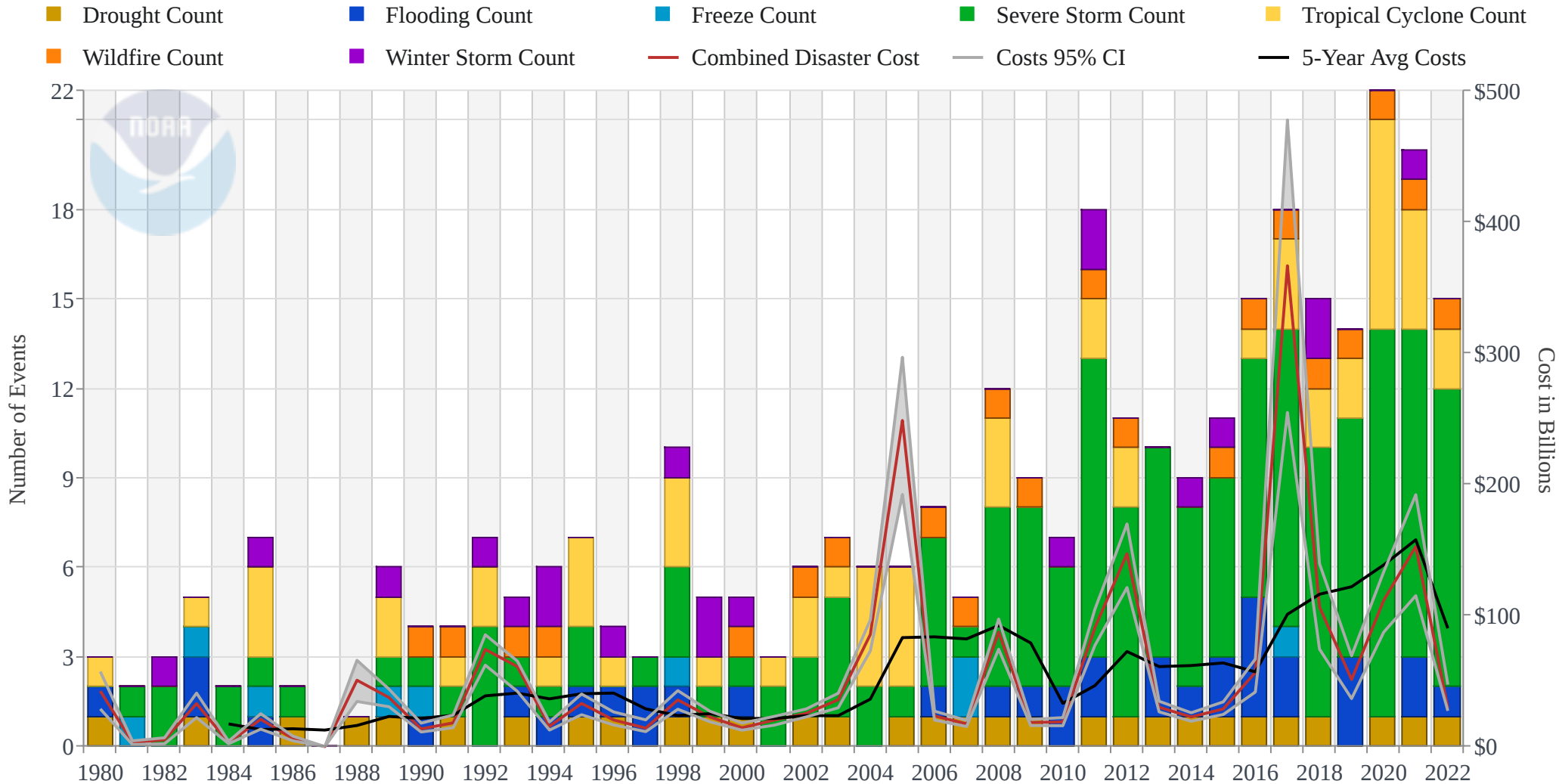


Autonomous Amphibious Rescue System Concept Briefing

Initial: July 8, 2022

Updated: November 22, 2022

United States Billion-Dollar Disaster Events 1980 - 2022



Likely to have more frequent and more intense extreme weather events in the future due to Climate Change.

