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From: Program Executive Officer, Command, Control, Communications,  
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Subj: PEO C4I 2014 ACQUISITION GAPS FOR SCIENCE & TECHNOLOGY  
Ref: (a) SPAWARINST 5238.2, SPAWAR CONOPS for S&T Forecasting,  
Investment, and Transition  
(b) U.S. Navy Information Dominance S&T Objectives (draft, 2014)  
Encl: (1) PEO C4I 2014 Capability Gaps for Science and Technology

1. Purpose. This memorandum provides PEO C4I's annual acquisition gaps for Science and Technology in accordance with reference (a).

2. Background. PEO C4I has compiled S&T capability gaps for associated Programs of Record based on current and projected needs and an associated timeframe when the capability is needed (near-term (0-3 years), mid-term (3-8 years), or far term (9+ years)). These consolidated S&T gaps have been aligned to the draft US Navy Information Dominance S&T Objectives Focus Areas as defined in reference (b).

3. Enclosure (1) provides a list of identified PEO C4I S&T gaps along with a detailed description of each desired capability. The gaps are presented in a non-prioritized manner, along with the associated program offices, to facilitate their resolution by the DoD/DoN Science and Technology Enterprise. Recommendations, questions or comments regarding this memo should be addressed to Dr. Robert Parker, APEO for S&T, at (619)524-7599 or [robert.parker@navy.mil](mailto:robert.parker@navy.mil).

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Subj: PEO C4I 2014 ACQUISITION GAPS FOR SCIENCE & TECHNOLOGY

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This enclosure contains PEO C4I's consolidated S&T capability gaps for 2014, aligned to the U.S. Navy Information Dominance (ID) Science and Technology Objectives (STOs). The individual gaps are mapped to the associated ID Technology Focus Area from the STO document, summarized below. Some of the Focus Areas do not appear in the following table because they are outside of the PEO C4I mission.

a. INFORMATION TRANSPORT AND INFRASTRUCTURE (ITI) - Move, manage, and maintain an increasingly large and diverse array of mission-critical data at the rapid pace needed to support effective tactical, operational, and strategic decision-making at sea and ashore. Improve dynamic and agile routing capabilities; enterprise-level grid awareness and management; tactical network control; communications diversity; and satellite communications resilience. Provide application services that support critical C2 infrastructure; assured connectivity and access in all operating environments; persistent network awareness and control; and bandwidth-efficient communication capabilities.

b. Information Security and Information Assurance (ISA) - Reduce vulnerability of operational networks and Information Technologies (IT), including risks due to the proliferation of dual-use, commercial solutions and supply chains. Develop innovative and cost-effective ways to mitigate those vulnerabilities through such measures as Identity and Access Management (IDAM); Attribute-Based Access Controls (ABAC); Trusted Data Format (TDF) tagging; the use of real-time, automated information guards to manage the provision of access to tagged data across multiple security domains; and the employment of modernized cryptographic devices and algorithms to encrypt data at rest and data in motion. Provide assured access and transparent identification and authentication across the network; nimble and proactive network defense posture against advanced persistent threats; detection, prevention and reporting of data exfiltration to counter the insider threat; resiliency under cyber-attack; improved information audit and forensics; and cloud computing security and assurance.

c. Advanced Sensing (AVS) - Support employment of diverse, persistent, and robustly networked sensors to achieve sufficient battlespace awareness in support of operational planning, tactical execution, and operational assessment. Develop advanced multi-role/multi-function sensors; bandwidth and energy efficient sensors; innovative sensor deployment techniques; and technologies that enable/improve maritime-unique collection and exploitation capabilities, especially where space-based ISR systems are concerned. Improve strategic/operational/tactical sensor coordination and collaboration; adaptive sensor netting; pre-processing of sensor data; dynamic sensor tasking and management; autonomous sensor operation; and sensor data processing.

d. Data Integration and Decision Support (DDS) - Support effective decision-making and the ability to rapidly and confidently move from data to options to informed decisions. Develop improved capabilities to collect data from multiple sources, fuse it, and

make it available to all relevant users in the right form, to enable better and faster decisions in any environment including in the presence of Anti-Access/Area Denial (A2AD) threats. Provide universal data discovery and access; automated data fusion and integration; improved display and visualization; advanced analytics and tools; user-centric designs; trend analysis; prediction tools; and targeting tools. Develop mission and operations architecture for improved decisions; technologies for management of sensor overload.

e. Enhanced Targeting and Fire Control (ETF) - Develop targeting and fire control capabilities that enable increased speed, accuracy, range, and lethality of maritime-related weapons against evolving threats. Provide net-enabled weapons and data links that share fire control data even in a denied environment; integrated C4ISR and combat sensors that automate and improve combat identification and target accuracy; integrated manned and unmanned systems to counter adversary ISR&T; and automated battle management aids and dynamic weapons coordination to optimize target/weapon pairings and support seamless, real-time C2.

f. Electromagnetic Spectrum Operations (ESO) - Develop an exceptional awareness of the Electromagnetic Spectrum (EMS) to enable the means to aggressively maneuver through, visualize, protect and control the spectrum at any time or place. Support pervasive sensing, measuring, mapping, predictive modeling and visualization; overall spectrum agility; acute spectrum sensing and awareness; increased survivability and maneuverability; and EMS synchronization.

