

Navy Cyber Science & Technology

Indiana University of Pennsylvania
2024 Cyber Security Day

Mr. Joey Mathews

Superintendent, Information Technology Division

US Naval Research Laboratory, Washington DC

29 Oct 2024



NSA Information Assurance Scholar



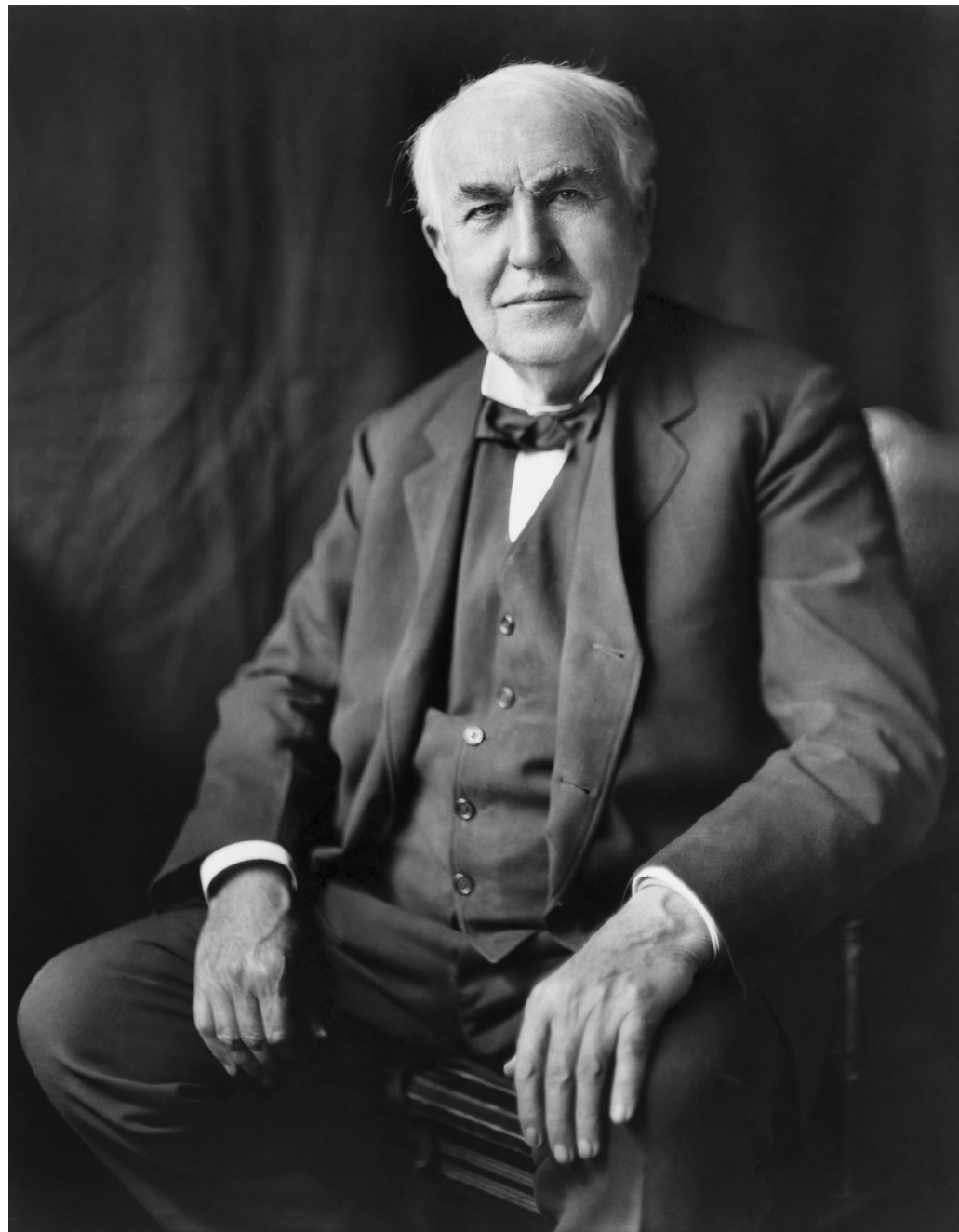
B.S., M.S., Computer Engineering

- Computer Architecture & Networks
- Computer Security & Info Assurance

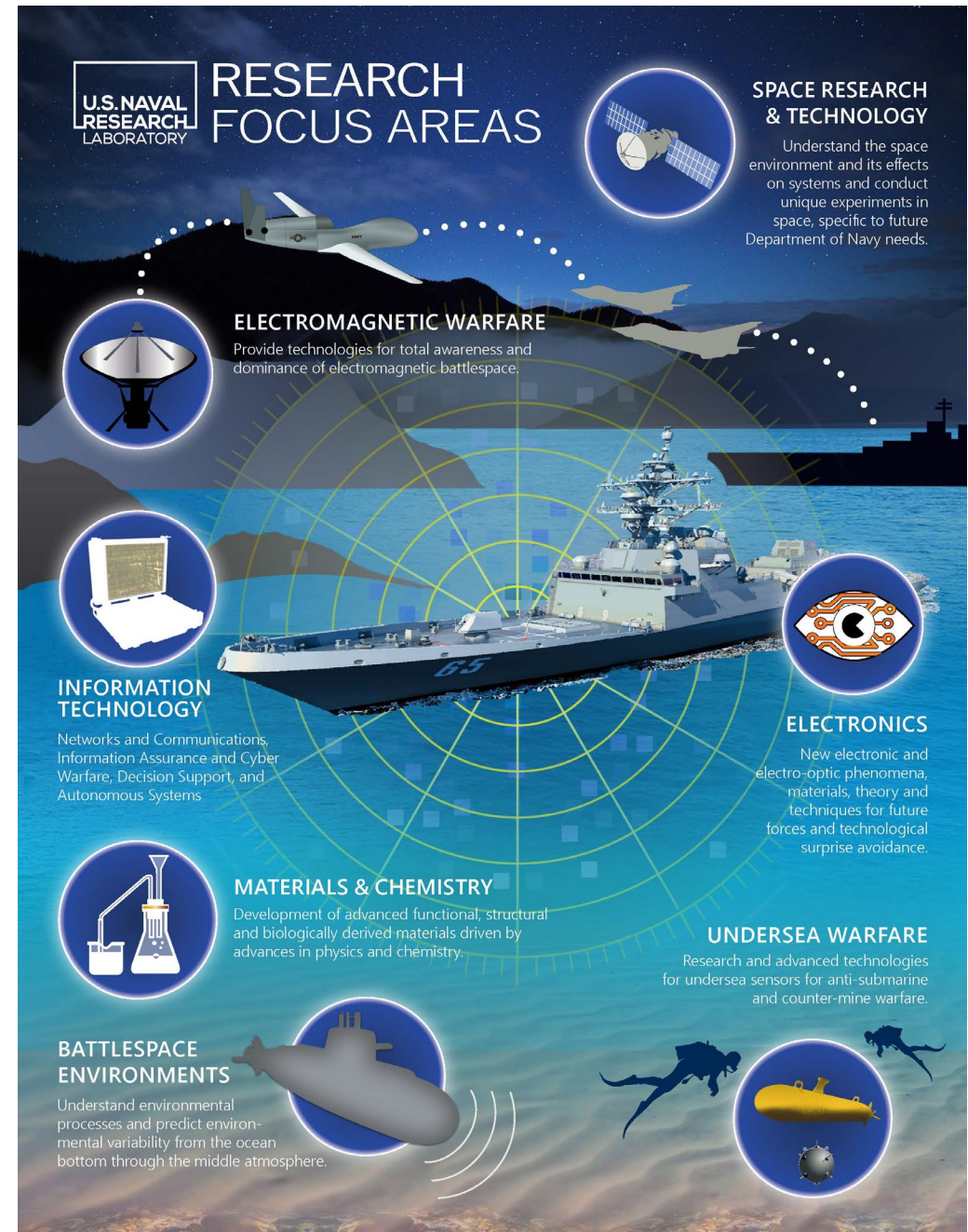


- Student Trainee
- Computer Engineer
- Section Head, Network Security
- Director, Center for High Assurance Computer Systems
- Superintendent, Information Technology Division





“The Government should maintain a **great research laboratory** to develop guns, new explosives, and all the technique of military and naval progression without any vast expense.”
– Thomas Edison, 1915



100 years later, NRL has tilted the world’s balance of power on at least three occasions with the **first U.S. radar**, the world’s **first intelligence satellite**, and the **first operational satellite of the Global Positioning System**.



