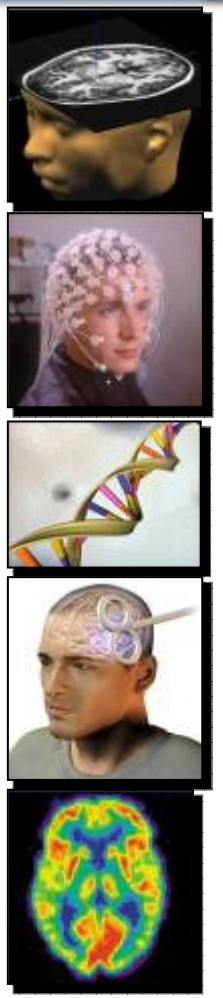
Big Dog

WASP UAV

Vaccine Manufacture

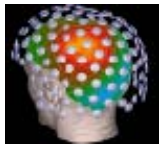
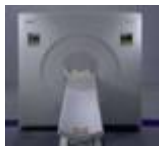
Methods to Understand Neural Basis of Human Cognition

- Brain lesions and cognitive neuropsychology
- Electrophysiological recordings in primates (mammals)
- Pharmacological and genetic studies
- Transcranial magnetic stimulation
- Functional Neuroimaging
  - Hemodynamic-metabolic methods including PET/fMRI
  - Electric-magnetic methods including ERP and MEG

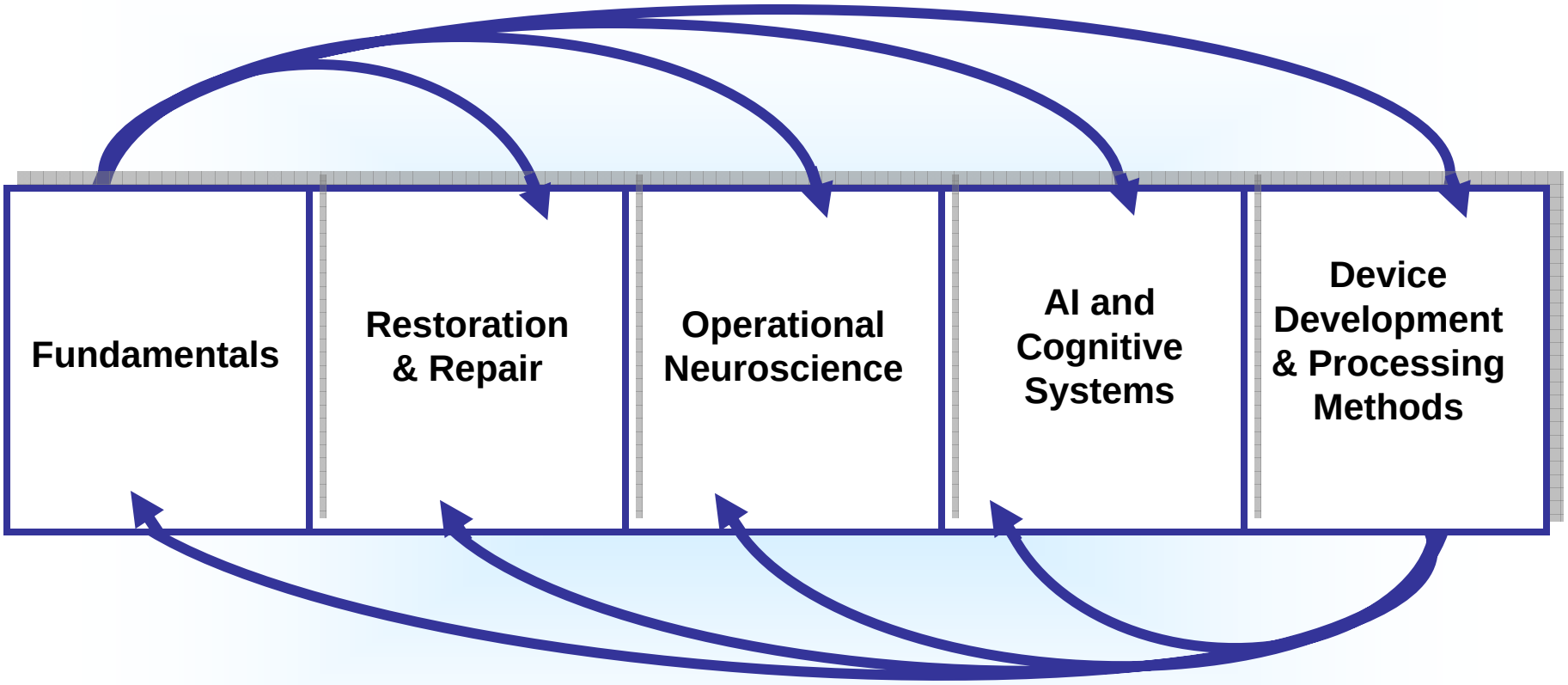


Functional neuroimaging allows the activity of all brain regions to be seen simultaneously – true network analysis is possible

Non-Invasive Sensor Technologies

Technology		Temporal Resolution	Latency	Spatial Resolution	Description	Operationally Feasible?
	EEG	ms	ms	cm	Measures electrical activity in the brain. Practical tool for applications - real time monitoring or brain-computer-interface.	Yes
	MEG	ms	ms	mm	Measures magnetic fields generated as a result of the brain's electrical activity. Research tool for investigating temporal properties of neuronal and cognitive processes.	**No**
	fMRI	s	min	mm	Measures the BOLD signal in neuronal tissue – oxygen uptake. Excellent structural localization of brain function. Important tool for foundational cognition research.	**No**
	PET	min	h	mm	Measures uptake of specially tagged molecules (e.g. glucose) in brain tissue following stimulus. Excellent spatial localization, poor temporally.	**No**
	fNIR	ms	ms	mm	Measures the ratio of oxygenation in cortical regions using near infrared light. Permits spatial and temporal measurements from the same volume of brain tissue.	Yes

My Vision of Neuroscience



Operational Neuroscience

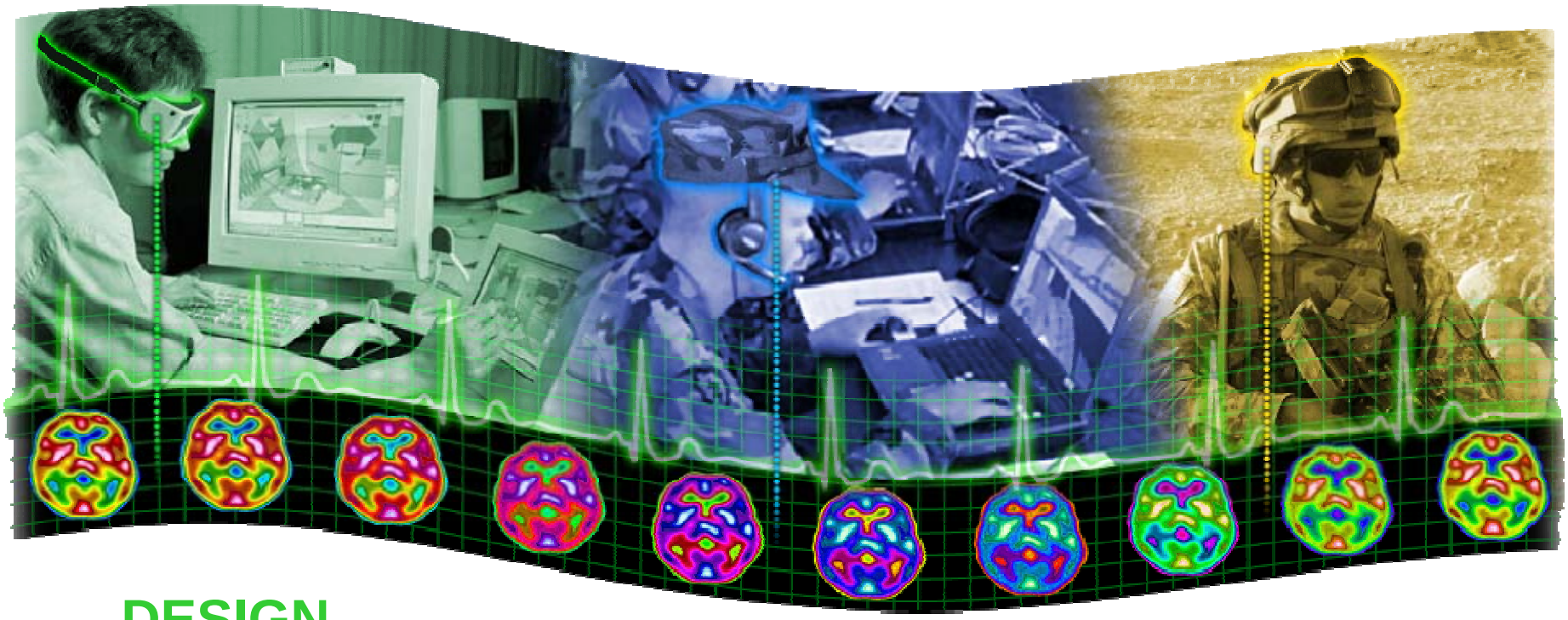
Brain activity can be monitored in real-time in operational environments with EEG

Desktop sleep deprivation assessment in desert stations

Dismounted training exercises lasting 7+ hours at a time

Images Courtesy of Honeywell, Aberdeen Test Center, and Advanced Brain Monitoring Inc.