g. Non-Kinetic Fires (NKF) - Develop offensive measures that leverage the Electromagnetic Spectrum (EMS) and the "wired" network to deliver weapons, either in information content or sheer energy. Develop both covert and destructive weapons for offensive cyberspace operations (OCO) and jamming. Support electronic attack, RF-enabled cyber incursion, and the characterization of the military effects of each. Develop improved capabilities for non-kinetic targeting and engagement; NKF operational aids/modeling/planning; non-kinetic counter C4ISR; and non-kinetic electronic attack.

h. Positioning, Navigation, Timing - Develop Positioning, Navigation and Timing (PNT) capabilities to provide common and precise position and time references to surface, sub-surface, air and space-borne assets; enable safety of navigation, communications, command and control, and combat and weapon systems. Develop GPS-independent PNT solutions; miniaturized and scalable PNT solutions; protected GPS-dependent PNT capabilities; diverse sensor applications; and navigation decision aids; improve hardening; and modernize existing GPS-dependent PNT capabilities.

i. AUTONOMY (ATY) - Develop Autonomous capabilities and incorporate them into systems (platforms, networks, etc.) to enable individual unit and collaborative/networked operations across all domain and multiple mission sets to provide a highly survivable,

self-organizing, adaptive mission capability that cannot be easily defeated by the loss of individual platforms and/or sensors. Autonomy includes location and nature of processing, exploitation, and storage of information to enhance operations and conserve bandwidth. Support unmanned system navigation; unmanned system mission execution (individual and networked); unmanned system sensor operation; intelligent autonomous networks and systems; and improved machine intelligence.

j. Human-Systems Interface (HSI) - Enhance Navy understanding of the physiological and cognitive characteristics that define and shape human interaction with technology at the individual and collective level and optimize system use in an operational context. This includes understanding how data and information are best delivered to the system and how it is best consumed by the user. Support user-centric system design and adaptive training and simulation; enhance user interfaces; improve performance assessment; and increase training-to-field knowledge retention.

k. Environmental Battlespace Awareness (EBA) - Provide knowledge of the current and predictive physical environment and its impact on naval operations from the bottom of the oceans to space. Support efficient and effective collection of environmental data; improve numerical weather and ocean modeling; provide new and improved tactical decision aides that describe environmental impacts; and develop capabilities for in-situ environmental sensing, advanced numerical environmental prediction, and sensor performance prediction. Provide decision management tools that fuse operational information, intelligence, and system performance information in a predicted environment to support optimal decision-making for asset allocation, weapons and sensor performance, route selection, and execution timelines to maximize warfighter advantage.

While not a specific S&T focus area, innovations that can reduce Total Ownership Costs (TOC) through reductions in procurement and sustainment costs are always a priority. In particular, PEO C4I seeks technologies to provide scalable energy solutions for diverse environments; reduce energy consumption through greater efficiency and power management; improve reliability and operational readiness; reduce or mitigate system or component obsolescence; reduce maintenance, manpower and training costs; and extend service life.

