Revolutionary Research . . . Relevant Results

13th Annual Expeditionary Warfare Conference

"The Long War-Strategy to Hardware"

Mr. George W. Solhan

Deputy Chief of Naval Research

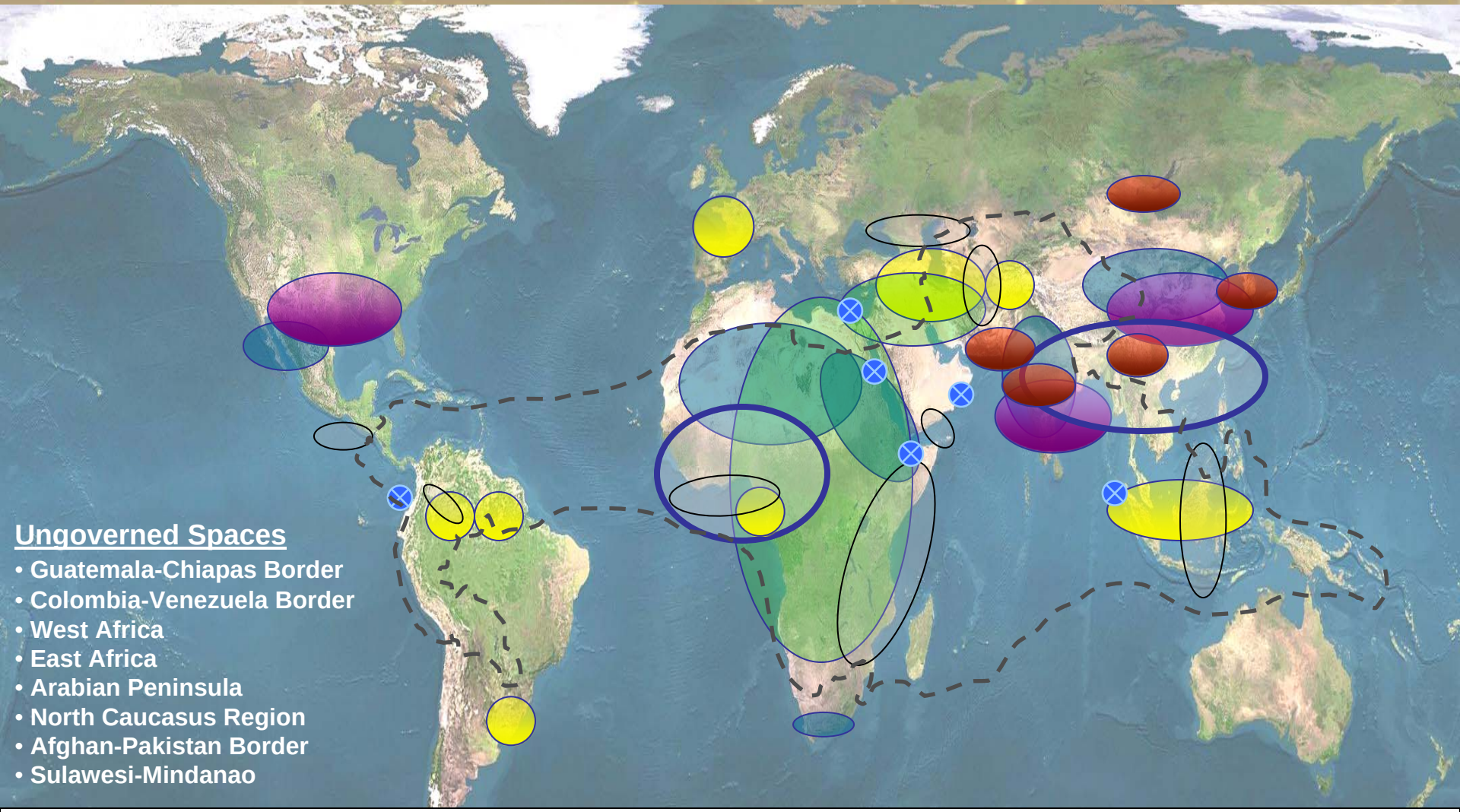
Expeditionary Maneuver Warfare

And Combating Terrorism

S & T Department (ONR 30)