Updated: October 11, 2022

<https://www.ncei.noaa.gov/access/billions/time-series>

A POTENTIAL OPPORTUNITY



Image: Marine Corps AAV Stocklist SL-3-07268C

The US Marines are in the process of retiring 900+ Assault Amphibious Vehicles (AAVs) and replacing them with new Amphibious Combat Vehicles (ACVs). There is the potential to convert “*swords into ploughshares*” in this transition, by upgrading and repurposing the retiring AAVs into a national civilian asset.

Past AAV Civilian Rescue Operations



<https://www.24thmeu.marines.mil/News/Article/Article/510947/blt-18-4th-aavs-rescue-victims-of-hurricane-katrina/>

Hurricane Katrina



Hurricane Harvey

<https://www.dvidshub.net/image/3726844/marines-use-amphibious-capabilities-rescue-and-assist-hurricane-harvey-victims>



Hurricane Irma Support

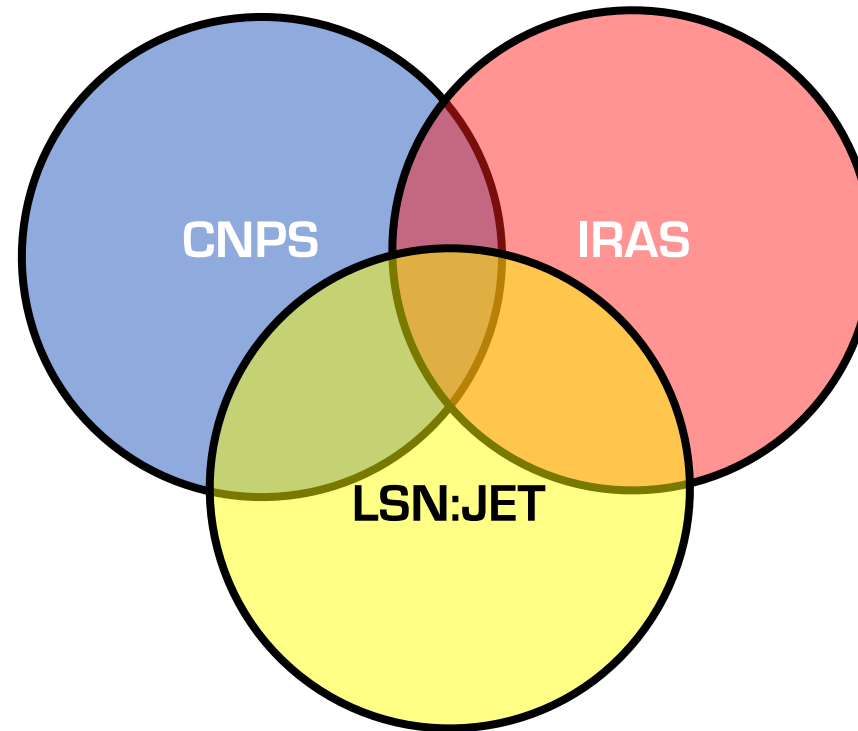
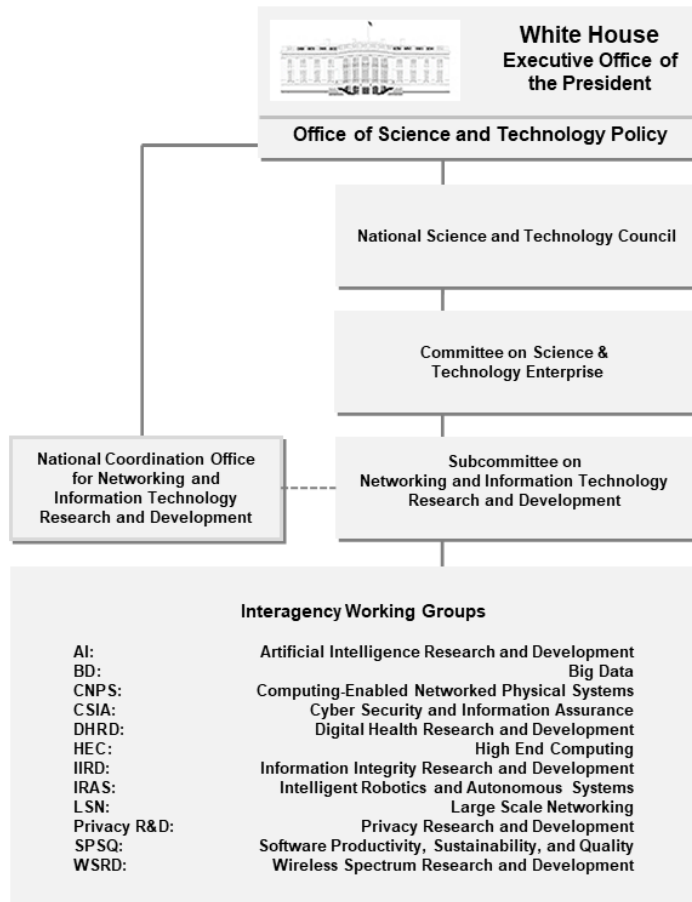
<https://www.fox13news.com/news/marines-await-hurricane-irma-at-raymond-james-stadium>

