Office Of Naval Research
Presented to: NDIA Science & Engineering Technology Conference

Dr. Walter F. Jones
Executive Director, Office of Naval Research
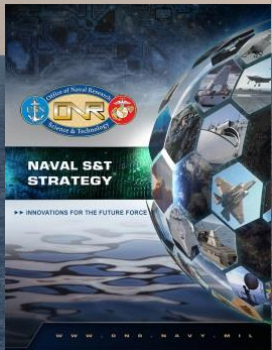*18 April 2017*

The Office of Naval Research
The S&T Provider for the Navy _and_ Marine Corps

- 4,000+ People
- 23 Locations
- $2.1B / year
- >1,000 Partners
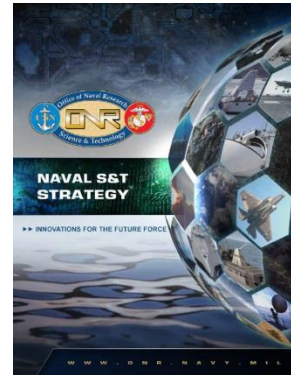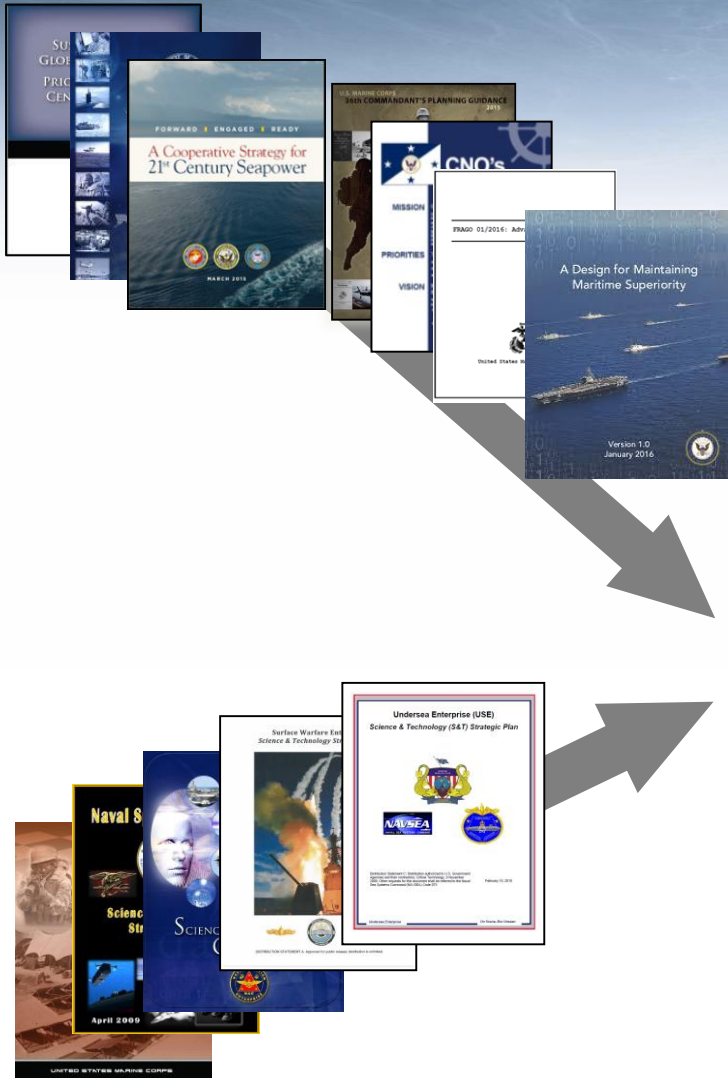
Discover → *Develop* → *Deliver* > *Technological Advantage*

Enhancing the CNO's Strategic Vision

- **Strengthen Naval Power at and from Sea**
- **Achieve High Velocity Learning at Every Level**
- **Strengthen our Navy Team for Future**
- **Expand and Strengthen Partner Networks**

