



Space and Naval Warfare Systems Center Atlantic S&T Strategic Plan

Presented to:
Small Business and Industry
Outreach Initiative (SBI/OI)
Thirty-First Symposium
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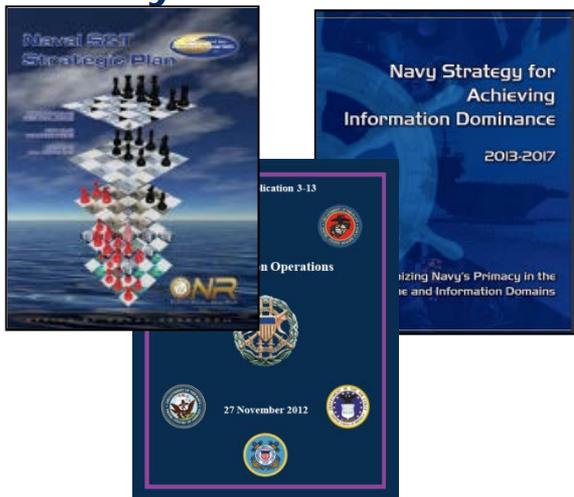
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Overview

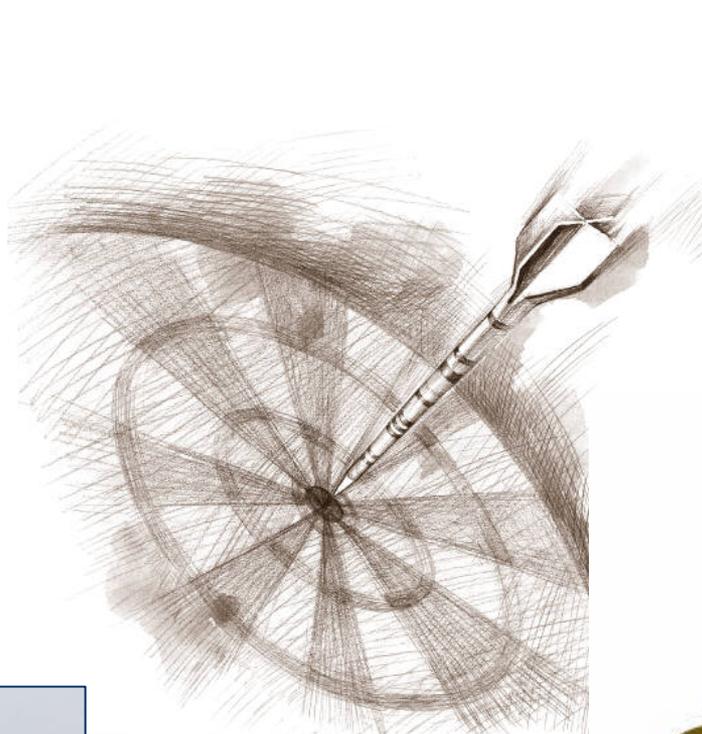
- ▼ Our development approach for the SSC Atlantic S&T Strategic Plan
 - Intent for use
 - Technology Assessment
 - Contextual highlight of emerging technology areas of interest to SSC Atlantic Core Information Dominance Mission
 - Targeted technologies: (considerations)
 - Grow: (workforce, infrastructure, critical to core capability)
 - Leverage: (research partnerships, contracts, agreements, prototypes, sandbox – research shaping and influence for DoD requirements)
 - Aware: (literature, conferences, site visits)
 - Snapshot of current S&T at SSC Atlantic