NITRD Mission

The Networking and Information Technology Research and Development (NITRD) Program is the Nation's primary source of federally funded research and development (R&D) in advanced information technologies (IT) in computing, networking, and software. NITRD is among the oldest and largest of formal Federal programs that coordinate the activities of multiple agencies to tackle multidisciplinary, multitechnology, and multisector R&D needs. The 26 NITRD member agencies now invest approximately \$7.8 billion annually in R&D programs that identify, develop, and **transition to practical use the advanced networking and IT capabilities needed by the Federal Government and the Nation.**



NITRD Organization Chart www.NITRD.gov



Joint Engineering Team (JET)

Propose a joint collaboration initiative between the agencies in the CNPS, IRAS, and LSN:JET Interagency Working Groups to help enable the **transition to practical use** Marine AAV's into Civilian Autonomous Amphibious Rescue Systems.

Concept Approach

Use the AAV systems to either Rescue and/or Re-supply Stranded Survivors & Assets

Refurbish a Small Subset to Enhance Robustness & Operational Capabilities



NITRD Site Visit Picture, November 10, 2022 (Y. Gawdiak)

Agencies can target the Systems for their Resiliency & Autonomy Technology Transfers & Gather Real-World Experience & Data

Launch & Recovery Platform:
Equip with Remote/Autonomous:
1. Deployable airborne systems
2. Deployable ground systems
3. Deployable marine systems
to support Search and Rescue Missions in Extreme Conditions