PEOPLE

ORGANIZATION

MISSION SUCCESS

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Warfighting Capabilities Enabled by S&T Investments
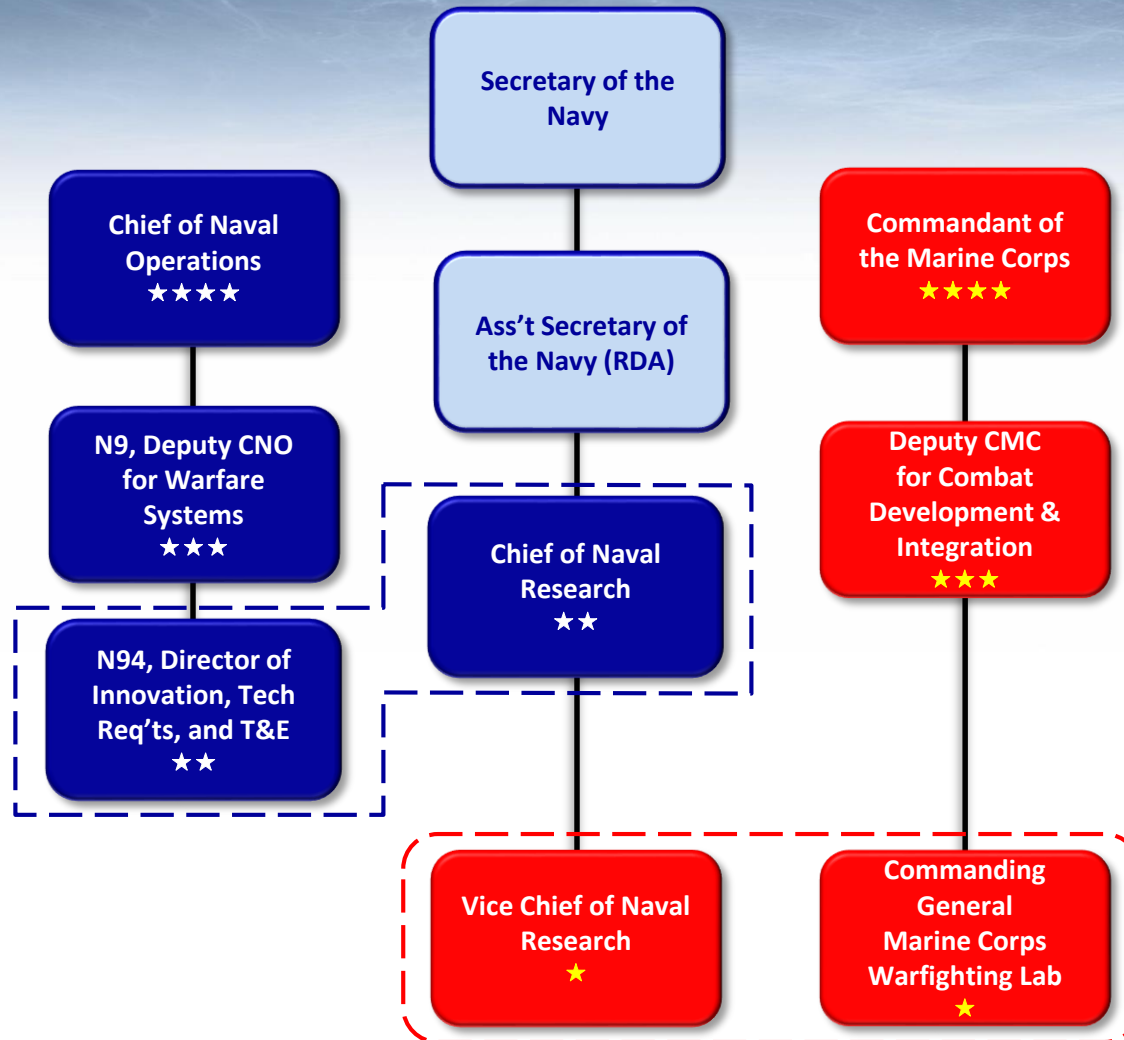
CNR's S&T Investment Priorities

- Directed Energy/Electric Weaponry
- Cyber
- Electromagnetic Maneuver Warfare
- UxS Maneuver Warfare
- Synthetic Biology/Bio-Inspired Technologies

Broad-Based Basic/Applied Research

NAVAL S&T STRATEGY

▶▶ INNOVATIONS FOR THE FUTURE FORCE

WWW.ONR.NAVY.MIL

Focus — Broad / Narrow

5-20 years
Discovery & Invention
(Basic and Applied Science)
≈ 50%

4-8 years
Technology Push
(Leap Aheads, Innovative Naval Prototypes)
≈ 12%

2-4 years
Technology Pull
(FNCs, ManTech, TechSolutions)
≈ 30%

1-2 years
Quick Reaction S&T
(SwampWorks, Experimentation)
≈ 8%

Current Fleet/Force   **Fleet/Force in Development**   **Future Fleet/Force**

Portfolio is balanced across near, mid and long term S&T investments

CNR / VCNR Reporting Structure

Secretary of the Navy

Chief of Naval Operations ★★★★

Commandant of the Marine Corps ★★★★

Ass't Secretary of the Navy (RDA)

