ONR Electronic Warfare S&T Industry Day

10 January 2014

Dr. Peter Craig

Electronic Warfare Program Manager

C4ISR Department

Office of Naval Research







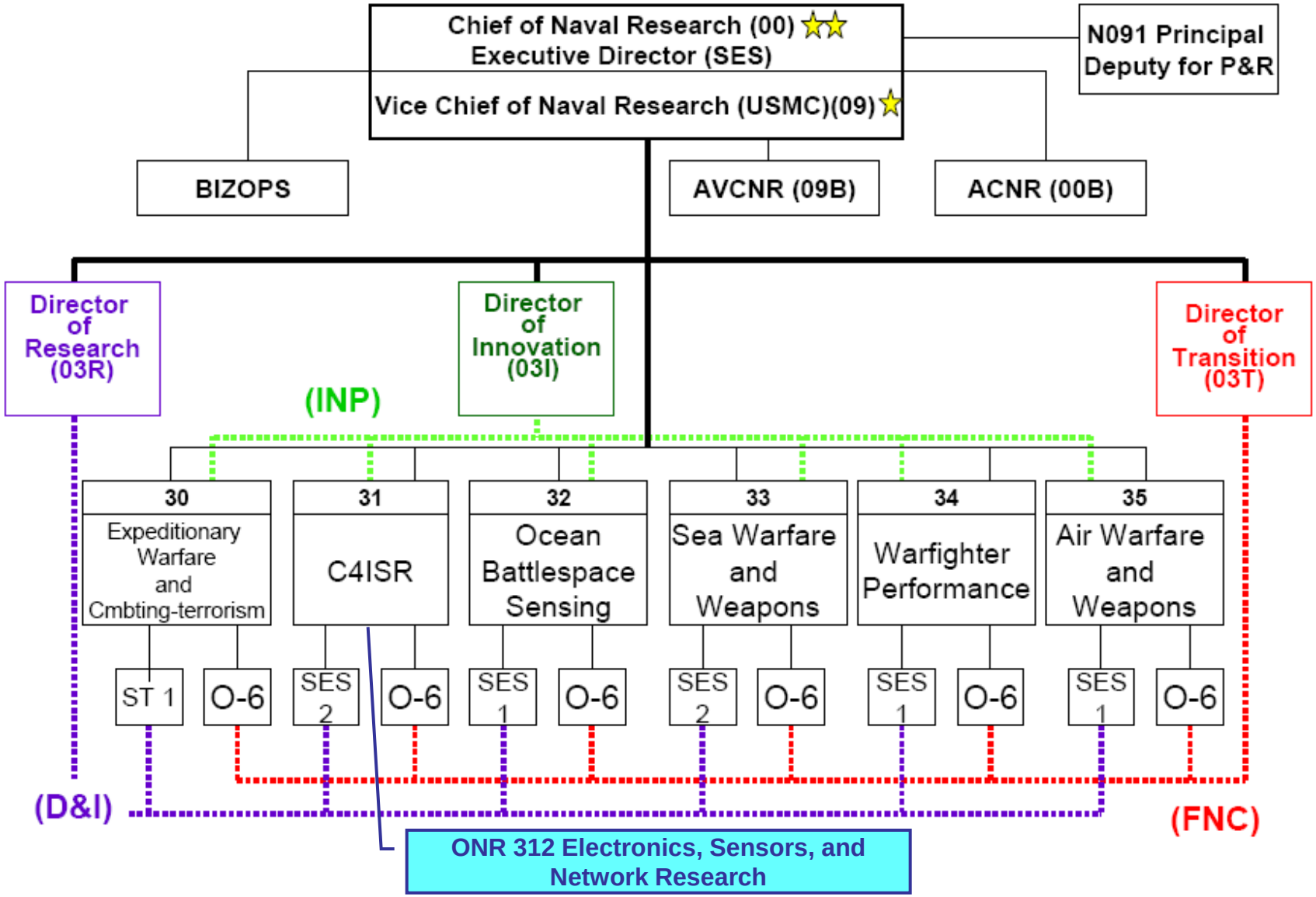

Office of Naval Research
Science & Technology

ONR Mission: ***To plan, foster, and encourage scientific research in recognition of its paramount importance as related to the maintenance of future naval power, and the preservation of national security; and to manage the Navy's basic, applied, and advanced research to foster transition from science and technology to higher levels of research, development, test, and evaluation.***

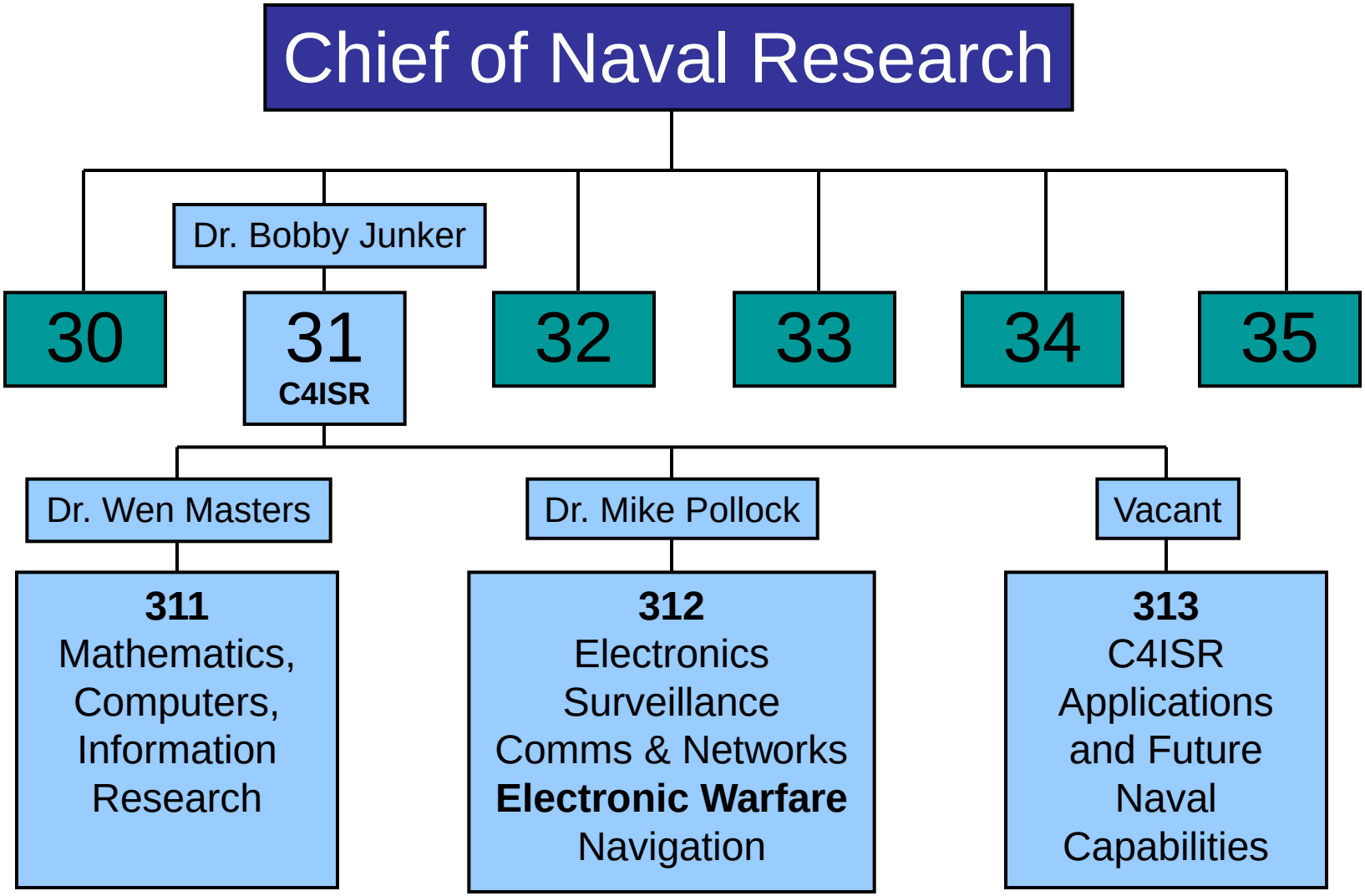
Naval S&T Vision: ***Sponsor scientific research and technology to:***

- ***Pursue revolutionary capabilities for Naval forces of the future,***
- ***Mature and transition S&T advances to improve naval capabilities,***
- ***Respond to current critical needs,***
- ***Maintain broad technology investments to anticipate and counter potential technology surprise.***

Office of Naval Research
Organization (S&T)



ONR Organization - S&T



ONR 312 Electronic Warfare

Electronic Warfare Technology Program

Dr. Peter Craig
EW Program Manager

Mr. Dave Tremper
EW Program Officer

Dr. Vince Cassella
EW Program Officer

Dr. Kevin Rudd
EW Program Officer

Mr. Bob Kusuda
CACI

Mr. Shane Stein
CACI

Mr. Tom Jesswein
CACI

6.2 Discovery & Invention

- EO/IR Countermeasures
- Wideband ES – Sensing/Processing
- Enabling Cognitive & Adaptive EW
- Spectrum Knowledge/Learning/ Reasoning/Attack
- Multi-Band Lasers
- Wideband EA – Components/Techniques
- Technologies for High Throughput & Rapidly Programmable EW Systems
- Multi-Mode CM Techniques
- High Power mmW Transmitters
- Emulation Environments for Adaptive & Targeted Electronic Warfare

Future Naval Capabilities (Sea Strike, Sea Shield, ForceNet & Expeditionary Maneuver Warfare)

Surface/Subsurface
- Next Gen CM for SMD
- Submarine Survivability – EW
- EW Battle Management
- Scalable Integrated RF (SIRFSUP)

Air
- Identification and Defeat of EA Systems
- Collaborative Electronic Attack
- Multi-Spectral Seeker Defeat

Marine Corps
- Future Joint Counter Radio-Controlled IED EW
- Hostile Fire (HF) Suppression

SBIR/STTR EW Technologies

Doing Business with ONR

Business Opportunities

- Broad Agency Announcements (BAA)
- Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR)
- Multidisciplinary Research Program of the University Research Initiative (MURI)
- Defense University Research Instrumentation Program (DURIP)
- DoD Experimental Program to Stimulate Competitive Research (DEPSCOR)

Detailed information can be found on the ONR website

http://www.onr.navy.mil/en/Contracts-Grants.aspx

What is Electronic Warfare?
Joint Service Definition

Development of technologies that maximize the operational use of the electromagnetic (EM) spectrum by U.S. forces, ...while denying same from the enemy, ...by using EM means to detect and attack enemy sensor, weapon and command infrastructure systems

- **– Immediate battlespace recognition of hostile scenario/intent and optimized, automated response decisions**
- **– Electronic denial, degradation, disruption or destruction of enemy C4ISR, IADS, acquisition and associated targeting/weapon systems**
- **– Timely EM control over the entire battlespace: temporal, spectral, spatial**