Development of S&T Objective Areas and Technology Environment Awareness

Policy and Guidance



Emerging Technologies



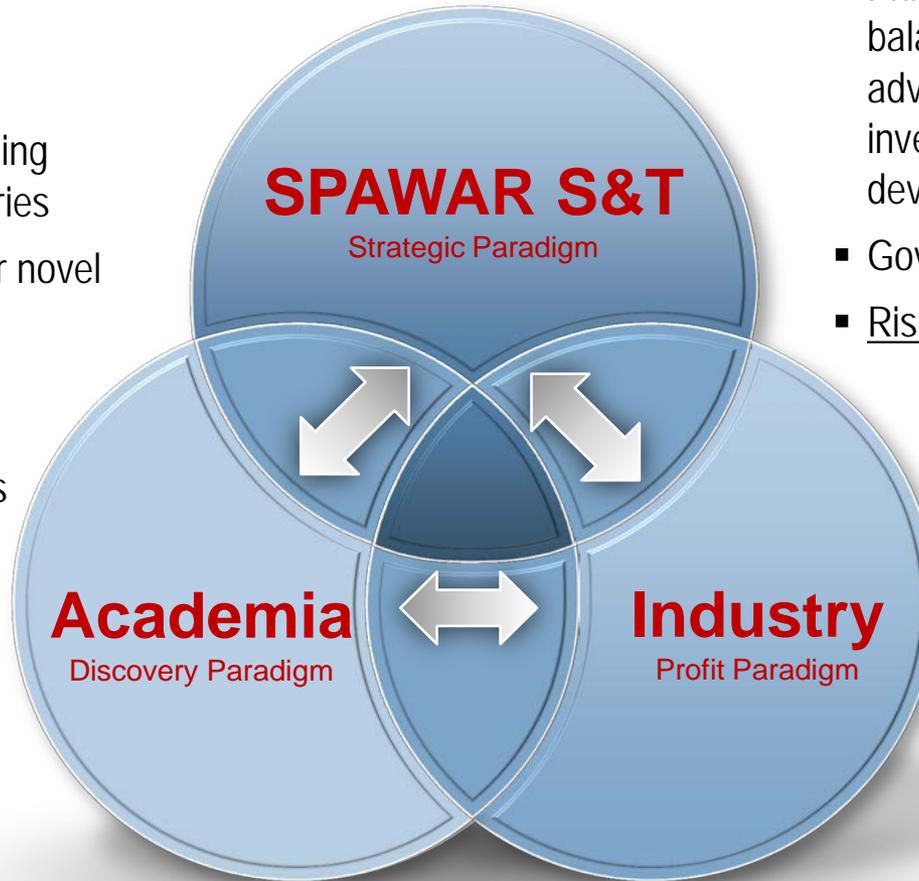
S&T Needs & Gaps



Commercial Markets & Investment Sector

Information Dominance Perspectives

- Primary focus is on discovery and pushing knowledge boundaries
- Risk acceptance for novel development and applications
- Exploration and discovery emphasis



- Primary focus on strategic outlook, balancing research policy advancement, fleet support, and investment in technology development
- Governance emphasis
- Risk neutral
- Primary focus is production emphasis with business case and profit motive
- Risk limited for unproven technologies and unconventional thinking
- Technology deployment solution emphasis

Information Dominance Perspective



Key Themes Emerging in Describing Information Dominance

- Superior operational advantage in decision making and warfighting through the integration of technical information functions, capabilities, and resources
- Combination of three fundamental capabilities: assured command and control, battlespace awareness, and integrated fires
- Full recognition and exploitation of information as a weapon, cyberspace as a modern warfighting domain, and computer networks as a modern battlespace
- Assure access to cyberspace and confident command and control, prevent strategic surprise in cyberspace, and maintain the ability to deliver decisive cyber effects
- Develop and sustain a viable and responsive Information Dominance Corps through a commitment to workforce planning and management processes, delivery of a Corps-wide learning continuum, and cultivation of an Information Dominance culture and warrior ethos

Information Dominance Perspective



Key Themes Emerging in describing Information Dominance

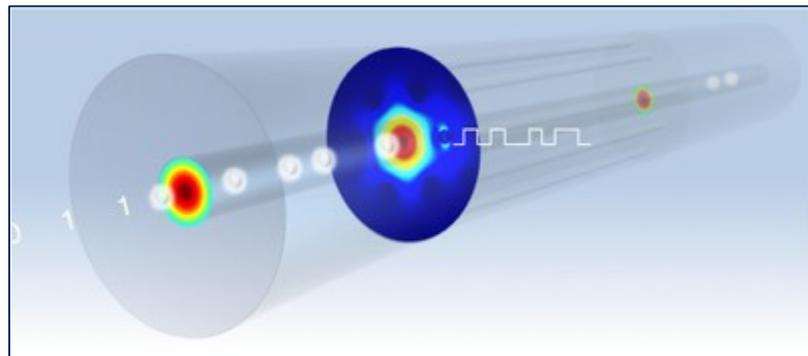
- Provides the framework through which the Navy's information capabilities will be mainstreamed into the Navy's culture as a distinct warfighting discipline
- Defined as the operational advantage gained from fully integrating the Navy's information functions, capabilities and resources to optimize decision making and maximize warfighting effects (cyber warfare)
- Focused on three fundamental capabilities: (1) Assured C2, communicate with and operate forces, using a variety of methods and pathways that are flexible, resilient, and well understood, (2) Battlespace awareness, what a commander or tactical unit needs to know about a contact or target area, and the air, land and water around it, and (3) Integrated fires, fusing, in a deliberate, systematic methodology, both kinetic and non-kinetic weapons to achieve desired effects