N9, Deputy CNO for Warfare Systems ★★★

Deputy CMC for Combat Development & Integration ★★★

Chief of Naval Research ★★

N94, Director of Innovation, Tech Req'ts, and T&E ★★

Vice Chief of Naval Research ★

Commanding General Marine Corps Warfighting Lab ★

CNR & VCNR are both dual-hatted; CNR Reports to ASN(RD&A) & CNO

Distribution Statement A: Approved for public release

Organization

NRL

PMR-51

ONRG

Chief of Naval Research
★★
Executive Director (SES)

Vice Chief of **(USMC)**
Naval Research ★

ACNR

AVCNR

BIZOPS

Code 30	Code 31	Code 32	Code 33	Code 34	Code 35
Expeditionary Maneuver Warfare & Combating Terrorism	C4ISR	Ocean Battlespace Sensing	Sea Warfare and Weapons	Warfighter Performance	Naval Air Warfare and Weapons
Focus Area: Expeditionary & Irregular Warfare	*Focus Areas: Information Dominance, Electromagnetic Maneuver Warfare*	*Focus Area: Assure Access to Maritime Battlespace*	*Focus Areas: Platform Design & Sustainment Power & Energy*	*Focus Area: Warfighter Performance*	*Focus Area: Power Projection & Integrated Defense*

Director of Research (03R)

Discovery & Invention, SwampWorks, and STEM

The nine S&T Focus Areas cut across all departments

Basic & Applied Research

Director of Transition (03T)

Technology Maturation Portfolio; Leap-Aheads; Quick Reaction S&T

The two Directorates manage cross-cutting programs

Future Naval Capabilities
Quick Reaction
Disruptive Technologies

Partnering with the Best Performers

Key Criteria:
- **Technical Quality**
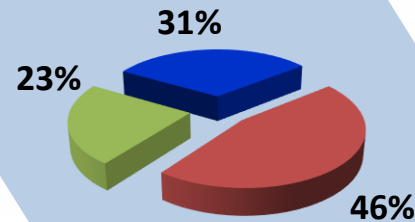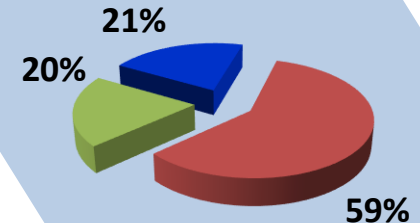- **Relevance / Responsiveness**
- **Cost & Affordability**
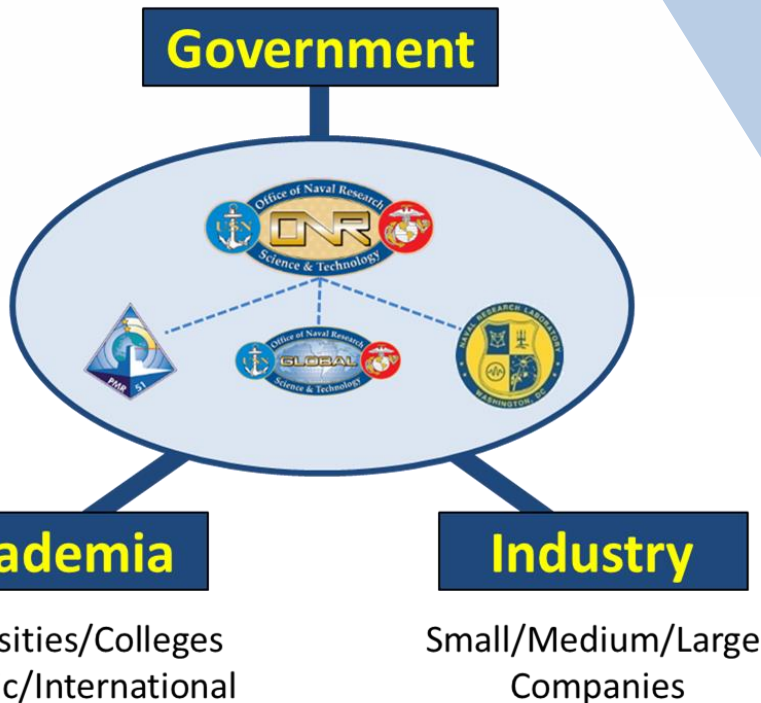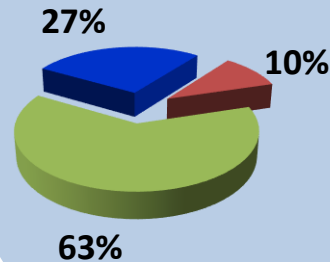
Navy Labs & Warfare Centers
Universities and Nonprofits
Industry

Basic Research

27%
10%
63%

Applied Research

31%
23%
46%

Advanced Technology Development

21%
20%
59%

Government

Office of Naval Research
Science & Technology

Academia

Universities/Colleges
Domestic/International

Industry

Small/Medium/Large
Companies

Driving Innovation and Fostering Partnerships

RDT&E Budget

S&T Budget

Basic Research	Applied Research	Advanced Technology Development	Adv. Comp. Development & Prototypes	System Development & Demonstration	RDT&E Management Support	Operational System Development