Operational Neuroscience



DESIGN

TRAIN

OPS


dobro Jutro
Ciao
la Orana
Merhaba
Sabbah-el-Khair
Olá
Bonjour
Hello
Ni hao
ACCELERATED LEARNING

Program Vision

- Utilize neuroscience to understand the development of expertise through learning
- Use this understanding to directly facilitate and accelerate task learning for the warfighter

- Learning is a continuous challenge in the operational environment
- Current methods of learning fail to capitalize on basic lessons from neuroscience
- Measures of learning on key skills only as good as *qualitative and subjective* assessments

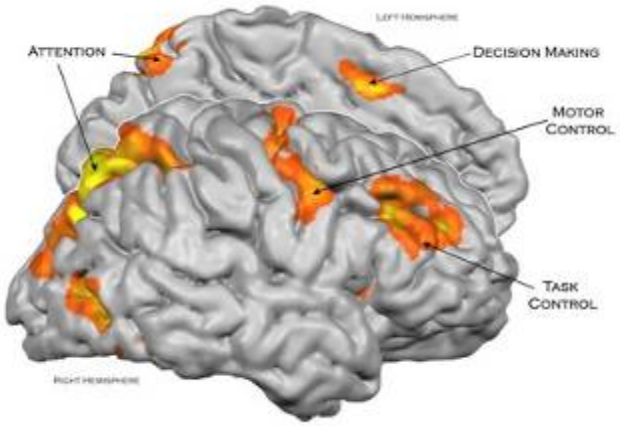
Using a neuroscience based approach, change the paradigm of learning in the military

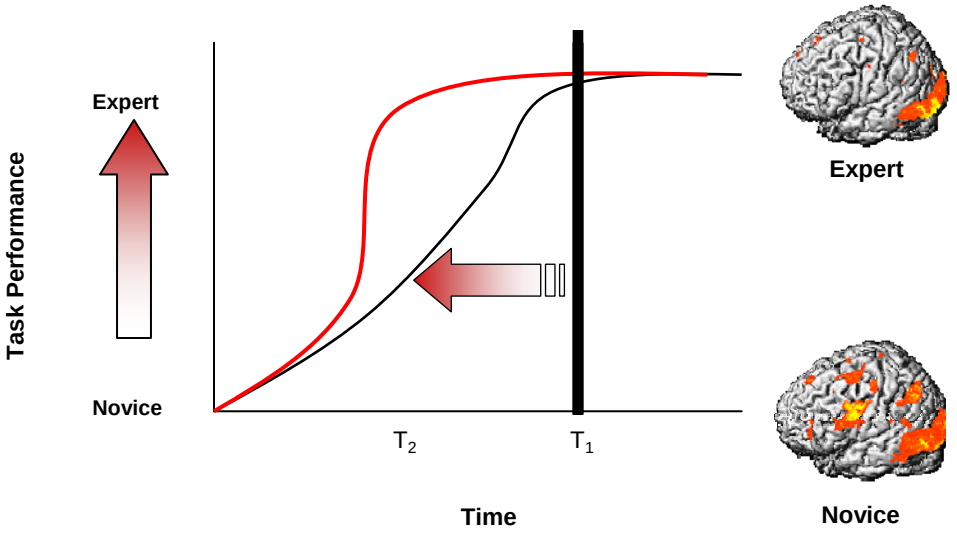
Phase I Goals

Utilize neuroscience to understand the development of expertise through learning to directly facilitate and accelerate task learning for the warfighter

Program Goals:

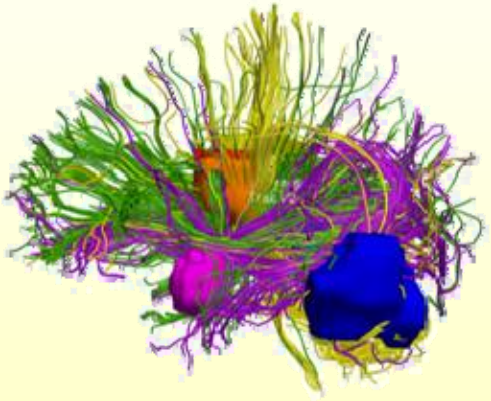
- **Identify the neural basis of expert performance**
- **Track progression from novice to expert with classification of intermediary stages**
- **Demonstrate a two-fold increase in the progression between stages of the novice-to-expert path**

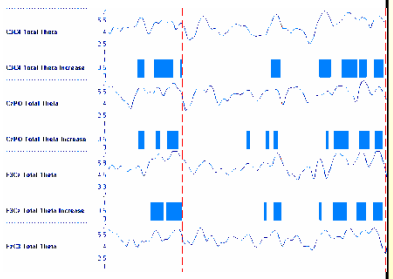


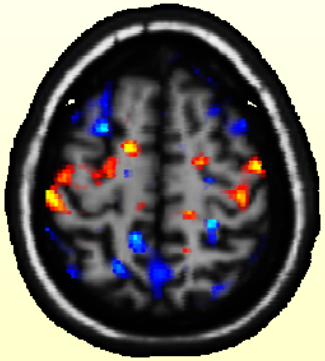


Phase I Approaches

Optimized Task Qualities	Neurofeedback	Global Network Measures	Direct Stimulation
• Apply multiple biological and cognitive findings about the user to customize the learning environment	• Present the user with real-time feedback on brainwave activity in the form of a haptic feedback during training	• Determine and facilitate the neural mechanisms of consolidation (declarative and procedural memory, attention networks, memory chunking)	• Utilize techniques such as tDCS in combination with functional imaging to directly stimulate neural pathways critical for learning





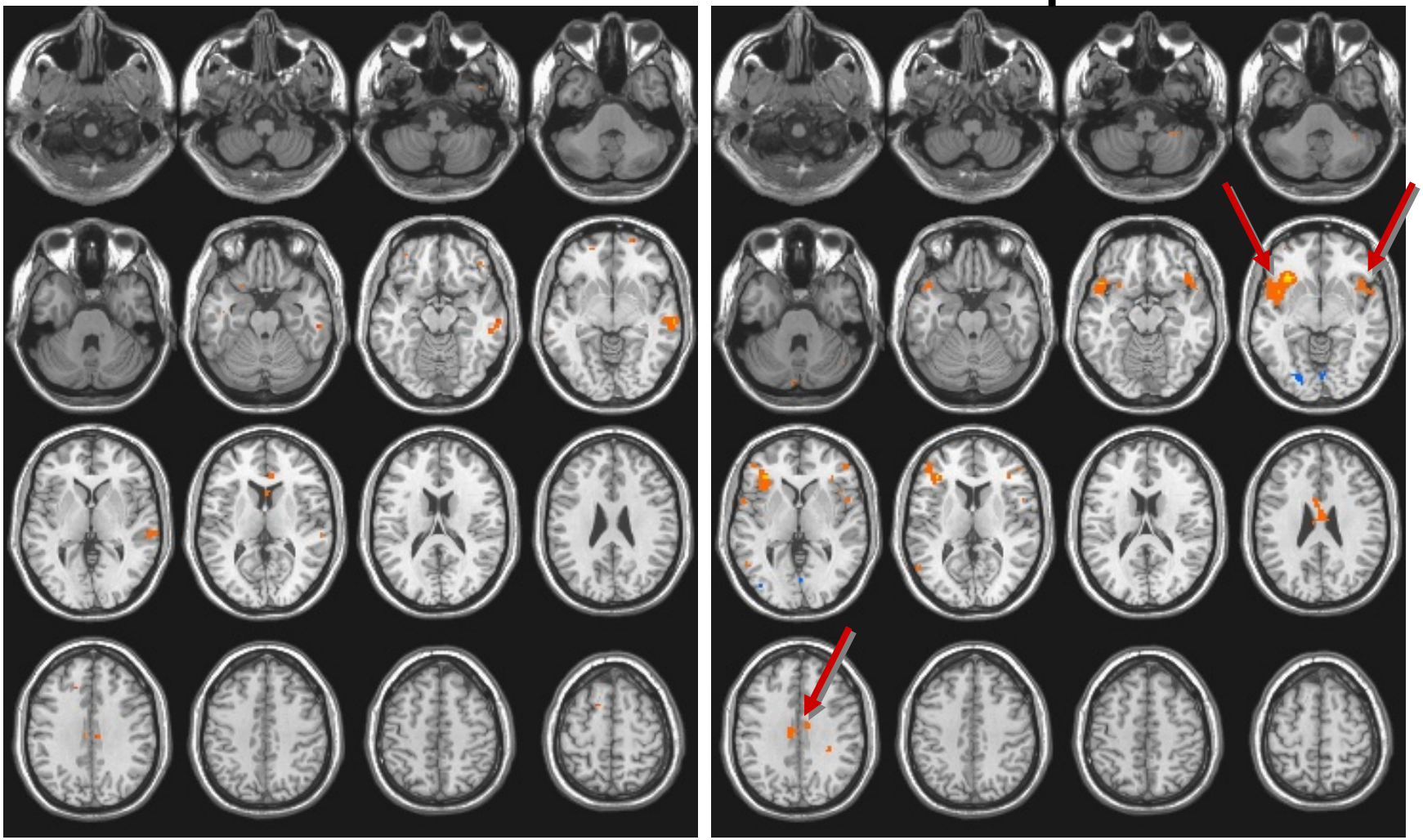


Innovation

Accomplishment: fMRI Signatures of Novice Vs. Expert Behavior

Threat - Nonthreat Stimuli

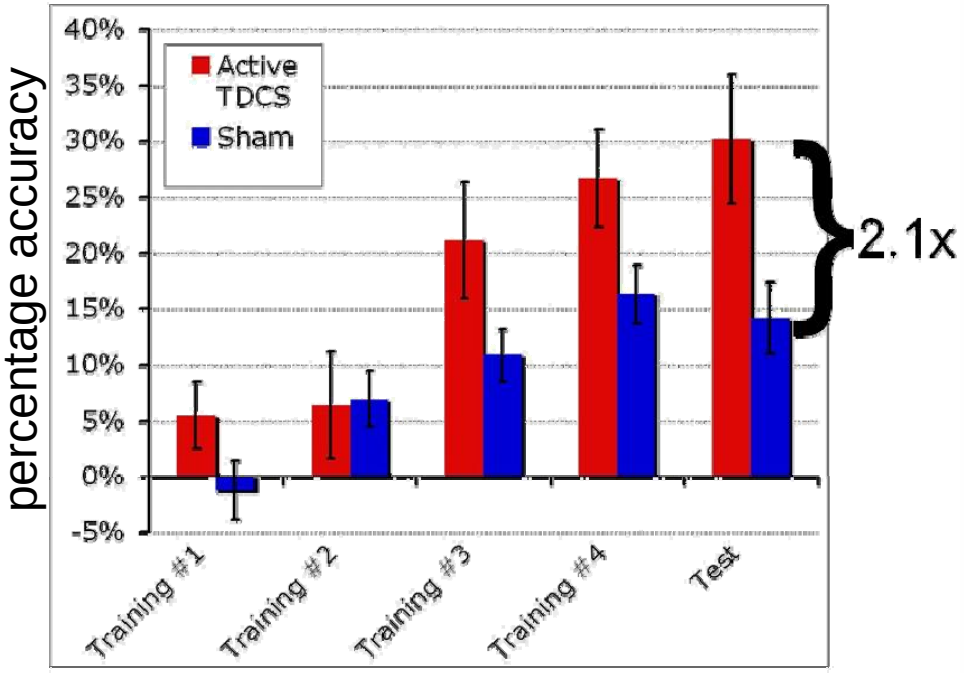
Novice | **Expert**



Accomplishment: Direct Stimulation leads to 2x Improvement

tDCS stimulation applied to the right sphenoid (right temple) at 2 milliamps for 30 minutes provides an improvement in learning vs. sham in threat detection training