Enclosure 1: PEO C4I 2014 Capability Gaps for Science and Technology

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Information Transport & Infrastructure (TI)0	<b>Assured Connectivity and Access in all Operating Environments</b>	150	Reduced Complexity Operating Environment	Develop/Leverage techniques which reduce the number and complexity of overhead tasks performed by shipboard personnel. These techniques should enable system configuration, trouble-shooting, maintenance, repair, and related housekeeping tasks to be performed remotely in either time or space. The intent is to maximize the percentage of shipboard resources devoted directly to warfighting, and to ensure that sophisticated communication and other technologies are used to maximum potential under stressful operational conditions.	Mid (3-8)
		160	Data Cloud Replication/Synchronization	Data Cloud Replication/Synchronization among different data cloud platforms. Replication and synchronization of data and metadata among multiple instances of data cloud infrastructures both under normal communications and DIL communication environments.	Near (0-3)
		160	Data Cloud Replication/Synchronization/Failover on a single platform	Data Cloud Replication and Failover on a Single Platform: Automatic replication/synchronization and failover for continuity of operations of Data Cloud (Accumulo/Hadoop) in the event of catastrophic failure/destruction of the main Data Cloud hardware.	Mid (3-8)
		160	Data Cloud Backup and Restoration	Backup and restoration of key data in Accumulo/Hadoop without duplicating entire Accumulo/Hadoop stack.	Mid (3-8)
		160	Tactical Storage Cloud Technologies	Technologies that will enable implementation of a tactical storage cloud afloat providing secure, reliable, scalable, low latency content storage for tactical applications (functionally equivalent to Amazon S3 storage).	Near (0-3)
		160	Tactical Data Cloud	Technologies that will enable implementation of a tactical data cloud afloat to provide a highly parallel analytic engine used to store, analyze and search petabyte scale data sets (functionally equivalent to a Google Big-table based cloud).	Mid (3-8)
		160	Combat Systems/Command and Control Information Gateway	Capability to securely exchange information between C4I network and SSDS or AEGIS Combat System.	Near (0-3)
		160	Improved Messaging Performance	Technologies to improve messaging performance when mediation is involved and there are added layers of security.	Mid (3-8)
		160	Data Cloud Analytic Index Optimization for Load Balancing	Optimization of indexes for data ingestion and subsequent analytic operations in Accumulo/Hadoop for different types of data to optimize performance and balancing load among data cluster/avoid overloading a cluster.	Near (0-3)
		170	Better Antenna side lobe performance	Antennas with reduced side lobe radiation via meta-materials and/or revised geometries.	Mid (3-8)
		170	High bandwidth multi-carrier CDL antenna	High bandwidth multi-carrier antenna with wide field of view (e.g., multi-panel phase array antenna) and low SWaP requirements.	Near (0-3)
		170	RF Multi-Channel Combiner/Coupler (RF-MC3)	A single digitally controlled RF combiner/coupler that significantly reduces SWaP and interference and will combine and couple up to four radio channels with matched antenna feed line power and transmission levels.	Mid (3-8)
		770	Time-sensitive, reliable communications with other fleet platforms & systems within full range of tactically relevant speed and depths	Air-water interface technology improvements and new capabilities. Command and control communications links for organically launched or non-organic unmanned systems. To include, but not limited to technology advancements in optical laser communications, buoyant cable antenna, towed buoys, & gateways (e.g. buoys, mobile or station keeping autonomous surface devices).	Mid (3-8)
		770	Submarine Outboard Systems (Line of Sight)	Antenna stealth improvements without compromise of RF performance. Improve antenna top hat design to integrate all desired L- band capabilities into an all-in-one solution. To include but not limited to reducing radar cross-section area, legacy L-band capabilities combined with incremental objective capabilities.	Mid (3-8)
		770	Submarine Outboard Systems (Beyond Line of Sight)	Improve reliability of submarine High Data Rate antenna system to include, but not limited to, improved materials for submarine radomes (e.g. deep-sea rated, stealth, mechanical strength, anti-fouling, electrical performance...); heat management of system components to reduce IR signature & improve RF signal performance; reduce overall size but improve bandwidth; co-site mitigation; low cost phased arrays.	Near (0-3)
		790	Fleet Broadcast Replacement	Develop an enhanced Common User Digital Information Exchange System (CUDIXS) to replace the Surface Fleet Broadcast capability. Technologies should optimize channel utilization, support increased data throughput, and provide assured delivery of C2 messages. System should use existing UHF SATCOM assets to replace obsolete AN/SSR-1 technology, mitigate Fleet Broadcast component shortfalls for Ship Construction Navy (SCN) ships, and decrease maintenance burden for shipboard messaging systems.	Near (0-3)
		790	Cost Effective Secure/Non-secure AS-SIP Handsets	Develop/leverage voice over IP (VoIP) handsets technologies that are independent of proprietary call management and session control devices. The technologies should accommodate the assured service session initiation protocol (AS- SIP) standard, applicable to both tactical and non-tactical environment to support the Navy Enterprise Network (NEN) and IT-21 network, and must be cost effective. Additionally, the handsets must comply with DoD Unified Capabilities Requirement 2013.	Near (0-3)

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Information Transport & Infrastructure (ITI)	Persistent Network Awareness and Control	160	Network Management and Monitoring of the Wide Area Network (WAN)	Capability to provide situational awareness to the warfighter on current WAN status and performance to include but not limited to Quality of Service (QoS), link utilization, traffic flows, and topology. Provide capability to generate and store reports, conduct analysis, and adjust network parameters.	Mid (3-8)
		160	Theater Network Modeling	Need capability to conduct predictive network modeling. Need tools to conduct mission planning of the network prior to conducting operations; ability to model adversaries' actions and impacts to friendly forces; and capability for warfighters to conduct realistic modeling of potential scenarios and weigh risks against mission success.	Far (9+)
		160	Disruption Tolerant Networking	New tools to simplify LAN administration, trouble shooting, maintenance and corrective measures, and to conduct mission planning of the network prior to conducting operations. Need technology to support the network's ability to sense impairments when the network experiences delays and disruptions, and to mitigate the effect of these impairments using techniques such as Disruption Tolerant Networking (DTN). Need protocols which enable store and forward networking.	Mid (3-8), Far (9+)
		160	Integration of Enterprise IDaM with tactical IDaM solutions	Identity and Access Management (IDAM) are key elements in securing the Navy enterprise, and solutions must exist that allow for tactical units to utilize the same identities of users that exist ashore in the afloat tactical environment even within a D-DIL networking environment. Need Capabilities for: Policy Enforcement Point (PEP); Policy Decision Point (PDP); Cell Level Security; Web Service Security; IDAM federation.	Near (0-3)
		160	Dynamic prioritization of C2ISR communications based on unit mission to support operations within a disadvantaged, intermittent, latent (DIL) environment	Capability for war fighters to conduct realistic modeling of potential scenarios and weigh risks against mission success.	Mid (3-8)
		170	Propagation aware Automatic Link Establishment (ALE)	Develop a method to balance traditional radio ALE in RF networking environment with persistent and continuous transport of TCP/IP data across a radio channels. Develop a Network Monitoring System (NMS) or extensions that measure the stability of an RF Network channel at each node (statistics and electro-magnetic interference conditions) and prompt the acquisition of additional channels and inhibit data flow (TCP/IP).	Mid (3-8)
		170	High fidelity dynamic range RF power measurement and control	Develop capability for large, high fidelity, dynamic range RF in-line measurements to compensate for operating temperature and frequency variations in support of SATCOM link power control.	Mid (3-8)
		770	Submarine Inboard Systems	Develop scalable and modular enterprise-wide services in cloud environments including information sharing and security/Information Assurance (IA). For each increment of Common Submarine Radio Room (CSRR) more capability of hardware & software is being added, but there is limited physical space remaining. There is a growing need to leverage common computing resources to eliminate unnecessary redundancies and increase computing efficiency/unit area.	Mid (3-8)
		770	Undersea Connectivity (Network Management)	Disruption Tolerant Networking demonstrated under conditions in which the bandwidth and latency constraints are the same as those encountered in the undersea environment. Automated in situ network management software, protocols, and algorithms for optimizing routing and control of priority data based on commanders intent. Undersea network mission planning and management tools.	Far (9+)
		790	Cross Domain Solution Network Management Services	Develop/leverage a gateway technology that will enable existing Cross Domain Solutions (CDSs) to pass "proxied" network management protocols such as SNMP. The technology should enable a single Network Management System suite (e.g., ENMS) to easily extend cross-domain management and monitoring. The technology should add robustness to NetOps situational awareness, reduce the number of network management suites required, and improve operational efficiency by providing a single management tool for all security domains.	Mid (3-8)
		790	Fleet NOC Converged and Optimized Infrastructure Services	Leverage and tailor industry best of breed tools for the Fleet NOC to provide a cost effective modular converged computing Infrastructure as a Service (IAAS) that has the agility to scale with increasing capacity demands. The technology would be agile and scalable to enable new services to have resources provisioned on demand and/or increased in a repeatable building block fashion, reducing fielding timelines.	Near (0-3)
		790	NetOps SA for Crypto Systems	Develop innovative solutions to enhance foundational crypto management technologies fielded by other Programs of Record (PORs) for the enterprise monitoring and management of integrated crypto systems. The technology should meet the Fleet Cyber Command's requirements to interface with the NetOps Manager of Manager (MoM) capability and provide critical NetOps and Cyber Situational Awareness data to enable proactive monitoring and management of crypto devices. The technology should follow DoD/NSA crypto standards for management and have a feasible path to accreditation.	Mid (3-8)
160	Enterprise Change Management Tools	Need technologies that enable management at an enterprise level. Need capability to quickly determine impacts of changes to configuration, new applications, services and security modifications; tools to flag proposed actions by one system or application which may impact other systems or applications; and capabilities to automate risk and impact assessment of the actions that a Program may have on the enterprise.	Mid (3-8)		