Electronic Warfare in Perspective

The RED Kill Chain…

Detect	ID	Track	Decide	Engage	Assess

… and the Electronic Warfare Response Chain…

Detect	ID	Track	Decide	Engage	Assess

Situational Awareness/Threat Warning

Requires capability to:

- **Continuously monitor all critical portions of the spectrum**
- **Quickly and accurately classify emitters/emitter function**
- **Provide specific emitter identification**
- **Precisely and rapidly locate platforms, events**
- **Conduct accurate long term monitoring/tracking**
- **Share key info in near real time**

Counter Targeting/Jamming/ Self-Protection

Requires capability to selectively:

- **Limit/deny access (jamming)**
- **Provide false/misleading information (countertargeting, decoys)**
- **Counter communications and networks**
- **Damage/degrade threat sensor capability**

EW Networked Capabilities, Analysis & Assessment, Electronic Protection

Battlespace Awareness **Spectrum Control**

Information Dominance

Electronic Warfare Terminology
DoD / JCS Definitions

Electronic Warfare (EW): **"Any military action involving the use of EM radiation … to control the EM spectrum or to attack the enemy."**

- **Electronic Warfare Support (ES):** Actions to search for, intercept, ID & locate intentional / unintentional EM sources for the purpose of immediate threat recognition
  - Provides information/data for immediate decisions regarding operations & tactical actions (avoidance, targeting, cueing)
- **Electronic Attack (EA):** Use of EM … to attack with the intent of degrading, neutralizing or destroying enemy combat capability
  - Includes jamming, EM deception, decoys/expendables
- **Electronic Protection (EP):** Actions taken to protect ... from any effects of friendly or enemy employment of EW that degrade, neutralize, or destroy friendly combat capability

Electronic Warfare Terminology

Scope & Domain Boundaries within the EMS

Electronic Warfare: **Military action involving the use of electromagnetic (EM) and directed energy to control the electromagnetic spectrum (EMS) or to attack the enemy.**

- **EP** — Protect EM systems against EM interference
- **Electromagnetic Spectrum Management**
- **EA** — Degrade, disrupt, deceive, & deny adversary EM system signals, processing, and C2 functions
  - **DE (EA)** — Induced currents or voltages
- **ES** — Tactical sensing for real-time response

- **PSYOP/MISO** — Induce alarms or failures / influence ideology
- **Counter-DE** — Protect non-EM system against EM interference and DE (Weapon)
- **C3** — Command, Control and Communications (voice, data, info)
- **Cyber Attack** — Operations intended to manipulate adversary info and/or cyber systems
- **DE (Weapon)** — Thermal / radiation bombardment
- **ISR/SIGINT** — Intelligence, Surveillance and Reconnaissance gathering systems

ONR Electronic Warfare
S&T Area Objectives

Dominate the Spectrum

Pervasive Spectrum Awareness **- Know who is out there, where they are, and what they are doing…**

Requires capability to:

ES

- **Continuously monitor all critical portions of the spectrum (RF/EO/IR)**
- **Quickly and accurately classify emitters/emitter function**
- **Provide Specific Emitter Identification (SEI)**
- **Precisely and rapidly locate platforms, people, things, events**
- **Conduct accurate long term monitoring/tracking**
- **Network sensors and share key info in near-real time**

Effective Spectrum Control **- Determine who sees what…**

Requires capability to selectively:

EA

- **Limit/deny access (jamming) (RF/EO/IR)**
- **Provide false/misleading information (countertargeting, decoys)**
- **Damage/degrade threat sensor capability (RF/EO/IR)**

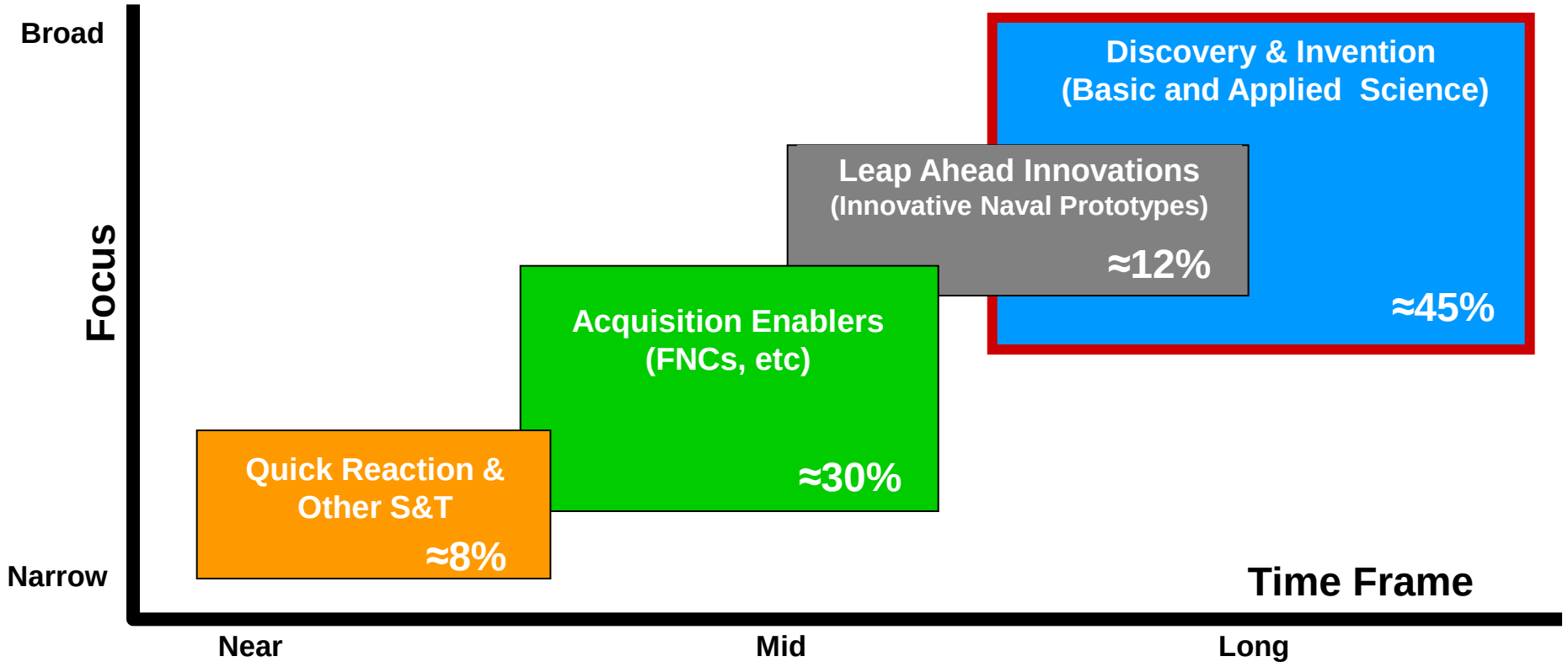
Unrestricted Spectrum Access **for Blue Forces – Protect our own ISR capabilities…**

Requires capability to:

EP

- **Negate the impact of hostile jamming on U.S. and allied sensors (RF/EO/IR)**
- **Preserve the integrity of critical networks and data links**
- **Precisely navigate and target weapons in a GPS-denied environment**

ONR S&T Portfolio Balance



Quick Reaction

- Tech Solutions
- Experimentation
- MC S&T (MCWL, JNLW, etc.)

Acquisition Enablers

- Future Naval Capabilities
- Warfighter Protection
- Capable Manpower
- LO/CLO

Leap-Ahead Innovations

- Innovative Naval Prototypes
- NSPs
- Swampworks

Discovery & Invention

- Basic & Early Applied Research
- National Naval Responsibilities
- Education Outreach HBCU/MI

ONR Portfolio Characteristics

	Direct Fleet Support / Quick Reaction	Future Naval Capability (FNC)	Innovative Naval Prototype	Discovery and Invention (D&I)
% of Portfolio	~8	>30	~12	>45
Focus	Solving emergent fleet / force needs	Transitioning mature S&T to acquisition program of record	Demonstrating Leap-ahead technology	Expanding frontiers of knowledge in areas of naval interest
Motivation	Fleet-identified need	OPNAV-identified capability gap	Significant military advantage	General Naval needs and opportunities
Example	IED Jammer	Enhanced NULKA Payload	Integrated Topside (INTOP)	Wideband GaN EW System Components
Type of Innovation	Disruptive or sustaining.	Sustaining - makes an existing capability better	Disruptive - makes an existing capability obsolete	Disruptive or sustaining.
Time frame	1-2 years	3-5 years	4-8 years	continuing
Typical TRL entry point	TRL-4 to TRL-5	TRL-3	TRL-2 to TRL-3	TRL-0 to TRL-2
Typical TRL end point	TRL-7	TRL-6	TRL-6	TRL-3 to TRL-4
Technical Difficulty	Medium	Medium	High	High
Operational Integration Complexity	Medium	Usually straightforward	High	N/A
Approval Level to start a program	ONR Corporate	Technology Oversight Group (3-Star)	DON Corporate Board (4-Star)	ONR Department

Technology Readiness Levels

1. **Basic principles observed and reported.** Example: Paper studies of a technology's basic properties.
2. **Technology concept and/or application formulated.** Example: Limited to analytical paper studies.
3. **Analytical and experimental critical function and/or characteristic proof of concept.** Example: Components that are not yet integrated or representative. **D&I**
4. **Component and/or breadboard validation in laboratory environment.** Example: Integration of "ad hoc" hardware in a laboratory.
5. **Component and/or breadboard validation in relevant environment.** Example: "High fidelity" laboratory integration of components.
6. **System/subsystem model or prototype demonstration in a relevant environment.** Example: Testing a prototype in a high fidelity laboratory environment or in a simulated operational environment.
7. **System prototype demonstration in an operational environment.** Example: Testing the prototype in a test bed aircraft.
8. **Actual system completed and qualified through test and demonstration.** Example: Developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9. **Actual system proven through successful mission operations.** Example: Using the system under operational mission conditions.

