Naval Science and Technology Update

PACOM Science and Technology Conference

4 April 2007

A Technological "Perfect Storm"?

Revolutionary Research . . . Relevant Results

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 nations 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."

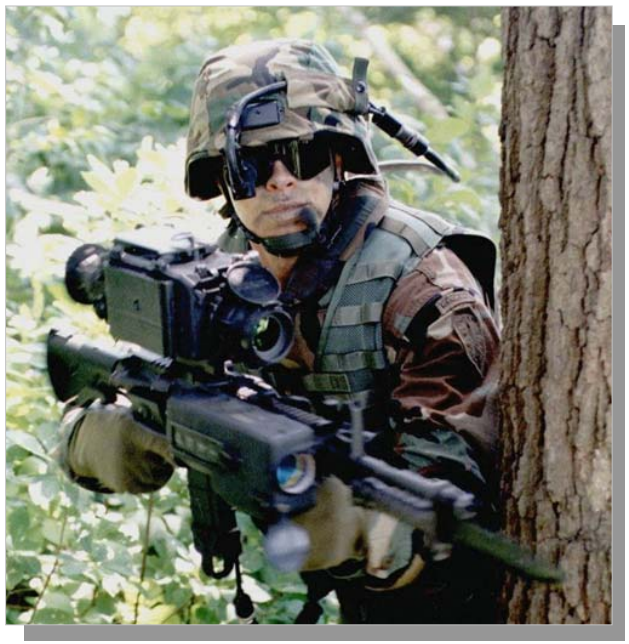
--Chinese Naval Officers at the Navy Research Institute in Beijing

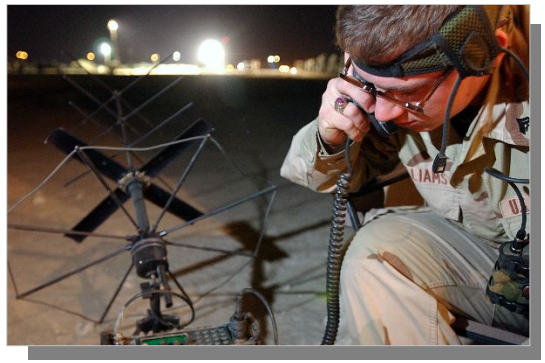
Technological Dominance

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 Afghanistan, Iraq, and elsewhere, our adversaries are leveraging sophisticated technology that is now easily available anywhere in the world—and at modest cost.

