Implementation of e-NAV in Arctic Waters

Enhancing Safe and Environmentally Sound Maritime Operations

E-NAV in Arctic Waters

This report, jointly prepared by Ocean Conservancy and the Marine Exchange of Alaska, highlights our common goal of promoting effective Electronic Navigation (e-NAV) technologies to advance maritime safety and efficiency and reduce impacts to the marine environment.

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Ocean Conservancy is working with you to protect the ocean from today's greatest global challenges. Together, we create science-based solutions for a healthy ocean and the wildlife and communities that depend on it.

MARINE EXCHANGE OF ALASKA

MARINE EXCHANGE OF ALASKA'S MISSION

Founded in 2001, the Marine Exchange of Alaska was established to provide information, communications, and services to enhance safe, secure, efficient, and environmentally responsible maritime operations.

Contents

Cover photo credit: Cory Mendenhall, USCG

Maritime Activity in the Arctic

DUE TO CLIMATE CHANGE and the commensurate reduction in ice concentrations, maritime traffic in Arctic waters is projected to substantially increase over time. Some trade routes will be redirected through Arctic waters to shorten transits by thousands of miles resulting in cost savings in both fuel and time. Additionally, as new resources are discovered in the Arctic more cargo ships and tankers will sail these waters to transport raw materials to market. The cruise industry views Arctic voyages as an emerging travel market and has been building additional ships to operate in the region.

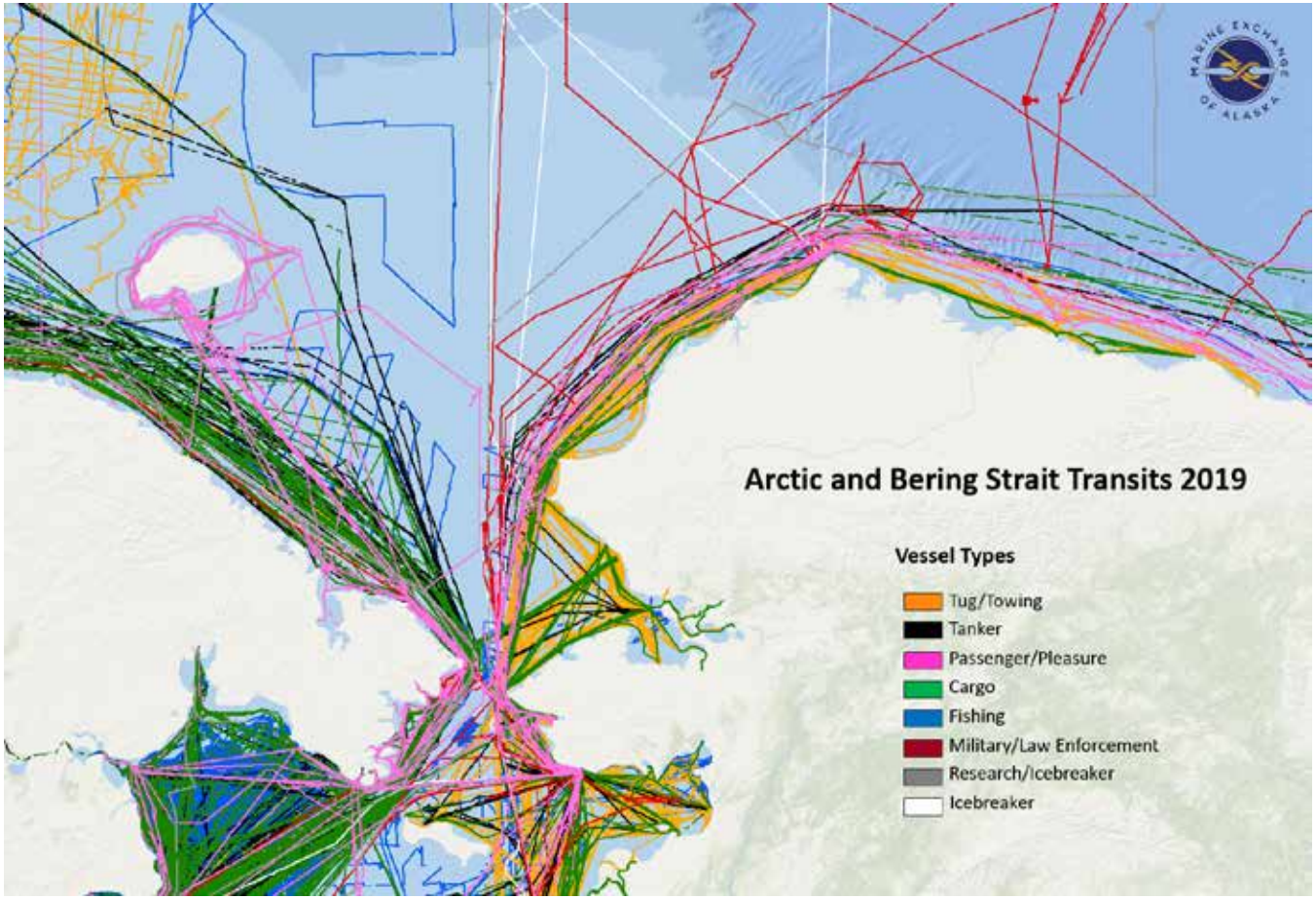
As more vessels operate in the Arctic the potential increases for maritime casualties resulting in loss of life and environmental impact. Unlike other maritime regions in the world, the network of maritime safety capabilities is sparse in this new maritime frontier.