Naval R&D Establishment
(ONR, SYSCOMs and their Warfare Centers, PEOs)

Office of Naval Research

SPAWAR

NAVSEA
NAVAL SEA SYSTEMS COMMAND

NAVAIR

Future Naval Capability (FNC) Program

A collaborative Naval process involving the S&T, Acquisition, Resource Sponsor (RS), and Fleet and Force communities which:

- Responds to Navy / Marine Corps requirements (Technology Gaps)

- Matures technology from proof of concept (Technology Readiness Level (TRL) 3), to a prototype tested in a relevant environment (TRL 6) within 5 years

- Transitions S&T solutions to Acquisition Programs of Record (PORs) for deployment to the Fleet and Force

Goal: Effectively deliver new capabilities to the warfighter

Example FNC
Advanced Material Propeller

Leverages Basic Research (6.1 / 6.2)	FNC Product (6.2 / 6.3)	Delivers to Acquisition POR (6.4 / 6.5)
• Cavitation Erosion-Resistant Coating & Matrix Materials • Hydro-Elasticity Effects of Composite Materials • Large-Eddy Simulation of Crashback Loads	Pitch-adapting Composite Submarine Propeller for: • Enhanced Performance • Reduced Weight • Less Maintenance • Reduced Acquisition & Life Cycle Costs	• Advanced Submarine Systems Development • Next Generation Submarines

• Carbon Fiber Composite Prop
• Individual Blade-Hub Connection
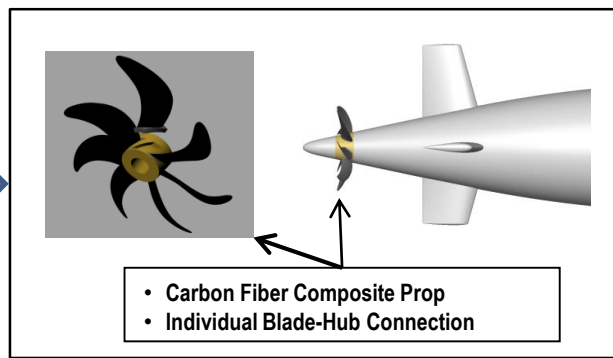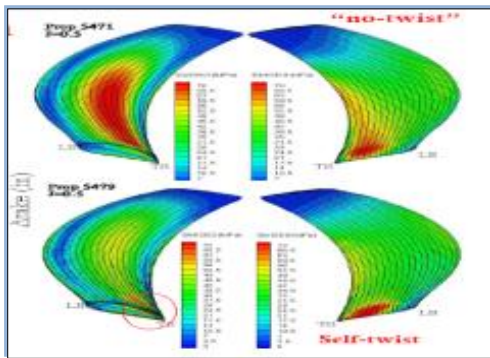
Innovative Naval Prototypes

EMRG

A high-power, kinetic-energy weapon capable of launching precision guided projectiles using electricity instead of chemical propellants. Fabrication in process for first of four full-scale Railgun launcher prototypes and power hardware to support repetition-rate and bore life objectives.

SSL

Develop and Demonstrate Integrated 150 KW Solid State Laser Weapon System on a Naval Surface Ship/Combatant for ship defense.

Claws

Develop and demonstrate a new class of payloads, delivered and deployed from LDUUV. Focus is new autonomy for operations near the surface, avoiding surface obstacles and threats, and in deploying payloads tat will act as a significant force multiplier. Will develop C4I and IA necessary for precision delivery of payloads in potentially contested waters and A2/AD environments.

HIJENKS

In a joint USAF/USN program using HPRF, develop a payload integrated on an air platform capable of engaging multiple electronic targets with a single scalable effects weapon, from outside of excessive standoff ranges across a variety of warfighting missions.

TPCP

Delivers cybersecurity S&T tools for protecting Naval platforms across surface, ground, subsurface and air domains from today and tomorrow's cyber threats..
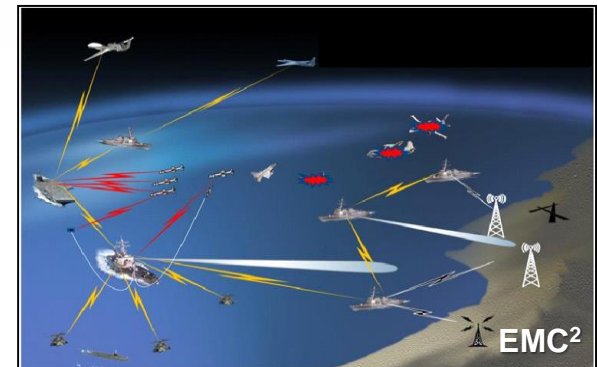
EMC^2

Enables a strike group to work cooperatively in the EM Spectrum to optimize EW, IO, Comms, and Radar performance to achieve Commander's intent to a set of priorities. Preliminary work has begun to look at how to translate Commander's intent to a set of priorities..