ONR EW S&T Development Process
Annual D&I Refresh

Sep - Oct

ONR EW S&T Future Vision
- Capability gaps (OPNAV guidance, NARG's)
- Roadmaps (S&T, Acquisition)
- Emerging threats (intell reporting)
- Technology trends (to avoid surprise)

Nov - Jan

D&I BAA
- Industry
- Academia

D&I Solicitation
- NRL
- Warfare Centers
- FFRDC / UARC

February

Review White Paper Submissions
- Evaluate technical merits/innovation, Naval relevance, prior experience, cost realism
- Down-select roughly 2x $$ available

March

EW S&T Review (Gathering) – Invitation Only

Agenda:
- EW Requirements view (OPNAV, HQMC)
- EW Acquisition view (NAVSEA, NAVAIR, MCSDC)
- Briefings of current D&I, SBIR, FNC efforts
- Briefings of proposed D&I new starts for following FY

Actions:
- Invited reviewers advise on D&I new start selection
- Begin dialog regarding new FNC needs
- De-conflict with other service reps (Army, Air Force)

April - May

Select new D&I projects
- Request full proposals

Jun - Aug
- Initiate contract actions
- Prepare FM documentation

Oct - Jan
- Award Contracts
- Send Funding Documents

ONR 312 EW D&I Products

Completed, Current, and Planned

FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18

Multiband EO/IR Subsystems

PLANNED

Wideband ES & EA Subsystems

- RF / Millimeter Wave EW Subsystem Demonstrators
- Compact & Efficient EW Antennas Covering HF to VHF
- W-Band Millimeter Wave High Power Transmitters

Adaptive/Cognitive Processing for EW

- Spectrum Knowledge & Cognitive EW Architectures
- Coherent Network-Centric Spectrum Attack
- Heterogeneous Parallel Mobile Computing for RF EW
- Signature Detection Based on Nonlinearity

Multiband EO/IR EA Transmitters

- Multiband Semiconductor Laser on Common Substrate
- Continuously Tunable Multiband Fiber/Waveguide Laser
- Non-Mechanical Beam Steering Technologies

Wideband ES & EA Concepts

- 1-110 GHz Photonic Cueing Receiver Technology
- Wideband ES Components & Signal Processing
- 1-110 GHz EA Components & Isolation Techniques
- Advanced DRFM-Based Systems and Techniques
- 18-45 GHz mmW High Power Transmitters
- Next Gen EW Components Based on Graphene
- UV Solar-Blind FPA & Advanced EO CM Techniques

Distributed ES & CM to Passive ES

- Cooperative Distributed Sensors for EW
- Unique Integrated EW Antenna Architectures
- Adaptive ES Signal Processing & Imaging
- Detect/Defeat Passive RF and EO/IR Sensors

Multispectral / Multi-Mode CM

- High-Power LWIR QC Lasers for Shipboard IRCM
- Multi-Wavelength Laser with Broad Spectral Coverage
- Layered Multi-Band Obscurants
- Directed Energy Defeat of Multi-Mode Threats

EW S&T Research Emphasis

- **Photonic Signal Processing**
- **Adaptive ES/EA Techniques**
- **EW Effectiveness Monitoring**
- **Multispectral EA Technologies**
- **Counters to Imaging Sensors**
- **Networked EW Concepts**
- **Lower Cost and SWAP**

Future EW Vision

Elements of Future EW Systems	Objective Capability (What?)	Enabling Technology (How?)
Distributed	Maximize EW spatial coverage with a minimum of resources without permitting single point failures	Small, lightweight, power efficient ES / EA payloads for manned and unmanned vehicles (UAV, USV, UUV, UGV)
Coordinated	Maximize effectiveness of EW across on-/off-board assets, manned / unmanned platforms, kinetic / non-kinetic resources	Multi-asset, coordinated kinetic / non-kinetic M&S; multi-platform ID / targeting / tracking / EA techniques and algorithms
Multispectral	Maximize EW spectral coverage (EO-IR-mmW-RF) and minimize spectral gaps that can be exploited by hostile forces	EO/IR/RF receiver / transmitter subsystems and components with extended spectral coverage and ultra-wide bandwidth
Adaptive	Maximize flexibility in dynamically responding to time critical, frequency agile emitters	Embedded ES / EA architectures with high-speed reactive ES processing and dynamic EA techniques generation
Robust EP	Maximize operational availability of ISRT sensor assets and preserve situational awareness in the presence of hostile EA	Dynamic / reactive / adaptive signal processing, hardened EO/IR/RF apertures and components

Increased Combat Effectiveness

DoD Electronic Warfare
Joint Service EW S&T Priorities

Technology Challenges (TCs) & Desired End States

TC1: Cognitive, Adaptive Capabilities
- **Effectively outpace adversary decision and technical options**

TC2: Coordinated / Distributed / Network-Enabled Systems
- **Spatially and temporally diverse responsiveness to dense and complex threat environments**

TC3: Preemptive / Proactive Effects
- **Real-time sensing, assessment and optimization of EA effectiveness**

TC4: Broadband / Multispectral Systems
- **Widest possible spectral extent to our control of the EMS**

TC5: Modular / Open / Software-Configurable Architectures
- **Timely deployment or insertion of advanced EW in response to rapidly changing conditions**

TC6: Advanced Electronic Protection Techniques & Technology
- **Allow unfettered operations in the increasingly dense EMS environment**

ONR Discovery & Invention
Last year: ONR BAA 13-005

Enabling Cognitive and Adaptive EW

Apply adaptive and machine learning algorithms to EW. Develop methods to represent real-time dynamic spectrum knowledge, sense and learn RF features and behaviors, and reason about threat systems and the environment to form electronic attack strategies on-the-fly. Specific areas include:

- Spectrum Knowledge
- Spectrum Learning
- Spectrum Reasoning
- Spectrum Attack

High Throughput and Rapidly Programmable EW Systems

Develop enabling technologies for reconfigurable EW systems that have extremely high-volume processing capability. The objective is a software defined RF system capable of performing real-time signal processing over not less than 3 GHz (threshold) and up to 10 GHz (objective) of RF bandwidth with low SWAP. The goal is to minimize the amount of data that needs to be moved from system to system or platform to platform by processing it at the data source.

Emulation Environments for Adaptive and Targeted EW

Develop emulated RF or M&S environments to enable the development, testing, and validation of cognitive and targeted EW techniques and systems. This includes the development of testbeds to test adaptive EW techniques, including representative models of EM systems and realistic EM background environments. Testbeds should support research into closed-loop techniques in order to anticipate and out-pace agile threat behavior.

Innovative EW Concepts

Explore truly innovative concepts in the EW areas of ES, EA, or EP which could fundamentally change the way naval forces conduct EW Operations.

ONR Discovery & Invention
Last year: ONR BAA 13-005

Enabling Cognitive and Adaptive EW

Spectrum Knowledge
- Spectrum Knowledge (SK) Framework (JHU/APL)
- An SK Signal Descriptor Language (NRL 5722)

Spectrum Learning
- Cognitive Architecture for Cooperative Electronic Warfare (NRL 5722)

Spectrum Reasoning
- Cognitive Radio Network Identification, Association, and Attack (NRL 5730)

Spectrum Attack
- Coherent Network-Centric Spectrum Attack (NAWC WD Pt. Mugu)

High Throughput and Rapidly Programmable EW Systems

- Heterogeneous Parallel Mobile Computing for RF Sensing and Spectrum Knowledge (Virginia Tech)

Emulation Environments for Adaptive and Targeted EW

- [No Award]

Innovative EW Concepts

- Signature Detection Based on Nonlinearity (NRL 6362)

ONR Discovery & Invention
This year: ONR BAA 14-006

ONR BAA Announcement # ONR 14-006

- **Posted:** ***18 December 2013***
- **Agency Name:** ***Office of Naval Research***
- **Research Opportunity Title:** ***Electronic Warfare Technology***
- **Program Name:** ***Electronic Warfare Discovery & Invention (D&I)***
- **Response Dates:**
  - **White Papers:** ***04 February 2014***
  - **Full Proposals:** ***06 May 2014***

ONR Discovery & Invention
This year: ONR BAA 14-006

ONR 312 Electronic Warfare (EW) seeks white papers for efforts that shall develop and demonstrate technologies for the next generation systems in electronic warfare. The primary emphasis of this BAA is on technologies towards

1. **Radio Frequency (RF) / Millimeter Wave (mmW) Electronic Warfare Subsystem Demonstrators (SSD)**
   a) **Broadband RF/mmW Receiver SSD for Unknown Signal Detection, Identification, Direction Finding, and Tracking**
   b) **Wideband, Multi-Signal, Simultaneous Transmit and Receive (STAR) RF Front-End SSD**
   c) **Millimeter Wave (mmW) Electronic Warfare SSD**
2. **Compact and Efficient EW Antennas Covering HF to VHF (3-300 MHz)**
3. **W-Band Millimeter Wave (mmW) High Power Transmitters**
4. **Innovative EW Concepts**

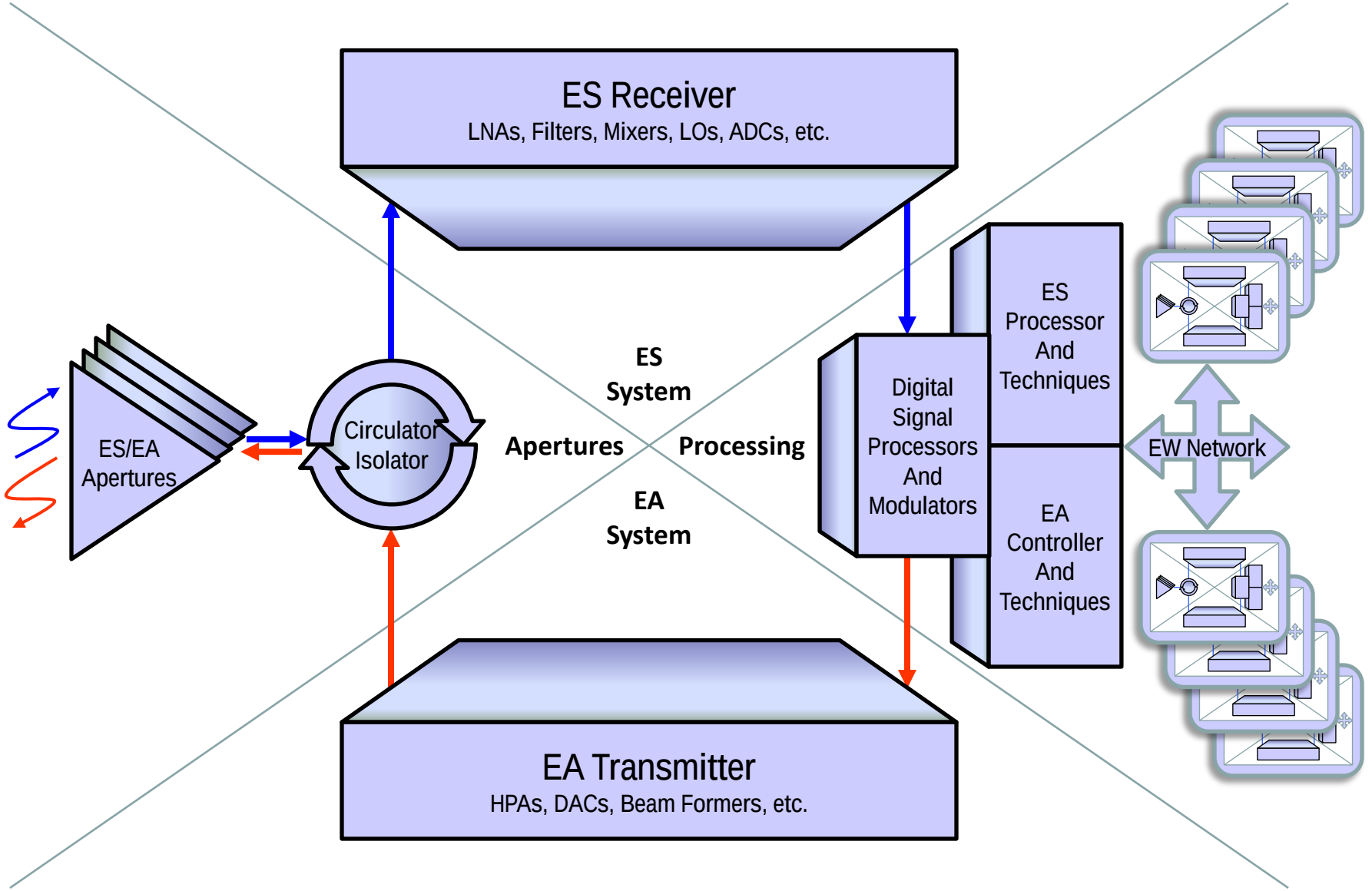
RF/mmW Electronic Warfare Subsystem Demonstrators (SSDs)