Map, facing page: Maritime Traffic in the Bering Strait region in 2019 Developed from Automatic Identification System (AIS) Information Transmitted by Vessels.

TYPES OF VESSELS THAT OPERATED IN THE BERING STRAIT DETECTED BY AIS OVER THE PREVIOUS 5 YEARS

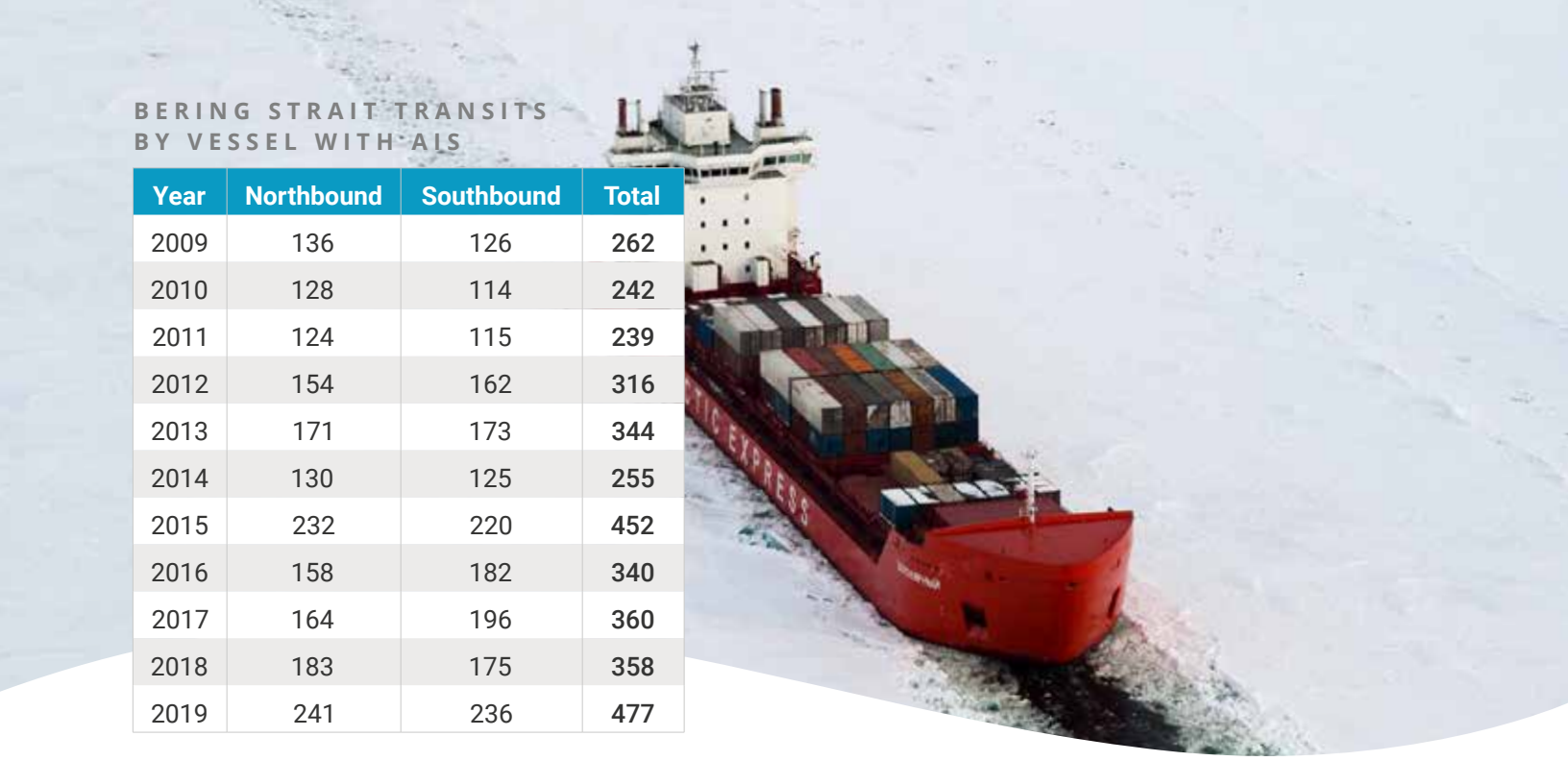
	Cargo	Towing	Passenger	Tanker	Military	Research	Icebreaker	Fishing	Drill Rig
2015	167	144	46	30	22	25	7	7	4
2016	145	135	20	29	10	24	3	3	0
2017	151	96	31	27	16	19	9	11	0
2018	147	89	14	36	23	24	7	18	0
2019	178	135	40	75	9	16	4	18	0

Photo credit: Adobe Stock



Aids to navigation such as buoys and lighthouses, vessel traffic services and communications are largely nonexistent in the Arctic. Setting buoys in ice-infested waters and fixing aids to navigation along Arctic shores are not viable options for aiding maritime safety.

Response to maritime incidents in the Arctic is hampered by the fact there are few ports, harbors of safe refuge, towing vessels, communications and emergency response resources available. These factors, compounded by the remoteness and extreme weather conditions in the Arctic, warrant elevated prevention measures and the use of new tools. E-navigation (or e-NAV for short) is one such tool. E-NAV harnesses new and emerging technologies to efficiently enhance maritime domain awareness and maritime domain management.



BERING STRAIT TRANSITS BY VESSEL WITH AIS

Year	Northbound	Southbound	Total
2009	136	126	**262**
2010	128	114	**242**
2011	124	115	**239**
2012	154	162	**316**
2013	171	173	**344**
2014	130	125	**255**
2015	232	220	**452**
2016	158	182	**340**
2017	164	196	**360**
2018	183	175	**358**
2019	241	236	**477**

What is e-NAV?

THE INTERNATIONAL MARITIME ORGANIZATION (IMO) defines e-NAV as "the harmonized collection, integration, exchange, presentation and analysis of marine information on board 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."

In layman's terms, e-NAV is the use of a suite of electronic navigational technologies to enhance maritime safety including but not limited to:

- AIS (Automated Identification System)
- GPS (Global Positioning System)
- ECDIS (Electronic Charting Information and Display System)
- Virtual and Synthetic Aids to Navigation (ATONS)
- DSC (Digital Selective Calling)

> *"e-NAV is the harmonized collection, integration, exchange, presentation and analysis of marine information on board 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."*
>
> ***The International Maritime Organization***

Photo credit: Vladimir Melnikov

Excerpt of International Maritime Organization's 2018 implementation plan for its e-NAV strategy.

