

United States Coast Guard Marine Transportation Systems



“Enhancing Mariners’ Situational Awareness”

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- Recommend link to the COMDT’s Maritime Commerce Strategic Outlook to the 3 major “lines of effort”
 - Facilitate commerce and trade (\$4.6 Trillion impact to US Economy)
 - Modernize Aids to Navigation & Marine Safety Information delivery
 - Building a resilient workforce
- Greater traffic volume
- Larger ships
- Increased technology – more reliance on electronic means of navigating
- Minimal change in waterway dimensions: width and depth of channels, air gaps of bridges
- No change in our waterway management methods: ATON and MSI
- We are long overdue for modernizing our waterways, and modernizing our waterways management



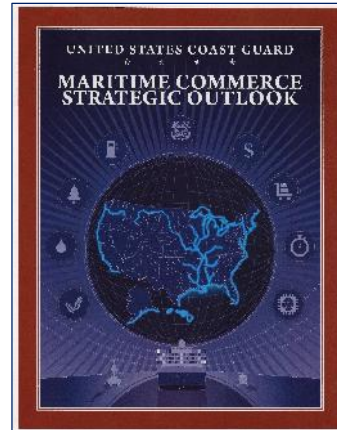
Strategic Outlook



By 2025, worldwide demand for waterborne commerce is expected to more than double.

Challenges to Safeguarding MTS:

- Increased vessel complexity
- Enhanced automation
- Advanced networked systems
- Greater use of MTS
- Increased vulnerability to cyber attacks



This is the Coast Guard's long-term vision for achieving America's economic prosperity across the maritime domain.

Safeguarding MTS has become more challenging:

- Increased complexity in vessel design and operations
- Enhanced automation, networked systems, and autonomous vessels
- Increased use of MTS with Panama Canal expansion, offshore wind energy, natural resource extraction, etc
- Increased vulnerability to cyber attacks



Lines of Effort



1: Facilitating Lawful Trade and Travel on Secure Waterways

2: Modernizing Aids to Navigation and Mariner Information Systems

3: Transforming Workforce Capacity and Partnerships







LOE 1. Facilitate Lawful Trade & Trvl on Secure WWs: a. mitigate risk to Critical Infrastructure, b. build resiliency, c. enhance unity of effort

LOE 2. Modernize ATON & Mariner Info Sys: a. improve nation's WWs, b. optimize maritime planning, c. recap aging assets, d. update info sys

LOE 3. Transform Workforce Capacity & Partnerships : a. leverage oversight of third parties, b. sharpen high-tech & adaptive competencies, c. advance Prev & Resp workforce

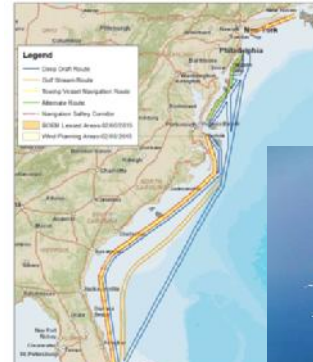


Marine Planning & Mitigating Risks



Current Initiatives:

- Identify Navigation Risks
- Ports and Waterways Safety Assessments (PAWSA)
- Rulemaking projects from Port Access Route Studies (PARS)
- Alternative Energy Plans and Safe Navigation



PAWSA Waterway Risk Model	Public Health and Safety	Navigation	Marine Environment	Port Operations	Other
Deep Draft	High	High	Low	High	High
Safe Stream	Low	Low	Low	Low	Low
Moving Vessel Restricted	Low	Low	Low	Low	Low
Alternative	Low	Low	Low	Low	Low
Navigation Safety Corridor	Low	Low	Low	Low	Low
Wind Planning Areas	Low	Low	High	Low	Low



- Continue partnerships with Federal, State, & local agencies to identify navigation safety risks.
- Encourage Ports and Waterways Safety Assessments (PAWSA) to help mitigate risks to waterways users.
- Develop rulemaking projects from Port Access Route Studies (PARS).
- Work with cooperating agencies on alternative energy plans and safe navigation.

Marine Planning is one of my top priorities and involves working amongst governmental agencies and our stakeholders as we navigate the next generation waterways in the U. S. MTS.

Since the early 20th Century, Congress has tasked the Coast Guard with protecting the safety and security of US ports and our navigable waters.

Marine Planning and risk-based decision making tools enable Captains of the Port to identify and mitigate risks before incidents occur.

Such incidents often require Captains of the Port to exercise their authority to control vessel movements and port operations.