**Artificial
Intelligence**



**Communications
& Networks**



**Information
Operations**



**High Assurance
Systems**

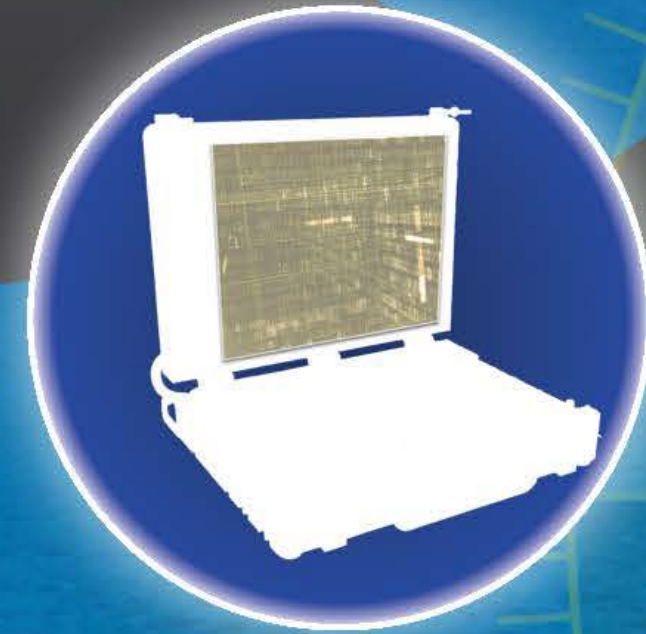


**Information &
Decision Sciences**



**Computational
Science**

NRL's Information Technology Division (ITD) carries out research and development in the collection, transmission, assurance, and processing of information to provide Naval and joint warfighting forces with the means to achieve and maintain information dominance in the battlespace.