1. Radio Frequency (RF) / Millimeter Wave (mmW) Electronic Warfare Subsystem Demonstrators (SSDs)

The objective is to **leverage prior investments** by ONR and other Government organizations **in electronic and photonic technologies, techniques, components, devices and subsystems to create subsystem demonstrators (SSDs) of advanced EW capabilities in the RF and mmW portions of the EMS.** For the purposes of this solicitation, an SSD will be defined as an integrated collection of components, devices and subsystems that, in conjunction with other established or developmental technologies and techniques, will demonstrate an end-to-end EW capability from the list below. **Each SSD will demonstrate both the functional configuration and capability of a final EW subsystem, though not necessarily the physical configuration, packaging, or form factor.** White Papers and subsequent proposals will encompass not only the development of these SSDs but also **a final government-witnessed demonstration in a tactically relevant real or simulated environment**. In order to speed the transition of these capabilities to military (Navy, Marine Corps and Joint service) systems, Offerors are encouraged to **make use of existing standards for open and modular systems** that are either non-proprietary (e.g. VITA, open VPX, etc.) or **to which the government has full and open rights.** The SSD shall **use technologies that are conducive to minimizing SWAP** requirements for future tactical implementation on SWAP-constrained vehicles or platforms. While each SSD description below highlights the need for reducing Size, Weight and Power (SWAP) by design, actual SWAP savings may be demonstrated through analysis rather than physical measurement.

RF/mmW Electronic Warfare SSDs

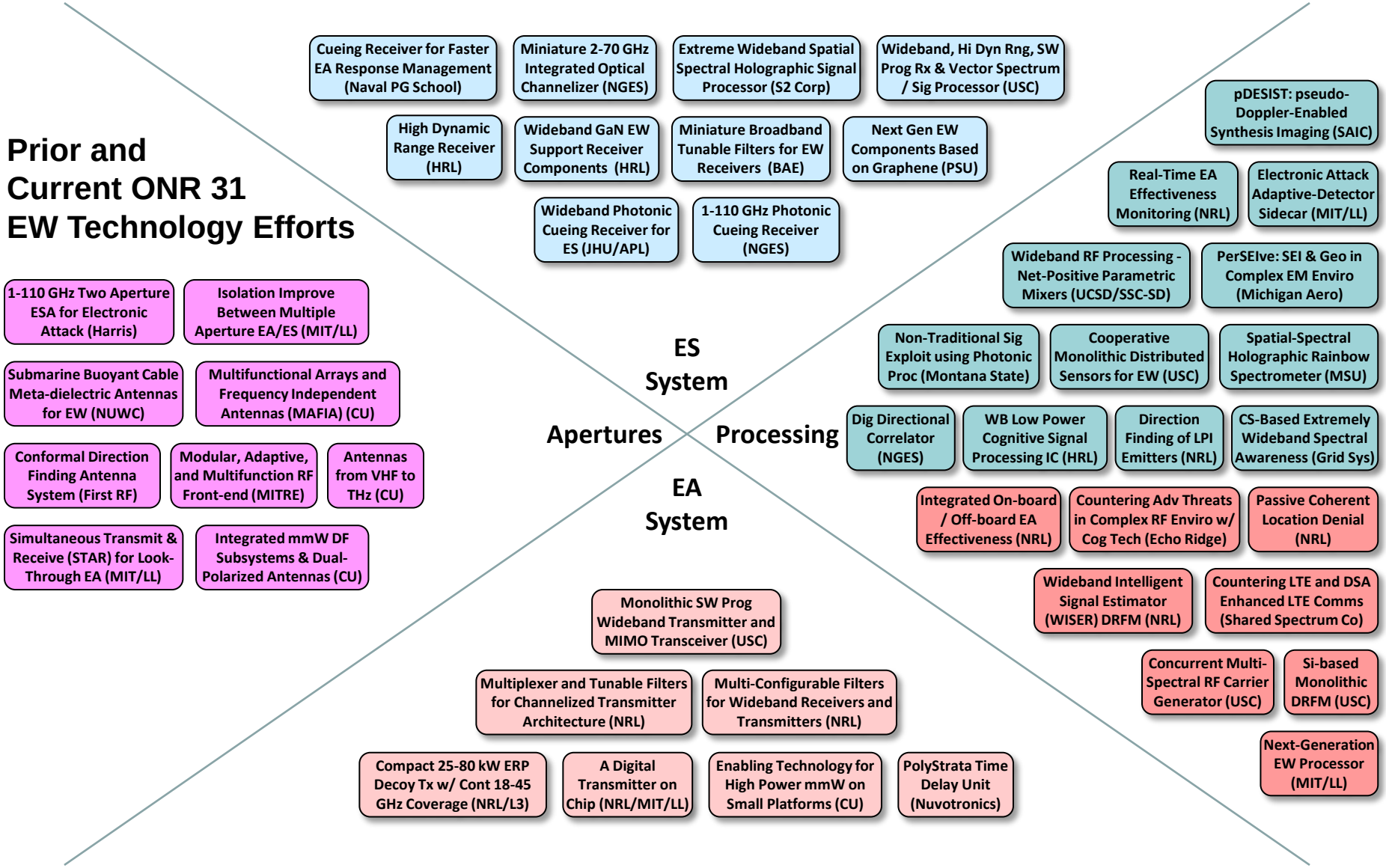
Component & Subsystem Architecture



RF/mmW Electronic Warfare SSDs

Component & Subsystem Architecture

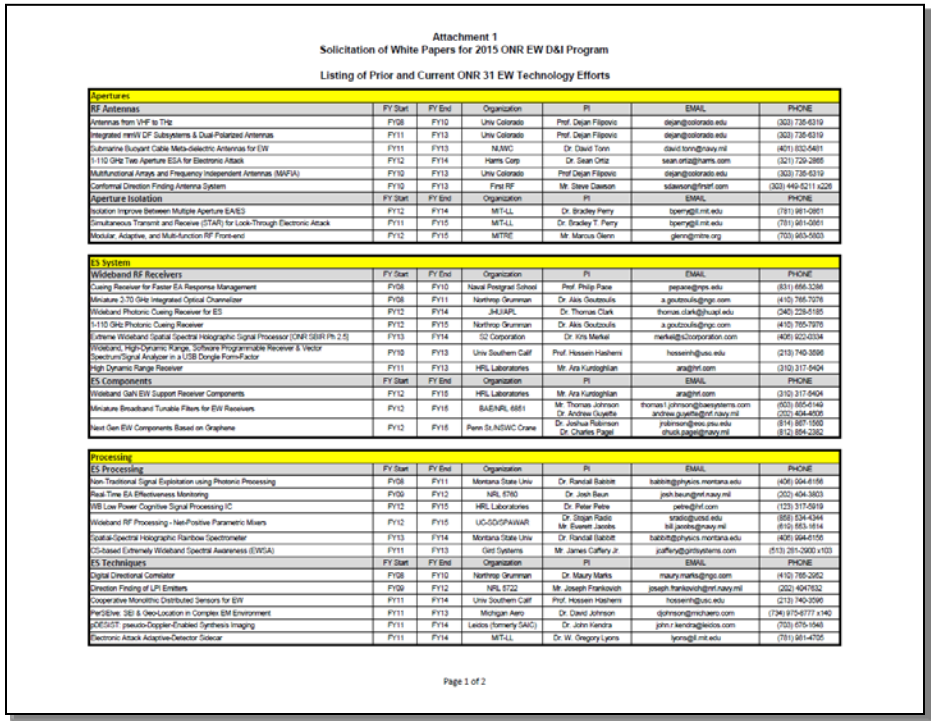
Prior and Current ONR 31 EW Technology Efforts



RF/mmW Electronic Warfare Subsystem Demonstrators (SSD)

A categorized listing of prior and current ONR 31 EW technology efforts, along with contact information for the performers, can be found in Attachment 1 of this BAA.

- **Other technology efforts funded by ONR and other government sponsors (e.g. DARPA, AFRL, ARL, DoE, NSA, NSF, ONI, etc.) can also be leveraged with proper acknowledgment.**



Attachment 1
Solicitation of White Papers for 2015 ONR EW D&I Program

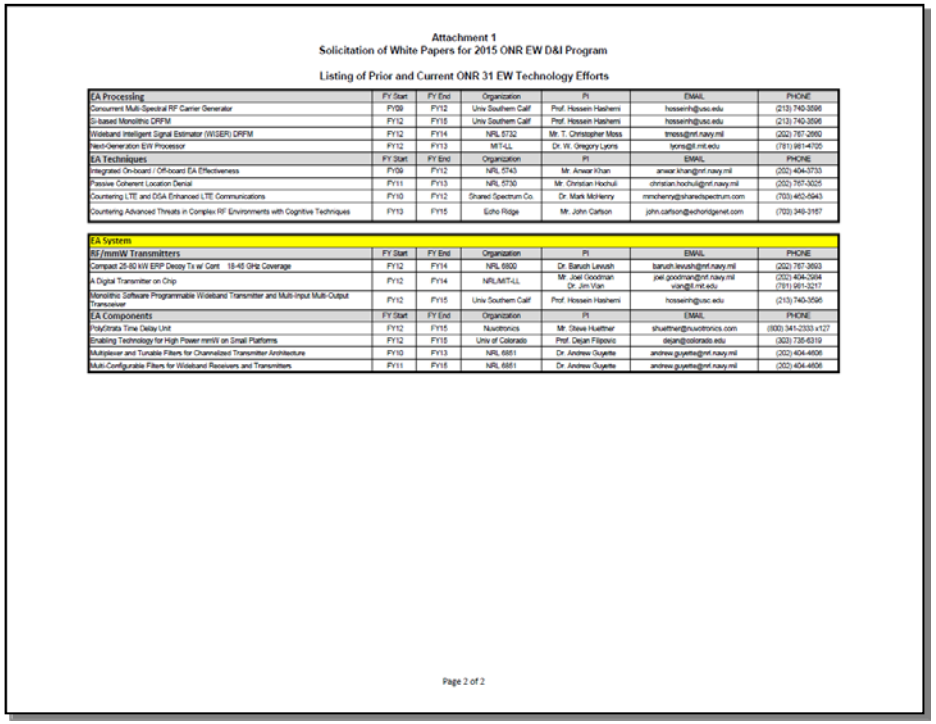
Listing of Prior and Current ONR 31 EW Technology Efforts