Such controls affect the flow of maritime commerce and can affect public faith in the safety of the entire maritime industry.

Use of standardized risk-based decision making tools enable repeatable, rational assessments of risks to public health and safety, including navigation safety. Traditionally, we have used these tools to advise Army Corps and local government stakeholders of navigation safety risks related to dredging, bridge, ATON, and port development projects.

Increased interactions between commercial vessels and recreational users on waterways means the nature of risks may be changing, even if only in intensity.

- "Kayakivists" – protestors in Washington State, Oregon, Hawaii, and many other places
- Stand-up paddleboarders, kayakers, weekend boaters – all becoming more affordable and more widespread
- Expansion of athletic events such as triathlons, dragon boat races, long-distance swimming, and extreme sporting events
- Larger gatherings at river "float" events and spectator sports that draw 1000s of spectators
- Larger commercial freight vessels with more limited close-range visibility in congested waters

Rapidly developing technologies also directly affect waterways risks and port safety:

- Autonomous operations (drones, advanced autopilots, actual Artificial Intelligence-based navigation systems)
- Expanding use of LNG, not just as cargo but also as fuel, even for smaller vessels like tugs and, possibly in the near future, water taxis and recreational boats.
- Commercial space vehicle launches from privately-owned or leased waterfront facilities – or from remotely operated mobile platforms at sea

So far, we have determined that the deliberative approaches we made in the past for Army Corps and local governments are still appropriate, with little need to adapt them or change the tools.

We are expanding our use of the tools to address more hazards in the waterway.

We are actively assessing whether our tools need to change to keep pace with change, or if we can simply apply the adage "if it ain't broke, don't fix it" to our own, well-designed and flexible decision-making tools.

USCG PAWSA process garners expert opinion on navigation risk in discrete waterways. PAWSA Workshops are highly structured two-day assessments that evaluate the relative risk of 24 specific variables that influence the causes of marine accidents and their consequences. The goal is to find mutually agreed solutions that are cost effective and meet the needs of waterway users and stakeholders. (see pic of PAWSA Risk Model)

Rulemaking projects: The Atlantic Coast PARS (ACPARS) was completed in July 2015 and released to the public in April 2017. The ACPARS included development of Marine Planning Guidelines to assist with the evaluation of navigational impacts of offshore development projects, and potential North-South routing measures along the Atlantic Coast of the U.S. that are currently being pursued. Plan to take the recommendations of the Atlantic Coast Port Access Route Study and work with BOEM to produce Safe Shipping Fairways along the Atlantic Coast. Agency coordination will allow safe access routes for mariners while affording other reasonable waterway uses such as construction and operation of renewable energy facilities. (see Route pic) depicts a combination of the towing & deep draft navigation safety corridors along the Atlantic Coast.



e-Navigation



- *Harmonizes timely and reliable maritime information onboard vessels and ashore by electronic means*
- *Integrates and transforms maritime data into decision and action*
- *Goal is safety and security at sea and protection of the marine environment*

- In addition to the change in vessel traffic and demographics, technology is re-shaping how we mark and manage waterways. The concept of e-Navigation is more than just virtual buoys...it is all about real-time and seamless data sharing to ensure mariners have the most timely and relevant information, whether that is ATON or Marine Safety Information, to maximize their situational awareness and increase resiliency of the MTS.

"...the harmonised collection, integration, exchange, presentation and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment."

~ International Maritime Organization

- The IMO definition alludes to the "e" standing for electronic...I argue it is more than that. It is electronic, enhanced, and efficient.

"The ultimate goal of e-Navigation efforts in the U.S. is to use timely and reliable information to make the U.S. Marine Transportation System operate better...the U.S. vision for e-Navigation is to establish a framework that enables the transfer of data between and among ships and shore facilities, and that integrates and transforms that data into decision and action information."

~ Committee on the Marine Transportation System

The key to building resiliency within our ports and waterways is preparation and forward thinking.

"What do we do?" is a question we must ask before something happens, not afterward.

With that in mind, I have tasked my offices with leaning forward and pushing traditional boundaries.

My Office Waterways and Ocean Policy Management program is actively expanding its professional training regime to include more targeted

- MTS Recovery and port reconstitution training.
- Stakeholder engagement that improve risk assessments to avoid disasters, or to recover from them more quickly.

Building the waterways managers of today is an investment in the future professionalism and capabilities of our Captains of the Port.

They have also begun a more formalized collection of best practices in waterways management, soon to expand nationwide and even internationally.