Cell Phones—Mobile Comms

Commercial Laser Rangefinder—Precise Targeting

Handheld GPS—Location with Extreme Accuracy

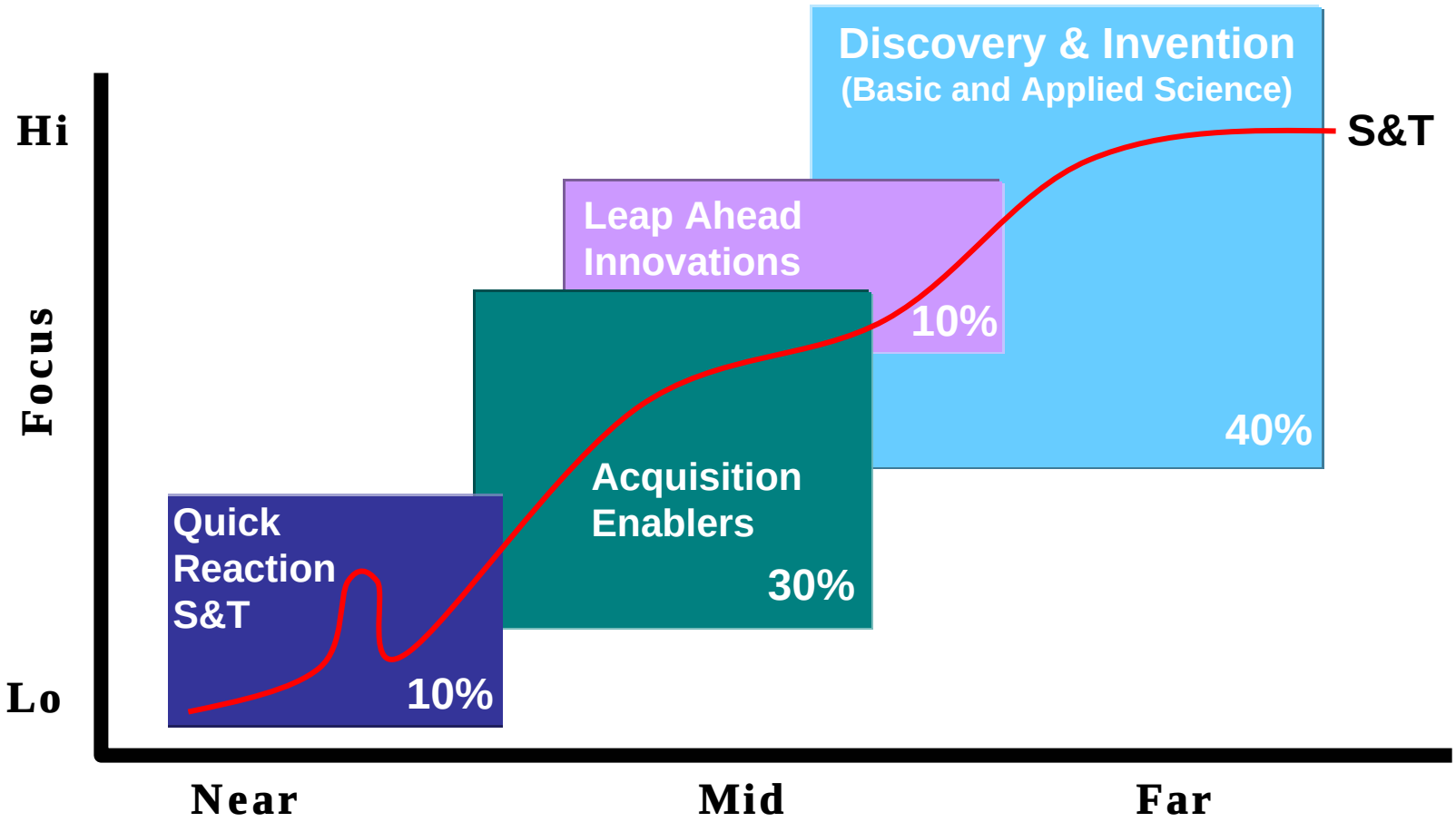
S&T Strategy Objectives

Revolutionary Research . . . Relevant Results

- Ensure alignment of Naval S&T with Naval missions and future capability needs
- Balance and manage S&T portfolio based on key tenets:
  - Strive to engage with intellectual capital worldwide
  - Leverage U.S. and global technology insights