Apertures						
RF Antennas	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Antennas from VHF to THz	FY08	FY10	Univ Colorado	Prof. Dejan Filipovic	dejan@colorado.edu	(303) 735-6319
Integrated mmW DF Subsystems & Dual-Polarized Antennas	FY11	FY13	Univ Colorado	Prof. Dejan Filipovic	dejan@colorado.edu	(303) 735-6319
Submarine Buoyant Cable Meta-dielectric Antennas for EW	FY11	FY13	NUWC	Dr. David Tonn	david.tonn@navy.mil	(401) 832-5401
1-110 GHz Two Aperture ESA for Electronic Attack	FY12	FY14	Harris Corp	Dr. Sean Ortaz	sean.ortaz@harris.com	(321) 729-2868
Multifunctional Arrays and Frequency Independent Antennas (MAFIA)	FY10	FY13	Univ Colorado	Prof Dejan Filipovic	dejan@colorado.edu	(303) 735-6319
Conformal Direction Finding Antenna System	FY10	FY13	First RF	Mr. Steve Dawson	sdawson@firstrf.com	(303) 449-5211 x226
Aperture Isolation	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Isolation Improve Between Multiple Aperture EA/ES	FY12	FY14	MIT-LL	Dr. Bradley Perry	bperry@ll.mit.edu	(781) 981-0861
Simultaneous Transmit and Receive (STAR) for Look-Through Electronic Attack	FY11	FY15	MIT-LL	Dr. Bradley T. Perry	bperry@ll.mit.edu	(781) 981-0861
Modular, Adaptive, and Multi-function RF Front-end	FY12	FY15	MITRE	Mr. Marcus Glenn	glenn@mitre.org	(703) 983-5803

ES System						
Wideband RF Receivers	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Cueing Receiver for Faster EA Response Management	FY08	FY10	Naval Postgrad School	Prof. Philip Pace	pepace@nps.edu	(831) 656-3286
Miniature 2-70 GHz Integrated Optical Channelizer	FY08	FY11	Northrop Grumman	Dr. Alex Goutzoulis	a.goutzoulis@ngc.com	(410) 765-7276
Wideband Photonic Cueing Receiver for ES	FY12	FY14	JHU/APL	Dr. Thomas Clark	thomas.clark@jhuapl.edu	(240) 228-5185
1-110 GHz Photonic Cueing Receiver	FY12	FY15	Northrop Grumman	Dr. Alex Goutzoulis	a.goutzoulis@ngc.com	(410) 765-7976
Extreme Wideband Spatial Spectral Holographic Signal Processor [ONR SBIR Ph 2.5]	FY13	FY14	S2 Corporation	Dr. Kris Merkel	merkel@s2corporation.com	(408) 922-0334
Wideband, High-Dynamic Range, Software Programmable Receiver & Vector Spectrum/Signal Analyser in a USB Dongle Form-Factor	FY10	FY13	Univ Southern Calif	Prof. Hossein Hashemi	hosseinh@usc.edu	(213) 740-3596
High Dynamic Range Receiver	FY11	FY13	HRL Laboratories	Mr. Ara Kurdoghlian	ara@hrl.com	(310) 317-5404
ES Components	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Wideband GaN EW Support Receiver Components	FY12	FY15	HRL Laboratories	Mr. Ara Kurdoghlian	ara@hrl.com	(310) 317-5404
Miniature Broadband Tunable Filters for EW Receivers	FY12	FY16	BAE/NRL 6851	Mr. Thomas Johnson Dr. Andrew Guyette	thomas1.johnson@baesystems.com andrew.guyette@nrl.navy.mil	(603) 885-9149 (202) 404-4806
Next Gen EW Components Based on Graphene	FY12	FY16	Penn St./NSWC Crane	Dr. Joshua Robinson Dr. Charles Pagel	jrobinson@eos.psu.edu chuck.pagel@navy.mil	(814) 867-1560 (812) 854-2362

Processing						
ES Processing	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Non-Traditional Signal Exploitation using Photonic Processing	FY08	FY11	Montana State Univ	Dr. Randall Babbitt	babbitt@physics.montana.edu	(406) 994-6156
Real-Time EA Effectiveness Monitoring	FY09	FY12	NRL 8760	Dr. Josh Baun	josh.baun@nrl.navy.mil	(202) 404-3803
WB Low Power Cognitive Signal Processing IC	FY12	FY15	HRL Laboratories	Dr. Peter Petre	petre@hrl.com	(123) 317-5919
Wideband RF Processing - Net-Positive Parametric Mixers	FY12	FY15	UC-SD/SPAWAR	Dr. Stojan Radic Mr. Everett Jacobs	stradic@ucsd.edu bill.jacobs@navy.mil	(858) 534-4344 (619) 553-1614
Spatial-Spectral Holographic Rainbow Spectrometer	FY13	FY14	Montana State Univ	Dr. Randall Babbitt	babbitt@physics.montana.edu	(406) 994-6156
CS-based Extremely Wideband Spectral Awareness (EWSA)	FY11	FY13	Gest Systems	Mr. James Caffery Jr.	jcaffery@gestsystems.com	(513) 291-2900 x103
ES Techniques	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Digital Directional Correlator	FY08	FY10	Northrop Grumman	Dr. Maury Marks	maury.marks@ngc.com	(410) 765-2952
Direction Finding of LPI Emitters	FY09	FY12	NRL 5722	Mr. Joseph Frankovich	joseph.frankovich@nrl.navy.mil	(202) 4047632
Cooperative Monolithic Distributed Sensors for EW	FY11	FY14	Univ Southern Calif	Prof. Hossein Hashemi	hosseinh@usc.edu	(213) 740-3596
ReSBEve: 3Bl & Geo-Location in Complex EM Environment	FY11	FY13	Michigan Aero	Dr. David Johnson	djohnson@michaero.com	(734) 975-6777 x140
pDE/GST: pseudo-Doppler-Enabled Synthesis Imaging	FY11	FY14	Leidos (formerly SAIC)	Dr. John Kendra	john.r.kendra@leidos.com	(703) 676-1645
Electronic Attack Adaptive-Detector Sidecar	FY11	FY14	MIT-LL	Dr. W. Gregory Lyons	lyons@ll.mit.edu	(781) 981-4705

Page 1 of 2



Attachment 1
Solicitation of White Papers for 2015 ONR EW D&I Program

Listing of Prior and Current ONR 31 EW Technology Efforts

EA Processing	FY Start	FY End	Organization	PI	EMAIL	PHONE
Concurrent Multi-Spectral RF Carrier Generator	FY09	FY12	Univ Southern Calif	Prof. Hossein Hashemi	hosseinh@usc.edu	(213) 740-3596
Si-based Monolithic DRFM	FY12	FY15	Univ Southern Calif	Prof. Hossein Hashemi	hosseinh@usc.edu	(213) 740-3596
Wideband Intelligent Signal Estimator (WISER) DRFM	FY12	FY14	NRL 5732	Mr. T. Christopher Moss	tmoss@nrl.navy.mil	(202) 767-2660
Next-Generation EW Processor	FY12	FY13	MIT-LL	Dr. W. Gregory Lyons	lyons@ll.mit.edu	(781) 981-4705
EA Techniques	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Integrated On-board / Off-board EA Effectiveness	FY09	FY12	NRL 5743	Mr. Anwar Khan	anwar.khan@nrl.navy.mil	(202) 404-3733
Passive Coherent Location Denial	FY11	FY13	NRL 5730	Mr. Christian Hochuli	christian.hochuli@nrl.navy.mil	(202) 767-3025
Countering LTE and DSA Enhanced LTE Communications	FY10	FY12	Shared Spectrum Co.	Dr. Mark McHenry	mmchenry@sharedspectrum.com	(703) 462-5943
Countering Advanced Threats in Complex RF Environments with Cognitive Techniques	FY13	FY15	Echo Ridge	Mr. John Carlson	john.carlson@echoridgenet.com	(703) 349-3187

EA System						
RF/mmW Transmitters	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
Compact 25-80 kW ERP Decoy Tx w/ Cont 18-45 GHz Coverage	FY12	FY14	NRL 6600	Dr. Baruch Levush	baruch.levush@nrl.navy.mil	(202) 767-3693
A Digital Transmitter on Chip	FY12	FY14	NRL/MIT-LL	Mr. Joel Goodman Dr. Jim Wan	joel.goodman@nrl.navy.mil wan@ll.mit.edu	(202) 404-3564 (781) 981-3217
Monolithic Software Programmable Wideband Transmitter and Multi-Input Multi-Output Transceiver	FY12	FY15	Univ Southern Calif	Prof. Hossein Hashemi	hosseinh@usc.edu	(213) 740-3596
EA Components	**FY Start**	**FY End**	**Organization**	**PI**	**EMAIL**	**PHONE**
YIG/Zirrata Time Delay Unit	FY12	FY15	Nuwtronics	Mr. Steve Huettner	shuettner@nuwtronics.com	(800) 341-2333 x127
Enabling Technology for High Power mmW on Small Platforms	FY12	FY15	Univ of Colorado	Prof. Dejan Filipovic	dejan@colorado.edu	(303) 735-6319
Multiplexer and Tunable Filters for Channelized Transmitter Architecture	FY10	FY13	NRL 6851	Dr. Andrew Guyette	andrew.guyette@nrl.navy.mil	(202) 404-4806
Multi-Configurable Filters for Wideband Receivers and Transmitters	FY11	FY15	NRL 6851	Dr. Andrew Guyette	andrew.guyette@nrl.navy.mil	(202) 404-4806

Page 2 of 2

1 – a. Broadband RF/mmW Receiver SSD for Unknown Signal Detection, Identification, Direction Finding, and Tracking

This SSD shall be able to **sense and process signals of unknown frequency, modulation, pulse duration (including non-pulsed waveforms), and strength** over a broad continuous spectral band encompassing RF and mmW frequencies (**500 MHz to 110 GHz objective**). The SSD shall be able to **precisely parameterize the detected signals** in order to identify the signal among a database of signal classes or types. The SSD shall further **precisely determine the direction of the signal**, referenced against the physical orientation of the receiver, in less than a second from signal detection, and be able to **precisely geo-locate the signal** when information **from multiple receivers** are **networked together**. The SSD shall be able to **detect and characterize weak signals (signal sensitivity -90 dBm or better threshold, -105 dBm or better objective**) in the presence of much stronger signals (**spur free dynamic range 50 dB or better threshold, 70 dB or better objective**), which are closely spaced in both frequency (**resolution bandwidth 50 MHz or better threshold, 1MHz or better objective**) and physical location. The SSD receiver **shall not rely on scanning any part of the frequency range or multiple-pulse integration** in order to detect low probability of interception / low probability of detection (LPI/LPD) type signals. **The processing of signal detection, identification, direction finding, and tracking shall be largely automatic**, though operator interaction in order to more precisely characterize signal parameters is permitted. A demonstration of this SDD over a smaller portion of the spectrum will be permitted if a clear and reasonable approach to scaling the concept to the full bandwidth is provided. Finally, the SSD shall use technologies that are conducive to minimizing SWAP requirements for future tactical implementation on SWAP-constrained vehicles or platforms.