Primary S&T Strategic Focus Areas

- ▼ Advanced Communications
- ▼ Networks
- ▼ Analytics & Artificial Intelligence
- ▼ Autonomous Systems
- ▼ Data Handling
- ▼ Mobility
- ▼ Computing
- ▼ Man & Machine

Advanced Communications Systems: Assessment

- ▼ Driven by the increased use of Unmanned Systems – payloads will demand improvements in weight, range, bandwidth efficiency, LPI, ECM resistance and lower latency
- ▼ Winning solutions will likely incorporate efficient spectrum usage methodologies
- ▼ Advanced communications waveform design
- ▼ New models and products will be required for the design, testing and verification of emerging communication protocols and systems
- ▼ Smart Radios will surpass current Cognitive Radio designs
- ▼ Speed increases in wireless networks will ease the integration of the radio link and wired/fiber networks
- ▼ Continued bandwidth increases as well as processing in fiber networks



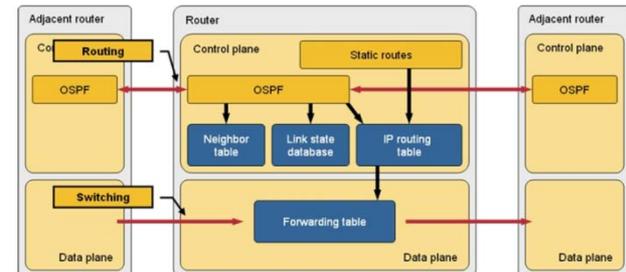
Advanced Communications Systems: Targeted Technologies

Advanced Communications Systems S&T Sub Thrust Area	Follow	Leverage	Grow
Free space optical communications	●	◐	○
LPI Techniques	●	●	◐
Waveform Development	●	●	◐
Smart Radio: Energy aware – energy efficient design (SW/HW/FW)	●	●	◐
Smart Radio: Inter-network gateway support	●	●	◐
Smart Radio: Multiband dynamic spectrum agility	●	●	◐
Long haul communications techniques (other than SATCOM)	●	◐	○
High data rate transmission (ie. Millimeter wave, optical)	●	●	◐
Simulators and next generation test bed development	●	●	●
EMC theory and algorithm development	●	◐	○
Datalink development	●	●	◐
Photonics	●	●	◐

Networks: Assessment

"If you think today's internet generates a lot of data, the Internet of Everything will be another matter entirely."

- ▼ While largely academic based efforts, many of the deployment solutions for Smart Networks will be moving from research to vendor solutions in the near future
- ▼ SDN, NFV, Network Virtualization well supported and growing in the open source community – well beyond OpenFlow
- ▼ Application awareness (priority, bandwidth, context,...) will work in concert with the network control plane and intelligent network nodes
- ▼ Wireless heterogeneous networks will lead to hierarchical internetworking architectures – thin line to the front line: larger infrastructure based mobile networks
- ▼ Methodologies and protocols for ensured delivery – opportunistic routing vs. best path
- ▼ Wireless security improvements will be required – jammer detection and defense, authentication, secure routing protocols, network security authentication
- ▼ Internet of Everything (IoE) – sensor networks
- ▼ Extreme high speed wireless networks-eases fiber on/off boarding