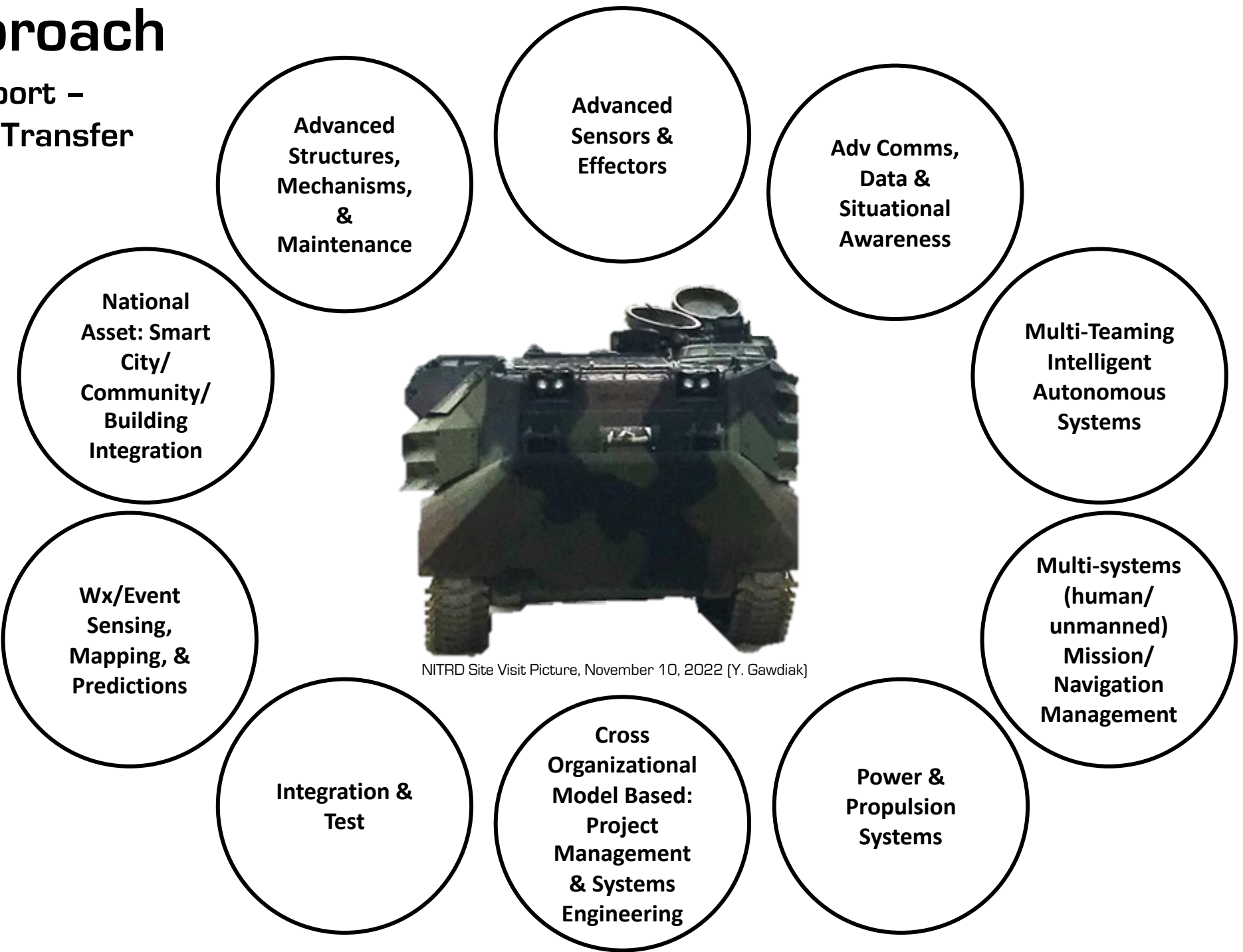
Add Advanced Sensors & Comms to Enhance Safety and Search Capabilities

Add Remote Operations Capabilities

Add Autonomous Operations Capabilities

Concept Approach

Multi-Agency Support –
Common Technology Transfer
Platform



NITRD Site Visit Picture, November 10, 2022 [Y. Gawdiak]

AARS Concept Whitepaper

Draft Outline

- I. Need for National Resiliency in terms of Extreme Weather Events
 - a. Systems designed to operate in harsh, dangerous conditions for search and rescue
 - b. Remote/Autonomous operations to minimize human risk exposure
- II. Target of Opportunity - Marine Amphibious Armored Vehicles being Retired
 - a. Concept Feasibility & Competitiveness – ROI
 - i. Ocean amphibious operations vs. flood & hurricane operations
 - ii. Other competing vehicle/platform options
 - b. NITRD Multiagency Collaboration Approach Options
- III. Previous Related Agency/Organization Work with AAVs/Amphibious Autonomous Systems
- IV. National Resilience Concept
 - a. Refurbish a small subset of AAVs to enhanced robustness & operational capabilities
 - b. Add Remote and then Autonomous Operations Capabilities
 - c. Add Advanced Sensors & Communications to Enhance Safety and Search Capabilities
 - d. Launch & Recovery Platform for Mobile Autonomous Subsystems:
 - i. Airborne
 - ii. Ground
 - iii. Marine
- V. Multi-agency Collaboration
 - a. Joint Technology Transfer Testbeds
 - i. Advanced Sensors & Effectors
 - ii. Advanced Communications, Data Management, & Situational Awareness
 1. Augmented Reality
 2. Virtual Reality
 3. Data Modeling
 4. Data Fusion
 - iii. Intelligent, Autonomous Systems
 - iv. Multi-systems: human & uncrewed mission management coordination and control
 - v. Power & Propulsion Systems
 - vi. Integration & Test
 - vii. Weather/Event Sensing, Mapping, & Predictions
 - viii. Smart City/Community/Building Integration to support Search and Rescue
 - b. Specific Agency Contributions
 - c. Economical, Low-Rate, Post-Production Repairs/Spare Parts Generation - Automated/Flexible Manufacturing/3D Printing, Condition Based Maintenance, etc..
 - d. Training/AI upgrades for long lifecycle, low-rate usage of complex systems
- VI. Cross Agency/Organization - Model Based Project Management & Systems Engineering