- 2.1x improvement (p=0.0093) in threat and non-threat detection accuracy
- 3.1x improvement for threats alone (p=0.0004)




NEUROTECHNOLOGY FOR INTELLIGENCE ANALYSTS
NIA

Problem: Imagery Overload

Operational Challenges

- Collections capabilities are increasing
  - Quantity
  - Modality
- Exploitation can require manual search through terabytes of overhead imagery

Resources

- Current brute-force method (Broad Area Search) is time- and labor-intensive
- Machine vision and ATR have not matched the detection sensitivity and flexibility of the human visual system
- Exploitation requires manually searching through ***terabytes*** of overhead imagery

Credit: nps.navy.mil

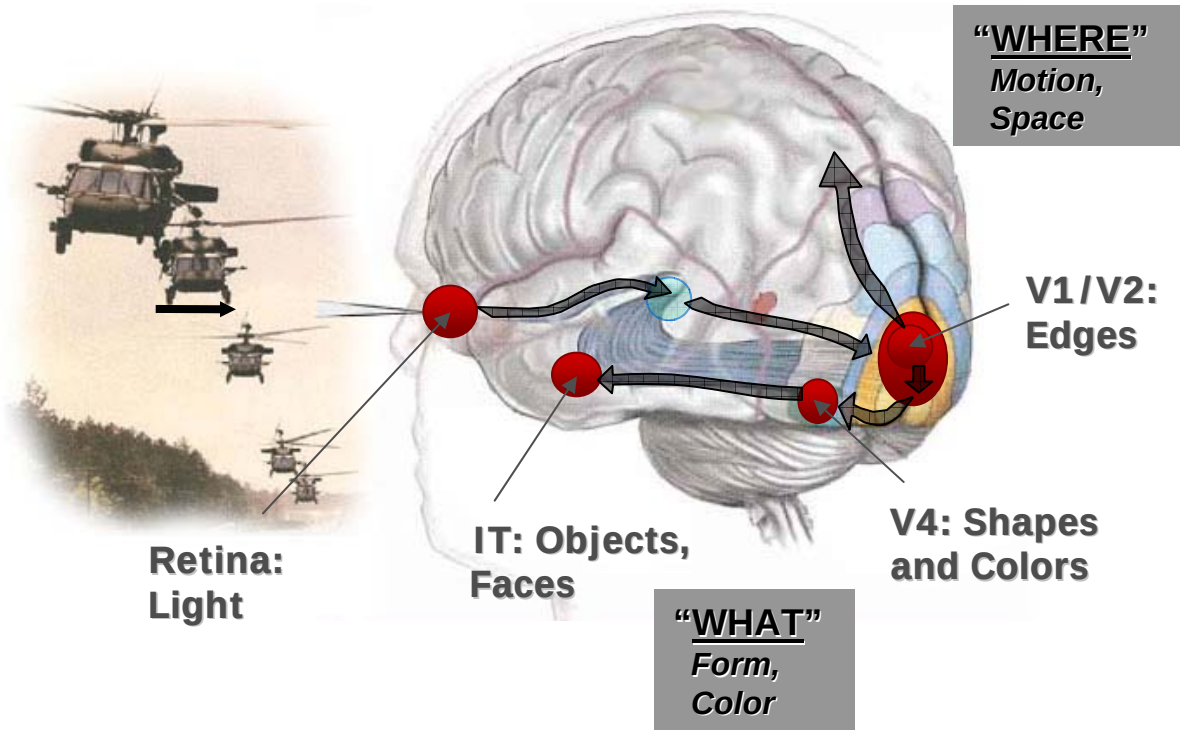
Credit: schreiver.af.mil

Result: Strategic analytical requirement exceeds available and foreseeable resources

One Solution: Leverage Human Perception

Human vision is fast, accurate and robust to changes

- **Speed: Earliest brain visual responses are <250 msec**
- **Accuracy: Human detection rate can be >>99%**
- **Robustness: Detection persists across a wide range of conditions**

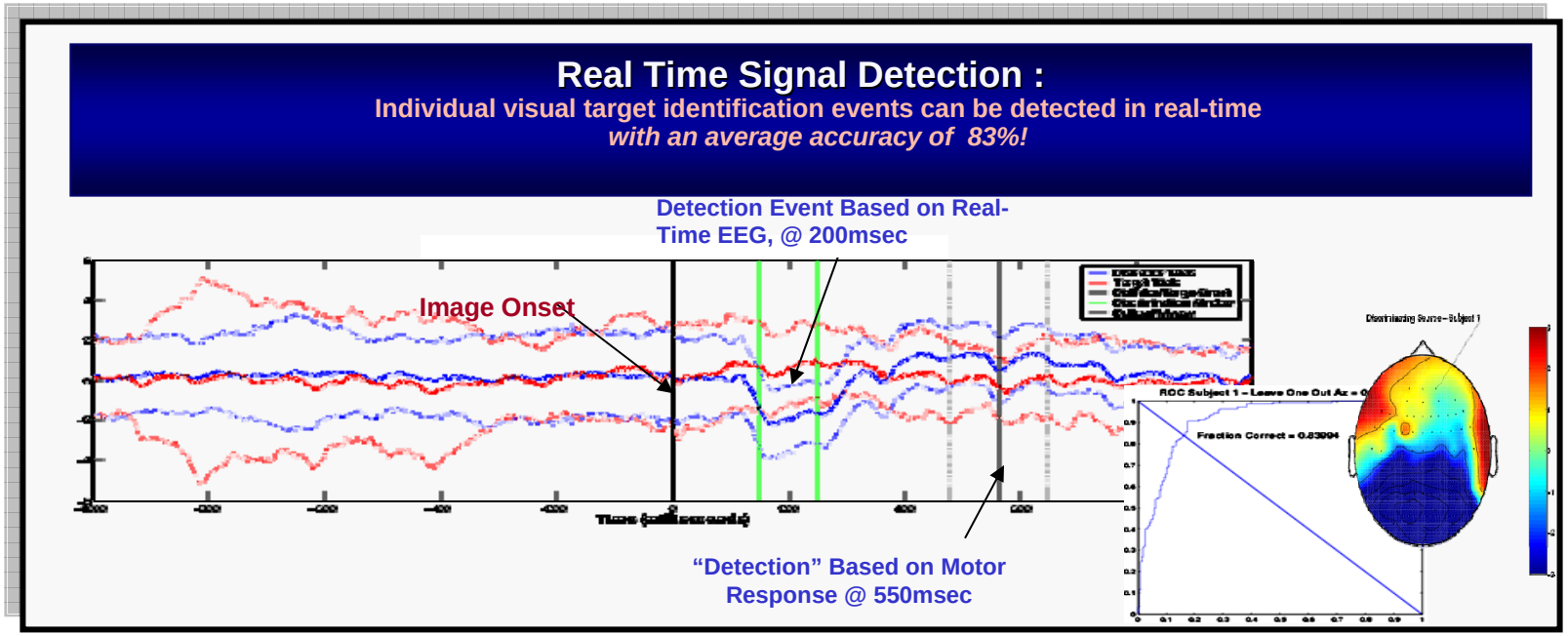


NIA Solution: Brain-assisted exploitation – but how?