1 – b. Wideband, Multi-Signal, Simultaneous Transmit and Receive (STAR) RF Front-End SDD

This SSD shall provide the capability to **simultaneously transmit and receive numerous signals across a wideband (500 MHz to 45 GHz threshold, 500 MHz to 110 GHz objective)** of the EMS. The objective is to support many simultaneous signals and functions such as EW, communications, and signals intelligence (SIGINT) using a common front-end with a limited number of power amplifiers and apertures. The RF front-end shall **provide an adjacent channel simultaneous transmit and receive (STAR) capability that allows for the operation of a large number of wideband (500 MHz) and narrowband (<50 MHz) RF functions**. This SDD can utilize analog, digital, and photonic technologies and techniques for achieving the filtering, channelization, isolation, and intermodulation reduction required between the adjacent signals. The SDD shall **provide up to 120 dB of isolation in adjacent transmit and receive (TX/RX) channels**. In addition to the full frequency band adjacent channel STAR capability, the SSD shall also be capable of **providing co-channel STAR capability for a reduced number of wideband (500 MHz) and narrowband (<50 MHz) signals that is tunable across the full frequency band**. A layered approach of aperture design, signal cancelation, analog filtering, digital pre and post distortion, and other technologies and techniques is envisioned to meet the required metrics. A demonstration of this SDD over a smaller portion of the spectrum will be permitted if a clear and reasonable approach to scaling the concept to the full bandwidth is provided. Finally, the SSD shall use technologies that are conducive to minimizing SWAP requirements for future tactical implementation on SWAP-constrained vehicles or platforms.

1 – c. Millimeter Wave (mmW) Electronic Warfare SSD

This SSD shall be able to **detect signals and automatically deceive or deny the operation of the system(s) emitting the signals over a full frequency range of 18 to 45 GHz**. The **transmitter subsystem** (consisting of power amplifier(s), matching network, and radiating element) shall be capable of achieving **1-4 kW or greater effective radiated power (ERP) for small decoy applications** or capable of being **combined to achieve 100 kW or greater ERP for large platform applications** across the entire 18-45 GHz frequency range. (These ERP goals are peak power levels measured at a 10% or better duty factor; higher duty factor operation is also desired but a decrease of the ERP by 6-8 dB at 100% duty factor is acceptable.) The receiver subsystem must be capable of **continuous operation when the transmit and receive subsystem apertures are closely spaced (threshold) or share the same aperture (objective)**, using advanced technologies to suppress or cancel self-generated interference. The SSD shall be capable of **automatic signal processing and generation of electronic attack waveforms and techniques** based on the received signal parameters using established or developmental techniques or technologies such as Digital RF Memory (DRFM)-based technique generators. Finally, the SSD shall use technologies that are conducive to minimizing SWAP requirements for future tactical implementation on SWAP-constrained vehicles or platforms.

2. Compact & Efficient EW Antennas Covering HF - VHF (3-300 MHz)

The objective is to improve the capability of military (Navy, Marine Corps and Joint service) EW systems to **detect, deny or deceive sensors, communications or other systems operating in the HF (3-30 MHz) and VHF (30-300 MHz) bands of the EMS**. Current constraints on EW systems in these bands are the physical size and performance of the required antenna. It is not unusual for whip antennas operating at these frequencies to be many meters in length and operate at less than unity gain. It is also typical for these antennas to be omnidirectional with no ability to either concentrate radiated power on a localized target (for an EA application) or determine signal direction (for an ES application). This section of the current solicitation seeks **technologies and techniques to achieve physically small antennas covering the HF and VHF with no physical dimension exceeding 1 meter (threshold) or 30 centimeters (objective).** Technologies that are conducive to **minimizing SWAP requirements** for future tactical implementation on SWAP-constrained vehicles or platforms are desired. Technologies that are **conformal to the skin of a vehicle or platform** are also desirable. The antenna design shall achieve **a voltage standing wave ratio (VSWR) of better than 3:1 (threshold) or 2:1 (objective)** while **maximizing efficiency and gain over the full 3-300 MHz band (unity gain or better is an objective)**. For EA antenna designs **a sustained power handling capability of greater than 100 watts (threshold) or 1 kilowatt (objective)** is desired. For ES antenna designs the ability to **precisely determine the direction of the detected signal** is desired, as well as the ability to **precisely geo-locate the signal when information from multiple antennas are networked together**.

3. W-Band Millimeter Wave (mmW) High Power Transmitters

The objective is to improve the capability of military (Navy, Marine Corps and Joint service) EA systems to **deny or deceive sensors or weapons guidance systems operating in the millimeter wave (mmW) bands of the EMS**. While ONR has on-going interest in wideband EA transmitter systems which operate across the breadth of the mmW spectrum, this section of the current solicitation is limited to the **W-Band (75-110 GHz) frequency range**. Transmitter systems (consisting of power amplifier(s), matching network, and radiating element) capable of **achieving 1-4 kW or greater ERP for small decoy applications** or capable of **being combined to achieve 100 kW or greater ERP for large platform applications across the entire 75-110 GHz frequency range** are desired. (These ERP goals are peak power levels measured at a 10% or better duty factor; higher duty factor operation is also desired but a decrease of the ERP by 6-8 dB at 100% duty factor is acceptable.) Technology solutions are permitted **using vacuum components, solid-state components, or combinations of both**. Proposed system concepts should include a **detailed end-to-end system analysis**, with such considerations as input power needs, power distribution, cooling, component placement, isolation, aperture architecture, and beam-forming. The delivered system should demonstrate the ability to project the requested ERP across the full 75-110 GHz spectral band against a far-field target in a controlled and sustained beam and be able to **transmit linear and phase controlled jamming waveforms capable of preserving complex signal content and coding**.

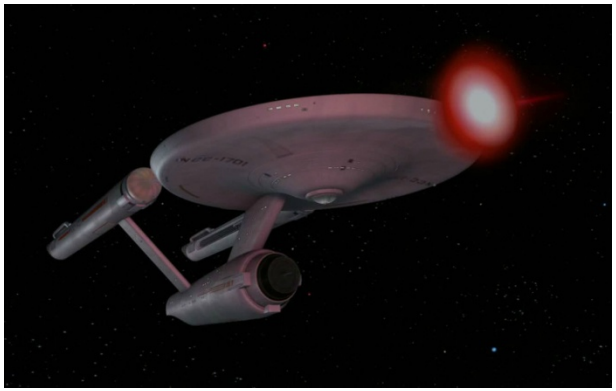
4. Innovative EW Concepts

The objective is to **explore truly innovative concepts in the EW** areas of ES, EA, or EP which could fundamentally change the way naval (Navy and Marine Corps) forces conduct EW operations.

This sub-section should only be cited by proposals that do not fall within any of the other sub-sections of this Research Opportunity Description.

Examples of what I would consider "Innovative Concepts" (circa 1966)

Phaser™ Technology



Shield Technology

Romulan™ Cloaking Device

ONR Discovery & Invention
ONR BAA 14-006 Award Info

- **In conjunction with the U.S. Army CERDEC and the U.S. Air Force AFRL, ONR plans to fund individual awards of $3M to $4M per year (Area 1 only), and $500K to $1.5M per year (Areas 2 – 4) using some combination of Budget Category 6.2 and Budget Category 6.3 funds. However, lower and higher cost proposals will be considered.**
- **Total funding under this BAA is anticipated to be $10.5M per year, or $31.5M over three years.**
- **The period of performance for projects may be from 12 to 36 months. Projects will have an estimated start date of 02 January 2015, subject to date of final award and availability of new fiscal year funds.**

ONR Discovery & Invention
ONR BAA 14-006 Award Info

- **At the same time this BAA was posted, the Government sent out a parallel solicitation to government labs and other parties that are barred from proposing to the BAA. There are no fixed percentages or set-asides for the two solicitations and ALL the White Papers/Oral Briefs/Proposals are evaluated together to determine which should be funded as the "best of the best."**
- **The award(s) will be made for the full performance period requested. Options will not be utilized.**

ONR Discovery & Invention
ONR BAA 14-006 Eligibility

- All responsible sources from academia and industry may submit proposals under this BAA.
- University Affiliated Research Centers (UARC) are eligible to submit proposals under this BAA unless precluded from doing so by their Department of Defense UARC contracts.
- There will be no set asides for Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs).
- Some topics cover export controlled technologies. Research in these areas is limited to "U.S. persons" as defined in the International Traffic in Arms Regulations (ITAR) - 22 CFR § 1201.1 et seq.

ONR Discovery & Invention
ONR BAA 14-006 Eligibility

- **Navy laboratories and warfare centers, as well as other Department of Defense and civilian agency laboratories, and Federally Funded Research & Development Centers (FFRDCs), including Department of Energy National Laboratories, are not eligible to receive awards under this BAA and should not directly submit either white papers or full proposals in response to this BAA.**
- **NOTE: Responses from these organizations are being solicited separately, though with the same guidance regarding research areas of interest, white paper format and deadlines.**

ONR Discovery & Invention
ONR BAA 14-006 Eligibility

- **<u>Bottom line</u>: All civilian, industry, government, and military organizations are encouraged to submit white paper responses to the four ONR EW research areas as solicited.**
- **Once a proposed effort has been chosen for funding, ONR will determine the best method to proceed.**
- **If a contract or grant is required, then the guidance, clauses, and limitations of this BAA are applicable.**
- **If other means are more appropriate (direct funds transfer to DoD laboratory or warfare center, use of existing contract vehicle, etc.) then separate guidance and limitations may apply.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