Sources of Stress, Instability & Conflict

Revolutionary Research . . . Relevant Results



Naval Expeditionary Operations

Train/Advise/Assist

Relief Operations

Nation Building

Peace Enforcement

Show of Force

NEO

Acts of Terrorism

COIN

Civil War

Limited War

Forcible Entry

Regional Conflict

Global War

Frequency

Task organized forces to meet CCDR mission requirements

Peacetime and Crisis

Low Intensity Conflict

Mid-Intensity Conflict

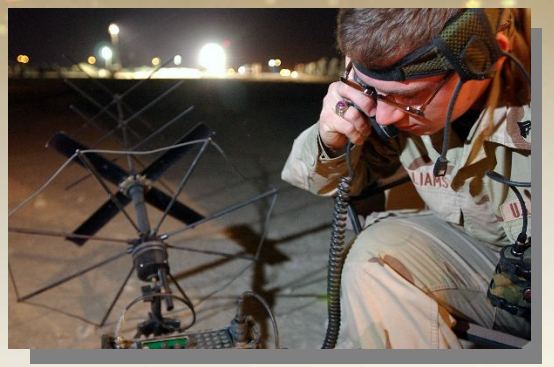
High Intensity Conflict

Technological Dominance

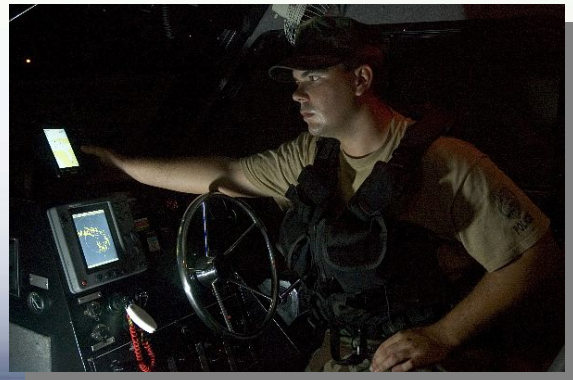
Revolutionary Research . . . Relevant Results

Laser-Guided Munitions

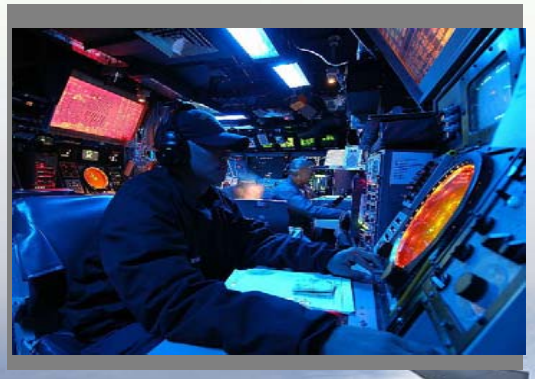
Today, Marines and Sailors have at their disposal the world's most sophisticated military technology



Mobile Communications



GPS Navigation and Targeting



Network-Centricity, Information Warfare, and Intelligence

Technological "Democratization"

Revolutionary Research . . . Relevant Results

Internet—Information Warfare and Intelligence

In the global war on terror and in Iraq and Afghanistan, our adversaries are leveraging sophisticated technology that is now easily available anywhere in the world—and at a modest cost.

Cell Phones—Mobile Comms

Commercial Laser Rangefinder—Precise Targeting

Handheld GPS—Location with Extreme Accuracy

A Technological "Perfect Storm"?

For decades, Western militaries have held a decisive technological advantage…

"It is by devising new weapons, and above all by scientific leadership, that we shall best cope with the enemy's superior strength."

--Winston Churchill

Today, enemies are able to acquire weapons and technology quickly and cheaply…

"Acquiring weapons for the defense of Muslims is a religious duty. If I have indeed acquired these weapons, then I thank God for enabling me to do so. And if I seek to acquire these weapons, I am carrying out a duty. It would be a sin for Muslims not to try to possess the weapons that would prevent the infidels from inflicting harm on Muslims."

--Osama bin Laden

And there also are adversaries willing to invest significantly in new technology

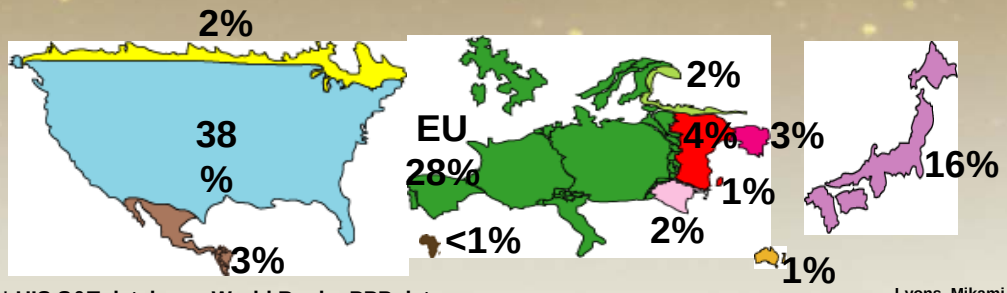
The 21st Century is also going to be an age of scientific change, with certain cutting-edge technologies likely to be applied to naval warfare...high-tech arms will make direct attacks on naval battlefields possible from outer space, remote altitudes and remote land bases...superconduction technology will bring superconductor ships to the naval order of battle, enabling ships to travel faster without noise...submarines will be able to go faster and deeper, with the seabed being the ideal place to build military bases."