  - Maintain equilibrium between long-term basic research and near-term advanced prototyping
  - Be innovative and adaptive—lead science where it is critical to the Navy/Marine Corps vision
  - Leverage technology development efforts across the entire DoD
- Communicate S&T vision and approach to senior decision makers, key stakeholders, S&T partners, customers, and performers

ONR S&T Portfolio Balance

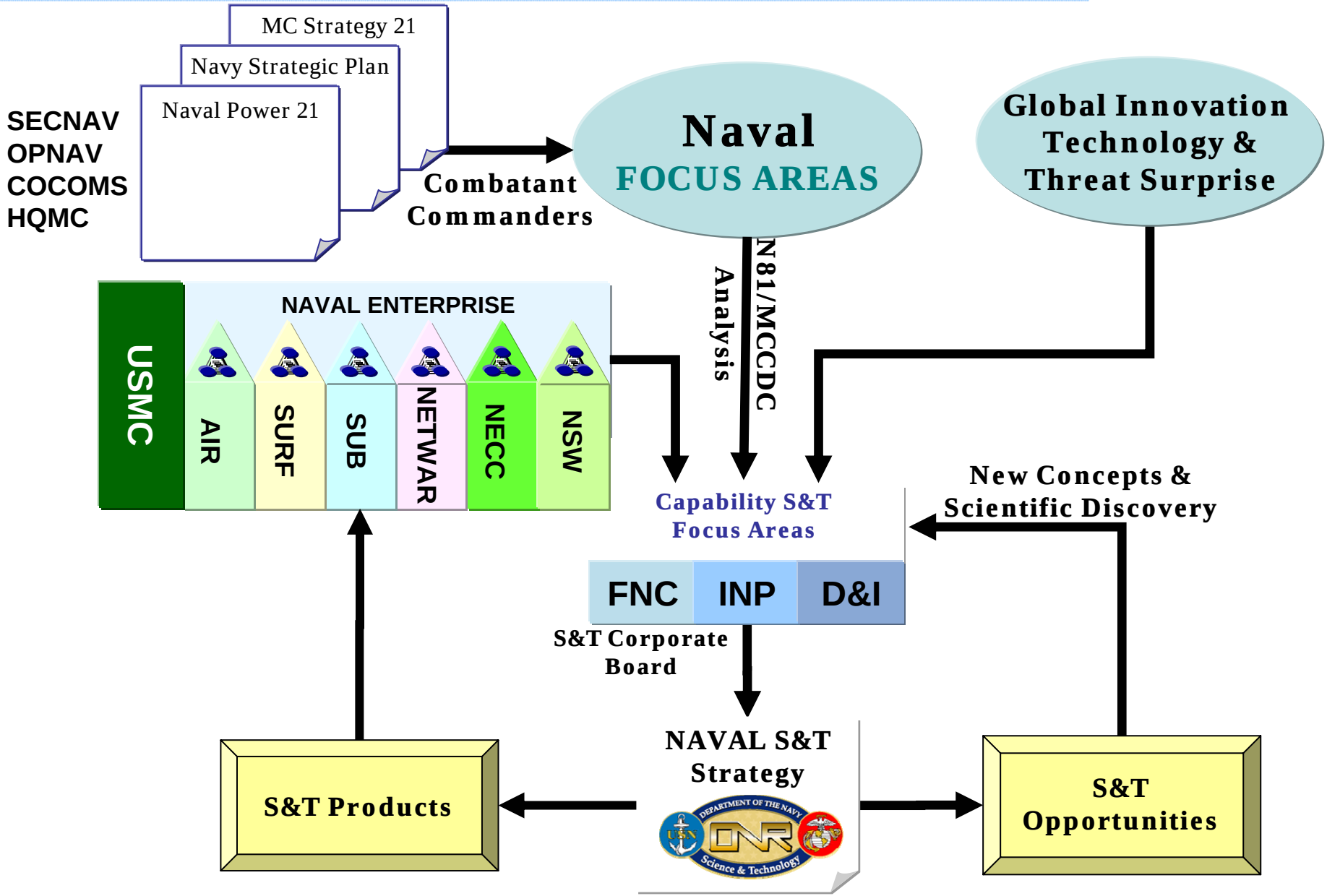
Revolutionary Research . . . Relevant Results