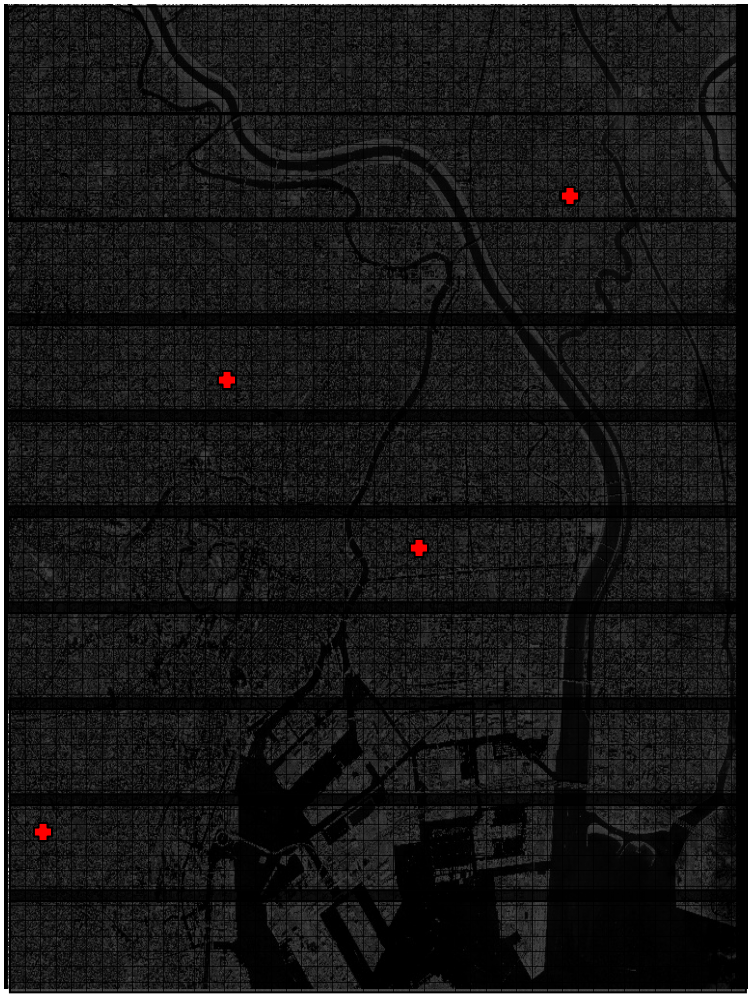
Science Behind NIA

Basic Science: Human visual detection events can be identified in EEG

- EEG signatures during Rapid Serial Visual Presentation
- Brain events can be detected in one-third of the time needed to press a button (Thorpe et al, Nature, 1996)
- Signature in neurophysiological recordings demonstrates detection of target images for presentation rates of up to 72 images/sec (Keysers et al, JCN, 2001)
- Demonstrated with faces, natural scenes, multiple presentations



Experimental Approach: Baseline



Credit: DigitalGlobe

= analyst indicated target during search

Baseline (Broad Area Search) Task Example:

Total Area (urban, riverine, maritime) = 314.86 km^2

Targets: Helipads

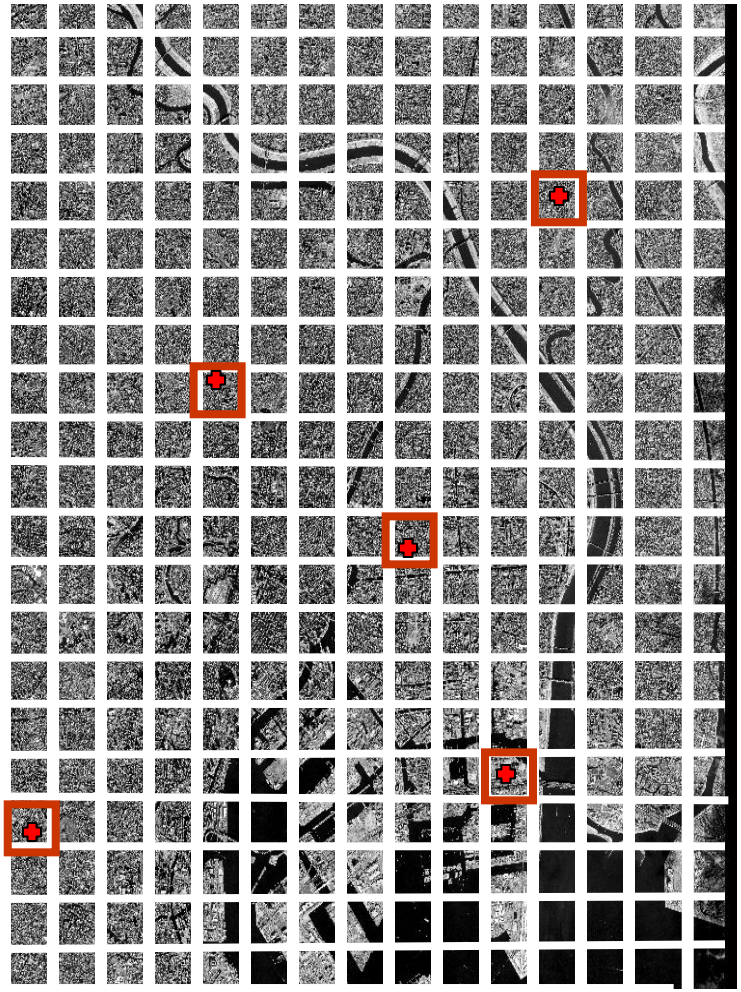
Imagery Analysts were instructed to exploit the full scene manually in a geospatial software environment and to mark a defined target.

Exploitation was self-paced and analysts were allowed to search the image until satisfied all targets had been located.

Analyst-marked target set was compared to ground truth (by 2 or more IAs) for sensitivity calculation.

Estimated search time for trained IA: 135 minutes

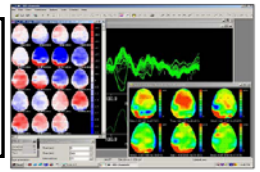
Experimental Approach: NIA Triage



= targets indicated via neural signals during triage

All images: Credit: DigitalGlobe

IA with neurophysiological sensors for image chip viewing (prototype display)

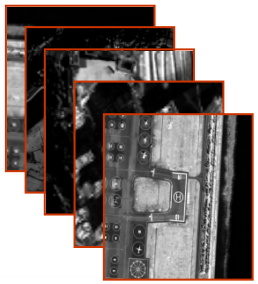


Full scenes were chipped into 512 pixels^2 (e.g. 3300 chips for 314.86 km^2 total area)

Chips were at a magnification suitable for exploitation (1:1) but sized to minimize eye movements during triage

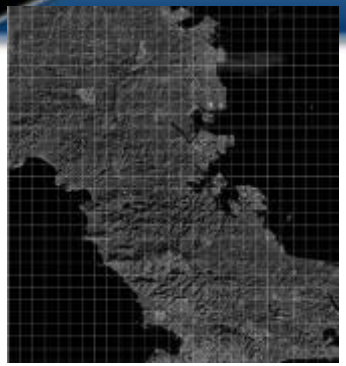
All chips were displayed rapidly (5-12 Hz) to IA. Neural signals were collected and classified in real time for target or non target properties

Triage mode time (10 Hz, including breaks): ~10 minutes



Chips with high target probability given by neural signal are marked and compared to truthed data for sensitivity assessment

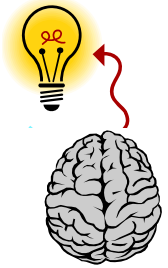
Phase I Results



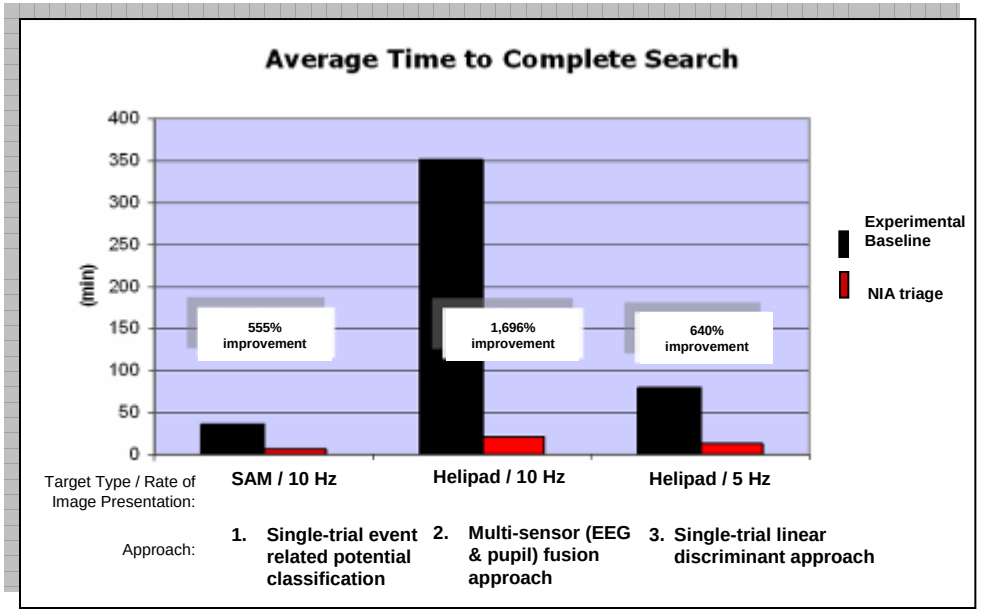
Original image tens of thousands of pixels wide and tall

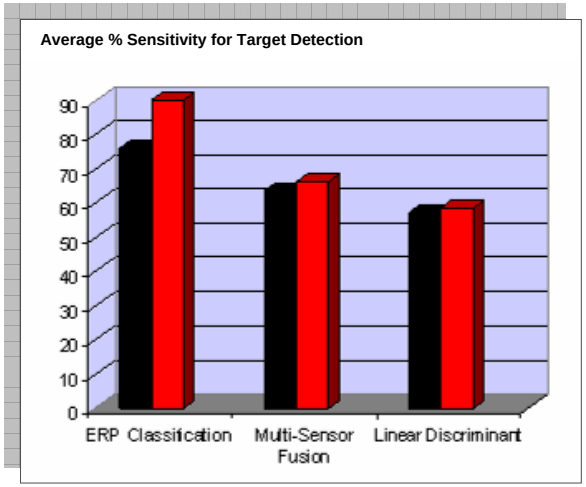
Decompose into chips few hundred pixels wide and tall

Present chips to users in high speed bursts (10 chips a second)



Evaluate neural activity to identify likely targets





Result: >300% throughput improvement and detection equal or better than current SOA

NIA Phase 2 Vision

Phase 2 Goal

Integrate modern neuroscientific techniques into imagery analysis workflow to improve throughput and quality of imagery analysis

Phase 2 Metrics

- Maintain 300% throughput increase in imagery exploitation in a realistic analyst software/hardware environment.
- Demonstrate greater than or equal to unassisted image analyst sensitivity.
- Maintain performance across 3 complex target classes and under variable operating conditions.