INFORMATION TECHNOLOGY

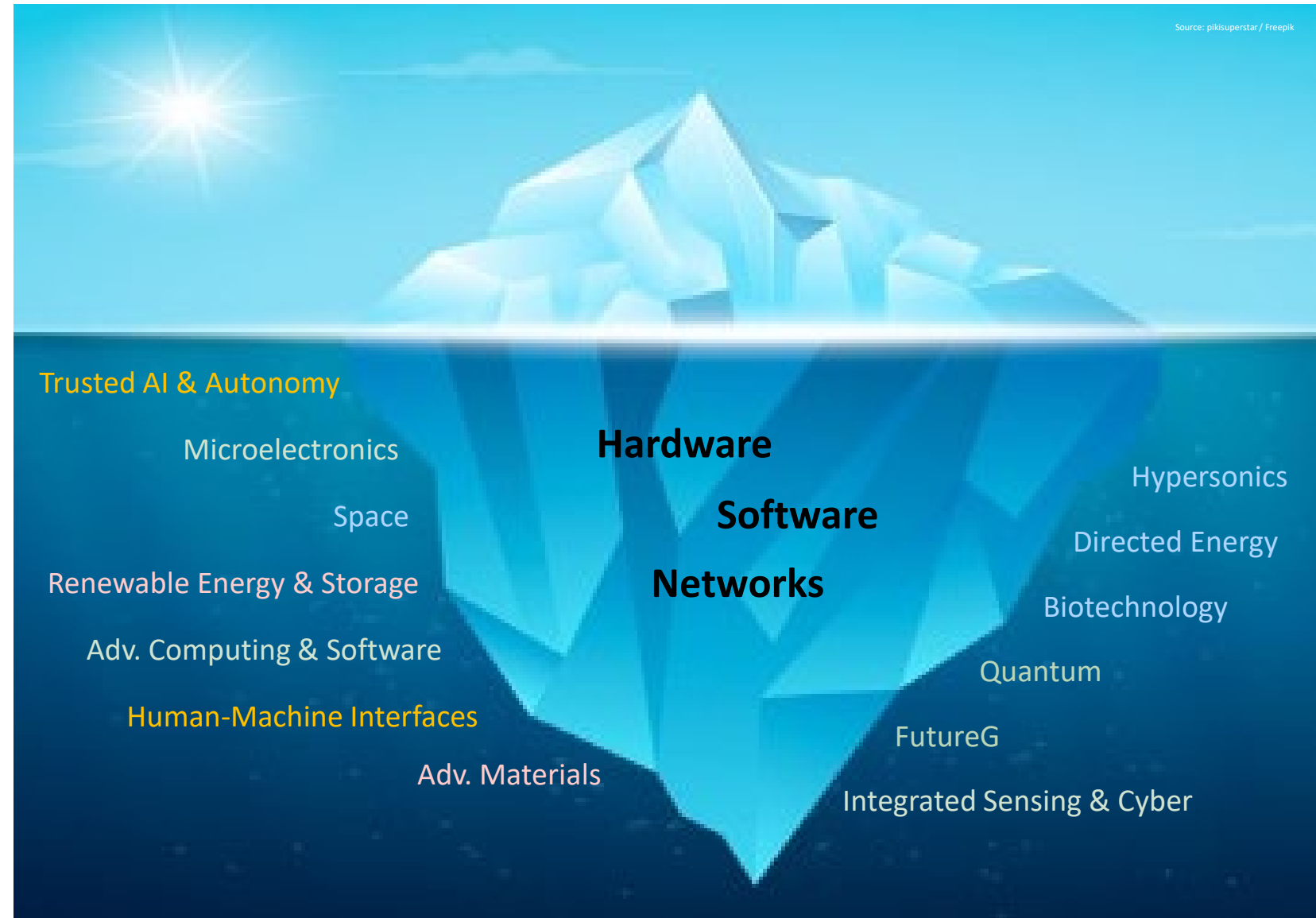
Networks and Communications,
Information Assurance and Cyber
Warfare, Decision Support, and
Autonomous Systems

Technologies that reduce time, cost, and cognitive load of missions; Also a new source of cyber vulnerabilities.

Technologies that create new cyberspace and underpin most warfighting missions.

Technologies that rely on cyberspace for breakthroughs from modeling & simulation.

Technologies that drive new cyber-physical platforms and infrastructure; Also a new source of cyber vulnerabilities.



<https://www.cto.mil/usdre-strat-vision-critical-tech-areas/>











THE WORLD HAS CHANGED

Threats and tech

- The PRC challenge goes well beyond just the size of the PLAN fleet
- A wounded Russia is dangerous, and increasingly linked to PRC
- Peace is brittle, the Navy provides options
- We have seen a breakthrough in battlefield innovation in the Black Sea and Red Sea



China Is 'Working Furiously' to Grow Its Fleet Ahead of a 2027 War—And That's a Clear Threat to America

PM Popular Mechanics · 1d

The PRC Chairman told his forces to be ready for war by 2027; We will be ready too



10/6/2024 3

<https://www.navy.mil/Leadership/Chief-of-Naval-Operations/CNO-NAVPLAN-2024/>

<https://www.popularmechanics.com/military/navy-ships/a62512551/is-the-us-navy-ready-for-war-with-china/>

The Challenge

- We have the most powerful military in history, but our strength doesn't stop cyber-attacks.
- Traditional military power is ineffective in cyberspace, where enemies can find weakness.
- The Navy faces growing threats from cyber adversaries and emerging AI-related risks.

Why it Matters

- Navy operates many long-lived platforms under disadvantaged conditions, complicating security.
- Global supply chains create implicit trust, leading to vulnerabilities in software-defined capabilities.
- Enemies exploit a wide range of attack methods, taking advantage of anonymity afforded by cyberspace.