--Chinese Naval Officers at the Navy Research Institute in Beijing

World Science and Technology Investment

Revolutionary Research . . . Relevant Results

1996*



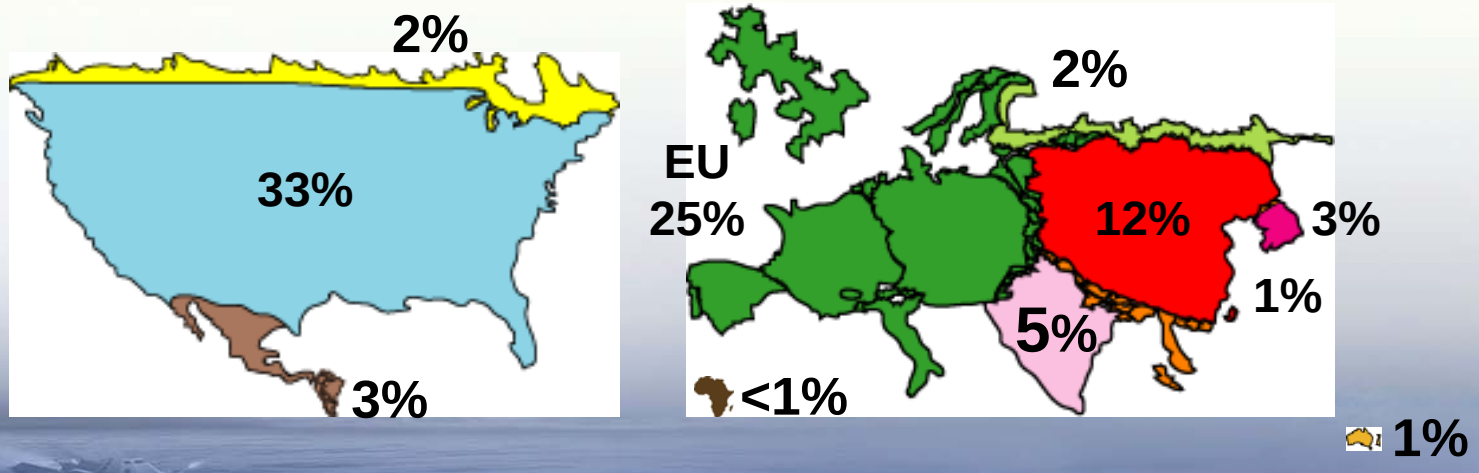
* UIS S&T database; World Bank - PPP data

Asia Share
1996: 26%
2004: 35%

Lyons, Mikami 2005, AOARD

+78%

2004**



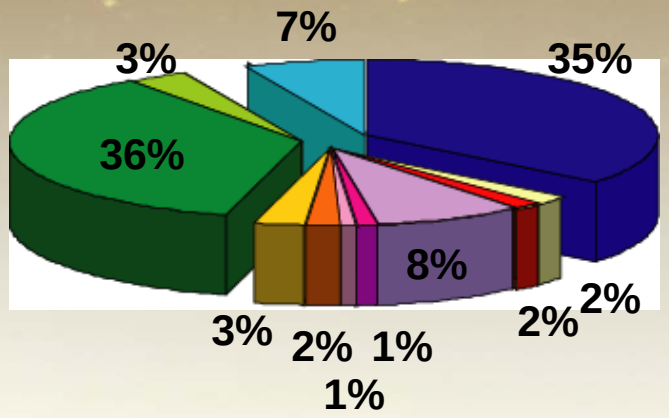
** OECD 2005 PPP; Global S&T Report (Batelle) - PPP data