NITRD Marine Technical Interchange Meeting

NITRD Site Visit Picture, November 10, 2022 (Y. Gawdiak)

November 10, 2022
VSE Corp. Ruther Glen, VA

Agenda:

1. Introductions - All
2. NITRD Overview
 - a. General – David Corman
 - b. CNPS – Davis Corman
 - c. IRAS – Juan Wachs
3. AAV as Autonomous Rescue Vehicle Whitepaper Outline/Concept – Yuri Gawdiak
4. USMC/VSE Corp Overview of AAVs and Retirement Details – Scot Suneson & Co.
5. Physical tour of the AAV units - All
 - a. Vehicle Walkthroughs
 - b. Vehicle Operation Demonstration
6. Wrap-up/Action Items - All
7. NITRD/NSWC Working Lunch

Meeting Summary:

NASA and NSF under the NITRD CNPS and IRAS Interagency Working Groups met with representatives of USMC as well VSE Corp for a Technical Interchange Meeting on the Marine Assault Amphibious Vehicles being retired. NSF members provided an overview of the NITRD consortium, and aspects of the technology transfers and scope that could apply to a civilian autonomous search and rescue system based on the Marine AAVs. NASA reviewed the outline of the current draft white paper being developed to scope and organize the concept. USMC & VSE Corp representatives provided details on the current status of the AAVs and their retirement efforts. USMC reps also discussed past remote control experiments with the AAVs. Upgrades, conversions, and maintenance considerations were discussed as well. The NITRD reps were given detailed tours of several AAVs and given a vehicle operational demonstration. The consensus at the meeting is that there is potentially significant national merit in pursuing this concept further and would be best served with several Search and Rescue Use Cases to be developed and then a RoI conducted.

In terms of ease of analysis and time savings, the analysis can be split into several sections that, save for one, can be conducted independently and in parallel (hence the time savings):

1. Feasibility and viability of mods (in stages, from minimum for remote to maximum for autonomous operations) to convert a single AAV to civilian rescue use;
2. Lifecycle costs of an individual vehicle and associated personnel + aggregated for a fleet;
3. Use cases with tech mapping.
4. Integration of analyses, including aggregated DVF for the system outcomes – the only sequential task.



Attendees:

- | | |
|------------------------|-------------------------|
| 1. Karl Wilkerson | PM AAA |
| 2. Jim Walker | PM AAA |
| 3. Yuri Gawdiak | NASA/Hq/CNPS/IRAS |
| 4. John Sprague | NASA/Hq/OCIO |
| 5. Paul Holt Nelson | NASA/GRC/CNPS |
| 6. David Corman | NSF/CNPS |
| 7. Alan Becnel | NSWCCD |
| 8. George Slyer | S&T Lead PM AAA |
| 9. Lawrence Snyder | NSWCCD |
| 10. Kenneth ? | PM AAA |
| 11. Juan Wachs | NSF |
| 12. Paula Love | PM AAA |
| 13. Deane Leonard | VSE Corp |
| 14. John Hennage | VSE Corp |
| 15. Ken Standley | VSE Corp |
| 16. Robert Iannuzzi | NSWC Carderock Division |
| 17. B. Danette Allen | NASA/LaRC/Autonomy |
| 18. Natalia Alexandrov | NASA/LaRC/Autonomy |
| 19. Scot Suneson | USMC |

Next Steps

1. Coordinate development of Amphibious Search and Rescue Use Cases – David Corman, Juan Wachs, Yuri Gawdiak
2. Development of Concept Whitepaper – All
3. Begin exploration of multi-agency Systems Engineering collaboration starting with Use Case support – Yuri Gawdiak, Paul Nelson, John Sprague, Rob Ianuzzi
4. Cost/Benefit/Risk Investment Analysis collaboration - All
5. Initial Vehicles Quick Access Strategy Development – Scot Suneson, Robert Ianuzzi, Paul Nelson, Yuri Gawdiak.