S&T has a long-term focus but is responsive to near-term Naval needs

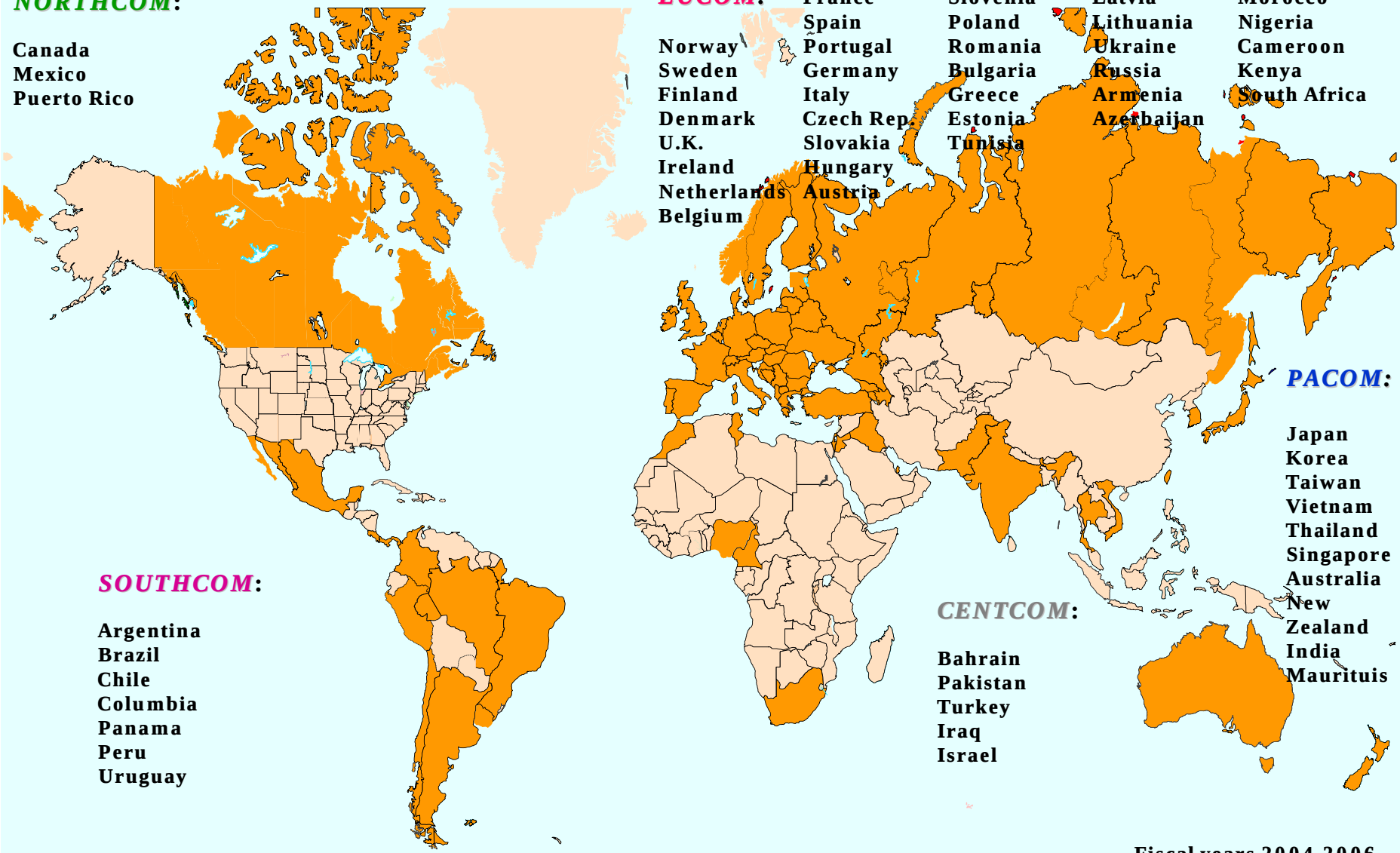
Naval S&T Strategy Process

Revolutionary Research . . . Relevant Results



International Engagement

Revolutionary Research . . . Relevant Results



Fiscal years 2004-2006

Resulting Naval S&T Focus Areas

Revolutionary Research . . . Relevant Results

- Power and Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric & Irregular Warfare
- Information, Analysis and Communication
- Power Projection
- Assure Access and Hold at Risk
- Distributed Operations
- Naval Warrior Performance and Protection
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Affordability, Maintainability, and Reliability

Assured Access and Hold at Risk

Revolutionary Research . . . Relevant Results

Vision: Attain maritime, littoral, and riverine access to denied areas and hold strategic and tactical targets at risk using lethal and non-lethal means.

Objectives

Anti-Submarine & Mine Warfare

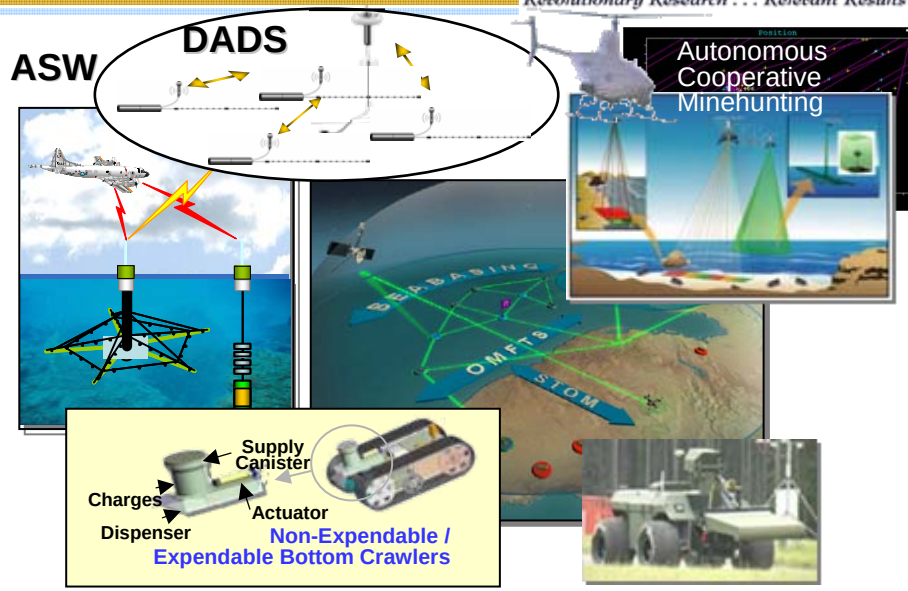
- Rapid Clearing and detection of mines
- Advanced autonomy in unmanned robotic systems to expand ground reach and reduce threat exposure
- Next generation data and contact fusion to expand the regional ASW, mine & amphibious warfare operating picture to the theater level

Distributed Surveillance

- Distributed, networked surface, ground, and underwater sensors
- Unmanned systems with onboard processing
- Autonomous Maritime Reconnaissance/Neutralization

Battlespace Shaping

- Non-lethal technologies to stop small vehicles and large ships
- Battlespace shaping technology for enabling information operations
- Decisive operations through a heavy EW attack area
- Access in GPS denied areas – Alternatives to GPS technology
- Operationally responsive use of space
- Tagging, Tracking, and Locating Technologies



Key Research Topics

Anti-Submarine Warfare Surveillance
Mine Hunting
Unmanned Vehicles
Intelligent and Autonomous Systems
Networked Sensors
Space Technologies
Nanoscale Electronic Devices & Sensors
Solid State Electronics
Functional Materials
EW – Attack
ISRT - EM
Large Vessel Stopping
Non-Lethal Weapons
Navigation and Precision-Timekeeping

Distributed Operations

Revolutionary Research . . . Relevant Results

Vision: **Enable dispersed small units to dominate extended battlespace through advanced warfighter training, unambiguous situational awareness, robust communications and sense and respond logistics.**

Objectives

Training
- Enhancement of Physical and Cognitive Performance
- Simulation – based scenarios for enhanced training
- Rapid assimilation of cultural environments