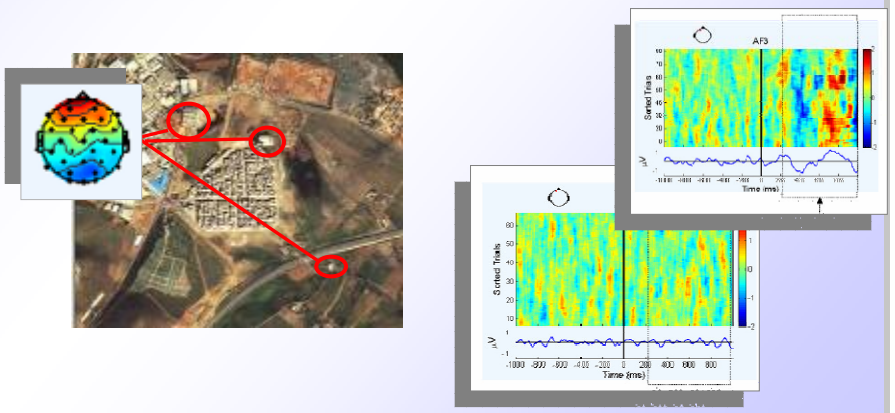
Phase 2 Technical Challenges

- Capture brain signals in real time during realistic imagery analysis on baseline imagery exploitation systems
- Categorize target detection brain signals based on object / scene complexity
- Integrate neuromorphic computational image analysis and physiological brain signals

Phase 2 Applied Science

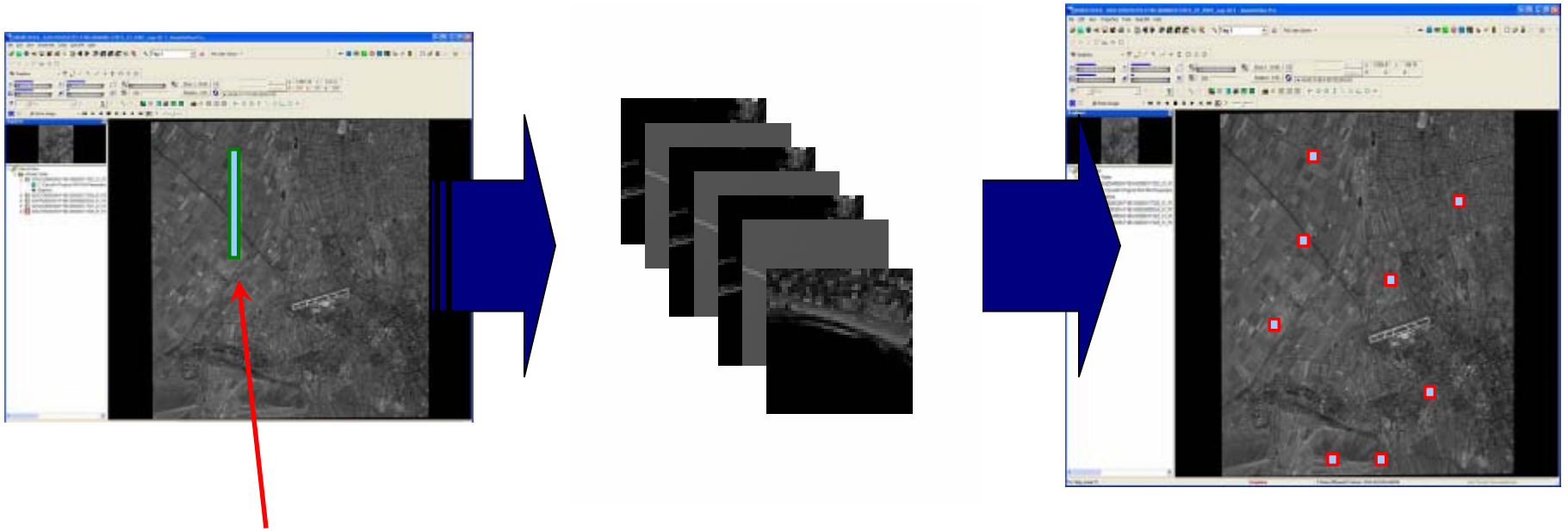
Apply Phase 1 breakthrough science in operational contexts

- **Extend capture of brain signals for target detection to:**
  - **Multiple imagery types**
  - **Diverse target and scene complexity**
- **Integrate brain-assisted search into standard imagery analysis software**
- **Leverage/converge with automated machine vision technologies**
- **Demonstrate with trained analysts with realistic tasks and environment**



Accomplishment: Remoteview Integration

Triage integration approach maintains context before RSVP and during verification



Triage Preview

RSVP Triage

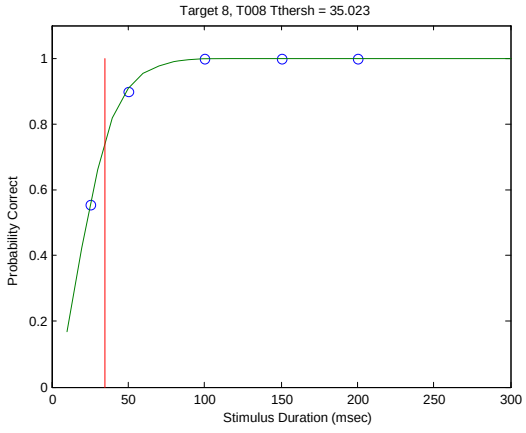
Post-Triage Review

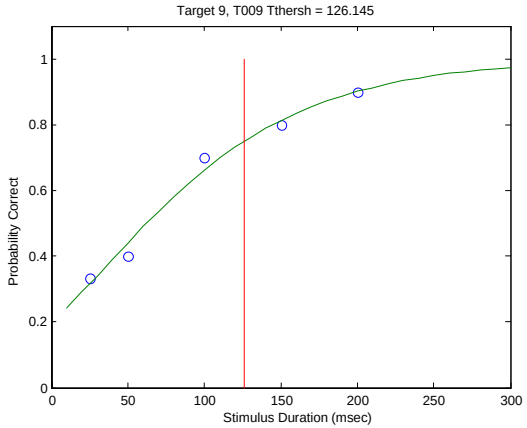
Credit: DigitalGlobe

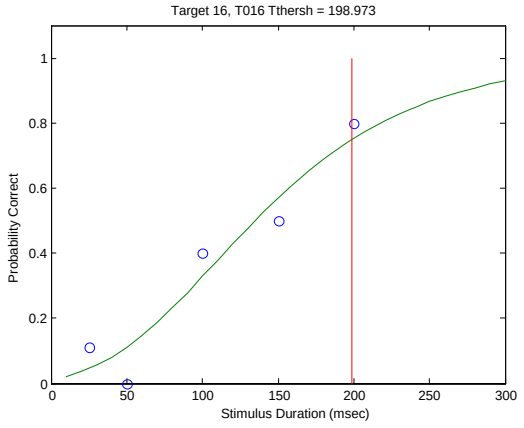
Analysts maintain “global view” before triage begins, and can “fly to” any target hit results during post-triage exploitation

Accomplishment: Uncovering impact of image complexity

As targets become less stereotypical, the image stimulus duration necessary for correct detection increases

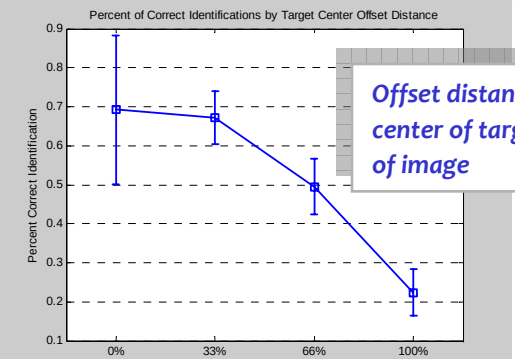




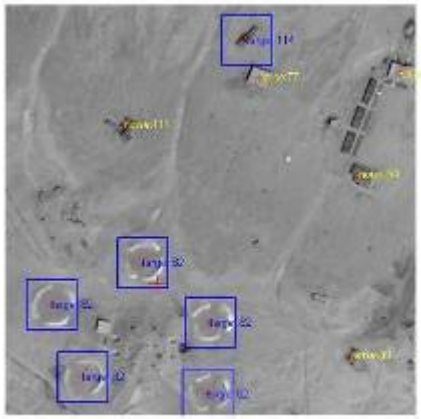


Credit: DigitalGlobe

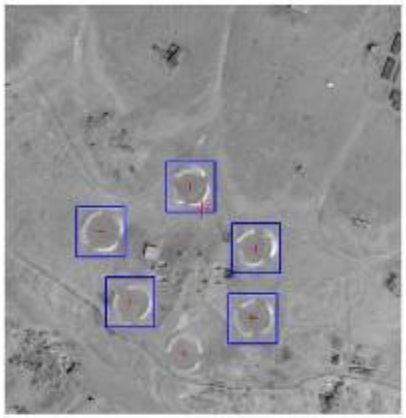
Accomplishment: Computer vision enables target centering enhancing detection



Human detection performance is weaker when targets are off-center



Result of default chipping



Result of computer vision aided chipping

- **Computer vision techniques identify objects that share features with target of interest**
- **Small adjustments are made so that chipped images place likely targets at center of each chip**
- **Approach employed simple features (edges, intensity, spatial filter responses etc.) that are easy to implement and relevant across target types**
- **All targets in validation set were better centered**

Credit: DigitalGlobe

Examples of New Target Types

Military Facility

Naval Order of Battle

Credit: DigitalGlobe

Credit: DigitalGlobe

POL Storage

Cargo Ships

CT2WS

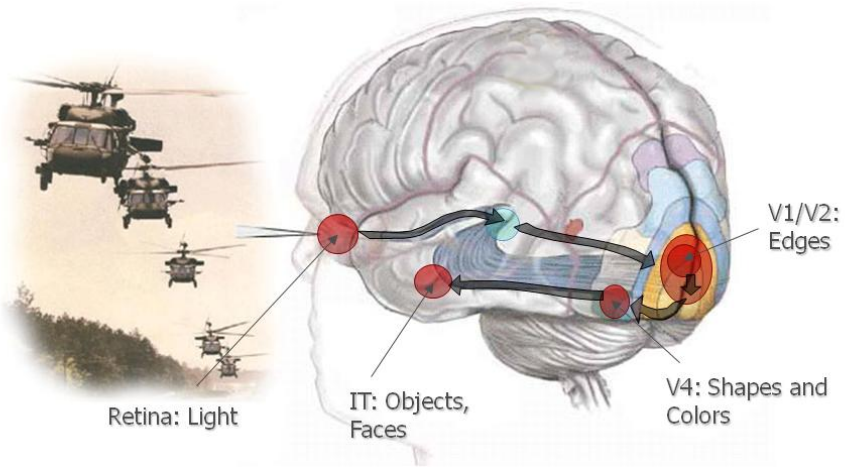
Cognitive Technology Threat Warning System

Problem: Situational Awareness

How can we take advantage of what we know about the mammalian visual system?