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Information Transport & Infrastructure (ITI)	<b>Bandwidth-efficient Communication Capabilities</b>	160	Virtualized Networking	Technology to enable replacement of traditional network H/W functions with virtual machines and solutions. Need integration of COTS virtual routers into existing architecture; improved security posture with fewer unique configurations; scalability with or without changing software components; and technologies that enable addition of new capabilities without requiring hardware installation.	Mid (3-8)
		160	Innovations for space, weight, and power (SWaP) reduction	Technology that contributes to consolidation of naval platforms' computing infrastructure and SWaP reduction. Navy ships continuously require more computing power yet there is a finite amount of ships power and weight and space available.	Near (0-3)
		160	Dynamic Modem to Router Interface	Capability to allow effective information exchange and feedback between modems and routers to maximize bandwidth in dynamic bandwidth environments.	Mid (3-8)
		160	Enterprise Change Management Tools	Need technologies that enable management at an enterprise level. Need capability to quickly determine impacts of changes to configuration, new applications, services and security modifications; tools to flag proposed actions by one system or application which may impact other systems or applications; and capabilities to automate risk and impact assessment of the actions that a Program may have on the enterprise.	Mid (3-8)
		160	Tools to support efficient installs	Need technologies for efficient data migration to reduce time required onboard for installations; test tools that automate all or part of the manual test functions to reduce time for integration testing, verification testing, and acceptance testing; technologies that allow for infrastructure upgrades without re-install of existing applications, thus eliminating the need for SOVT and ship visits for hosted programs; tools for efficient and repeatable install preparation processes; and tools to enable provisioning of resources.	Near (0-3)
		160	Tools to support information sharing and provisioning	Need technology to enhance management of servers and provision resources to hosted applications, to include Enterprise, Database, Applications, Environmental, Traffic, Performance, SNMP, VoIP, and Web. Full situational awareness of our networks is imperative as we learn how to operate and respond to harsh, denied environments. A new capability is needed that enables the commander to make decisions based on the status of the network.	Mid (3-8)
		160	Software Defined Networking (SDN)	Examine application of SDNs to tactical networks to improve granularity of QoS, facilitate communications in D-DIL environments, enable resilient networking, and improve security posture.	Far (9+)
		170	Bandwidth efficient and threat resilient COTS satellite modem	Incorporate latest COTS satellite modems in to CBSP program to improve throughput while providing limited resistance to SATCOM threats.	Mid (3-8)
		170	Better Solid State Power Amplifier (SSPA) performance	Higher efficiency SSPA for use across all communications systems.	Mid (3-8)
		170	Dynamic router-to-modem interface	Modem to router (vice versa) interface standard to allow for exchange of control and management data along with appropriate division of responsibilities (e.g., queues in either/or modem and router).	Near (0-3)
		760	RF Distribution and Switching	Automated RF Distribution and Switching.	Near (0-3)
		760	Improved Apertures	Integrated Modular LOS/BLOS Planar and Conformal Arrays.	Near (0-3)
		770	Submarine Strategic Systems	Enhance performance, reduce size and reliability of components, & improve electrical efficiency of transmitter system. Dynamic tuning technologies and new materials to increase ability of shore VLF to operate at lower frequencies. New materials and technologies to decrease VLF/LF Helix house size. Advance present theory of electrically small antennas to enable optimization of the bandwidth, shape, size and configuration of VLF/LF systems. Material and processes to mitigate reliability due to aging and weathering of components.	Mid (3-8)
		790	Bandwidth Efficient Directory Synchronization	Develop/leverage capabilities to enable scalable, bandwidth efficient ship-to-shore synchronization of directory information to support services such as enterprise email and Identity and Access Management (IDaM). Technologies to support synchronization process should be adaptable to provide more data for ships with higher bandwidth but throttle back for ships with lower bandwidth or those ships in DIL conditions. (Work with PMW 130 /160).	Near (0-3)
Information Security and Information Assurance (ISA)	<b>Assured Access and Transparent Identification and Authentication across the Network</b>	130	Provide a means of assured information sharing with need-to-know	Assured information sharing is the ability to confidently share information with those who need it, when and where they need it, as determined by operational need and an acceptable level of security risk. The desired capability should be providing appropriate security measures to share information with entities that have a mission-critical need.	Mid (3-8)
		160	Cross Domain Solutions for Data and Services	Capability for single point of access across domains and classifications based on user authentication (access, privilege, need-to-know) new technology that will enable a single desk top and single login to enable the warfighter to successful work across a multitude of security domains.	Near (0-3)
		770	Undersea Connectivity (Network Vulnerability)	Develop methods of securing data & C2 transport in a dynamic & mobile networked multi-point architecture. To include but not limited to novel LPI/LPD undersea communications waveforms and techniques, crypto & timing synchronization in the undersea environment, & anti-tamper methods.	Far (9+)