How We Tackle the Problem

Develop scientific foundations for how the Navy will operate and defend its cyberspace

- **Software Debloating:** Remove unused code to shrink the cyber-attack surface.
- **Binary Diversification:** Reshape software to force adversaries to target multiple variants.
- **Cyber-Separability:** Design failover systems with different vulnerabilities than the primary system.
- **Vulnerability Discovery:** Use static, dynamic methods, and exploitability tools to find issues early.
- **Formal Methods:** Reduce bugs by generating code from mathematically verified specifications.



<https://www.wsj.com/articles/navy-industry-partners-are-under-cyber-siege-review-asserts-11552415553>



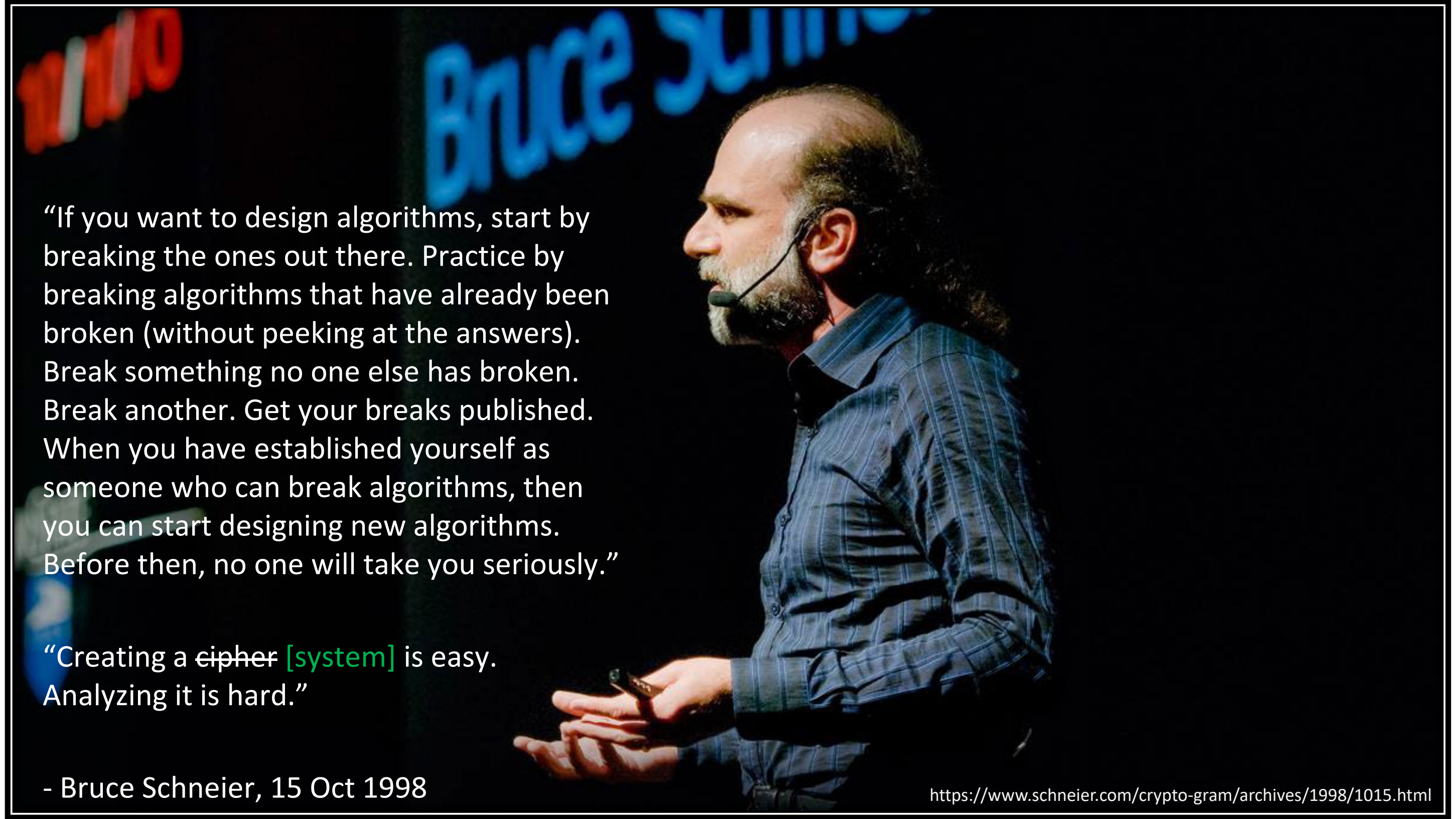
[2022] “The role of the cloud in mitigating these types of attacks also cannot be understated.” - Microsoft President Brad Smith, on the **Solarwinds** attack.