Operational Need for Ground-Based Persistent Situational Awareness

Current manual method is slow, imprecise and distance-limited



Using visual science knowledge how can we provide a tactical advantage to the warfighter?

- -Visual Pathways
- -Neural Signatures
- -Object Recognition and Classification

CT2WS aims to provide reliable early warning
= More options, greater sphere of influence

DEFENSE SCIENCES OFFICE

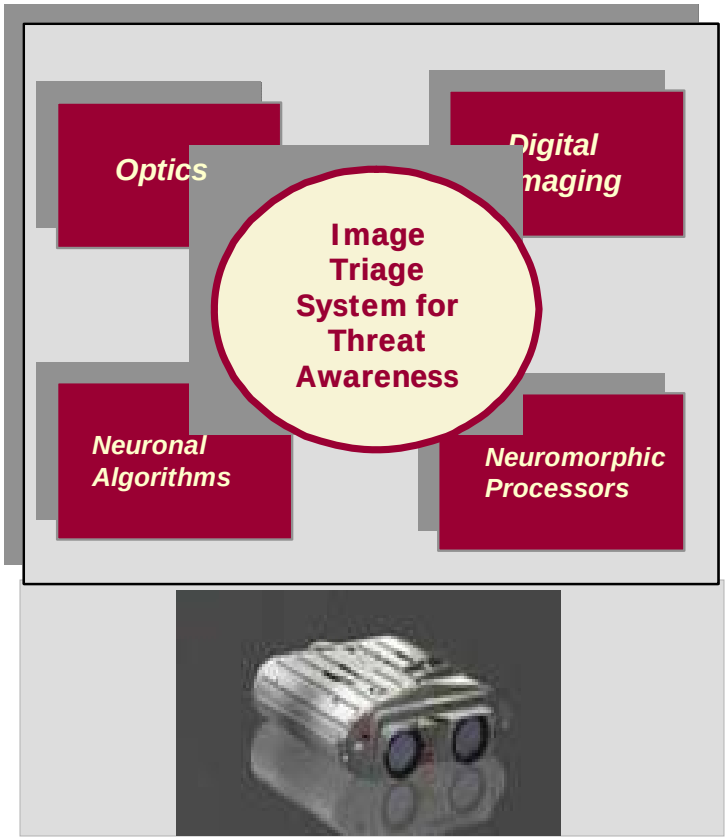
Cognitive Technology Threat Warning System

***Goal**: Tactical device which incorporates fusion of actual and simulated neural processing in real time to detect threats*

Current: 1000-2000 m

Current (M22): 9° 22'

CT2WS: 1000-10000 m



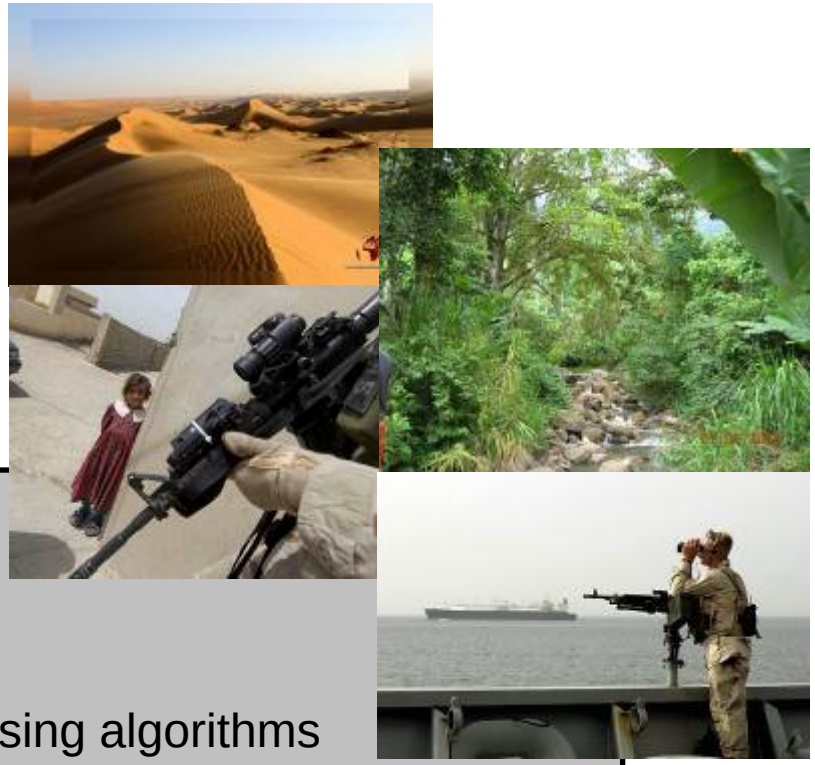
CT2WS: 120° FOV

DEFENSE SCIENCES OFFICE

CT2WS Objectives

Detection Requirements

- Walking dismounts: 1 Km
- Stationary vehicles: 5 Km
- Moving vehicles: 10 Km
- FOV: 120°



Technologies

- Optics: Flat-field, wide-angle
- Imagers: High pixel-count, digital
- Image Algorithms: Cognitive visual processing algorithms
- Neurally-based target detection signatures → Brain in the loop
- Electronics: Ultra-low power analog-digital hybrid signal processing

Metric: Pd ≥ .98, False Alarm Rate < 10 in less than 5 min.

Scene Triage: ***Objects of Interest*** rapidly detected and presented to operator for discrimination

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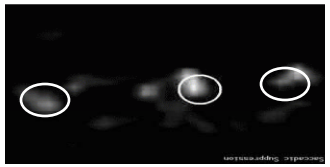
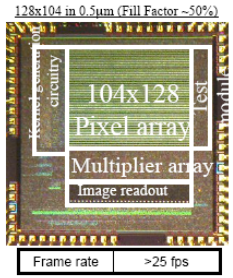
Implementation Concept

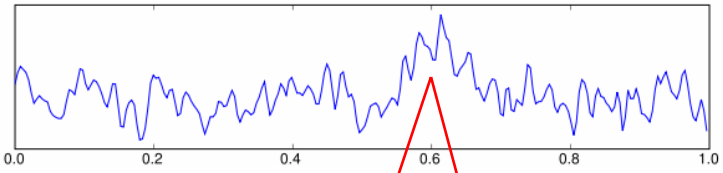


Cognitive algorithms scan ROI to give preliminary potential target information



Neuromorphic processors provide a platform for algorithms to run with maximum efficiency

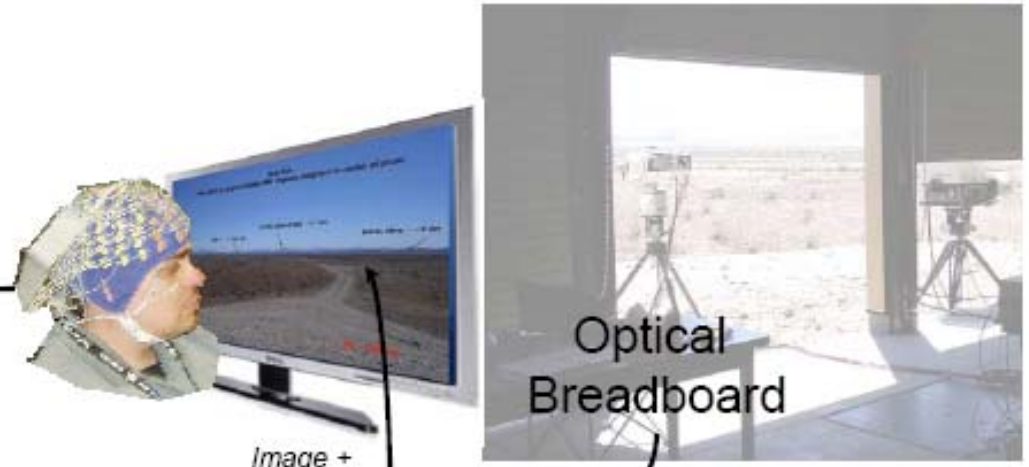
EEG coupled technology rapidly presents potential targets to user allowing neural signal classification of target/nontarget