Enclosure 1: PEO C4I 2014 Capability Gaps for Science and Technology

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Information Security and Information Assurance (ISA)	<b>Nimble and Proactive Network Defense Posture against Advanced Persistent Threats</b>	130	Provide an effective means of detecting and eradicating advanced malware that are capable of the following attack vectors: polymorphism, stealth, regeneration and disabling existing anti-malware applications	Advanced Persistent Threats (APTs) are organized cyber attacks that can access and steal information from compromised systems. APTs can create such opportunities via multiple attack vectors, such as kernel-mode rootkits and software-based key loggers, which can occur when compromised software is downloaded, a compromised with a known vulnerability is visited or a malicious e-mail is opened. The desired capability goes beyond traditional reactive "scanning and cleaning" to counter these advanced attack vectors.	Mid (3-8)
		160	Computer Adaptive Network Defense in Depth	Technologies that enable the tactical edge commander to manage their network. Priority technology gaps include the detection of configuration changes, provide alerting of suspicious traffic monitoring for unauthorized accounts, detection of data leakage, detection of unauthorized devices, and the monitoring for remote access attempts.	Near (0-3)
		160	Emerging Cyber Threat Defense	Need technologies to defend against emerging cyber threats. Need Supply Chain Risk Management (SCRM) technology & techniques to protect networks & respond to cyber threats at the tactical edge; system monitoring that can differ between naturally occurring network issues & malicious actions; improved audit capability with greater information capture, data protection, synchronization & resiliency; effective means to detect & eradicate Advanced Persistent Threats (APT); technologies that allow cyber situational awareness across the Navy's shore and afloat environment; automated reasoning in near real-time across stove-piped cyber security systems & data sources to achieve a system's approach to cyber SA; emerging technologies such as Next Generation Firewalls & Dynamic	Near (0-3)
	<b>Detection, Prevention and Reporting of Data Exfiltration to Counter the Insider Threat</b>	130	Strengthen existing Data Loss Prevention (DLP) solutions to tackle alternative data exfiltration mechanisms	Data exfiltration today is combated using Data Loss Prevention (DLP) solutions. Unfortunately one can easily manipulate, encode or encrypt such sensitive information that would bypass DLP functions or utilize auxiliary devices such as printers and fax machines as other vehicles for data leakage. This desired capability will strengthen existing DLP solutions to counter such attacks that are not easily detected via deep packet inspection.	Near (0-3)
	<b>Resiliency Under Cyber Attack</b>	130	Tools to identify critical mission-supported information and technology assets that would be affected in a cyber attack and for which resiliency tactics would apply.	Before resiliency mechanisms can be deployed, critical mission-supported information and technology assets need to be identified. This will enable better scoping of protection tactics and improved risk assessment in the event of a cyber attack.	Mid (3-8)
		130	Implement controls to protect identified critical mission-supported information and technology assets from harm	The desired capability is to implement proactive measures to existing critical assets, which include behavioral and anomaly detection, evolving current reactive and signature-based techniques.	Near (0-3)
		130	Implement controls to sustain the ability of identified critical mission-supported information and technology assets to operate under stress and recover from disruptive events	Resiliency provides the capability of continued mission operations during a disruptive event and returning to normal operations once the event has been addressed. The desired capability must go beyond INFOCON guidance for an automated execution that is both effective and streamlined.	Mid (3-8)
		130	Develop resiliency processes that maintain and repeatedly carry out protection and sustainment activities	The desired capability is to ensure that implemented resiliency mechanisms are protected from tampering and non-availability, ensuring they are properly set in motion once a disruptive cyber incident has occurred.	Mid (3-8)
	<b>Improved Information Audit &amp; Forensics</b>	130	Supply user-based information to existing Computer Network Defense (CND) audits for stronger inspection and forensic analysis	Currently deployed Computer Network Defense (CND) capabilities produce audits for inspection and forensic analysis. This gap addresses including more content at a user-level (i.e. keystrokes and tracking website visits and file transfers) to strengthen inspection and forensic analysis.	Near (0-3)
		130	Protect Computer Network Defense (CND) audits from unauthorized access, modification and deletion	Tampering with audits could negatively impact detection of an attack during and after it has occurred.	Near (0-3)
		130	Synchronize CND auditing records across all network operations centers (NOCs) with respect to timestamps	Computer Network Defense (CND) audits that are not synchronized across all sites could skew forensic analysis. Audits today are not synchronized.	Near (0-3)
		130	Provide an alternative Computer Network Defense (CND) audit tool in the event of a failure of the primary CND audit capability	Currently deployed Computer Network Defense (CND) capabilities produce audits for inspection and forensic analysis. If current auditing tools fail, a backup capability must be in place to continue inspection and forensic analysis operations. Current auditing mechanisms do not have this backup capability.	Near (0-3)
	<b>Cloud Computing Security &amp; Assurance</b>	130	Provide the capability of processing encrypted data without decrypting	As the Navy transitions to a cloud-based architecture, processing/manipulating data while in a decrypted state could put data confidentiality at risk should the data center be susceptible to an attack. Ideally, mechanisms should be developed to allow computing (i.e. executable code) on encrypted data without decrypting it at the data center. This, in turn, would make an adversary's operations of injecting malware more difficult.	Far (9+)
		130	Provide automated application of Intelligence Community Metadata Standard for Information Security Marking (IC-ISM) security metadata to files of unknown data types	Cloud computing security and assurance relies on a better identification of data that is to be protected. This could be greatly aided by the application and association of metadata. Department of Defense (DoD) directive 8320.02 states that "data assets shall be made visible by creating and associating metadata ('tagging') including discovery metadata for each asset". The IC-ISM is widely used today. There are existing software tools that can automatically tag common data assets (i.e. file types such as pdf, doc, ppt, xls); however, the desired capability is to tag files of unknown data types which includes defining the metadata and identifying the mechanism for tagging.	Mid (3-8)