<https://www.intelligence.senate.gov/sites/default/files/documents/os-bsmith-022321.pdf>



[2024] “The fallout, which was immediate and inescapable, highlighted the brittleness of global technology infrastructure.” -The New York Times, on the **Crowdstrike** outage.

<https://www.nytimes.com/2024/07/19/business/microsoft-outage-cause-azure-crowdstrike.html>

A photograph of Bruce Schneier, a man with a beard and a blue shirt, speaking at a conference. He is wearing a headset microphone and holding a small object in his hands. The background is dark with blue and red text. The name "BRUCE SCHNEIER" is visible in large blue letters. There is also some red text in the top left corner.

“If you want to design algorithms, start by breaking the ones out there. Practice by breaking algorithms that have already been broken (without peeking at the answers). Break something no one else has broken. Break another. Get your breaks published. When you have established yourself as someone who can break algorithms, then you can start designing new algorithms. Before then, no one will take you seriously.”

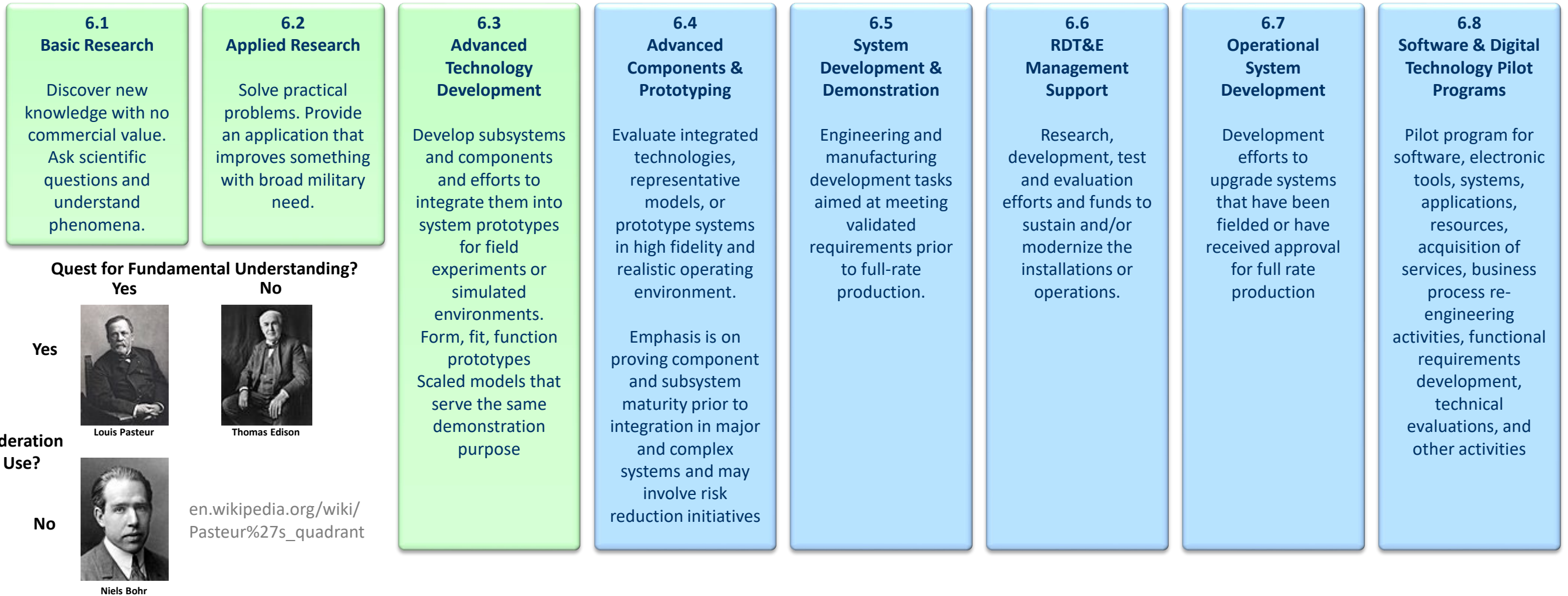
“Creating a cipher [system] is easy. Analyzing it is hard.”