Although we have engaged in learning from our partners for years, I am encouraging them to focus on how our management can be better, how others make things work in their ports and harbors.

My Office of Navigations Systems is seeking new and innovative ways to apply centuries old technology – and adopt a wide range of new technologies.



Future of Navigation



Current Initiatives:

- Nationwide Waterways Analysis and Management Studies
- Marine Safety Information
- eATON (Aids to Navigation)
- ECS / ePub Policy
- Unmanned / Autonomous Vessels



- These are our current top initiatives. All of them are a part of a 5-year strategic plan to guide how we move towards the next generation waterway and ensure the U. S. MTS is a global leader.
 - Conduct Nationwide Waterways Analysis and Management Studies to better understand current waterway user requirements and update the Coast Guard's Level of Service.
 - Modernize delivery of Marine Safety Information.
 - Incorporate eATON (Aids to Navigation) into waterway system design, management, and recovery.
 - Update NVIC 01-16 regarding ECS / ePub policy to incorporate modern technology with navigation equipment and carriage requirements.
 - Produce future guidance concerning Autonomous Vessels.



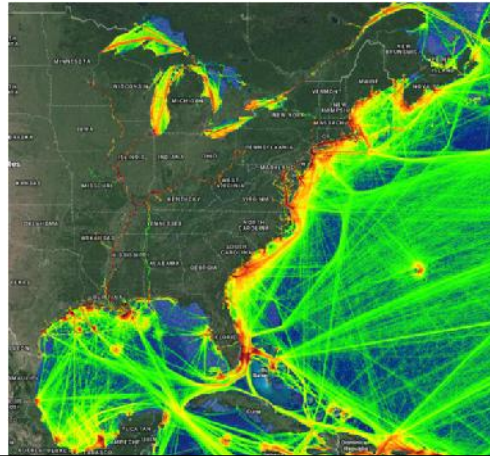
Nationwide WAMS



- A holistic and systematic analysis of our waterway systems to determine consistent levels of service and optimize the mix of emerging technologies and legacy methods for the modern mariner.

- Studies:

- Atlantic and Gulf Coast Seacoast (completed 2017)
- Pacific Seacoast (in progress)
- Western Rivers (in progress)
- Deep Water (>12 ft)
- Shallow Water (<12 ft)
- Intracoastal Waterway



- The AGSS study was completed last summer and found:
 - The Coast Guard should continue to maintain the Atlantic and Gulf Coast Seacoast (AGSS) system to ensure safe navigation during coastal transits or when making landfall.
 - The Coast Guard should no longer provide bells, gongs, or whistles on ATON within the AGSS.
 - The Coast Guard should provide ATON for hazards with 30 feet or less of water. The ATON should have a minimum visual/operational range of 3 NM. This is the first time we've defined shoal water!
 - The Coast Guard should provide landfall lights with an operational range of 5nm from the 30 ft curve for a vessel with a height of eye of 15 ft – facilitates lighthouse modernization (or elimination)
 - The CG should mark entrances to major channels or pilot embarkation areas with virtual ATON where an operational range of 5 NM can be achieved. If virtual ATON cannot be used, a physical aid should be considered.
- Currently analyzing the Pacific Seacoast and WR feedback.
- IMO Considerations
 - Critical turning points
 - Wrecks
 - Obstructions
- IALA Guidelines
 - Be available at the time needed
 - Provide timely warning of channel limits and fixed obstructions
 - Enable mariners to determine quickly their location with the channel
 - Enable a safe course for the vessel to be determined.

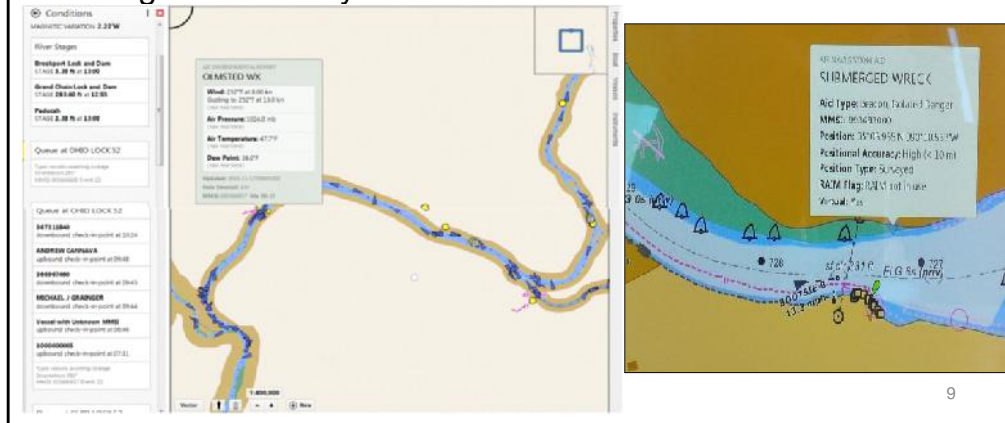


Enhanced Marine Safety Information



Modernize Delivery of MSI

- Current delivery of LNM/BNM not reaching all waterway users
- Augment delivery via electronic format