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ElectroMagnetic RailGun (EMRG)

Railgun is a high-power, kinetic energy weapon capable of launching precision guided projectiles using electricity instead of chemical propellants. Magnetic fields created by high electrical currents accelerate a sliding metal conductor, or armature, between two rails to launch projectiles to velocities up to Mach 6 at muzzle exit.

Phase I (2005-2011): Achieved goal of developing a 32 MJ muzzle energy proof-of-concept demonstration. Focused on the development of launcher technology with adequate service life and reliable pulsed power technology and projectile component risk reduction.

Phase II (2012-2019): Goal is to advance technology for transition to an acquisition program. Technology efforts will concentrate on demonstrating launcher and pulsed power system capable of 10-rounds-per-minute firing rate including thermal management techniques required for sustained firing rates.
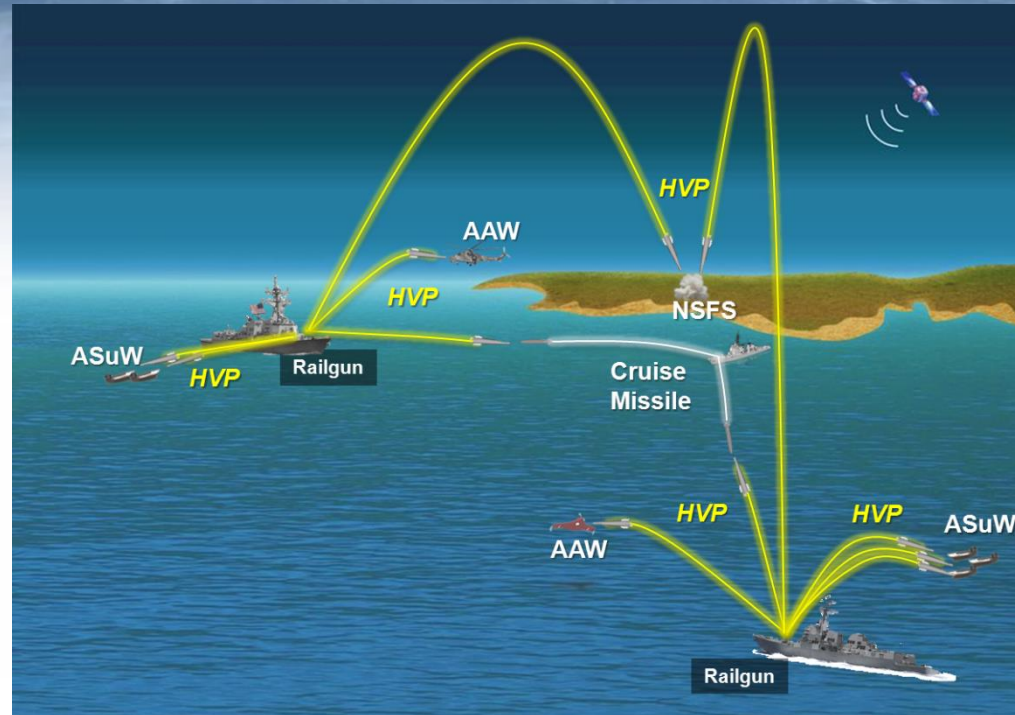
- Railgun INP will deliver a 32MJ barrel and power system capable of high firing rate operations.
- HVP FNC will deliver an NSFS round for conventional Mk 45 gun systems
- Both will contribute to the development of a 32MJ railgun weapon system firing guided projectiles 100+ NM with a multi-mission capability:
  - ❑ Naval surface fire support or land strike
  - ❑ Ship defense
  - ❑ Anti-air and anti-surface warfare

When combined with Hyper Velocity Projectile, Railgun will transform the capabilities of the warfighter.

Innovative Naval Prototypes

InTop

Provides affordable architectures, standards and technology for wide-band, multi-beam, multi-function RF systems capable of supporting all warfare areas simultaneously by implementing priorities in order to meet the commander's intent.
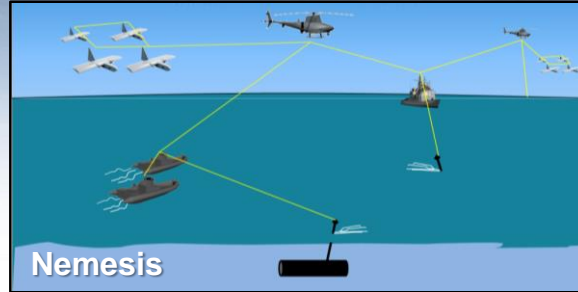
Nemesis

Coordination and synchronization of EW techniques and systems across a variety of distributed EW platforms, both above and below the surface. Elements of mission planning command and control infrastructure will be demonstrated during Trident Warrior'16.