BACKUP

CNPS

The CNPS Interagency Working Group (IWG) was formed in 2013 to coordinate Federal CNPS R&D across 23 participating agencies and to support the advancement and assurance of these types of systems. Guided by the [Cyber Physical Systems Vision Statement](#), the IWG's work includes complex, high-reliability, safety and security-critical, real-time computing, and engineered systems with varying degrees of autonomy and human-system interaction. Applications include automated vehicles, manufacturing, intelligent defense systems, smart grids, and smart cities.

Strategic Priorities

- **Develop core science and engineering** for CNPS technologies including unified foundations, models and analysis tools, system capabilities, interoperability standards, assurance approaches, and architectures.
- **Support and enable the safety and security** of critical, high-dependability applications, especially those using assured autonomous and AI technologies.
- **Support advances in smart cities and communities** by investing in multidisciplinary, multisector collaborations that leverage CNPS applications for smart city solutions in areas such as transportation and public safety.
- **Facilitate CNPS technology transfer** to public and private systems while prioritizing security, protecting privacy, and promoting the safe use of CNPS and IoT technologies.
- **Promote inclusive education, training, and career development** through curricula that integrates CNPS and providing venues for communications and collaboration among scientists and researchers.

Co-chairs: David Corman, NSF; William Bradley Martin, NSA;

IRAS

The Intelligent Robotics and Autonomous Systems Interagency Working Group (IRAS IWG) was formed in 2017 to coordinate Federal IRAS R&D across 28 participating agencies. Their work grew out of the [2011 National Robotics Initiative](#) and involves various aspects of autonomous robots including the accelerated development and use of collaborative robots and other intelligent physical systems. IRAS is focused on developing robust, safe, efficient, and ethical robots and intelligent systems that can assist people in their work and everyday lives. Advanced robotic systems can enhance safety, minimize human risk, support the elderly and disabled, and boost the Nation's economic security and national defense.

Strategic Priorities

- **Promote safe, efficient human-robot teaming**, including evaluating human-robotic interaction systems for safe, trustworthy, transparent collaboration to increase quality of work and life
- **Improve validation and verification of robotic and autonomous systems**, including developing metrics, information models, methods, protocols, and tools.
- **Advance intelligent physical systems** to improve their abilities to robustly sense, model, act, plan, learn, and behave ethically in complex and uncertain situations.
- **Enhance wearable robotic fabrics and devices** including exoskeletons and exosuits that improve worker safety and performance in various settings and provide rehabilitation for injured or disabled persons.

Co-chairs: Frank Hearl, NIOSH; Juan Wachs, NSF;

LN:JET

The Joint Engineering Team (JET) was established in 1997 and provides an opportunity for information sharing among Federal agencies and non-Federal participants who have an interest in high-performance research and engineering or research and education networking (REN) and networking to support science applications. Participation includes such organizations as:

- Federal Agencies:* Department of Defense (DoD), Department of Energy (DOE), National Aeronautics and Space Administration (NASA), National Institute of Health (NIH), and National Oceanic and Atmospheric Administration (NOAA)
- Industry:* CenturyLink and Juniper
- Non-profits:* Internet2 and US Ignite
- International RENs:* Research and Education Advanced Network of New Zealand (REANNZ) and Rede Nacional de Ensino E Pesquisa (RNP) Brazil
- Academic:* Capital Area Advanced R&E Network (CAAREN), Great Plains Network (GPN), Indiana University (IU), Mid-Atlantic Crossroads (MAX), Pacific Wave/Pacific Northwest Gigapop (PNWGP); Three Rivers Optical Exchange (3ROX); StarLight; Utah Education and Telehealth Network (UETN), and University of North Carolina (UNC)

Co-chairs: Richard Carlson, DoE; Kevin Thompson, NSF;