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MSC.1/Circ.1595
25 May 2018

E-NAVIGATION STRATEGY IMPLEMENTATION PLAN – UPDATE 1

1 The Maritime Safety Committee, at its eighty-first session, recognizing the technological advancement in shipping, agreed on the process of developing a regulatory framework for e-navigation.

2 At its ninety-fourth session, the Committee approved the e-navigation Strategy Implementation Plan (SIP), finalized by the Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), at its first session.

3 At its ninety-ninth session, the Committee, recognizing the need to regularly update the e-navigation SIP to allow for prioritized tasks to be included in the work programme of the NCSR [illegible] the *E-navigation Strategy Implementation Plan – Update 1,*

Strategy Implementation Plan (SIP) e-NAV Solutions

The IMO's 2018 e-NAV Strategy Implementation Plan calls for:

- improved, harmonized and user-friendly bridge design;
- the means for standardized and automated reporting;
- improved reliability, resilience and integrity of bridge equipment and navigation information;
- integration and presentation of available information in graphical displays received via communication equipment; and
- improved communication of VTS Service Portfolio (not limited to VTS stations).

E-NAV, Maritime Domain Awareness and Maritime Domain Management

E-NAV TECHNOLOGIES ARE ALREADY IN USE around the world at varying levels. With the advent of Automatic Identification System (AIS), maritime domain awareness (MDA) has been extended far offshore providing the capability to manage the risk of maritime operations beyond the safety net established in port regions and high traffic areas.

E-NAV technologies not only facilitate MDA, they allow for more active maritime domain management (MDM). For instance, in Europe, a Sea Traffic Management system—employing AIS and satellite communications—is being implemented outside of port regions and established vessel traffic centers to enhance safety and efficiency of maritime operations. In British Columbia, Proactive Vessel Management is in the process of being implemented by the Canadian government to address the concerns raised by the Indigenous people of Haida Gwaii by establishing offshore routing measures and employing AIS to monitor vessels in order to compel compliance.

In the U.S., in 2014 the Alaska Maritime Prevention and Response Network implemented an MDM system for Arctic waters, the Bering Sea and waters surrounding the Aleutian Islands. The Marine Exchange of Alaska operates a 24-hour AIS vessel traffic management center to closely monitor and promote compliance with the Network's MDM system and IMO-designated Areas to be Avoided (ATBAs) in the 1.5 million square miles of ocean bordering Western Alaska.

MDA

Maritime Domain Awareness: Tracking maritime activities that could affect security, safety, economy or the environment.