Lyons, Mikami 2006, AOARD

World Science and Technology Publications

Revolutionary Research . . . Relevant Results

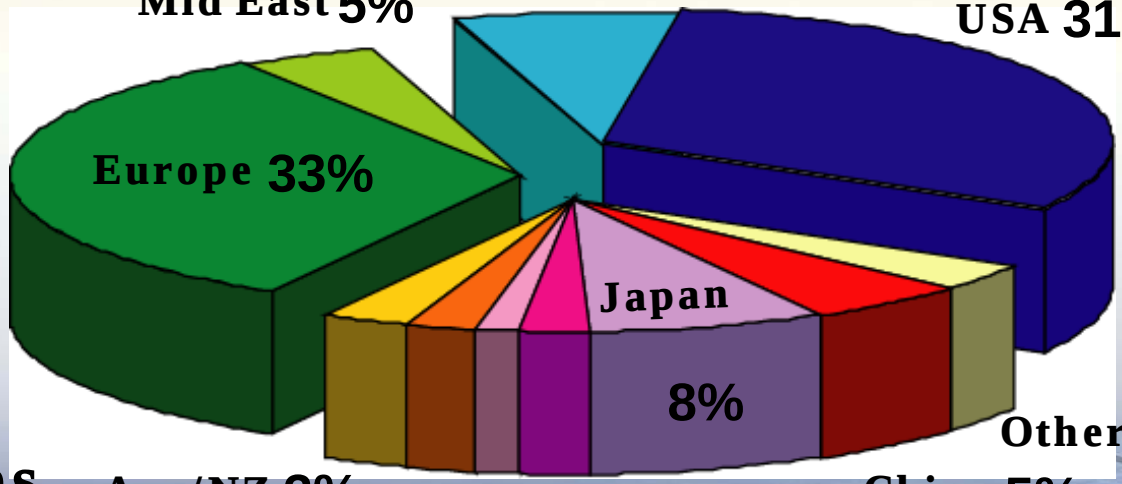
1996



851,764 articles

Asia Share
1996: 19%
2004: 24%

2004



+28%

1,094,017 articles

OFFICE OF NAVAL RESEARCH

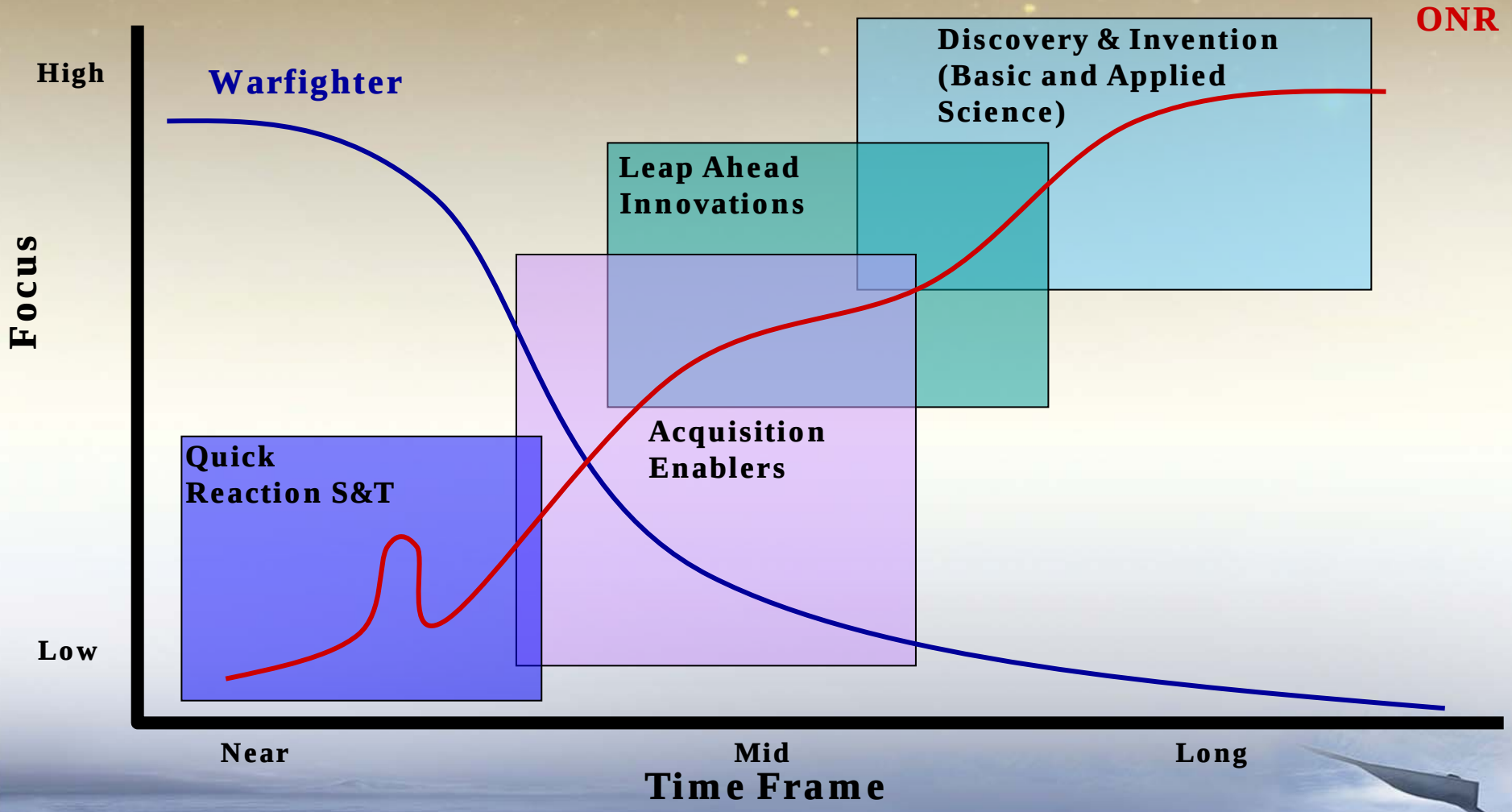
* Data from Science Citation Index, Web of Science, Thomson Scientific; November 2005 (Lyons, Wegener, Hubbard)

A Swiftly Changing Planet

- In an era of increasing globalization, new technology is more readily available—and more quickly—than ever before
- The natures of "combatant" and "weapon" are changing, and new challenges can come from anywhere in the world

- We must accept the fact that adversaries will use our technology against us
- To stay competitive on tomorrow's battlefields, we must:
  - **Ensure** our people and research enterprises are more innovative
  - **Maintain** our technological advantage

S&T Focus to Meet Naval Needs



Dominating the Battle in the Littorals

ONR Technology will enable Sailors and Marines to:

- **Survive and Win**
- **be more lethal**
- **expand their area of influence**
- **be flexible in all phases of warfare**
- **move between kinetic and non-kinetic tactics**
- **predict actions of Irregular enemies**
- **generate combat power operationally/tactically**
- **Operational Adaptation in new paradigm of Hybrid Complex Warfare**

Dominating the Battle in the Littorals

Revolutionary Research . . . Relevant Results

Programs featured in this theme include:

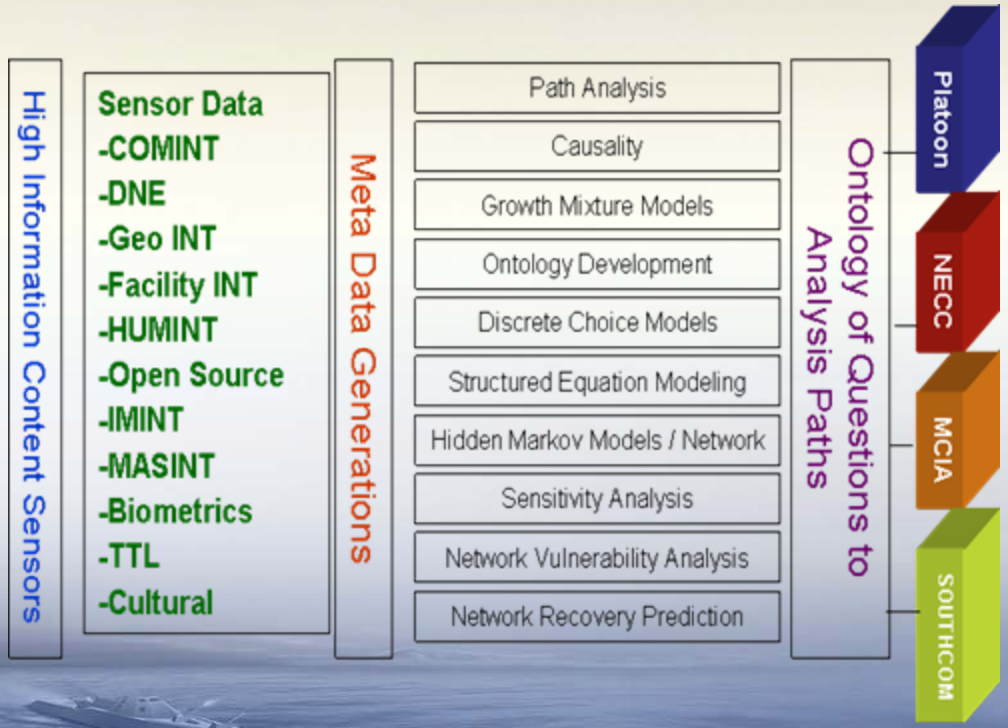
- Intelligence, Surveillance, and Reconnaissance
- Naval Expeditionary Overwatch
- Suicide Bomber Detection
- Maneuver
- Force Protection
- Squad Personal Power
- Seabasing
- Lightweight Materials
- Air Vehicle Deep Sustainment\
- Counter-IED Research
- Conformal Antennas
- Non-lethal Weapons—Active Denial System

I will provide more detailed information as we move forward

Intelligence, Surveillance and Reconnaissance (ISR)

Vision

Develop and leverage advanced technologies for applications in future intelligence, surveillance, and reconnaissance systems. Enhance situational awareness to enable real time tactical decision making for Distributed Operations and provide proactive and predictive capabilities for Asymmetric and Irregular Warfare.

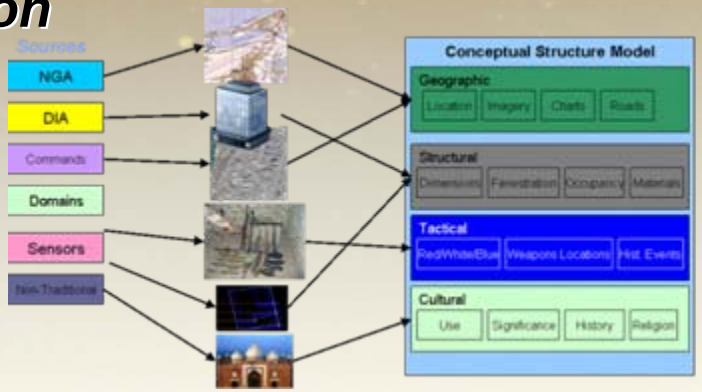


Key Research/Technology Investment Areas

- **Sensor Fields**
  - Unique Materials for Advanced Sensors
  - Sensors for Entity Recognition
  - Sensors for the Urban Domain
  - Sensor Network
  - Sensor Comm
- **Relevant and Situational Information on Demand**
  - Tag, Track. Locate
  - Multi-Modal Sensor Fusion and Networking
- **Actionable Intelligence for Expeditionary and Irregular Warfare**
  - Warfighter Interface and Decision Tools
  - Threat Prediction Models

Urban Situational Awareness

ONR through-wall sensing technology will provide vital decision-making information



Program Officer

Martin Kruger

ONR Program:

- **Urban Situational Awareness**

1. **ONR research provides enhanced sensoring for Urban environments**
   - ONR is Developing “through-wall” sensing
   - ONR research is focusing on improving multi-path imaging
   - Developing enhanced sensors and inference engines
2. **Collaborating with Army and DARPA**
   - Program development began in 2007
   - Investing in signal processing algorithms
   - Very narrow broadband radar is a focus area
3. **Research Challenges**
   1) Need for radar signal processing algorithms
   2) Increased standoff range of through-wall sensors
   3) Need for suitable inference engines