- Bruce Schneier, 15 Oct 1998

<https://www.schneier.com/crypto-gram/archives/1998/1015.html>

Science & Technology

Research, Development, Test, & Evaluation



Technology Readiness Levels

1	2	3	4	5	6	7	8	9
Basic principles observed and reported	Technology concept and/or application formulated.	Technology concept and/or application formulated.	Component and/or breadboard validation in laboratory environment.	Component and/or breadboard validation in relevant environment.	System/subsystem model or prototype demonstration in a relevant environment.	System prototype demonstration in an operational environment.	Actual system completed and qualified through test and demonstration.	Actual system has proven through successful mission operations.



Naval Air Warfare Center Weapons Division (NAWC WD)

Point Mugu and China Lake, CA

- Research and Development
- Missiles and Freefall Weapons
- Weapon System Integration
- Land/Sea Range
- Non-Lethal Weapons

Naval Facilities Engineering Command (NAVFAC) Engineering & Expeditionary Warfare Center (EXWC)

Port Hueneme, CA

- Expeditionary Equipment Life-Cycle Management
- Energy Technology Solutions
- Environmental Security
- Facilities Engineering

Naval Information Warfare Center Pacific (NIWC PAC)

San Diego, CA

- Research and Development
- Engineering, Test and Evaluation
- Installation and In-Service Engineering Support
- Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR)
- Cyber
- Space

Naval Undersea Warfare Centers (NUWC)

Keyport (Keyport, WA) and Newport (Newport, RI)

- Submarine Systems and Torpedoes
- Undersea Warfare Systems
- Autonomous Undersea Vehicles

Naval Research Laboratory (NRL)

Washington, DC; Monterey, CA; and Stennis, MS;

- Radar
- Information Technology
- Optical Sciences
- Tactical Electronic Warfare
- Chemistry
- Material Sciences & Technology
- Plasma Physics
- Electronics Science & Technology
- Biomolecular Science
- Acoustics
- Remote Sensing
- Marine Geosciences
- Marine Meteorology
- Space Science
- Space Systems Development
- Spacecraft Engineering

Naval Air Warfare Center Aircraft Division (NAWC AD)

Patuxent River, MD; Lakehurst, NJ; and Orlando, FL

- Research and Development
- Aircraft Modeling, Simulation, and Analysis
- Airborne Surveillance Systems
- Air Anti-Submarine Warfare Systems and Sensors
- Aircraft Electronic Warfare

Naval Information Warfare Center Atlantic (NIWC LANT)