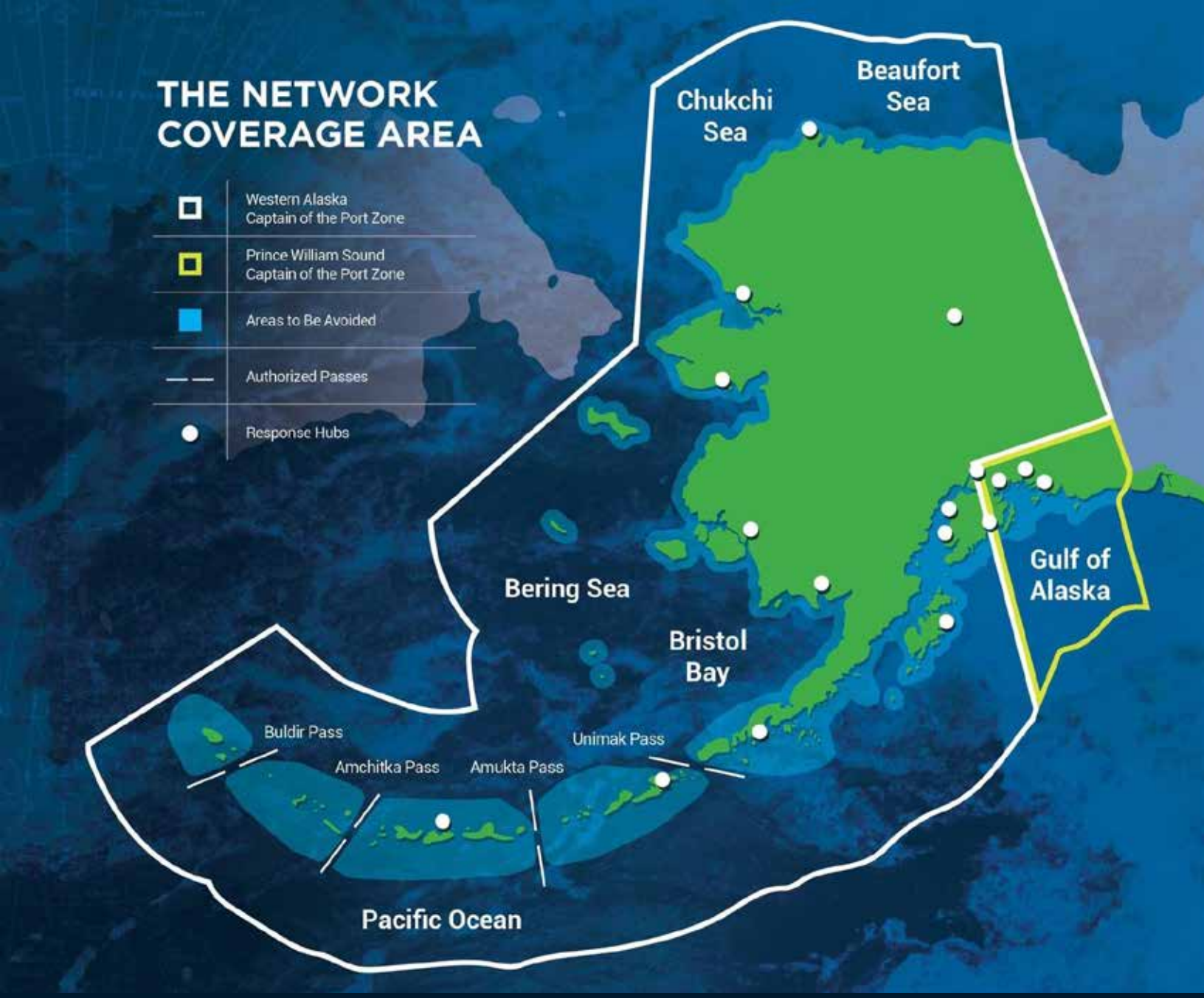
MDM

Maritime Domain Management: Integrating and disseminating relevant information about the maritime domain to facilitate better decision-making.