Enclosure 1: PEO C4I 2014 Capability Gaps for Science and Technology

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Data Integration and Decision Support (DDS)	<b>Enhanced Data Discovery and Access</b>	120	Storing, Accessing, Replicating and Archiving Large Data Sets	There is difficulty storing, accessing, replicating, handling and archiving the exponentially growing amounts of data being acquired by all sensor and collection systems. Access and replication during periods of disconnected, intermittent and low bandwidth (DIL) conditions is an issue. Need new database management system (DBMS) solutions for effective storage and retrieval of battlespace information; access and replication of metadata and data during DIL conditions; Improved storage systems (HW) and improved data management systems (SW).	Mid (3-8)
		120	Data Fusion and Analysis	Data fusion and analysis does not occur across the entire metadata level. Need improved meta data fusion & analysis to gain intelligence, knowledge, wisdom.	Mid (3-8)
		120	Tagging and Labeling Maritime Big Data	The amount of time it takes to appropriately tag and label new data types can be extensive and if done inappropriately prevent the data from being used in an operationally effective maritime environment. Cloud data storage solutions require effective tagging and labeling of the data to be of value to maritime analytics, searches, and user interfaces. Need improved storage systems (HW) and improved data management systems (SW).	Near (0-3)
	<b>Advanced Analytics and Tools</b>	120	Real Time Fusion of Historical and Real Time Sensor Data with Pattern Recognition	Analysts have to make several queries and spend significant amounts of time to match historical information with new real time data. The analyst must then determine if a pattern change worthy of pursuit has occurred. Need capability to automatically fuse historical data with real time sensor data and then determine if the normal pattern of life has altered. Queries must be across multiple classification levels to provide increased understanding of maritime entities of interest.	Near (0-3)
		120	Assimilation and Prioritization of Data	Enormous quantity of data being acquired overwhelms analyst's ability to assimilate the data and identify critical elements. Need Decentralized, semi-autonomous intelligence analysis tools; Improved semi-automated agents/engines that help intelligence analysts gather data semi-autonomously; Help for analysts to triage raw intelligence data to filter out the 'noise' and alert analysts to significant changes/areas of interest from intelligence data gathered from the DCGS-N system.	Near (0-3)
		120	Analysis of Distributed Data Across Multiple Clouds	As data sources become more distributed, it is increasingly difficult to fuse the data and conduct analysis. Need a capability to analyze and fuse data residing on multiple clouds.	Mid (3-8)
		120	Automatic Trip Wires for System Readiness	There is a need for automated tools that would alert maintainers on system readiness issues. Need a capability to automatically compile and review system readiness and performance data to queue APMs on potential readiness issues.	Mid (3-8)
		150	Automated data fusion for association with overall COP and Track Management	Provide the capability to input data from multiple sources, whether sensors or other systems. Provide automated analysis of that data and associate it with relevant records being tracked on the COP, to include system readiness, environmental sensing, etc.	Near (0-3)
	<b>Advanced Data Display and Visualization</b>	120	FMV Annotation and Search	Need capability to annotate full motion video with value added content in near real time; automatically and manually search historical FMV data for entities and activity of interest; improve the classification of merchant vs. combatant based on past behavior captured in FMV. Full motion video that has been annotated with appropriate symbology, descriptions and content has value added to the War Fighter; accomplishing this in near real time contributes to the value; a significant amount of data is collected, but it is not always known which data is the most important. Having the capability to search video in the past to identify an entity or event of interest in the present would increase the speed analysts processing of FMV data.	Mid (3-8)
		120	All Source Predictive Analysis and Pattern Recognition	The time it takes to identify activity of interest in the maritime environment takes too long and sometimes is missed entirely. Pattern recognition is a function of analyst's experience. Need capability to automatically predict anomalous behavior from pattern of life in a maritime environment from all source data to improve the detection of potential entities and activities of interest.	Near (0-3)
		150	Predictive SA and threat assessment for COA generation	Utilize existing platform and COP data in the generation of COA plans to respond to various maritime scenarios. Planning tools would provide ability to theoretically task various platforms in a single strike group and evaluate chances of success given platform capabilities and current status.	Near (0-3)
		790	Smart Display Capability	Develop/leverage advanced and interactive wall data display and visualization technologies to formulate a standardized display architecture for all Maritime Operations Centers (MOCs). The architecture and underlying technologies shall enable the MOC operators to receive and display information from the various C4I systems, applications and sensors such as JDOCS, MTC2, GCCS-J, DCGS-N; share and distribute information to remote watch cells; and promote real-time understanding of the information through interactive collaboration and coordination, thus reducing analysis cycle time	Near (0-3)