LDUUV

Effort to increase capacity of ISR by using large UUVs capable of 1,000+ nm and 70+ day endurance launched from piers and large amphibious ships.

AACUS

Sensor suite and software package suitable for installing and integration into an existing USMC rotary wing aircraft to enable optionally unmanned autonomous flight. A UH-1 is being modified to facilitate future technology maturation and capability expansion and demonstrate optional unmanned aircraft capabilities in support of an Assault Support Mission.
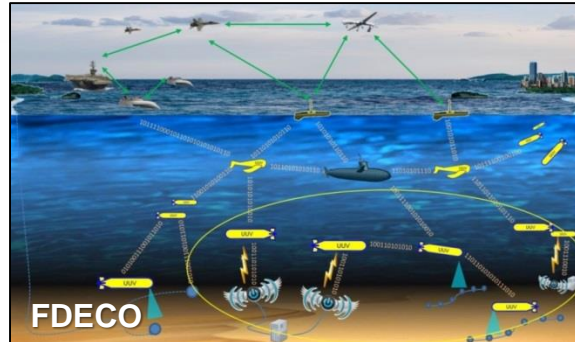
FDECO

Provides an expeditionary infrastructure for undersea energy and information distribution. Scalable game-changing capability that will provide composable and relocatable resources for undersea warfare.
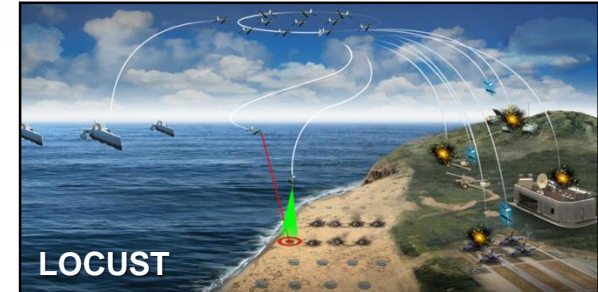
LOCUST

Develop and deliver DC3 autonomy science and architecture, C2 architecture, and a series of modular payloads to provide a robust, scalable, flexible, multi-functioned swarming UAV system providing cross-domain capability. Employable from surface, sub-surface, airborne, and ground manned and other un-manned systems.
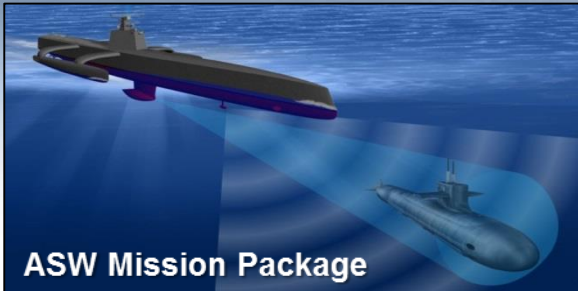
Characteristics:
- **Long endurance (60+ days)**
- **Autonomous over horizon ops**
- **Multi-Mission Capability**
- **Open Architecture**