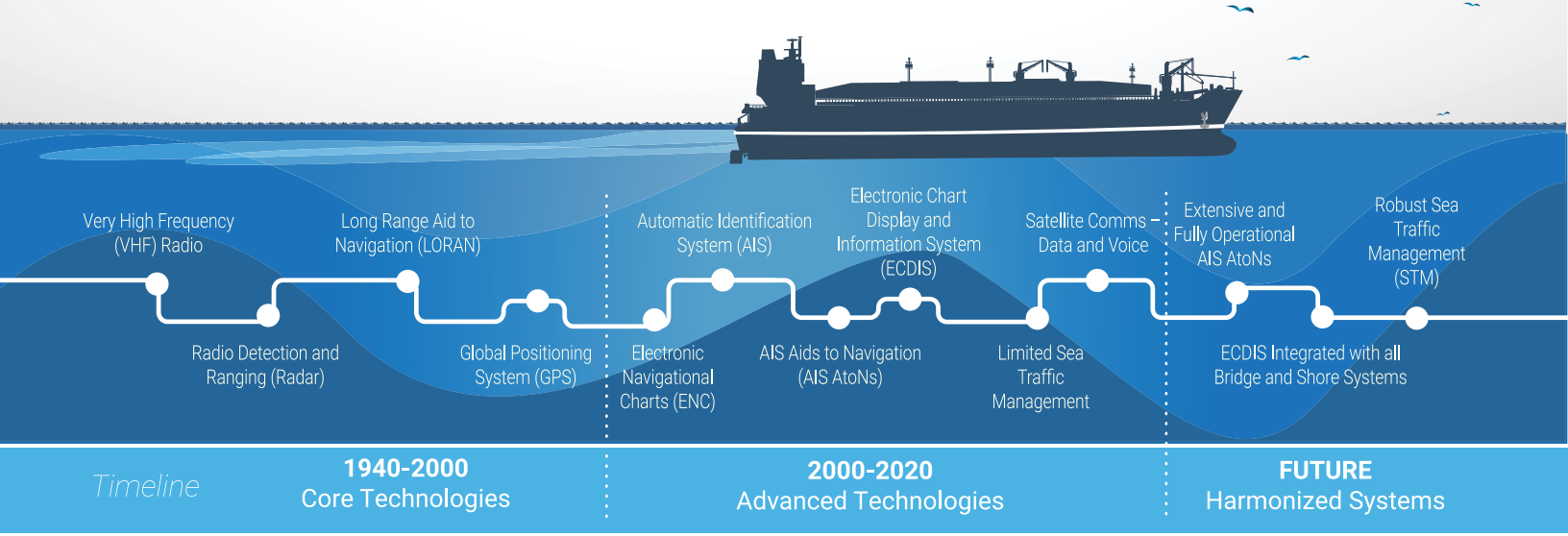
ATBA

Areas to be Avoided: A designated area that should be avoided by all or certain classes of ships.

Photo credit: Marine Exchange of Alaska



The nonprofit Alaska Maritime Prevention and Response Network implements an MDM system that covers a vast area off the coast of Alaska. The MDM system is designed in large part to reduce the risk of accidents. Vessels traveling in these waters and making a U.S. port call can enroll with the Network to comply with certain Coast Guard pollution prevention regulations.



Evolution of e-NAV

E-NAV APPLICATIONS HAVE EVOLVED OVER THE PAST 100 YEARS.
In the early 1900s VHF radios first came online to receive calls for help and to provide safety information to vessels. Subsequently, RADAR, LORAN, GPS navigation and AIS have been developed to enhance navigational safety.

Today, Vessel Traffic Services in major port areas around the world employ VHF communications, RADAR and AIS to aid safe and efficient maritime transportation in the vicinity of ports or heavily trafficked shipping corridors.

The recent implementation of satellite and AIS vessel tracking technologies dramatically changed maritime domain awareness, enhancing maritime safety for offshore areas where maritime activity was not able to be monitored or managed in the past.

As a result of AIS, maritime operations can now be monitored anywhere in the world and enhanced communications provide the ability to transmit safety and environmental alerts and information to mariners.

VHF

The Very High Frequency spectrum of radio waves; used for many types of communication including two-way communications by vessels.

Radar

Use of radio waves to identify the position and speed of vessels and other distant objects.