Networks: Targeted Technologies

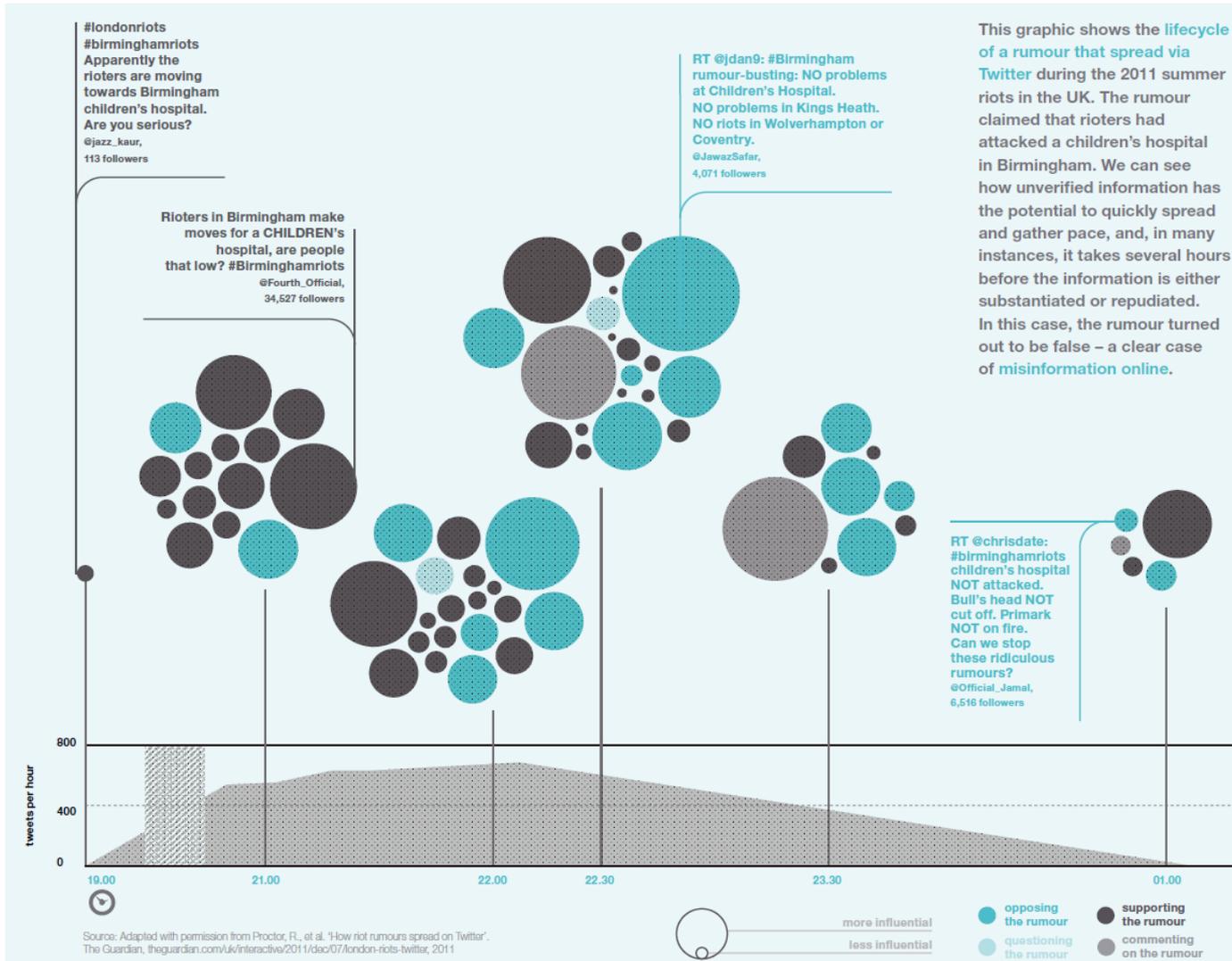
Networks S&T Sub Thrust Area	Follow	Leverage	Grow
High Speed Wireless Point to Point	●	◐	○
Efficient and Resilient Routing Algorithms	●	●	◐
Self organization and auto configuration	●	●	◐
Dynamic load distribution	●	●	◐
Embedded systems SW development (Mobility & Adv Comms)	●	●	●
Attack Tolerance (fragmentation, dispersion, coding)	●	●	◐
Attack Detection	●	●	◐
Control Plane Management	●	●	◐
Network Security and Authentication	●	●	●
Data priority and context awareness	●	●	◐
Sensor Development	●	●	○

Analytics: Assessment

Predictive models and optimization algorithms allow you to not only predict the most likely outcome, but what's the best that could happen.

- ▼ The value that can be derived from big data is driving new and novel analytics innovation beyond traditional approaches
- ▼ Past inhibitors (slow computational performance, high cost HW/SW, limited data sets) have dissipated significantly
- ▼ Analytics demands new advances in Artificial Intelligence and Machine Learning
- ▼ Quickly changing interests and large data volumes quickly modify statistics and challenge earlier single machine training algorithms
- ▼ Analytic applications will provide the typical user level interface to big data analytics – Reliable, Repeatable, Relatable
- ▼ Data integrity, trust and context will be significant data characteristics that must be understood (misinformation) and utilized

Lifecycle of Misinformation - Information Vacuum Effects: 2011 London Summer Riots



Analytics: Targeted Technologies

Analytics S&T Sub Thrust Area	Follow	Leverage	Grow
Analytic functional libraries (Analytics as a service)	●	●	◐
Data Verification/Trust Analytics	●	●	◐
Linguistic Analytics	●	◐	○
Sentiment/Emotion Analytics	●	●	◐
Business Analytics	◐	◐	○
Image Analytics	●	●	◐
Predictive Analytics	●	●	◐
Web Analytics	●	◐	○
Entropy and Information Theory	●	●	◐