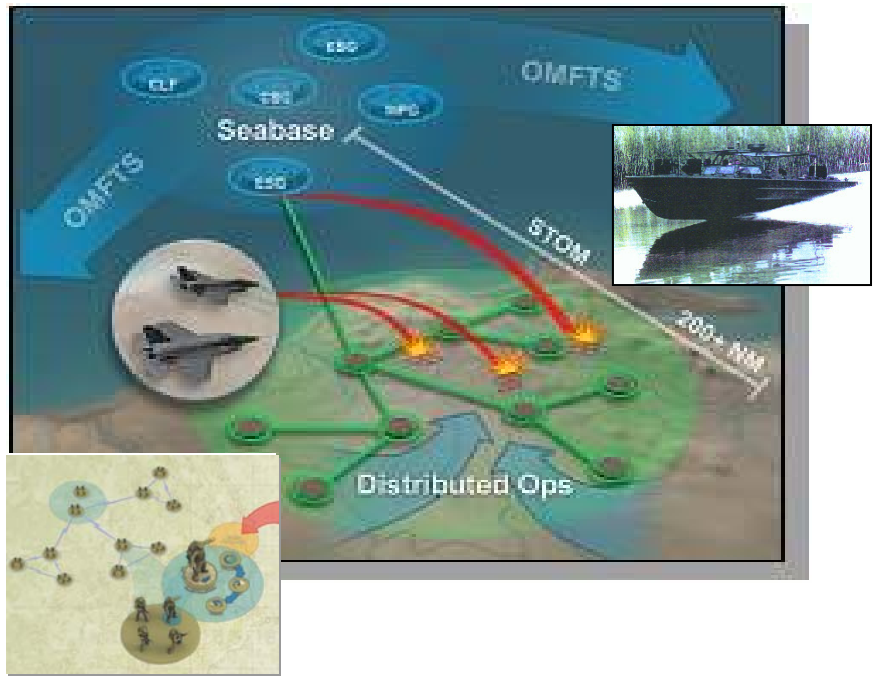
Communications
- Robust Command and Control networks
- Airborne relays on manned and unmanned platforms

Logistics
- Rapid re-supply and medical evacuation whenever possible
- Real–time automatic supply sensors and network
- Optimize medical self-sufficiency

Fires
- Integrate firepower of distributed ground, offshore, and air assets
- Blue Force Tracking down to the individual

Survivability
- Warfighter stealth technology
- Warfighter exoskeleton technology

Maneuver
- Adaptable and survivable tactical mobility systems to enhance operational tempo and extend range of vehicles and soldiers
- Advanced materials to reduce combat load



Key Research Topics

Training, Education & Human Performance
Expeditionary C4
Communications and Networks
Expeditionary Logistics
Expeditionary Firepower
Precision Strike
Expeditionary ISR
Unmanned Air and Ground Vehicles
Special Warfare / EOD
Land Mine Countermeasures
Expeditionary Maneuver/ Individual Mobility

Survivability and Self-Defense

Revolutionary Research . . . Relevant Results

Vision: Enable manned and unmanned platforms to operate in any hostile environment and avoid/survive attack through innovative materials, sensors, countermeasures and counter-weapons.

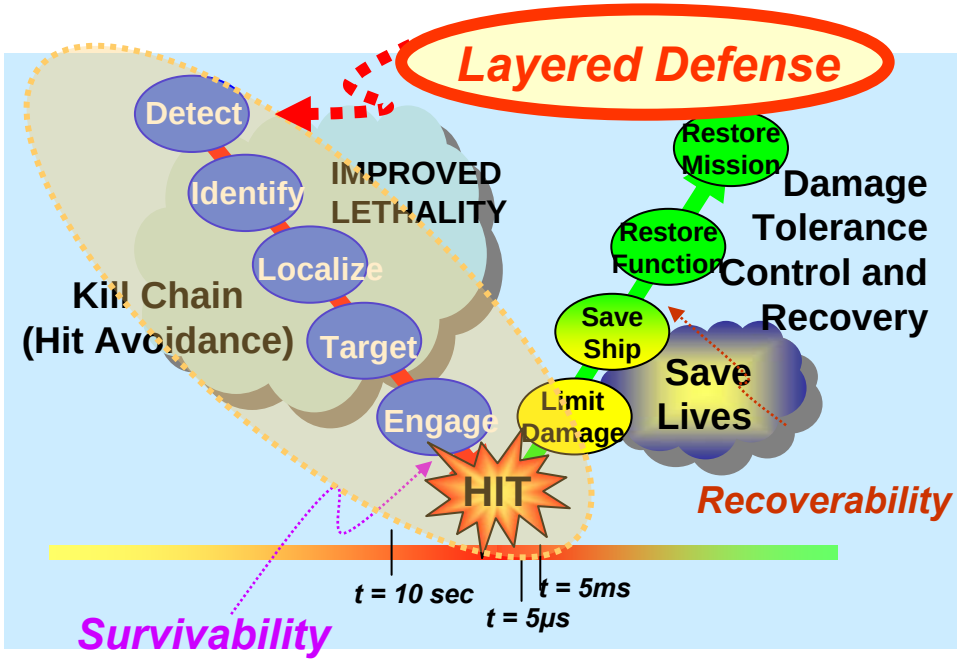
Objectives

Platform Stealth
- Reduce above water and subsurface signatures
- Multi-spectral LO technologies