Navy Expeditionary Overwatch (NEO) Operational View

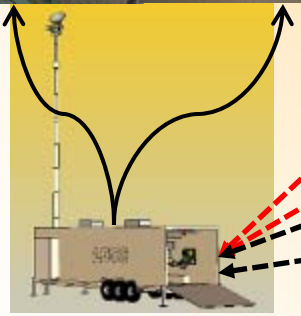
- System-of-Systems – Detect, Locate, Engage
- System > Than Sum of Parts – Each Platform is Enabled by Others
- System Enables Faster Reaction Time and Coverage of Larger Area
- Communications Infrastructure Enables Collaboration
- Platform Independent

Data
Voice

Aerial Platform
(Detect/Locate/Relay)

"Multiple vehicle integration to provide persistent ISR with prosecution capability"

TOC



LBCS
(Land Based Control Station)
Operated by MESF

Waterborne Platform
(Detect/Locate)

Land-Based Platform
(Detect/Locate/Engage)

MESF Small Boat w/ Forward Eyes RRS

(Detect/Locate/Engage)

Navy Expeditionary Overwatch (NEO) Operational View

ONR technology will enable vital decision-making information and tools

Program Officer

Nelson Mills

ONR Program:

- **Naval Expeditionary Overwatch (NEO)**

1. **ONR technology enables Navy expeditionary unit distributed operations**
   - Responds to NECC, SOF, and USMC requirements
   - Developing communication network
   - Provides multi-sensor platform control station
2. **ONR technology integrates Radar, IR, FLIR and EO for expeditionary units**
   - Integrates manned and unmanned sensors
   - Integrates both lethal and non-lethal engagement systems
   - Integrate USV, Scan Eagle UAV, and HMMWV platforms
3. **Research Challenges**
   1) Safe and Legal Engagement Systems for UXV's
   2) On-Board Data Processing
   3) Cooperative Perception and Communication for UXV's

Force Protection

Vision

To allow the force to maintain operational tempo at the small unit (battalion and below) and individual Warfighter levels, the Thrust will provide technology that protects from a myriad of modes of enemy attack throughout the spectrum of warfare. Each system will be expeditionary in nature, lightweight, and capable of providing a far greater degree of protection than any comparable system currently available.

Key Research/Technology Investment Areas

- **Detection**
  - **Multi-modality signature detection (THz, spectroscopy, gas chromium, RADAR)**
  - **Optics/void detection**
  - **Subsurface explosive hazard detection**
  - **Directed Energy**
  - **Confirmation through spectral signatures**
- **Neutralization**
  - **Explosive neutralization independent of trigger mechanism**
  - **Magnetic/Acoustic/Seismic signatures**
  - **Directed Energy**
- **Mitigation**
  - **Advanced materials**
  - **Bio-effects modeling and simulation**
  - **Fiber-level modeling**
  - **Modular design tools**

Suicide Bomber Detection

ONR technology will provide real-time decision-making information

Program Officer

Lee Mastroianni

ONR Program:

- **Suicide Bomber Detection**

1. **Bomb detection research is being applied to the suicide bomber threat**
   - Imaging sensors and spectroscopy
   - Data fusion architecture to reduce Pfa and increase Pd
   - Behavior detection and intelligent video
2. **Suicide bomber detection draws upon a variety of technologies**
   - Passive and active NIR, MWIR, and LWIR imaging, mmW and THz imaging (2D RADAR), mmW and THz imaging (3D RADAR), LIBS and Raman Spectroscopy
   - Characterization of clutter and algorithm development
   - Fusion efforts in ISR realm
   - Personnel and crowd tracking algorithms
3. **Research Challenges**

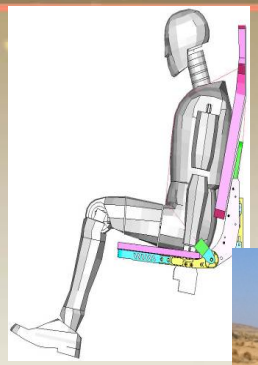
1) Detection at Operationally Relevant Ranges: Significant standoff is required in order to reduce exposure

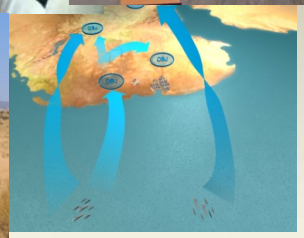
2) Clutter/False Alarms: Automatic differentiation of potential items of interest carried on body

3) Data/Sensor Fusion: Combination, alignment, and analysis of data from multiple modalities

4) Crowd Surveillance: Investigation of moving individuals within a larger crowd

Maneuver





Vision:

Marine forces of the future will be significantly more agile, lethal, mobile and survivable. Technologies will be developed to increase the warfighting capabilities and effectiveness of the Marine Corps Air Ground Task Force (MAGTF) with emphasis on improving survivability, providing enhanced maneuver, and providing maneuver enabler systems in Distributed Operations and Asymmetric / Irregular Warfare.