Autonomous Systems: Assessment

*The last fighter pilot has
already been born...*

- ▼ Technologies will need to be developed to counter the threat of small form factor unmanned systems
- ▼ Soft robotics will find specialized applications – mimic of creatures such as octopuses, starfish and squid
- ▼ Technologies will be developed to support the development, integration and onboard pre-processing of multimodal advanced sensors
- ▼ Situational understanding – “recognition of sensor data” with limited onboard pre-processing computational capability points to “Cloud on the move” and improved “Datalinks”
- ▼ Broadening the context of autonomous systems from unmanned systems to smart machines – Movers, Sages, Doers
- ▼ “My Computer, My Friend” – artificial intelligence driven situational awareness and advice – automated judgment
- ▼ Combining artificial intelligence, machine learning and natural user interfaces (voice recognition) simple knowledge worker tasks will be eliminated

Autonomous Systems: Targeted Technologies

Autonomous Systems S&T Sub Thrust Area	Follow	Leverage	Grow
Sensor integration and onboard pre-processing	●	●	◐
Language processing	●	◐	○
Mission dependant collaborative behaviors	●	●	◐
Perception (importance, context)	●	●	◐
Small form factor detection	●	●	◐
Machine learning and deep learning algorithm development	●	●	◐
Automated/Assisted Decision Planning/Making	●	●	◐

Data Handling: Assessment

90% of all the data in the world has been generated over the last two years

- ▼ Big Data in Motion – what is happening this second – enabling on the fly decisions – instantaneous analytics feedback
- ▼ Real time decision making will require efficient data utilization, correlation and computational processing across the cloud
- ▼ Data explosion will grow significantly faster with machine to machine systems – dwarfing the data created during the human:internet era
- ▼ Beyond data processing, new approaches will need to be developed for knowledge management
- ▼ By 2016, big data will be used more often to innovate or invent products and services than to incrementally improve existing business processes

Data Handling: Targeted Technologies

Data Handling S&T Sub Thrust Area	Follow	Leverage	Grow
In memory computing	●	●	◐
Novel data compression techniques	●	●	◐
Data forensics	●	●	●
Data storage, proliferation, retrieval, and replication models	●	●	◐
Data security on distributed systems	●	●	◐
Intelligent management and distributed processing	●	●	◐
Efficient metadata models	●	●	◐

Mobility: Assessment

How to enable and empower employees by “bringing work to devices”, no matter who owns the hardware or exercises administrative rights.

- ▼ Mobile application development in the “gold rush era” and no sign of slowing
- ▼ The use of presence technology will be ubiquitous in the mobile experience – beyond GPS
- ▼ Bring Your Own Device(BYOD) will be passé – teleworking and offsite work locations is more in-line with Bringing Work to Devices (BWTD)
- ▼ Next generation endpoint wireless security will open doors for greater acceptance
- ▼ Multi-processor type interaction (GPP, DSP, FPGA) will require new development skills for embedded systems.
- ▼ Significant impact in consumer electronics with developments in high energy density - fast charge energy storage devices

Mobility: Targeted Technologies

Mobility S&T Sub Thrust Area	Follow	Leverage	Grow
Energy generation and harvesting	●	●	◐
Embedded systems design and SW instantiation	●	●	●
Wireless security methodologies	●	●	◐
Presence technology	●	●	◐
Alternative energy sources	●	●	○
Mobile Application Development for DoD	●	●	◑
Many Related S&T Interest Areas Covered In Advanced Comms and Wireless Networks			

- ▼ Computing architectures will become virtualized and delivered as a service
- ▼ Cloud integration and hyper cloud concepts will drive standards for infrastructure programmability
- ▼ Smart machines will move us well past simply automating our business processes
- ▼ Need for speed and agility will drive computational, data and network boundaries
- ▼ Within 10 years, non-overridable "smart systems" will be used in activities risking human life.

Computing: Targeted Technologies

Computing S&T Sub Thrust Area	Follow	Leverage	Grow
Trusted, secure, scalable architectures, hardware, software	●	●	◐
Improvement in processing efficiency and processing speeds	●	●	○
Multi-core chip use-parallelization automation	●	●	◐
Size, weight, power use reduction	●	●	○
High availability systems w/ dynamic resource management	●	●	◐

Man and Machine: Assessment

*Hyper Modality Space – Beyond 3D Vision:
Multi-modality and cross modality interfaces use
a multitude of human senses simultaneously*

- ▼ New widely accepted HMI interfaces have failed to move traditional interfaces
- ▼ Acceptance of wearable devices will need to pass the “elegance” test and satisfy unmet needs
- ▼ User arousal, alarm and other emotions will become part of the interface to the “smart machine” awareness
- ▼ Complex communication will approach the art of the possible
- ▼ Privacy concerns will continue to inhibit rich presence technologies