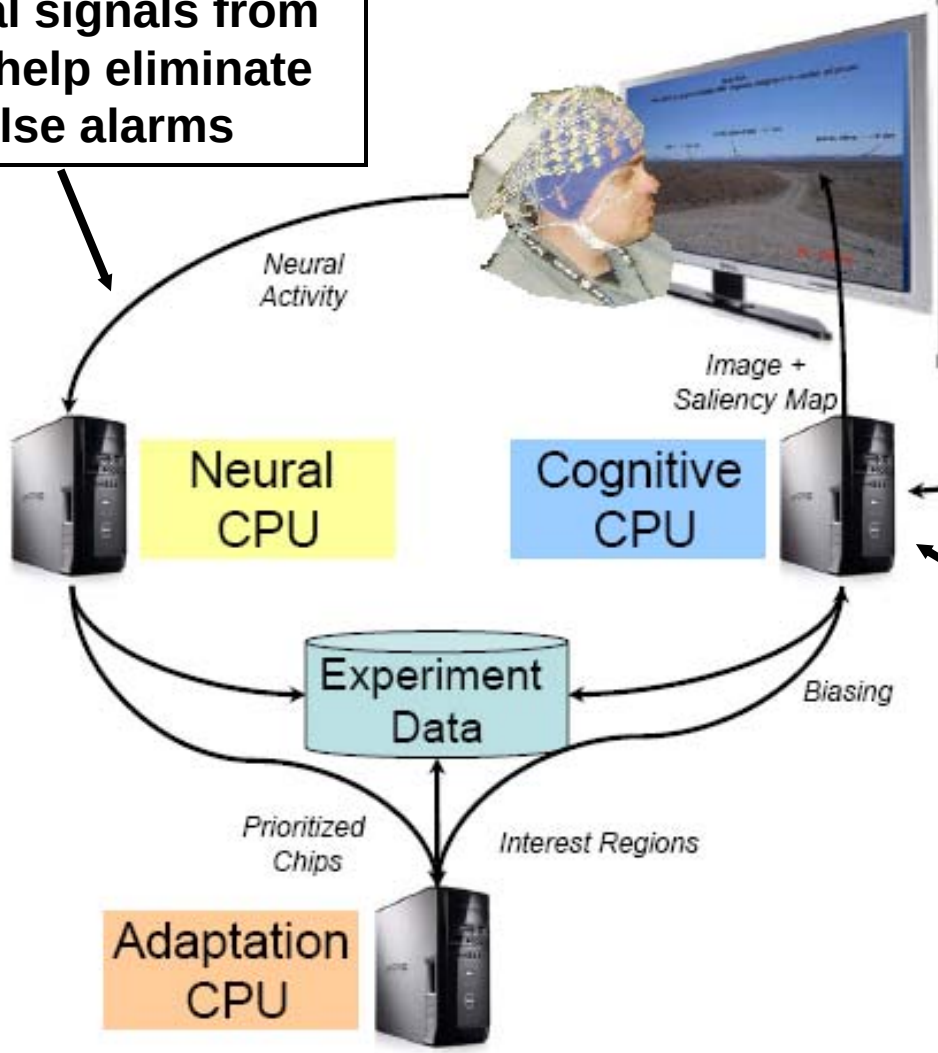


Algorithms can learn from the human, in real-time, to separate real targets from distractors, enhancing the overall utility of the system

Field Test Breadboard Concept

Neural signals from EEG help eliminate false alarms





Cognitive algorithms run on image data – high detection rates, high false alarm rates

Data Collection and Field Test Locations

- **Data Collected from Test Sites**
  - YPG
    - 87 hours of daytime data
    - 15 hours of nighttime data
  - Hawaii
    - 100 hours of daytime data
    - 12 hours of nighttime data
- **Current performers in the field THIS week testing initial systems components**

Questions?

Ideas?

Where might you apply Neuroscience to future problems of interest to IC/DoD?

Intelligence Advanced Research Projects Activity (IARPA)

Dr. Lisa Porter
Director, IARPA

5 November 2008

This briefing is UNCLASSIFIED

Overview

The IC needs a way to sponsor high-risk/high-payoff research that has the potential to provide the U.S. with an overwhelming intelligence advantage over our future adversaries

- This is about taking real risk.
  - This is NOT about “quick wins”, “low-hanging fruit”, “sure things”, etc.
- Failure is completely acceptable as long as …
  - It is not due to failure to maintain technical and programmatic integrity
  - Results are fully documented
- Best and brightest.
  - Competitive awards and world-class PMs.
  - Every IARPA program will start with a good idea and a good person to lead it. Without both, IARPA will not start a program.
- Cross-community focus.
  - Address cross-agency challenges
  - Leverage agency expertise (both operational and R&D)
  - Work transition strategies and plans

The “Heilmeier Questions”

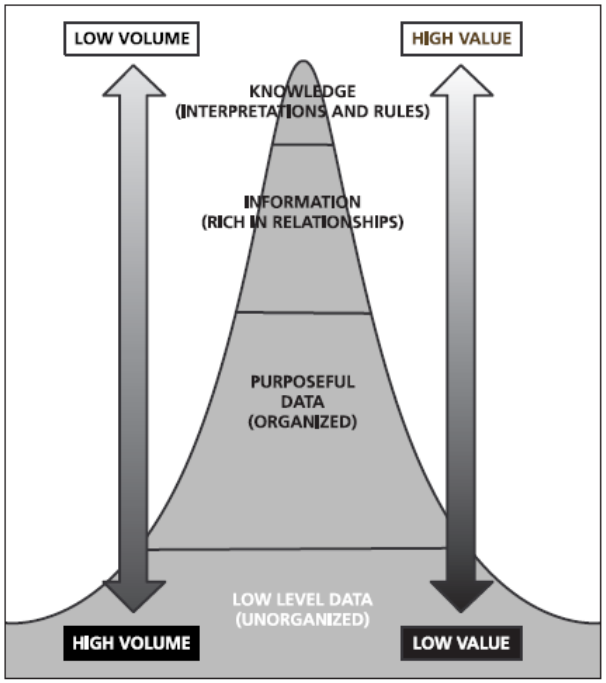
1. What are you trying to do?
2. How does this get done at present? Who does it? What are the limitations of the present approaches?
   - Are you aware of the state-of-the-art and have you thoroughly thought through all the options?
3. What is new about your approach? Why do you think you can be successful at this time?
   - Given that you’ve provided clear answers to 1 & 2, have you created a compelling option?
   - What does first-order analysis of your approach reveal?
4. If you succeed, what difference will it make?
   - Why should we care?
5. How long will it take? How much will it cost? What are your mid-term and final exams?
   - What is your program plan? How will you measure progress? What are your milestones/metrics? What is your transition strategy?

The “P” in IARPA is very important

- Technical and programmatic excellence are required
- Each Program will have a clearly defined and measurable end-goal, typically 3-5 years out.
  - Intermediate milestones to measure progress are also required
  - Every Program has a beginning and an end
  - A new program may be started that builds upon what has been accomplished in a previous program, but that new program must compete against all other new programs
- This approach, coupled with rotational PM positions, ensures that…
  - IARPA does not “institutionalize” programs
  - Fresh ideas and perspectives are always coming in
  - Status quo is always questioned
  - Only the best ideas are pursued, and only the best performers are funded.

The Three Strategic Thrusts (Offices)

- **Smart Collection**: dramatically improve the value of collected data
  - Innovative modeling and analysis approaches to identify where to look and what to collect
  - Novel approaches to access
- **Incisive Analysis**: maximizing insight from the information we collect, in a timely fashion
  - Advanced tools and techniques that can handle large volumes of multiple and disparate sources of information
  - Innovative approaches (e.g., using virtual worlds, shared workspaces) that dramatically improve the productivity of analysts
  - Methods that incorporate socio-cultural and linguistic factors into the analytic process
- **Safe and Secure Operations**: countering new capabilities of our adversaries that could threaten our ability to operate effectively in a networked world
  - Assure the confidentiality, integrity and availability of our cyber systems
  - Quantum information science and technology



Concluding Thoughts

- Technical Excellence & Technical Truth
  - Scientific Method
  - Peer/independent review
  - Full and open competition
- We are looking for outstanding PMs.
- How to find out more about IARPA:

www.iarpa.gov

Building an Integrated Ground Architecture to Respond to Present Challenges

5 Nov 2008

Pete Rustan

INTEGRATED GROUND ENTERPRISE

- ***Vision***
  - ***To implement a fully integrated Intelligence Community ground architecture where information is virtual, assured, available on demand, and globally accessible to authorized users empowered with the tools and services necessary to generate tailored, timely, trusted and actionable intelligence products.***

- ***Mission***
  - ***To develop, deliver, and sustain a responsive, secure, interoperable, and integrated ground architecture while collaboratively providing timely, value-added, trusted information to users worldwide through innovative solutions.***

THE 1ST DECADE OF THE 21ST CENTURY

- The speed of change is phenomenal
  - In 2000 17 billion SMS messages were sent, in 2004 500 billion
  - In 1995 18,000 web sites, in 2007 106,875,138
  - In 1998 there were 0 Blackberries, in 2007 8,000,000
- Space can provide a great asymmetrical advantage
  - But the global economy and advances in space capabilities worldwide are leveling the playing field
- We must have
  - Speed (of thought as well as action)
  - Agility (no more stovepipes)
  - Scale (e.g. must be able to handle the torrent of text messages per day)

Unpredictable Growth in Mobile Communications

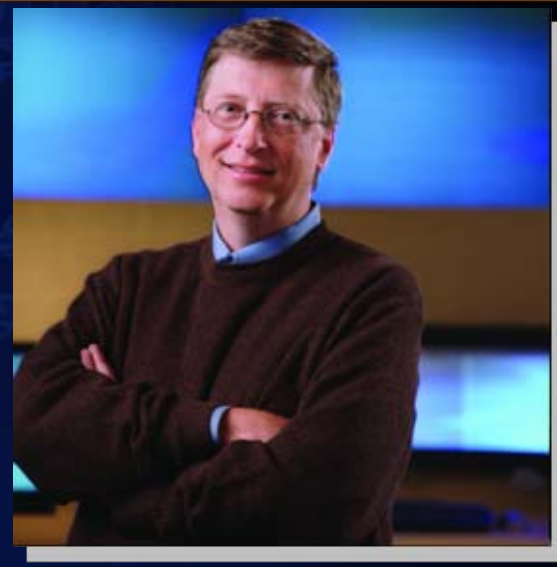
LIVING IN EXPONENTIAL TIMES

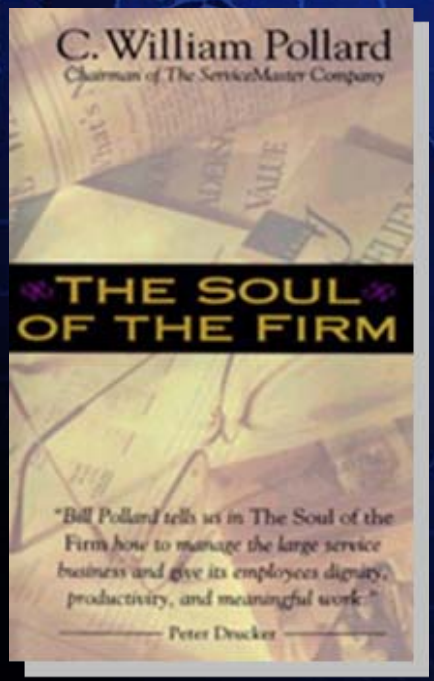
- U.S. is 20th in the world in broadband internet penetration
  - Just behind Luxembourg
- There are over 110 million MySpace users and 300,000 new users per day
- Over 2.7 billion Google searches each month
- Number of daily text messages exceeds the population of the planet
- 3rd generation fiber tested to 10 trillion bits/second on one fiber line
  - Equivalent to 1,900 CDs or 150 million phone calls every second
- 47 million laptops shipped worldwide in 2005

IT Revolution has fundamentally changed everything we do

"Never before in history has innovation offered promise of so much to so many in so short a time."