Modernize Delivery of MSI

- Current delivery of LNM/BNM not reaching all waterway users
 - LNM as PDF files online via NAVCEN website
 - BNMs broadcast via VHF-FM marine band at specified time intervals
 - Multiple OGAs provide critical MSI (USACE, NOAA, etc)
- Augment delivery via electronic format
 - Provide BNM/LNM in machine readable formats
 - ECDIS/ECS securely pulls applicable MSI for specified route
 - Leverage NAIS to broadcast BNM, environmental, meteorological, and hydrographic MSI over AIS
 - Portray applicable MSI on integrated Chart & Radar
- Current voyage planning requires mariners to seek out information from various sources – PDF LNMs, websites, etc. Additionally, BNMs only broadcast via VHF at specified intervals.
- From there, the mariner also needs to decide which of these information bits apply to their location, intended voyage, and vessel type.
- Through an interagency effort, we are working to simplify and automate this process. We want the distribution of MSI to be automated, machine-to-machine, geographically-specific, and easy for the mariner to understand.
- NAVCEN is prototyping an initial concept of this in D5 by delivering BNMs through the GovDelivery e-mail system to subscriber's smartphones and e-mail accounts. Initial feedback has been positive, and NAVCEN and CG-NAV are working to evaluate these results before possibly expanding this capability. However, this is not the final vision – we want eMSI to fully integrate in ECDIS/ECS programs as the mariner's main situational awareness tool.
- This photo is a screen shot of an ECS during an eMSI test bed we conducted on the Ohio River. The pop-up box on the screen shows environmental conditions at a nearby lock, and the sidebar shows the vessel queue for nearby locks. This demonstration successfully simulated an inter-agency (USCG-NAIS, USACE, and VTS Louisville) AIS transmit capability, but also highlighted a gap between the current NAIS system and the original CONOPS. The CONOPS stated that NAIS should have the capability to transmit environmental, geographic notice, search and rescue and law enforcement patters, and target of interest info, but the current system is not capable of creating, routing, managing, transmitting, and monitoring these messages.
- Through systems like this, we hope one day that a vessel leaving Minnesota can transit at a slower overall speed, minimize lock queue times, yet arrive in Baton Rouge two days early having burned less fuel.

e-ATON

- Electronic message broadcast that can be displayed on an integrated radar and/or electronic chart. Currently via AIS.
- **Virtual:** AIS ATON message broadcast (typically from shore) to an assigned position with NO corresponding buoy/beacon.
- **Synthetic:** AIS ATON message broadcast (typically from shore) to an assigned position with a corresponding buoy/beacon.
- **Physical:** AIS ATON message broadcast from the buoy/beacon.

- e-ATON are broadcasted electronic messages that can be displayed on an integrated radar and/or electronic chart. Currently being broadcasted via AIS. We currently have 390 permanent e-ATON nationwide. There are three types of e-ATON.
 - Physical: The beacon is physically located on the buoy or beacon. Typical range of these is about 8 nm. We have two of these in service in San Fran.
 - Synthetic: Broadcasted remotely to an assigned position with a corresponding buoy or beacon. This is currently being done via the NAIS network. We have 337 of these nationwide.
 - Virtual: Broadcasted remotely to an assigned position with no corresponding buoy or beacon. 51 in service. NAIS range is approximately 24 nm, depending on line of sight.
- Currently broadcasted through our Nationwide Automatic Information System (NAIS). This system does not provide 100% coverage of the MTS, but we are developing options for stand-alone and deployable systems to expand our footprint.
- San Francisco is the first major port in the world to have all three types. CGC ASPEN installed two Physical AIS-ATON on SF Main Ship Channel 1 and 2 – the Bar Pilots reported these buoys were difficult to locate visually and even by RACON due to the buoys dipping below large swells.