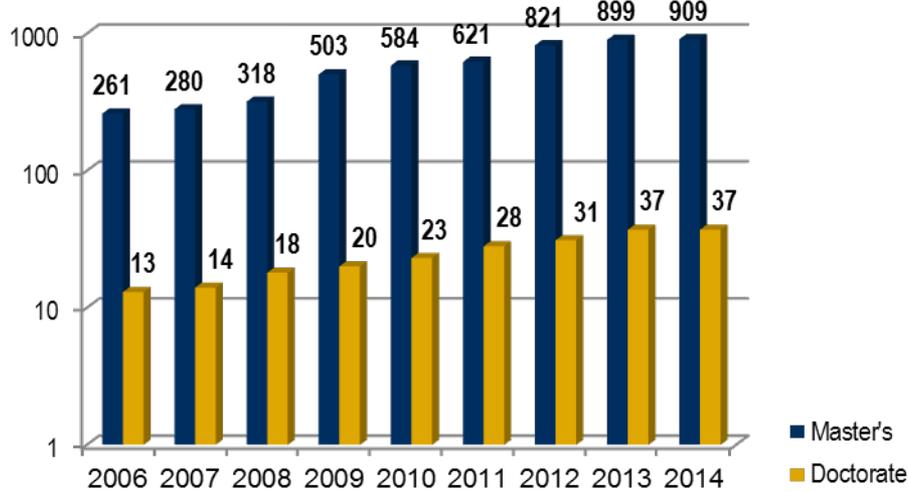


Man and Machine: Targeted Technologies

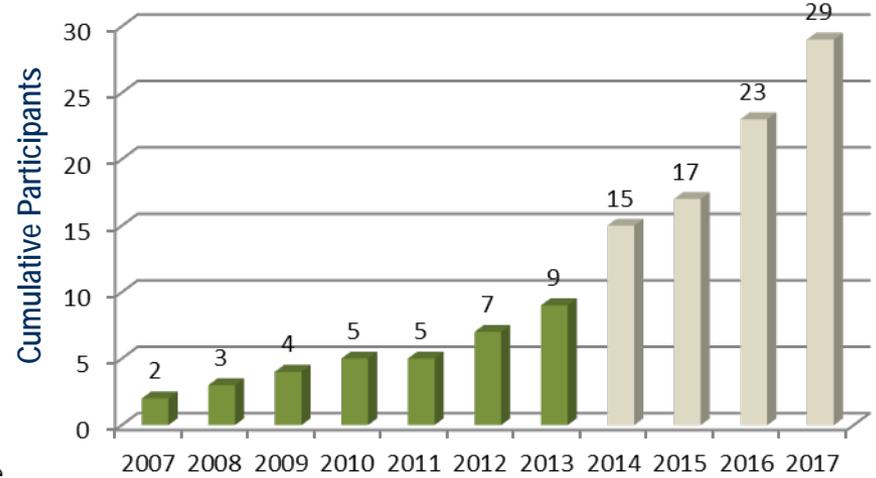
Man and Machine S&T Sub Thrust Area	Follow	Leverage	Grow
3D auditory interfaces	●	●	◐
Display technologies	●	◐	○
Gamification	●	●	◐
Brain:Computer Interface	●	●	◐
Information visualization (analytics)	●	●	◐
Claytronics	●	●	○
Augmented reality	●	●	◐
Facial recognition and emotion research	●	●	◐