Open Architecture Modular Payloads

Innovative Naval Prototypes

ASW Mission Package
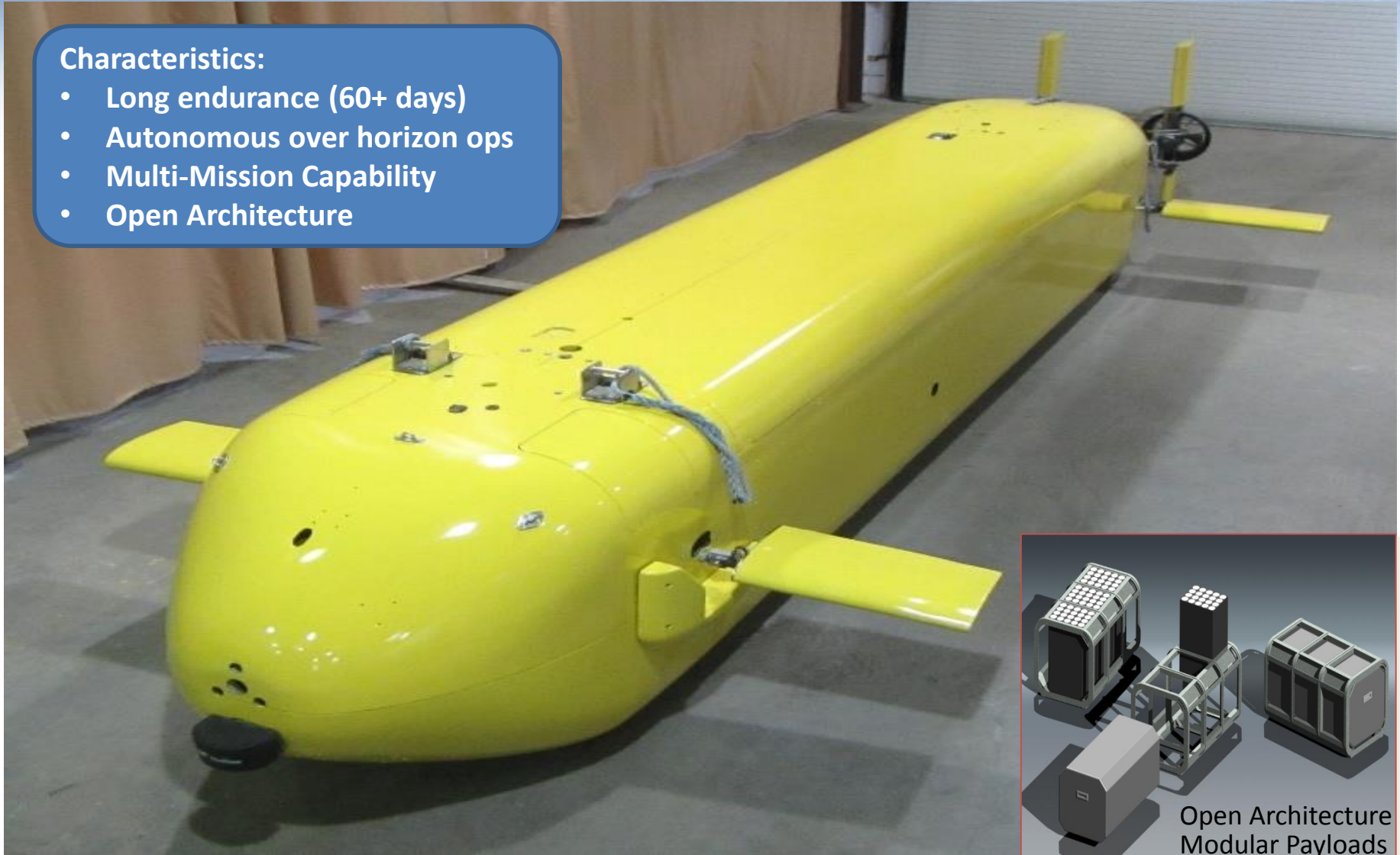
Demonstrate the ability for a UUV to autonomously conduct ASW missions using two sensor types.

LDUUV Power & Energy

Develop novel, air-independent, UUV energy system technology to meet the Navy's increasing energy endurance needs. Seeking a 2X-3X+ increase in energy density over current state of art battery technology

USV Swarm

Develop and demonstrate highly autonomous, multi-USV operations for offensive and defensive missions, using small inexpensive USVs. Demonstrate and assess operational utility and develop CONOPs, and demonstrate autonomous control performance to generate human operator trust.

Sea Hunter

Demonstrate multi-mission versatility of MDUSV using MIW, ASW and EW payloads. Identify key interface requirements for future payloads and assess the autonomy performance with EO/IR components.

Tern

Demonstrate Air Vehicle technologies enabling long range sustained air presence at medium altitudes with vehicles operable from small decks. Enable persistent ISR, BLOS comms to enable long range weapons & operations.

SALRS
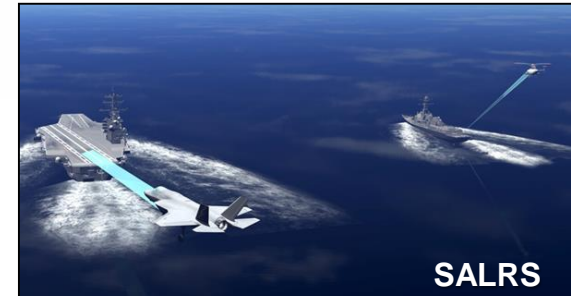
Develop non-GPS dependent precision ship-relative navigation (PS-RN) technologies for automated ship landings, suitable for use in degraded weather and EMCON Alpha. Enable robust, routine UAV operations from Navy air capable ships in expanded conditions.