Enclosure 1: PEO C4I 2014 Capability Gaps for Science and Technology

2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Data Integration and Decision Support (DDS)	<b>Mission and Operations Architecture for Improved Decisions</b>	770	Undersea Connectivity (Data Management)	Lack of architecture, standards, interfaces and protocols to transform data collected from undersea assets into timely, decisive, actionable, information. Data Strategy, Data to Knowledge Algorithms, Data Exfiltration, convert collect knowledge from undersea network to aid decision makers.	Far (9+)
		790	Telecommunication Management System	Develop/leverage advanced telecommunications situational awareness management technologies to include DISA Unified Capabilities requirement of fault, configuration, accounting/billing, predictive analysis, and performance analysis and security management. The technologies should integrate with the Navy Enterprise Network (NEN) operations to provide common operational picture of telephony situational awareness within each region. The technologies should capture, correlate, and analyze data to meet predictive requirement as well to meet real-time on demand analysis. The tool should accommodate billing requirements of the NCTAMS and other commands such as NAVSEA, NAVAIR, and CNIC.	Near (0-3)
	<b>Management of Sensor Overload</b>	120	Remoting and Distributed Operations	Shipboard IO sensors are not netted and therefore cannot be remotely operated. Result is Sub-optimal performance. Need capability to net shipboard IO sensors and remotely control their operation from other units, ashore activities or National agencies.	Mid (3-8)
Enhanced Targeting and Fire Control (ETF)	<b>Net-enabled Weapons</b>	120	Improved ID of Speaker, Platform, and Emitter	Navy linguists are in critical demand and not always available for shipboard deployment. Need capability to automate the identification of individual foreign language speakers, platforms and specific emitters.	Near (0-3)
	<b>Improved Combat Identification</b>	120	Automated Target Recognition From FMV	Need Capability to automatically detect vessels and other targets from full motion video. As more ISR platforms proliferate, the volume of FMV being collected is going to overwhelm the ability of analysts to view every frame for content; Automated detection of specified targets from the raw video is required to enable analysts to focus on identification and other tasks. Automated detection of specified targets from the raw video is required to enable analysts to focus on identification and other tasks.	Near (0-3)
Electromagnetic Spectrum Operations (ESO)	<b>Acute Spectrum Sensing and Awareness</b>	120	EMI Mitigation	Electromagnetic Interference (EMI) is a continuous problem for ships and agile emitters have exacerbated the problem. Need EMI mitigation strategies capable of dealing with the dynamic nature of the shipboard environment. Strategies should encompass all disciplines including but not limited to; mechanical means, modifications to operational procedures, software applications, cryogenics, and electronic means (filters that have electrical tuning speed in the nanoseconds, that maintain high quality factor across the bandwidth, that are able to withstand the high power from HF radars, and that are controlled by an RF spectrum monitor) or any other novel mechanism.	Near (0-3)
		120	Multifunction Antennas	There are too many IO/SIGINT antennas used on board navy ships and aircraft. The antennas are too large, they have only one function, and they do not have wide enough apertures. Need low RCS, multifunctional antennas for IO Transmit, Receive and Direction Finding that operate over 3 MHz to 100 GHz. Applicable to future platforms like DDG-1000, LCS, submarines, etc. Retrofit to current US Navy ships.	Mid (3-8)
Non-Kinetic Fires (NKF)	<b>Non-Kinetic Targeting and Engagement</b>	120	Countering Emerging Signals	The current approach to address emerging signals of interest (SOIs) is to develop hardware or software solutions that are prototyped, then fielded; The rapid pace of signal proliferation requires a new approach to countering these signals; Agile SIGINT reconstruction and Joint Signal Processor (JSP) are not integrated with SSEE. Need a software/hardware approach that can be pushed to the ships is a more rapid mechanism to solving the problem. Integration with JSP will improve response to agile signals.	Near (0-3)
		120	Integrated Fires	There is no system to coordinate or integrate the kinetic fires of combat systems and the non-kinetic fires from IO. There is no path to move data from the Combat System to SCI Networks and the Ship's Signal Exploitation Space (SSES) or vice versa. Need capability to exchange data between the ship's Combat System and the SSES to facilitate coordination and integration of kinetic and non-kinetic fires.	Mid (3-8)
		120	Modeling and Simulation	The SIGINT/IO community does not have a capability to conduct mission planning for placement of sensors, nor a mechanism to conduct analysis of employment of those sensors (what-if analysis). Need capability for modeling and simulation of the battlespace to conduct mission planning. Optimize sensor placement and employment.	Near (0-3)
	<b>NKF Operational Aids/ Modeling/ Planning</b>	120	Counter UxV	UxV proliferation has created exploitation opportunities. Need capability to track and monitor UxVs. Additional details of the desired capability are classified; contact PMW120 for additional information.	Mid (3-8)