Snapshot of current S&T at SSC Atlantic: Personnel and Research Partnerships

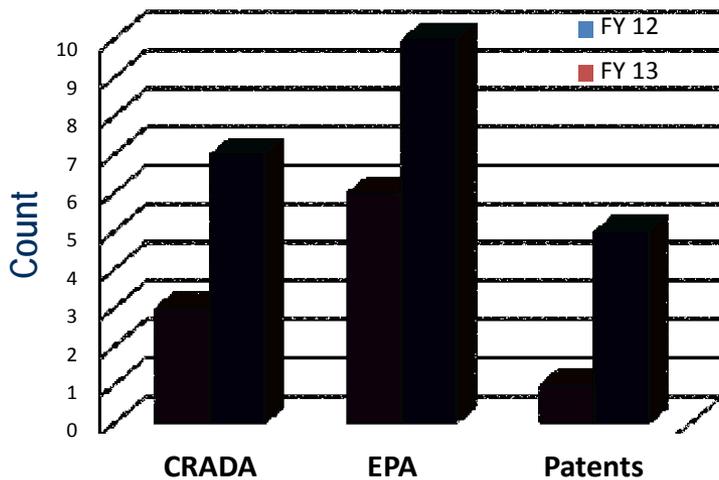
Degree Distribution



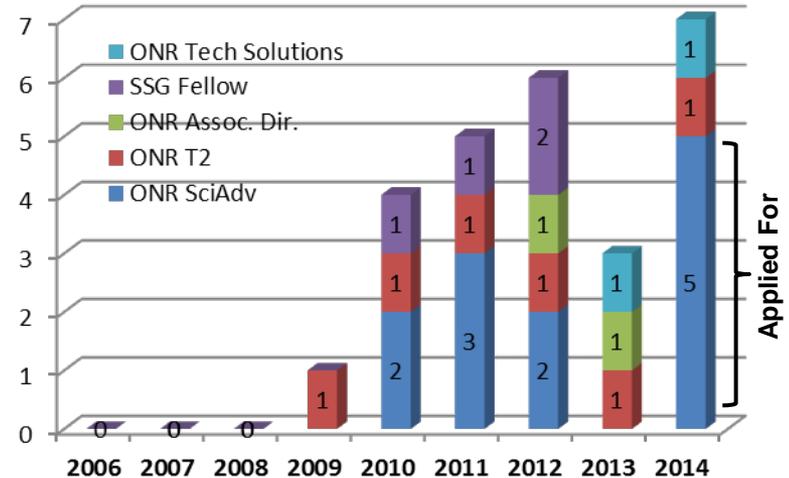
SMART Doctoral Program



Partnerships

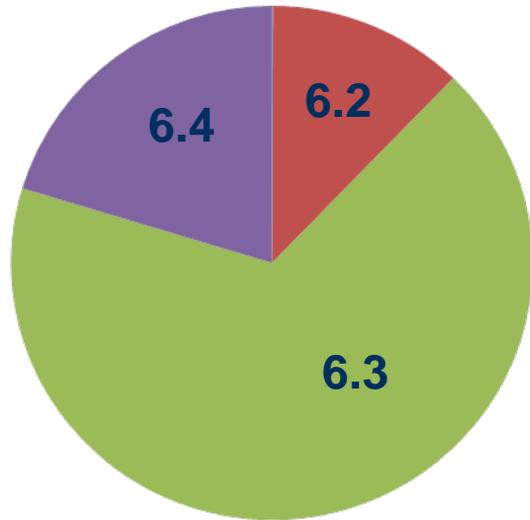


S&T Outreach

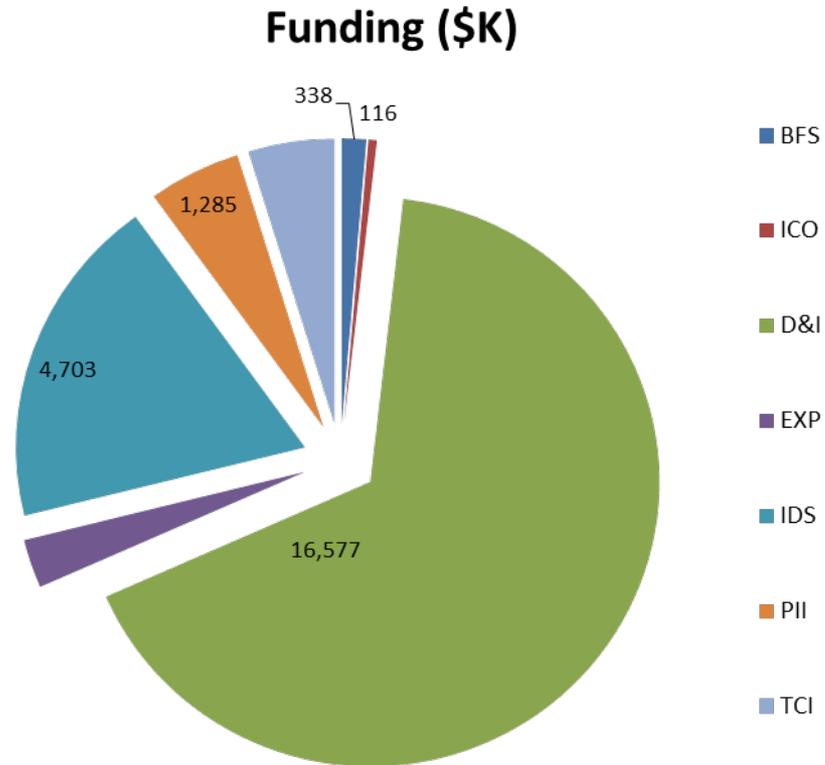


Snapshot of current S&T at SSC Atlantic: 6.1 – 6.4 Funding Profile