Use of AIS-ATON

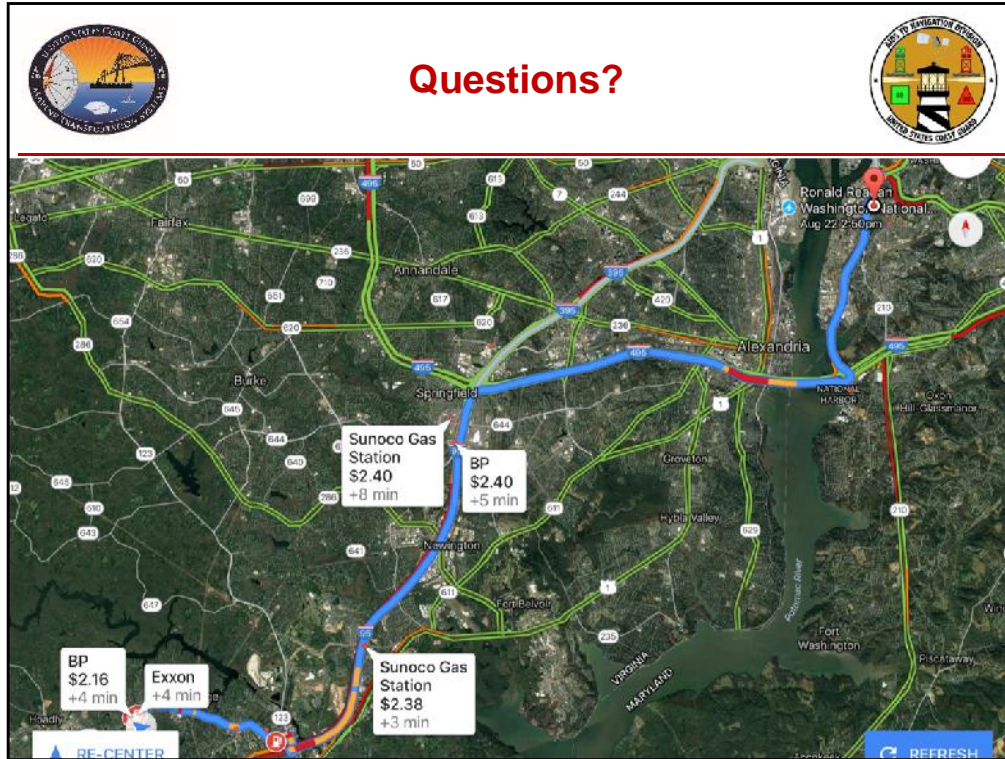


- Harbor Approach and Safe Water Mark Buoys
- Traffic Separation Schemes
- Discrepancy Response
- Natural Disaster Recovery
- Marking Wrecks
- Historically Unreliable Physical ATON
- Locations where Physical ATON is not feasible



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- AIS-ATON is not intended to replace physical ATON. AIS-ATON augments the existing physical ATON constellation. Through our ongoing Nationwide WAMS studies and by controlled trials in different situations, we are developing our policy on how to best capitalize on this emerging technology.
- Harbor Approach: The AGSS found that virtual AIS-ATON may augment these.
- Discrepancy Response: AIS-ATON can be your first line of defense in augmenting a discrepant physical ATON.
- Hurricane preparation and response. We have successfully utilized AIS-ATON to augment key physical ATON ahead of hurricane arrivals, providing resilience to buoys and beacons that may be prone to damage.
- Historically unreliable: If a buoy has a history of going off-station due to high currents or unreliable bottom types or vessel allisions...augment with AIS-ATON? The photo shows the "SF" buoy that marks the entrance to the San Francisco Main Ship Channel. This buoy used to be run over every 30 months...hasn't happened since we augmented with a synthetic ATON.
- Right now, NAIS is just capable of broadcasting points. However, we are looking into more advanced systems that can broadcast polygons – think security or safety zone.



- We are still learning something every day about AIS-ATON capabilities. As we develop these capabilities, we plan to integrate into our ATON and waterway design policy and procedures. If you have a scenario where you think AIS-ATON would be a good tool, let us know!
- You may be wondering about the Google Map I have here. Today, a driver with a smartphone can enter their start and end points, and that system will tell them the most effective route, traffic conditions, locations of speed traps, locations and prices of fuel, and the nearest Starbucks. Additionally, once the driver is enroute, the system will monitor their trip and re-route them if conditions change. Yet, among all of that, we still need lines on the road and street signs to help guide the way. Ironically, these two things, route planning and route monitoring, are the two base IMO requirements for ECDIS.
- This is how we envision legacy systems (street signs and physical ATON) working seamlessly with eNavigation technology (smartphone apps and eATON/eMSI).