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2014 PEO C4I S&T CAPABILITY GAPS					
Focus Area	Tech Objective	PMW	Capability General Description	Desired Capability Synopsis	Need Date
Non-Kinetic Fires (NKF)	<b>Non-Kinetic Counter C4ISR</b>	120	Coordinated Counter ISR	Increasing number of sensors and tools devoted to countering adversary ISR capabilities requires a command and control function to coordinate the efforts to optimize employment, enable re-tasking and prevent fratricide. Need capability to command and control counter ISR sensors and non-kinetic responses.	Mid (3-8)
		120	Cyber Capabilities	Current SSEE systems have limited access to adversary cyber systems and limited capability to affect those systems. Need a capability to access adversary networks and affect those systems.	Mid (3-8)
Positioning, Navigation, & Timing (PNT)	<b>Protected GPS-dependent PNT</b>	170	Reliable GPS independent PNT solutions	Need a ship-based autonomous fused sensor and clock system that is stable enough to maintain PNT during GPS/radio navigation outages. Need reliable and redundant alternative methods of globally distributing precise PNT to support the network-centric force architecture.	Near (0-3)
Autonomy (ATY)	<b>Reliable and Durable Power Sources for Unmanned Systems</b>	770	Undersea Connectivity (System Level Power Management)	Lack of architecture, standards, interfaces and protocols distribution and control of energy across all network assets. Smart network algorithms and protocols to optimize energy cost decisions to ensure mission critical nodes are operationally available even in a degraded network.	Far (9+)
		770	Undersea Connectivity (Reliable Connection and Transfer of Data and Energy)	Lack of architecture, standards, interfaces and protocols for reliable undersea connections between undersea assets (sensors, nodes, undersea vehicles, and fixed assets for data and power). High efficiency wireless energy transfer technologies for UUVs and fixed sensors. Mobile or static caches of energy/information that are platform agnostic. Scalable & rapid charge power cells. Long haul energy efficient submarine cable network transponders for high bandwidth data flow.	Mid (3-8)
Human-Systems Interface (HSI)	<b>User-centric System Design</b>	120	Workflow Analysis (within IO and between IO and ISR and METOC)	Optimized workflow does not exist between IO, ISR and METOC systems. Need capability to analyze workflow and compose new workflow paths and actions as missions change; Automated way to dynamically compose Community of Interest (COI) services in order to optimize mission specific work flows.	Near (0-3)
Environmental Battlespace Awareness (EBA)	<b>In-situ Environmental Sensing Capabilities</b>	120	Automated Characterization of the Atmosphere Temperature, Relative Humidity, and Barometric Pressure	Currently atmospheric measurements are made manually from ships. Aircraft and some UAVs make measurements but the data is not captured. Need capability to automatically take and transmit temperature, barometric pressure, & relative humidity atmospheric measurements from ships, ground units, aircraft & UAVs.	Mid (3-8)
		120	Accurate Atmospheric Acoustics and EM/EO from Boundary Layers	Unable to sense key environmental parameters (relative humidity, air temperature, winds, and turbulence), assimilate data and update performance tools such as propagation algorithms. Provide boundary layer characteristics at sufficiently high vertical resolutions to support accurate atmospheric acoustics and EM/EO performance prediction and sensor capabilities assessment.	Mid (3-8)
		120	Organic Capability to Measure Evaporative Duct	There is no shipboard organic capability to measure the evaporative duct and its impact on shipboard sensors. Need automated capability to measure continuously the height of the evaporative duct aboard ship.	Near (0-3)
	<b>Advanced Numerical Environmental Prediction Capabilities</b>	120	Visibility Prediction	There is no Navy capability to predict visibility continuously at sea. Need a automated capability that forecasts surface visibility in the maritime global environment.	Mid (3-8)
	<b>Sensor Performance Prediction Capabilities</b>	120	Optimized Spectrum Utilization	There is no mechanism to acquire or measure key atmospheric characteristics and integrate these environmental characteristics with appropriate electromagnetic assessment tools for optimal sensing and communication link utilization. Need to provide key environmental parameters and validated performance tools to optimize spectrum utilization in the battlespace.	Mid (3-8)
		120	Modeling of Biological Impact on Sonar Performance	The presence of fish schools negatively affects active sonar performance by scattering and attenuating acoustic energy; The now casting of these biological hot spots "through-the-sensor" is currently possible; Links between ocean temperature fluctuations, eddy formation, nutrient movement and the resulting response by fish schools have not yet been established by the 6.1/6.2 RDT&E community. Need to provide a capability to accurately forecast the movement of bio-acoustic activity (i.e. fish schools) in order to better support U.S. Navy mid-frequency hull-mounted active sonar performance predictions.	Mid (3-8)