Portfolio Distribution of BA 1-4 Funding

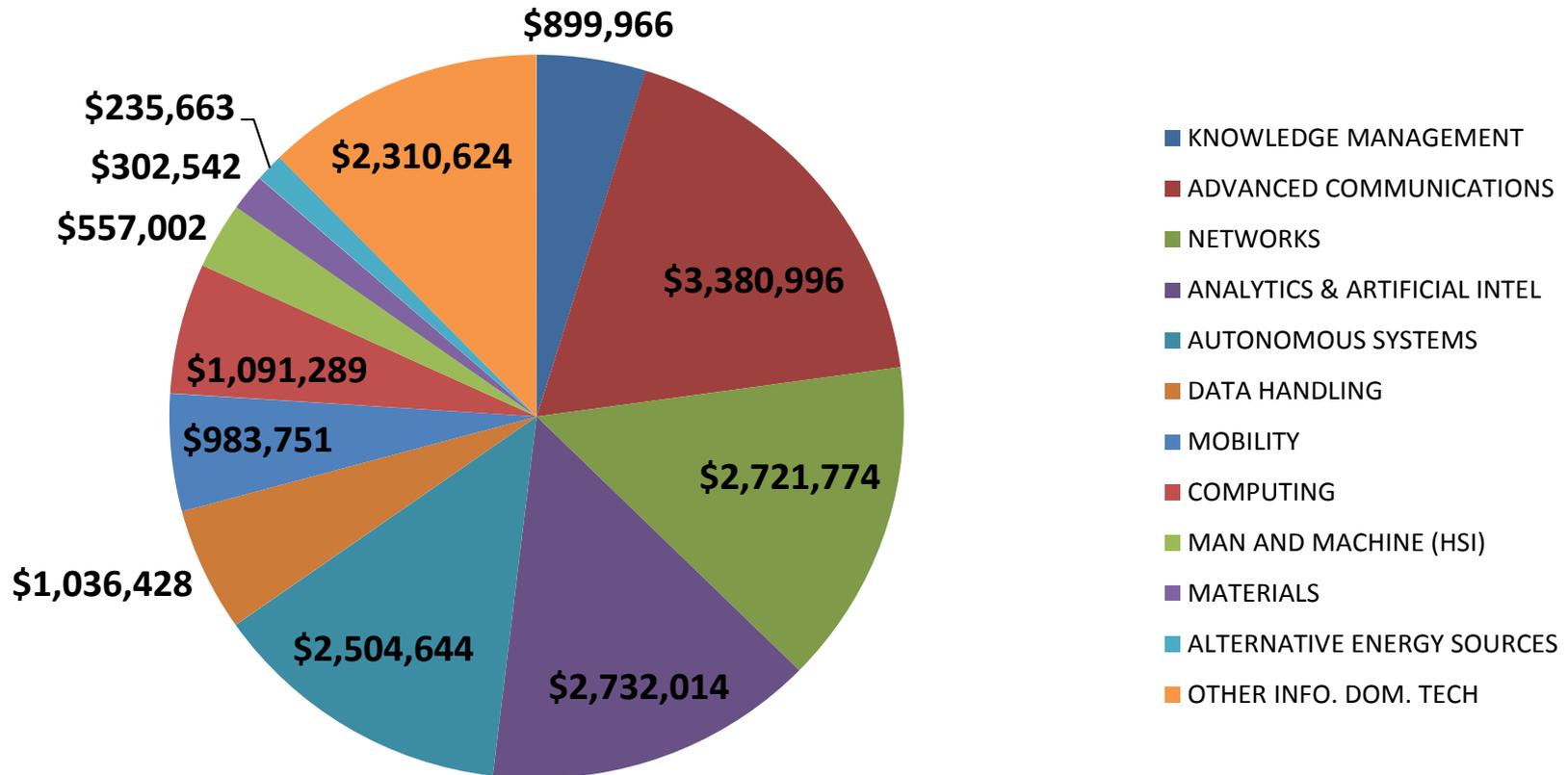


BA	Amount
6.1	\$16,402
6.2	\$2,983,616
6.3	\$16,533,388
6.4	\$4,978,480



Snapshot of current S&T at SSC Atlantic: SSC Atlantic NISE Program Totals – FY13/14

Total Funding **\$18,756,693**



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▼ SSC Atlantic Science and Technology Advisory Council

Questions?