Countermeasures & Counterweapons
- Threat weapon tracking
- Automated decision making
- Low False alarm rate 360 degree detection
- Hard kill and soft kill against threat kinetic weapons
- Increase standoff to outside threat damage range
- Directed energy weapons for speed of light engagement
- Counter-LO

Survivable Platforms
- Advanced materials in platform construction
- Damage tolerant platform architectures
- Automated damage control focusing
- Advanced materials for self healing platforms

Force Protection
- Anti-swimmer technology
- Detect and determine threat intent
- Non-lethal response



Key Research Topics

Signature Control (LO/CLO)
Undersea Weaponry
Torpedo Defense
Directed Energy
Survivable Platforms Structures
Functional Materials
Electro-Optics
Solid State Electronics
EW Attack
ISRT – EM
Expeditionary Force Protection
Non-Lethal Weapons

Future Naval Capabilities

Revolutionary Research . . . Relevant Results

The **Future Naval Capability** program is aligned with the pillars of Naval Power 21, and focuses on providing enabling capabilities to close warfighting gaps.

Examples of current (FY07) enabling capabilities and corresponding products in execution:

	FY05	FY06	FY07	FY08
Products in Execution	129	119	114	112
Product Transitions	31	27	48	24
Enabling Capability Transitions	5	3	10	11
Enabling Capabilities in Execution	36	37	39	48

Pillar	Enabling Capabilility	Products
Sea Shield	*Mine Countermeasures*	Communications and Navigation Aids for MCM Operations, Buried Mine Sensor Development for Detection and Classification of Buried Sea Mines
	Over-the-Horizon Missile Defense	Distributed Weapons Coordination, Advanced Area Defense Interceptor, Distributed Sensor Coordination
	Defense of Harbor against Asymmetric Threats	Intelligent Video Surveillance, Underwater Threat Neutralization, Passive Acoustic Fiber-Optic Array for Swimmer Detection, Terminal Swimmer Detection and Targeting
Sea Strike	*Advanced Naval Fires Technology*	Adaptive Expeditionary Maneuver Warfare System, Advanced Fires Coordination Technology, Advanced Gun Barrel Technology, Advanced Target Acquisition
	Transparent Urban Structures	Sensing Through Walls, Detect and ID Facilities, Decision Aids
	Modular Scaleable Effects Weapons	Scalable Effect Weapon Concept Development, Indirect Prototype (Scalable Effect)
Sea Basing	*Sea Base Mobility and Interfaces*	Small to Large Vessel At-Sea Transfer Sea Base Connector, High Speed Seabase-to-Shore Connector, High Rate Vertical / Horizontal Material Movement, High Lift Density Air Interface Ramp Technologies, Intra-Connector Material Handling
	Surface Connector Vehicle Transfer	
FORCEnet:	*Marine and UxV Tactical ISR*	Dynamic Replanning/Autonomous Vehicle Control, Fully Integrated Advanced Demonstrator Engine, Multi-Vehicle Cooperation / Targeting, Multi-Vehicle Networking / Comms Software
	Global Information Grid-Compliant Networking	High Altitude Airborne Relay and Router Package, Integrated, Autonomous Network Management,Intra-Battle Group Wireless Networking Block II
Enterprise/ Platform Enablers	*Compact Power Conversion Technologies*	Multi-Function Motor Drive, BiDirectional Power Control Module, Power Management Controllers
	Maintenance Reduction Technologies	Improved Non-Skid Coatings, High Performance Topside Coatings, Improved High Ship Rudder Coatings

Making an Impact Today

Modular Hybrid Pier

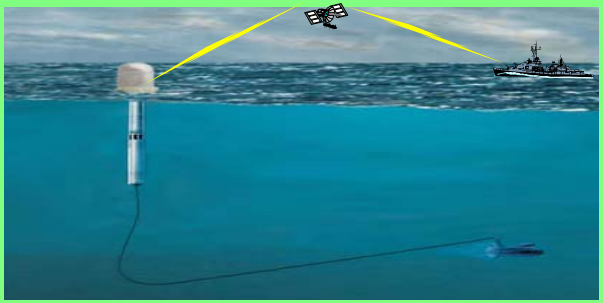
Modular, double-deck pier constructed of new corrosion-resistant concrete

- Demonstrated in FY05
- Transitioned to P327/N46 in FY07

Next Generation Submarine Comms at Depth

Two-way comms support submarine comms at depth

- At sea test in late FY07
- Transitions to PEO C4I PMW770 in FY08



Intra-Battle Group Wireless Networking

High bandwidth, line-of-sight, wireless network within a battle group using existing advanced digital network system