Sea Hunter

Artist's Concept
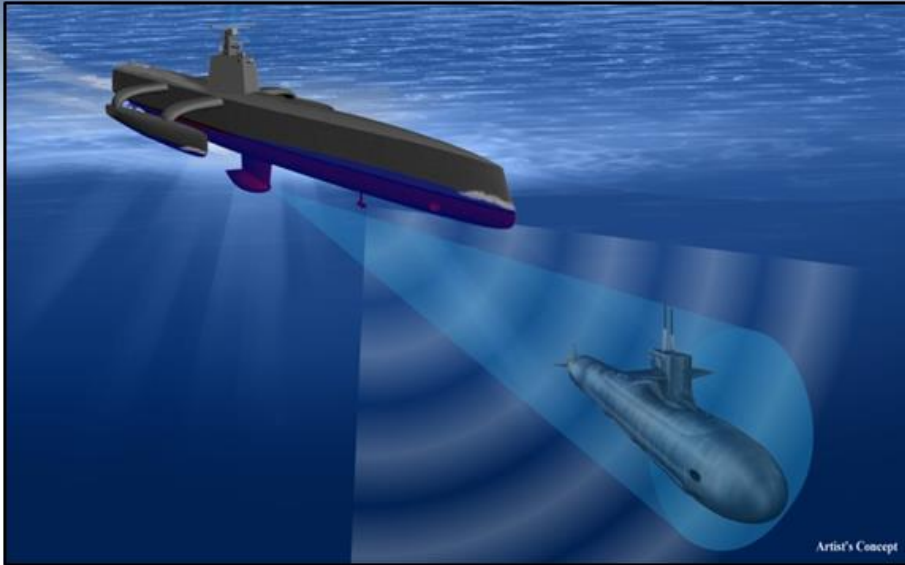
Characteristics:
- **Ocean-Spanning Range**
- **Autonomous Control**
- **Multi-Mission Capability**
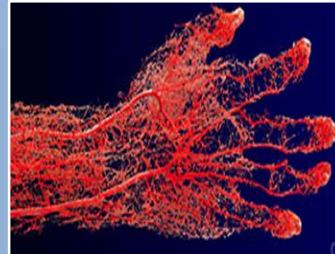- **Large Payload Capacity**
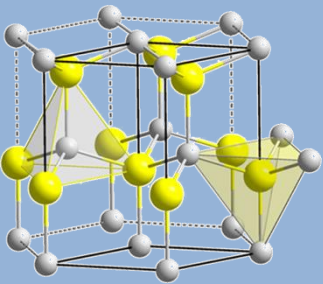
Basic Research:
From Test Tubes to Launch Tubes
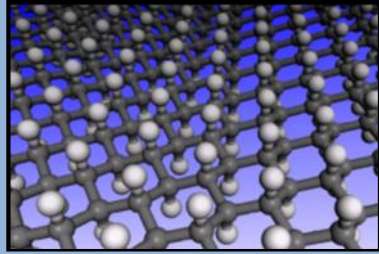
Graphene

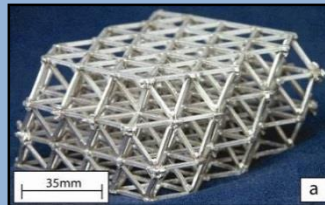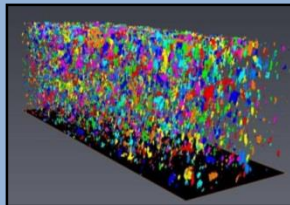Crack & Failure Prediction

3D Printing of Veins

Gallium Nitride

Microbial Fuel Cells

Blast/Energy Absorbing Structures

Mesoscale Characterization

-Advanced Materials
-Algorithmic Phenomenology
-Synthetic Biology

Enabling the Future Generation of Warfighting Capabilities

Accelerating S&T Process Through Partnership

Washington, D.C. Region
Executive Officer
Arlington International Liaison Office
N9 ★★★
N81 ★★
C10F ★★★

ONR Global Headquarters London
Commanding Officer
Technical Director

ONR Global Prague

Newport
CNO SSG ★★★★

San Diego
C3F ★★★
AIRFOR ★★★
SURFOR ★★★
I MEF ★★★
UWDC ★
NSMWDC ★

Mayport
C4F ★★

ONR Global Tokyo

Norfolk
FLTFOR ★★★★
NAVIFOR ★
SUBFOR ★★★
MARFORCOM ★★★
NECC ★★
NWDC ★

Naples
NAVAF/NAVEUR/
C6F ★★★

Bahrain
C5F ★★★

Yokosuka
C7F ★★★

Camp LeJeune
II MEF ★★

Okinawa
III MEF ★★★

Hawaii
PACOM ★★★★
PACFLT ★★★★
MARFORPAC ★★★

ONR Global Singapore

ONR Global Santiago

ONR Global São Paulo

★ Joint Command
★ Naval Command
★ Marine Corps Command

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- Tokyo (USA/USAF)
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- Singapore (USA)
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