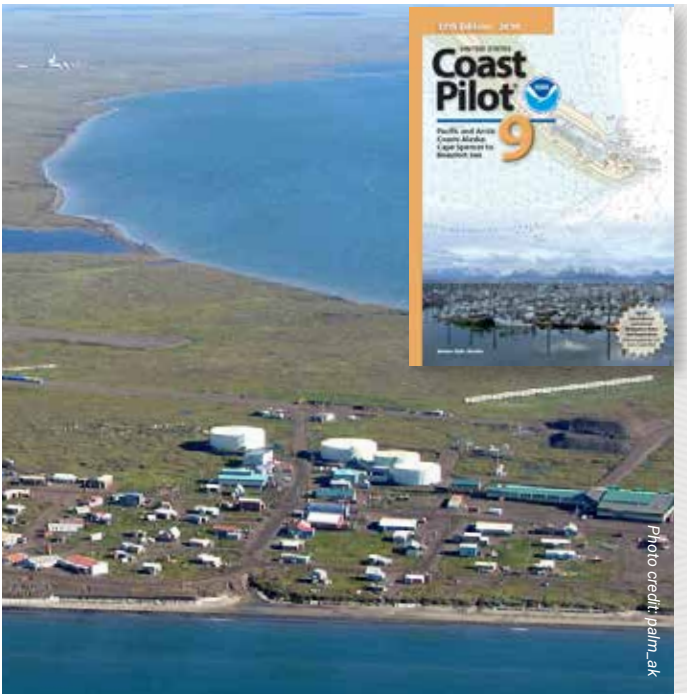
AIS

Automatic Identification System; a vessel tracking system that uses VHF, global positioning and vessel-based transceivers to broadcast a ship's identity, position, course, speed and other information.

E-NAV in the Arctic

AUTHORITIES HAVE RECOGNIZED THAT THE REMOTE AND HARSH WATERS OF THE ARCTIC warrant implementation of additional safety and environmental measures. For instance, IMO promulgated the Polar Code in 2018 to bolster navigational safety and environmental standards for vessels traveling in polar waters.

IMO also established routing measures and marine traffic lanes in the Bering Strait in 2018 to help manage the risk of maritime accidents from occurring in the region bordered by Alaska and Russia. However, establishment of traffic lanes and other risk mitigating operating procedures are only effective if MDA and MDM are applied to monitor and compel vessels' compliance.



"Wainwright, on the beach 2.5 miles NE of the inlet has stores, a hotel and restaurant, a school, a church, and an airstrip. Wainwright bans the possession, sale and importation of alcohol.Limited quantities of fuel are also available in town and include marine gasoline and diesel. Subsistence hunting of marine mammals occurs around Wainwright year round but is heaviest during the spring Bowhead whale season. Vessels should contact the Alaskan Eskimo Whaling Committee when transiting near Wainwright during the spring and summer month.Wainwright operates a volunteer search and rescue service that can be contacted on VHF-FM channel 16. Vessels are requested to check in with Wainwright SAR with their vessel name and position when transiting near Wainwright on VHF-FM channel 16."

The graphic above shows an excerpt from Coast Pilot 9, advising how a vessel can obtain current information on whaling activity by calling the local community via VHF. E-NAV technologies are capable of providing real-time information on whaling activity. ATBAs and other navigation information can be displayed graphically on the vessel's ECDIS, and if local whaling boats are equipped with AIS, they will appear on approaching vessels' AIS displays.

E-NAV in the Arctic (cont'd)

In the Arctic, seasonal sea ice, remoteness and extreme weather largely preclude the use of traditional aids to navigation and maritime management tools. However, the Arctic is ripe for implementation of e-NAV technologies to address these challenges and ensure expanding Arctic maritime operations are safe and environmentally sound.

Despite the major advances in e-NAV technology, the application of these new tools is still evolving. Even today, most commercial vessels are still required to have on board some version of traditional charts and publications, including tide and current tables, Coast Pilots and Notice to Mariners for the waters they sail. For instance, a vessel operating in U.S. Arctic waters is required to have on board the U.S. Coast Pilot 9, a 500+ page reference book that provides safety information related to Western Alaska waters. Mariners are also required to have a copy of the weekly updated Coast Guard Notice to Mariners, typically a 20+ page notice.

Much of the information in these documents is not relevant to a mariner's voyage and is often outdated. A better approach would be to use e-NAV technologies to provide mariners with relevant, up-to-date navigational, safety and environmental information in real time. In U.S. Arctic waters, real-time data could include information about weather, safety hazards, dynamic marine protected areas (presence of marine mammals), and regional maritime activity such as Indigenous whaling.