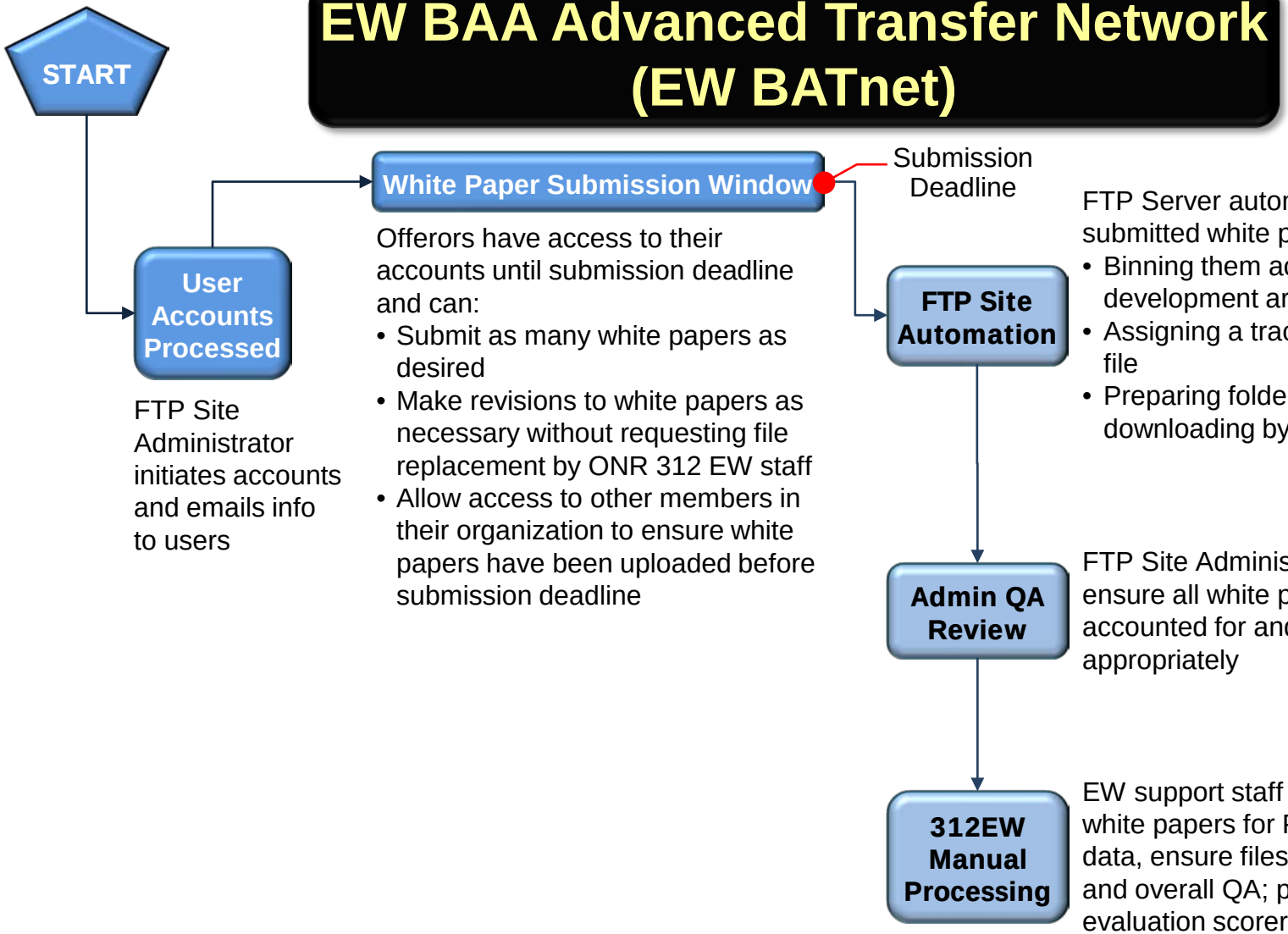
- **The due date for white papers is no later than 3:00 PM (EST) on Tuesday, 04 February 2014. White papers received after the published due date and time are not eligible to participate in the remaining Full Proposal submission process and are not eligible for Fiscal Year (FY) 2015 funding. Each white paper should state that it is submitted in response to this BAA and cite the particular sub-section of the Research Opportunity Description that the white paper is primarily addressing.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

- **This year White Papers shall be submitted as an Adobe PDF or Word 2007 file via a secure (encrypted) file transfer protocol (FTP) site. Procedures are as follows:**
  - **Register for a user account to the FTP site prior to submitting White Papers by sending an email to ONR_312_EC@navy.mil.**
  - **The subject line of the email must state "BAA 14-006 FTP User Registration".**
  - **The body of the email must include the primary point of contact's name, any additional points of contacts (names), title(s), organization, department(s) or company division(s), telephone and fax numbers, and email address(es).**
  - **Registrants will receive a reply email from the FTP Site Administrator that includes the user name, a temporary password, and the internet protocol (IP) address of the FTP site along with uploading instructions.**
  - **Potential Offerors will be able to start registering for user accounts on Monday, 13 January 2014, and will be issued within two business days of the received email request.**
  - **Registration requests for user accounts that are submitted less than 48 hours before the White Paper submission deadline may not be issued.**
  - **All user accounts will be disabled on Tuesday, 04 February 2014 at 3:00:01 PM (EST) and further file uploads will not be permitted.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

EW BAA Advanced Transfer Network (EW BATnet)



ONR BAA 14-006 White Papers

White Paper Format

- **Paper Size – 8.5 x 11 inch paper**
- **Margins – 1” inch**
- **Spacing – single spaced**
- **Font – Times New Roman, 12 point**
- **Number of Pages – No more than six (6) pages (excluding cover page, resumes, bibliographies, table of contents and Attachment 2). White Papers exceeding the page limit may not be evaluated.**
- **Format – One (1) electronic copy in Adobe PDF or Microsoft Word 2007 compatible file formats uploaded to the secure (encrypted) FTP site.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

White Paper Content

- **Cover Page**
  Including BAA number, proposed title, administrative and technical points of contact (telephone and facsimile number; e-mail address)
- **Technical Concept**
  Must address the following without exceeding the six (6) page limit:
  1. **Project Manager and/or Principal Investigator**
  2. **Relevance to BAA Research Opportunity Description and specific sub-section(s) being addressed**
  3. **The technical objective of the proposed effort**
  4. **The technical approach that will be pursued to meet the objective**
  5. **The anticipated deliverables at the successful completion of the effort**
  6. **A summary of recent technical breakthroughs that will reduce risk; and**
  7. **A clear and complete description of how the proposed approach compares to the current state of the art.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

White Paper Content

- **Other Requirements (without exceeding the six (6) page limit)**
  - **Operational Military Concept: The concept of operation for the new capabilities to be delivered, and the expected operational performance improvements.**
  - **Operational Utility Assessment: A plan for demonstrating and evaluating the operational effectiveness of the Offeror's proposed products or processes in field experiments and/or tests in a simulated environment.**
  - **Programmatic Section: A project schedule, a summary of planned milestones and a funding plan showing requested funding per government fiscal year, as well as the total funding request.**

- **The following sections must also be included but will not be counted against the six (6) page limitation:**
  - **Leveraged efforts (Area 1 only): A listing of leveraged ONR- and Government-funded efforts, using the template provided.**
  - **Resumes: A single page (each) summary resume (including previous relevant experience and pertinent publications) for Project Manager and/or Principal Investigator.**

ONR Discovery & Invention
ONR BAA 14-006 White Papers

White Paper Content

- **Leveraged Efforts (Area 1 only)**
  - **ONR BAA14-006 Attachment 2 (below) provides a template that should be followed in submitting a listing of current and/or prior government-funded S&T efforts that will be leveraged by the Offeror.**

Attachment 2
Solicitation Number ONRBAA14-006
Electronic Warfare Technology

Title of Proposed Effort:
Lead Organization:
Principal Investigator:

Listing of Leveraged Government-Funded S&T Efforts (Must be Completed for Area 1-a, 1-b, and 1-c Submissions)

#	Title/Description of Prior S&T Effort	Performing Organization	Technical POC (Name, Email, Phone)	Government POC (Name, Email, Phone)	Funding Organization & Contract / Grant / Funding Document #	Function Enabled in Proposed Effort	Percentage Contribution to Proposed Effort
1	*Example: Investigation of Gravitic Anomalies on Wormhole Generation*	*Vulcan Institute of Science*	*Mr. Spock spock@vulcaninstitute.edu 999-555-2230*	*CAPT James T. Kirk james.kirk@starfleet.mil 999-555-2233*	*Office of Starfleet Research Grant S00016-67-1-2245*	*Generation of non-RF comms channels to permit jam-proof networks for transmitting EW message sets.*	*10% of proposed budget will mature this technology for demonstration.*
2	*Example: Wideband Transtators Fabricated from Rodinium Nitride*	*Scott Engineering Corporation*	*Montgomery Scott scotty@scottengineering.com 111-555-2222*	*CAPT James T. Kirk james.kirk@starfleet.mil 999-555-2233*	*Office of Starfleet Research Contract S00016-67-C-1701*	*Wideband transtators will be used for generating delta ray emissions for jamming photon torpedoes.*	*20% of proposed budget will be used for a limited foundry run of wideband transtators for demonstration unit.*
3	*Example: Detection of Warp Field Emissions Using Polarization of Spatially Inverted Tetryons*	*Starfleet Research Laboratory*	*Pavel Chekov pavel.chekov@srl.starfleet.mil 555-555-2245*	*CAPT James T. Kirk james.kirk@starfleet.mil 999-555-2233*	*Office of Starfleet Research Funding Document S00016-67-WX-65658*	*Enables precision location, identification, tracking, and targeting of cloaked starships.*	*5% of proposed budget will implement this signal processing technique in MatLab for evaluation and testing.*
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

ONR Discovery & Invention
ONR BAA 14-006 Schedule

The following schedule has been established to facilitate the submission of white papers and their follow-on review and possible selection for FY 2015 funding.

04 Feb 2014	White paper responses to EW research areas due to ONR
21 Feb 2014*	ONR notify selected parties to prepare briefing for EW Review
11 Mar 2014	Quad Chart due to ONR
14 Mar 2014	Briefings due to ONR
19 Mar 2014*	Oral presentations at the ONR EW S&T Review
28 Mar 2014*	ONR notify selected parties to prepare/submit full proposal
06 May 2014	Full technical/cost proposal due to ONR
03 Jun 2014*	ONR notify selected parties of intent to fund efforts
02 Jan 2015*	ONR issues awards

**** These dates are estimates***

ONR Discovery & Invention

ONR BAA 14-006 Evaluation Criteria

Evaluations will be conducted using the following evaluation criteria

- **The four (or five) technical factors are of equal value**
  - **Subparagraphs under each factor are not subfactors; rather, they provide insight into the areas that evaluators consider when assessing proposals under each factor**
- **The four technical factors 1 – 4 (or 1 – 5 for Area 1) are significantly more important than cost**
  - **Importance of cost will increase with the degree of equality of the proposals or when the cost is so significantly high as to diminish the value of the proposal's technical superiority**

1. **Overall scientific and technical merits of the submission**
   a. **Degree of innovation,**
   b. **Soundness of technical concept,**
   c. **Awareness of the state of the art and understanding of the scope of the problem and the technical effort needed to address it, and**
   d. **Successful achievement of goals will significantly reduce technical risk to a subsequent development effort.**

2. **Military relevance, transition potential and anticipated contributions of the proposed technology to Electronic Warfare operations.**
   a. **Technology addresses a military critical need,**
   b. **Military program or initiative depends on the technology,**
   c. **Potential transition effort identified, and**
   d. **Part of a joint service technology effort.**

ONR BAA 14-006 Evaluation Criteria

Evaluation criteria (continued)

3. Program structure and execution plan
   a. Level of technical risk appropriate for applied research,
   b. Clear statements of objectives, applicability to BAA, anticipated end state, and deliverables,
   c. Concise schedule with clearly identified milestones to objectively measure progress, and
   d. Timing is right (e.g. addresses current or future capability need, leverages recent S&T breakthrough or emerging COTS technology, constructive relationship with other on-going work , etc.).

4. The qualifications, capabilities and experience of the proposed Principal Investigator (PI), team leader and key personnel who are critical in achieving the proposal objectives
   a. Offeror's experience in relevant efforts with similar resources,
   b. Ability to manage the proposed effort, and
   c. Offeror's overall capabilities, facilities, techniques or unique combinations of these which are integral factors for achieving the proposal objectives.