- Block II transitioned to PMW160 in Dec 06
- Deployed on *John C. Stennis* strike group Jan 07

QuikClot

Hemostatic agent that almost instantaneously stops severe arterial bleeding

- Original product already in battlefield use with Marines
- FDA approval for Advanced Clotting Sponge expected in late FY07/early FY08

Lightweight Mortar System

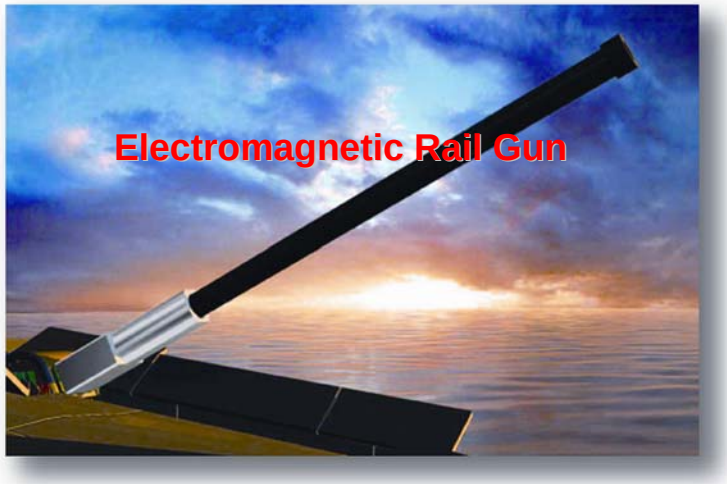
Developed lightweight 81mm and 60mm mortar tubes base plates, and bipod assemblies

- Lightweight 81mm gun tube design transitioned FY06
- Lightweight 81mm bipod and base plate and 60mm mortar systems designs transitioned FY07