- Bill Gates





"Learning and innovation go hand in hand. The arrogance of success is to think that what you did yesterday will be sufficient for tomorrow."

- William Pollard

(U) CUSTOMER NEEDS: ACCESS

Need for Easy Access

- Problem: Users require relevant data and information that is readily available. Common, user-friendly interfaces to obtain, understand, and use intelligence—regardless of its source or type—is critical to operational success
- Solution: Post all information products and services for easy access through a single portal to authorized users

Desired Outcome: Users can access data any time, from anywhere

CUSTOMER NEEDS: CONTENT

Need for Better Content

- Problem: Users demand improved intelligence content, such as better geolocation, improved radiometric quality, and integrated data sources
- Solution: Improve the information derived from individual data types and fuse products from various collectors to provide a large number of new products and services

Desired Outcome: Users receive new types of information products and services to generate actionable intelligence

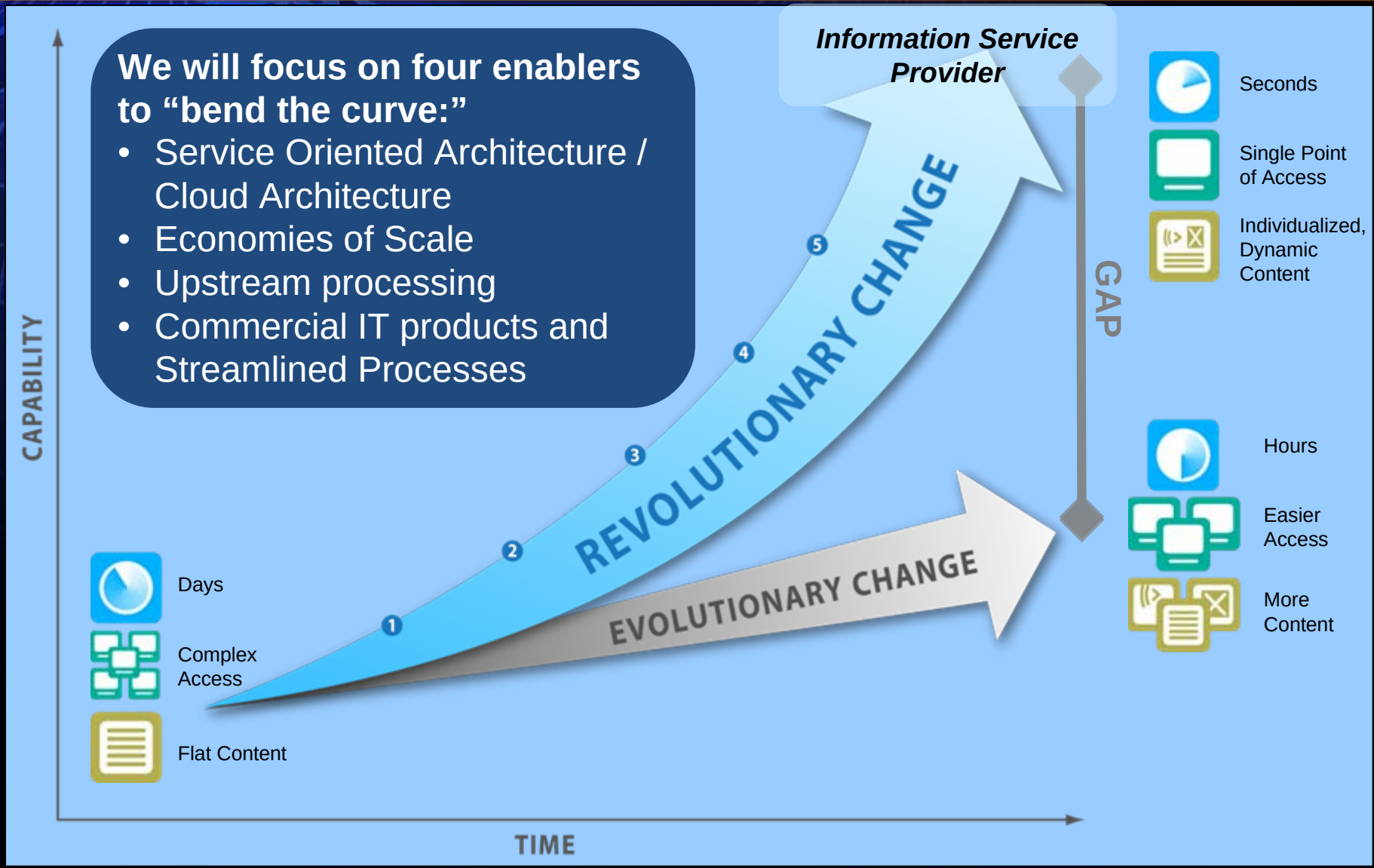
CUSTOMER NEEDS: TIMELINESS

Need for More Timely Delivery

- Problem: Users demand the information they want -- when they want it -- and have little patience for delays
- Solution: Emphasize real-time availability of all products and services

Desired Outcome: Users get the information they need within their timelines

LINKING VISION TO PRODUCTS AND SERVICES



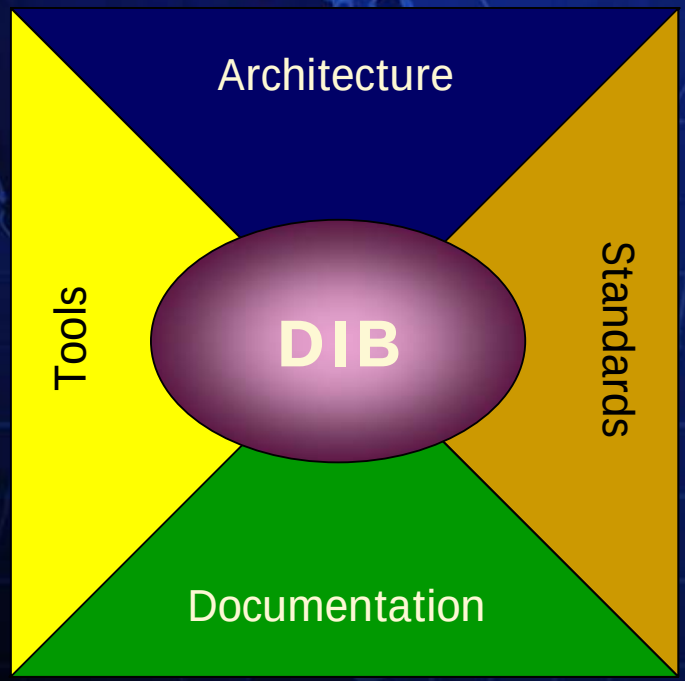
SOA

- ***Open Standards*.** Our ground architecture will evolve away from customized solutions aimed at solving specific problems; we will adopt commercial open standards into our acquisition processes.

- ***Challenge: Interfacing with legacy systems*.** Our Ground SOA Framework will use adapters to convert legacy Application Program Interfaces (API) to SOA-compatible formats.

Adoption of a SOA will allow for a persistent architecture where developers can bring content to the Intelligence, Surveillance and Reconnaissance (ISR) enterprise

IMPLEMENTING A SOA/CLOUD ARCHITECTURE COMPATIBLE WITH THE DCGS



- DCGS Integration Backbone (DIB)
- Governance
- Common core services, infrastructure
- Re-use of Services
- Single query access to multi-INT
- Delivery of unique, net-enabled, value-added IC services
- Ubiquitous, common-standard visualization interface
- “Discoverable” data and services
- Global Situational Awareness
- Rapid acquisition and transition
- Use of “live/real” data for testing

UPSTREAM PROCESSING

- Integrate upstream overhead SIGINT and GEOINT processing
- Integrate tactical SIGINT data with overhead SIGINT
- Automate new upstream processing and fusion procedures
- Assist users to take full advantage of the fused upstream data products
- Provide analysts tools needed to convert manual exploitation into semi-automatic procedures
- Develop a process to support incremental delivery of upstream ground capabilities and the discovery process that is intrinsic in spiral development
- Employ common baseline of signal and data processing components that can be reused in upstream SIGINT and GEOINT applications
- Define standards to publish metadata to capture the result of GEOINT and SIGINT upstream processing and analysis
- Enable the exchange of GEOINT and SIGINT upstream signals by defining upstream signals data interfaces

Take full advantage of commercial and government advances in automated target recognition and upstream processing to deliver information products and services in near real-time

CALL TO ACTION

History does not crawl, it jumps	→	Understand our challenges
Implications for the IC	→	Convert these challenges into great opportunities

Desired State

An Intelligence Community enterprise that operates as efficiently as the best commercial IT and knowledge service companies enabling authorized users to receive, task and query trusted information on-demand to improve the speed and execution of decisions from anywhere in the world.