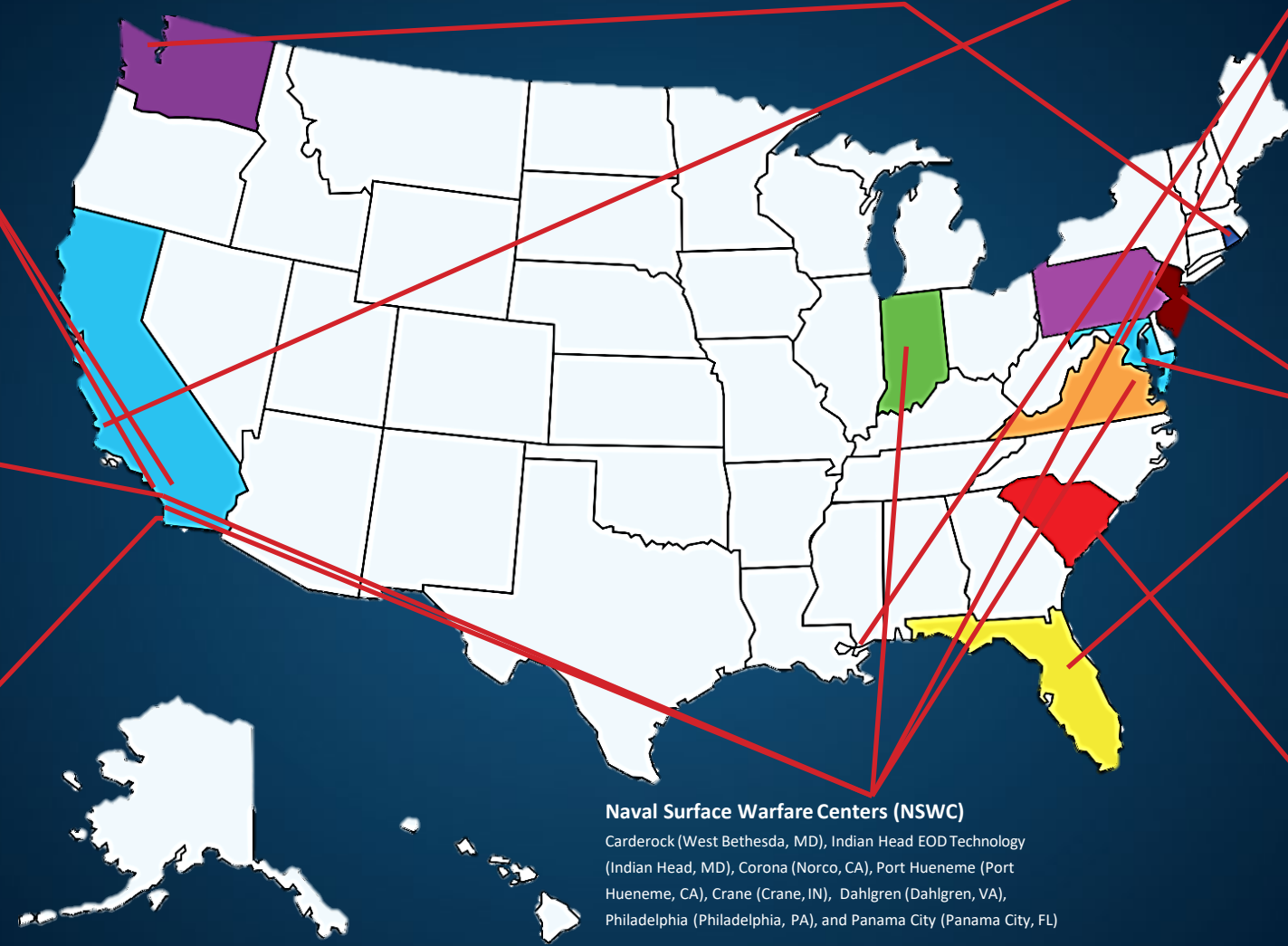
Charleston, SC

- Intel Collection/Processing
- Communications
- Info Management
- Business Information

Naval Surface Warfare Centers (NSWC)

Carderock (West Bethesda, MD), Indian Head EOD Technology (Indian Head, MD), Corona (Norco, CA), Port Hueneme (Port Hueneme, CA), Crane (Crane, IN), Dahlgren (Dahlgren, VA), Philadelphia (Philadelphia, PA), and Panama City (Panama City, FL)

- Ships and Ship Systems
- Warfare Systems Readiness and Assessment
- Sensors
- Electronics and Electronic Warfare Systems
- Surface Ship and Expeditionary Warfare Systems
- Surface Warfare Logistics and Maintenance
- Energetics
- Explosive Ordnance Disposal
- Mines and Mine Countermeasures
- Diving Systems





<https://navalstem.us/>



CENTENNIAL CELEBRATION 1923-2023



Be self-aware and adaptable: Know your strengths, weaknesses, and interests. Stay humble, seek mentors, and always be ready to learn.

Communicate and collaborate effectively: Listen first, speak clearly and with enthusiasm, measure your outcomes, and uplift your team by sharing credit.

Start now: Remember, the average age of NASA engineers who put humans on the Moon was just 28. Young minds can lead major achievements.