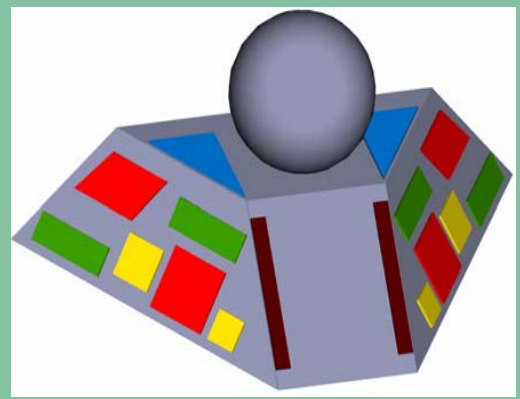
Innovative Naval Prototypes

Revolutionary Research . . . Relevant Results

Current INPs



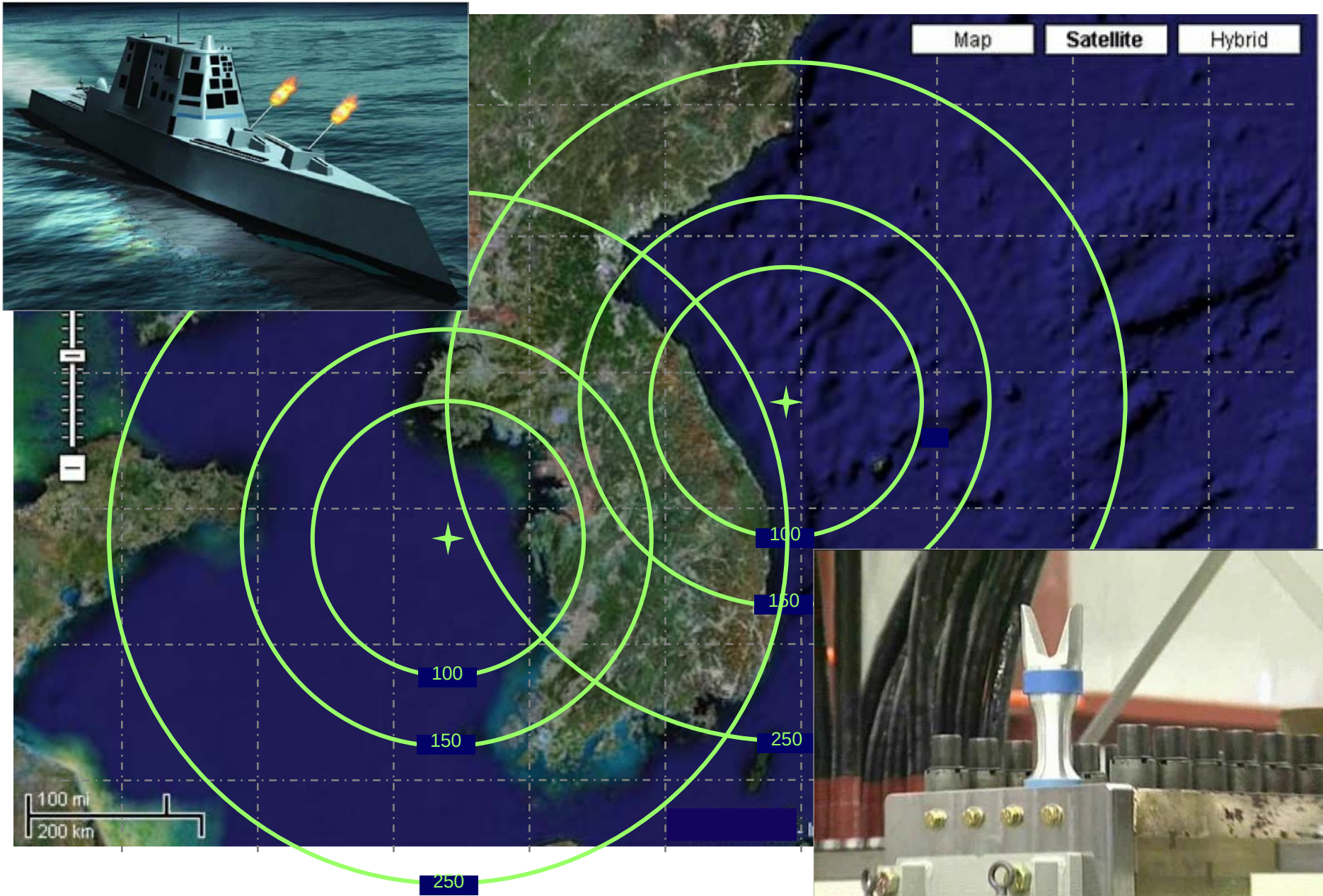
Potential INPs



Integrated Digital Apertures and Array Radars

Electromagnetic Rail Gun

Revolutionary Research . . . Relevant Results

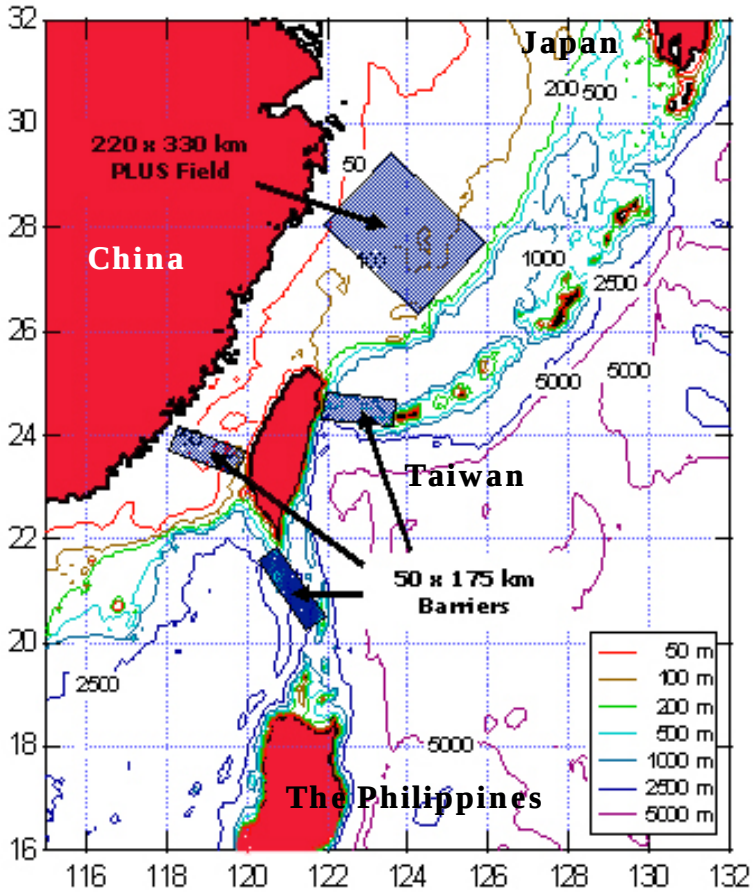


Persistent Littoral Undersea Surveillance (PLUS)

Revolutionary Research . . . Relevant Results

Mission:

Hold-at-Risk ASW strategy requires effective undersea surveillance against multiple, quiet targets over large littoral areas (100 x 100 nm) for months



Game Changing

- Inverts ASW asymmetry using autonomous, mobile, controllable sensor/weapon network
- Adapts to environment, targets, and threats
- Persists clandestinely for months
- Autonomous self deployment

Innovative Elements

- Autonomous, cooperative behavior among structured, mobile sensors (gliders, mobile scanning arrays, intervention units)
- Feedback control to meet operational detection thresholds
- Adaptive target closures yielding actionable kill chain

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

Questions?

If technology doesn't seem like magic—it's probably obsolete.