ONR BAA 14-006 Evaluation Criteria

Evaluation criteria (continued)

5. Number and quality of leveraged efforts (Area 1 ONLY)
   a. How many prior/current ONR and Government-funded electronic and photonic technology, technique, component, device and/or subsystem research efforts are leveraged for the proposed EW demonstrator? (NOTE: multiple funded efforts that advance the maturity of the same fundamental technology will be counted as ONE research effort),
   b. How critical are the prior ONR and Government-funded efforts to enabling the proposed EW capability demonstration? and
   c. Offerors that utilize partnerships or teaming arrangements between multiple performers (industry, academic, government) to facilitate the incorporation of leveraged technologies will be given favorable consideration.

6. The realism of the proposed cost and availability of funds

ONR Discovery & Invention
ONR BAA 14-006 Deliverables

The following is a sample of reporting deliverables that could be required under a research effort. The following deliverables, primarily in contractor format, are anticipated as necessary. However, specific deliverables should be proposed by each Offeror and finalized with the contracting agent:

- **Detailed Technical Data**
- **Technical and Financial Progress Reports**
- **Presentation Material(s)**
- **Other Documentation or Reports, as required**
- **Final Report**

Research performed under contracts may also include the delivery of software, prototypes, and other hardware deliverables.

ONR Discovery & Invention
ONR BAA 14-006 Facilities / GFE

- **Government research facilities and operational military units are available and should be considered as potential government-furnished equipment/facilities. These facilities and resources are of high value and some are in constant demand by multiple programs. It is unlikely that all facilities would be used for any one specific program. The use of these facilities and resources will be negotiated as the program unfolds. Offerors submitting proposals for contracts, cooperative agreements and Other Transaction Agreements should indicate in the Technical Proposal Template, Section II, Blocks 8 and 9, which of these facilities are critical for the project's success. Offerors submitting proposals for grants should address the need for government-furnished facilities in their technical proposal.**
- **Proposals that are contingent upon ONR providing government furnished equipment, instrumentation, test facilities, or threat hardware and information for exploitation are NOT acceptable.**

ONR Discovery & Invention
ONR BAA 14-006 Classification

- **All white papers and proposals are expected to be unclassified. However, classified white papers and proposals are permitted.**
- **In order to facilitate intra-program collaboration and technology transfer, the Government will attempt to enable awardees to work at the unclassified level to the maximum extent possible.**
- **If awardees use unclassified data in their deliveries and demonstrations regarding a potentially classified project, they should use methods and conventions consistent with those used in classified environments. Such conventions will permit the various subsystems and the final system to be more adaptable in accommodating classified data in the transition system.**

Things ONR will look for in white paper submissions

- An understanding of Electronic Warfare principles and needs
- Innovative applications of cutting edge science and technology to address Electronic Warfare priorities
- Efforts that focus on RF/mmW EW subsystem demonstrators, compact and efficient EW antennas covering HF to VHF, W-band mmW high power transmitters, and innovative EW concepts
- Clear statements of the effort's objectives, applicability to Electronic Warfare, anticipated end state, and deliverables.
- Clear and concise schedule including intermediate milestones to objectively measure progress toward goals
- Funding request broken out by performing organization and Government fiscal year.

Things that will cause ONR to reject white papers

- **Proposed effort is <u>not</u> Electronic Warfare related**
  - **Communications or navigation systems (counter comms/nav is okay)**
  - **Intel, reconn, surveillance (ISR) systems (counter ISR is okay)**
- **Proposed effort is <u>not</u> Discovery & Invention**
  - **Off-the-shelf solutions without any clear innovation**
  - **Demonstrations and field testing of existing systems or components to show military application**
- **Reliance on GFE/GFI without prior arrangement/agreement**
- **Poor program planning**
  - **No explanation or understanding of underlying S&T**
  - **Scattershot approaches with little methodology**
  - **Lack of intermediate milestones to gauge progress**
  - **No substantiation for requested budget**

ONR Discovery & Invention
ONR BAA 14-006 Final Comments

- **ONR 312 EW will not entertain requests for individual meetings with industry representatives to discuss potential white paper submissions**
  - **No pre-selection of ideas or concepts**
  - **If in doubt, write the white paper and submit it**
- **This is your opportunity to ask questions**
  - **Written questions are permitted, but all questions and answers will be posted to the ONR BAA website**
- **White paper questions of a business nature can be submitted by e-mail through Tuesday, 21 January 2014**
  - **All questions and answers will be posted to the ONR BAA website**

ONR Discovery & Invention

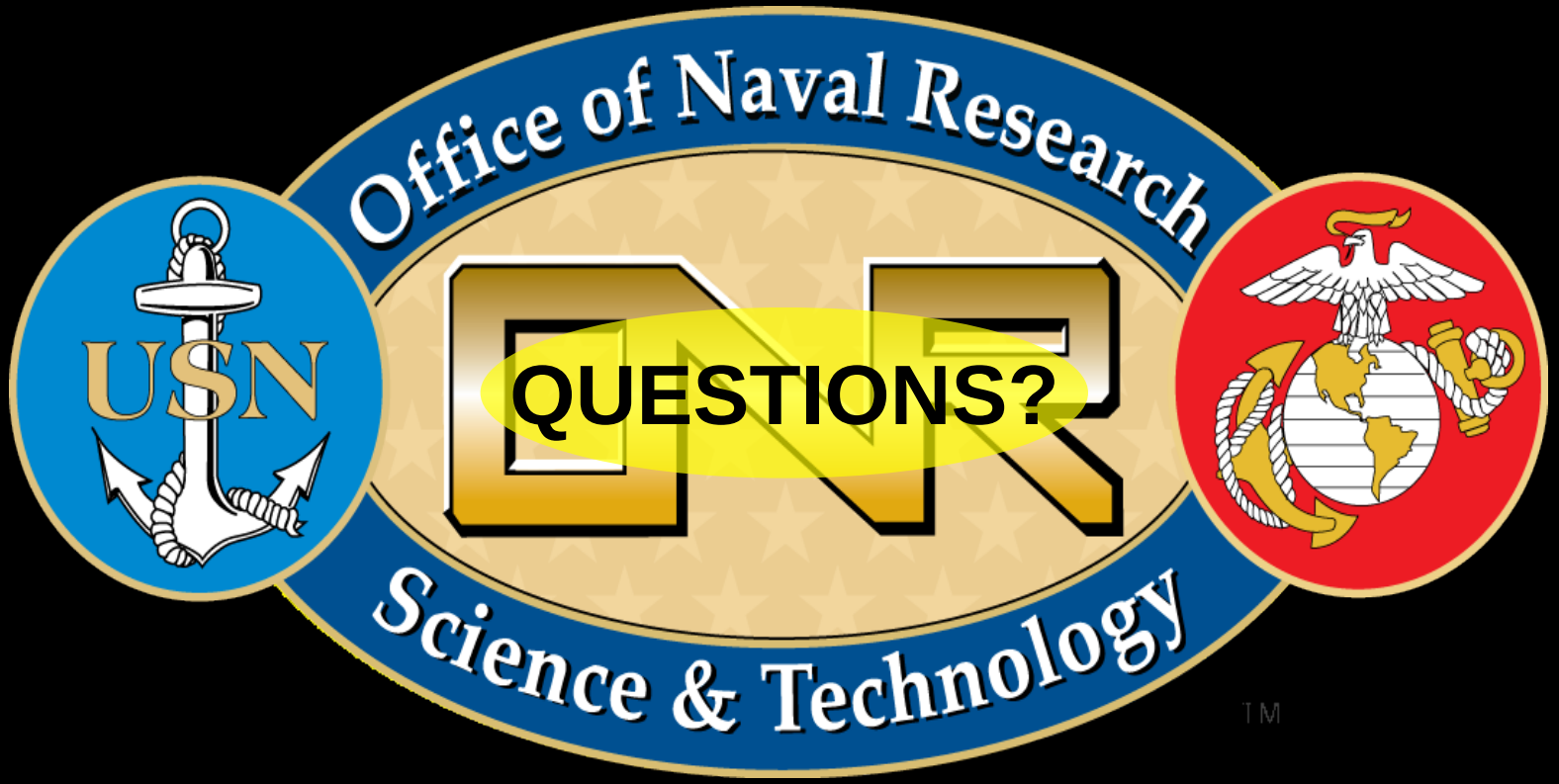
ONR BAA 14-006 Points of Contact

Technical

Dr. Peter Craig
Electronic Warfare Program Manager
Office of Naval Research (ONR 312)
875 North Randolph Street, Suite 1112
Arlington, VA 22203-1995
E-mail: peter.craig@navy.mil

Business

Mr. Alan Kesten
Contract Specialist
Office of Naval Research (BD 252)
875 North Randolph Street, Suite W1272D
Arlington, VA 22203-1995
E-mail: alan.kesten@navy.mil


Office of Naval Research
USN
ONR
QUESTIONS?
Science & Technology
TM

ONR Discovery & Invention
This year: ONR BAA 14-006

RF/mmW EW Subsystem Demonstrators

Leverage prior investments in electronic and photonic S&T to create subsystem demonstrators (SSDs) of advanced EW capabilities. SSDs will demo both functional configuration and capability of a final EW subsystem, though not necessarily the physical configuration, packaging, or form factor. A final demo in a tactically relevant environment is desired. Use existing standards for open and modular systems and technologies that are conducive to minimizing SWAP. Potential SSDs:

- Broadband RF/mmW Receiver SSD for Unknown Signal Detection, Identification, Direction Finding, and Tracking
- Wideband, Multi-Signal, Simultaneous Transmit and Receive (STAR) RF Front-End SSD
- Millimeter Wave (mmW) Electronic Warfare SSD

EW Antennas Covering HF to VHF

Improve the capability to detect, deny or deceive sensors, communications or other systems operating in the HF (3-30 MHz) and VHF (30-300 MHz) bands of the EMS. Technologies and techniques are needed to achieve physically small antennas covering the HF and VHF with no physical dimension exceeding 1 m (threshold) or 30 cm (objective). Technologies that minimize SWAP and are conformal are desired. A VSWR of better than 3:1 (threshold) or 2:1 (objective) and maximizing efficiency and gain over the full 3-300 MHz band (unity gain or better is an objective) is desired. For EA a sustained power handling capability of > 100 watts (threshold) or 1 kilowatt (objective) is desired. For ES the ability to precisely determine the direction of the detected signal is desired.

W-Band mmW High Power Transmitters

Improve the capability to deny or deceive sensors or weapons guidance systems operating in the W-Band (75-110 GHz) frequency range. Transmitter systems capable of achieving 1-4 kW or greater ERP for small decoy applications or capable of being combined to achieve 100 kW or greater ERP across the entire 75-110 GHz frequency range are desired. Technology solutions are permitted using vacuum components, solid-state components, or combinations of both. Proposed system concepts should include a detailed end-to-end system analysis. Should be able to transmit linear and phase controlled jamming waveforms capable of preserving complex signal content and coding. .

Innovative EW Concepts

Explore truly innovative concepts in the EW areas of ES, EA, or EP which could fundamentally change the way naval forces conduct EW Operations.