Key Research / Technology Investment Areas

Survivability:

- Enhanced materials for armor and vehicle structures
- Active and dynamic protection systems
- Shock mitigating seats & attenuation technologies for crew protection

Advanced Mobility:

- Advanced suspension systems for enhanced off road mobility
- On board vehicle power generation and highly efficient power train components

Maneuver Enablers:

- Situational awareness decision aids and planning tools
- Unmanned and autonomous vehicle systems

Combat Tactical Vehicle

ONR is developing affordable, cutting edge, future light armored vehicles

Program Officer

Jeff Bradel

ONR Program:

- **Combat Tactical Vehicle**

1. **CTV brings light vehicle armored technology into the 21st Century**
   - Six-passenger combat variant of the Joint Light Tactical Vehicle family of vehicles
   - Configurable for various missions with crew-served weapon station, sensors, & comm suite
   - Payload of up to 6,000 pounds
2. **CTV's aluminum armor-based hull design protects against IEDs**
   - Applique armor provides additional protection against kinetic energy and shaped-charge rounds
   - Demonstrates art of the possible for next generation of inherently protected land transport
3. **Research Challenges**

   1) Development of a tactical wheeled vehicle with increased survivability
   2) Integration of an advanced suspension with ride height adjustment
   3) Integration of armor structure as vehicle structure
   4) Development & integration of high mass efficiency and active armors

Logistics

Vision:

Marines of the future will benefit from a precisely tailored level of logistic sustainment from seabased platforms to rapidly maneuvering forces ashore. Logistic delivery systems of the future will be more responsive and flexible, enabling Marines to out-pace rapidly changing operational scenarios. Likewise, delivered logistic commodities will provide more operational value per unit weight, enhancing combat unit self sufficiency and maneuverability. Finally, operational units will benefit from technologies that maximize equipment readiness by minimizing both down-time and maintenance requirements.

Key Research Topics

Asset Visibility

- Low-power high-clutter RF propagation (for wireless sensors and RFID tags

Logistic Transport

- Structural composite mechanics and fabrication (for modular lightweight bridges)
- Ergonometrics (for human load transport)
- Aeromechanics (for autonomous aerial logistic delivery)

Operational Sustainment

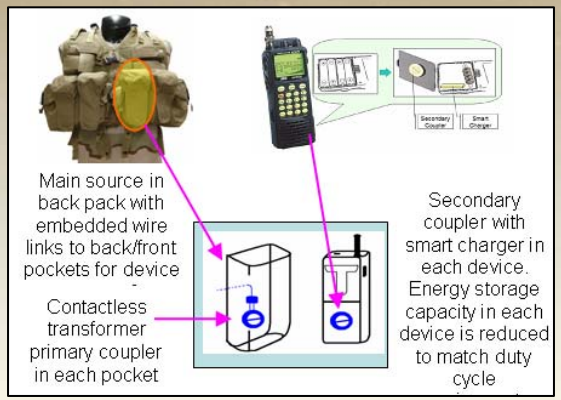
- Raman Spectroscopy
- Membrane transport and filtration for water purification
- Solid Oxide fuel cell electrochemistry, thermoelectric materials, electrochemical capacitors and metal-air batteries
- Casualty stabilization and life support automation

Maintenance Reduction

- Materials science for prevention of corrosion and wear

Squad Portable Power

Squad Portable Power will enable small combat units to optimize portable energy sources



Program Officer

Cliff Anderson

ONR Program:

- **Squad Portable Power**

1. **Squad Power Network will exploit wearable power systems**
   - ONR is improving the portability of electronic devices for Marines
   - Optimizing the aggregate assembly of devices and power sources
   - Developing small power sources and load configurations
2. **Squad Power Network will eliminate issues with incompatible batteries**
   - Research will result in weight savings for portable power
   - Bridge compatibility issues with legacy portable systems
   - Smart Charging systems will match each device's duty cycle
3. **Research Challenges**

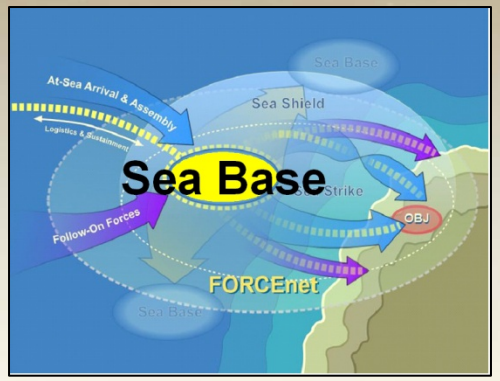
   1) High specific energy electrochemical capacitors to function as short term energy storage
   2) Intelligent small scale voltage conversion and power distribution networks
   3) Robust energy coupling approaches that facilitate ease of momentarily disconnecting devices

Seabasing Logistics

ONR Seabasing technology overcomes limitations of geographic shore bases support

ONR Program:

- **Seabasing Logistics**



Program Officer

Dr. Geoff Main

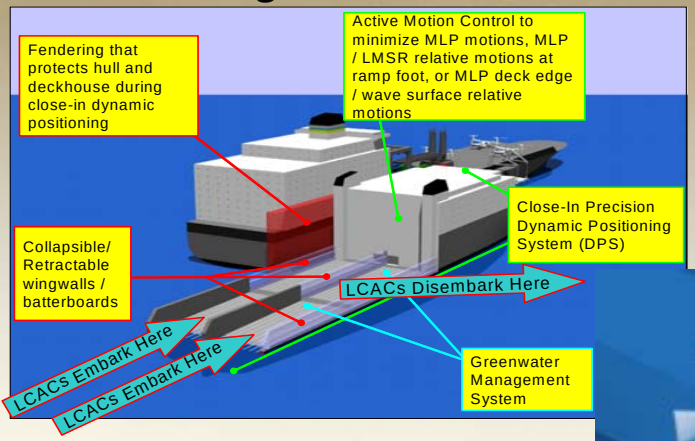
1. **Seabasing logistics supports a completely new concept of forward presence**
   - Enables improved ship-to-ship logistics
   - Improves sustainment of assembled Naval forces
   - Reduces response times to humanitarian mission requirements
2. **ONR is developing flexible, responsive afloat warehousing technology**
   - Seabase research enables sea to shore connectors in high sea states
   - Fuel transfer from sea to shore is a vital focus area
   - Enables maritime operations where shore support is limited
3. **Research Challenges**

   1) Ship motion prediction in high sea states for ship-to-ship transfer
   2) Interface with and support of point-of-delivery and heavy lift aircraft
   3) Integration of logistics systems into a COP - provide better, more flexible resupply and asset visibility

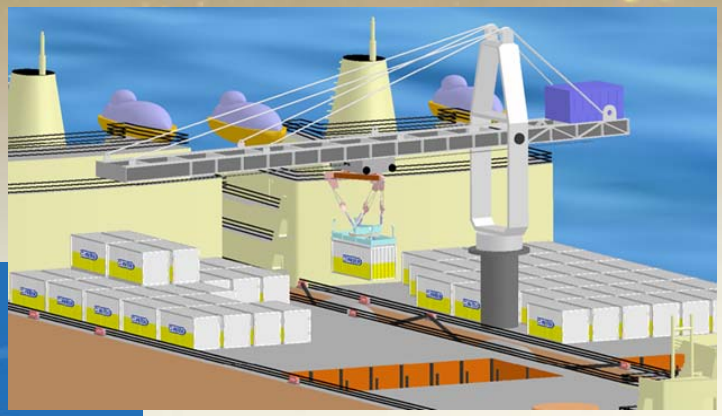
Ship-to-Ship Transfer & Material Handling

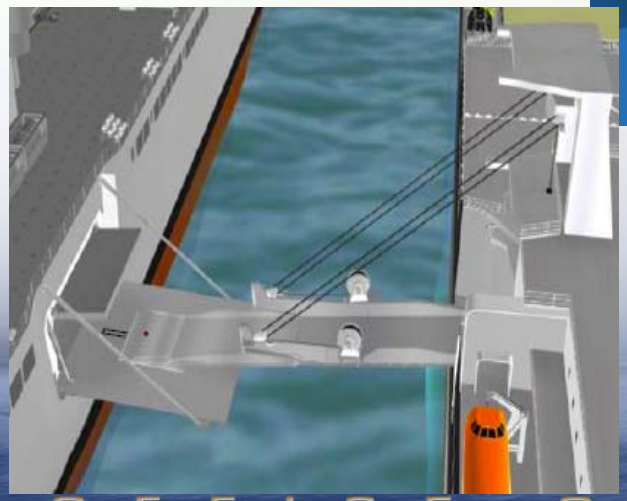
Revolutionary Research . . . Relevant Results

Small-to-Large Vessel at-Sea Transfer



Large Vessel Interface Crane Technology





Interface Ramp Technologies

High Rate Vertical/Horizontal Material Movement

Dominating the Battle in the Littorals

Recent engagement opportunities:

- Modern Day Marine Exposition, Marine Corps Base, Quantico, VA, 30 September – 2 October 2008
- Human Social Cultural and Behavioral Sciences Workshop 8-9 Oct.
  - Dynamic Tactical Communications Network BAA 08-020 (Closed)
    Expeditionary Maneuver Warfare Applied Research and Advanced
  - Technology Development BAA 08-012 (Closed)

Future engagement opportunities:

– ONR Long Range BAA 09-001. (Annual FY opportunity)

– NEO VIP Demonstration Day 14 Nov 08.

Program Officers Contact Info

Name	Program	ONR Code	
Mr. Cliff Anderson	Exp Logistics	Code 30	
Mr. Jeff Bradel	Maneuver (CTV)	Code 30	
Mr. Martin Kruger	ISR – Urban SA	Code 30	
Mr. Lee Mastroianni	Force Protection	Code 30	
Mr. John Moniz	Exp C4	Code 30	
Mr. Nelson Mills	NEO	NSWCDD	
Mr. John Keenan	Non-Lethals	JNLWD	
Mr. Dan Simons	Firepower (Fires)	Code 30	
Dr. Roy Stripling	Human Performance, Training & Education	Code 30	
Dr. Geoff Main	Sea Basing	Code 33	
Mr. Tony Seman	Sense & Respond Logistics	Code 33	

Revolutionary Research . . . Relevant Results

QUESTIONS?