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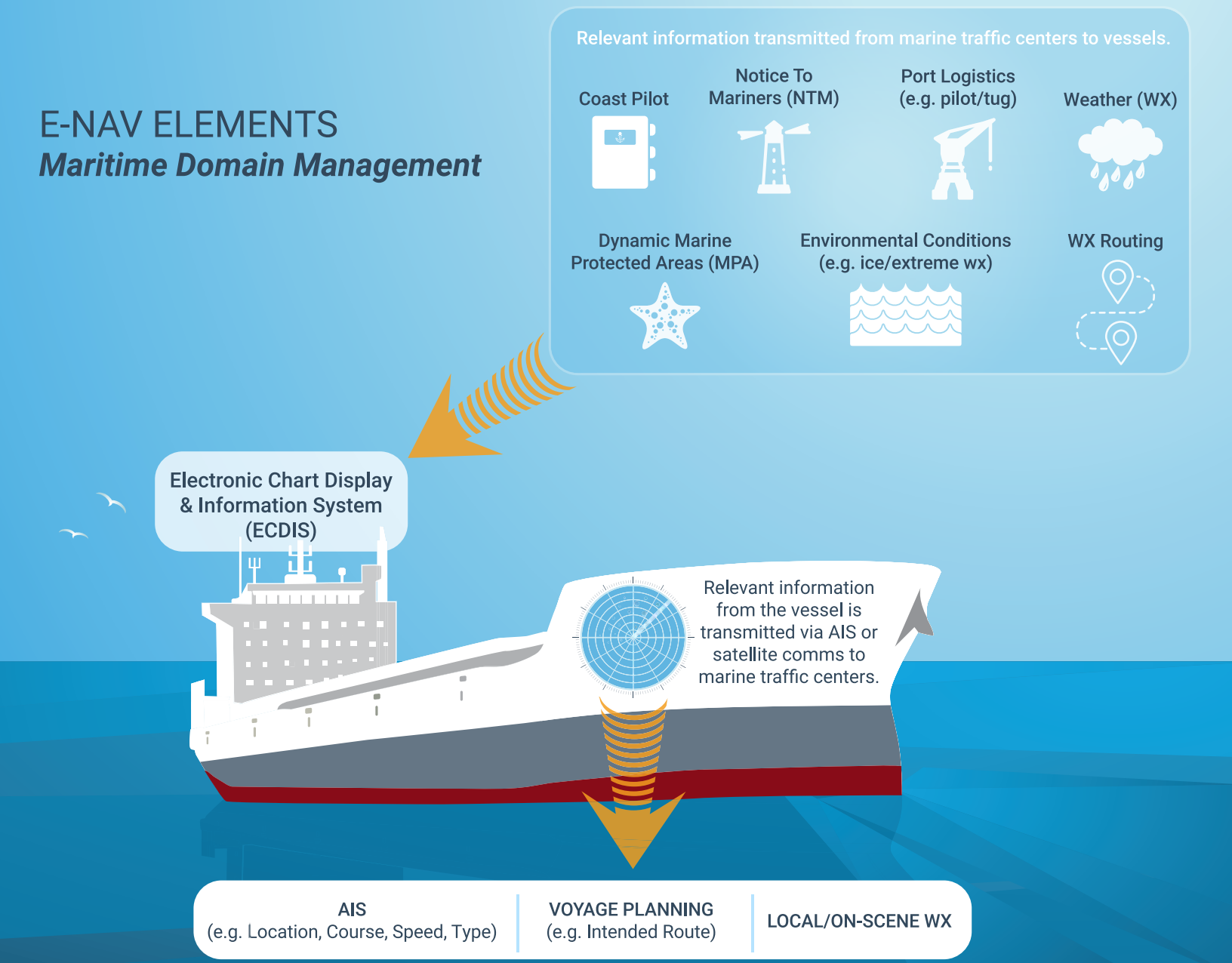
Photo credit: Adobe Stock

E-NAV ELEMENTS

Maritime Domain Management



Using e-NAV technologies, it is possible to use a vessel's AIS to evaluate the vessel's location and destination, identify relevant data and information and transmit that information to the vessel's Electronic Charting Display and Information System (ECDIS) in real time. While this technology and means of disseminating relevant information exists, its implementation has been limited.

ECDIS Display on a vessel.

Photo credit Monty Rakusen

Current e-NAV Applications

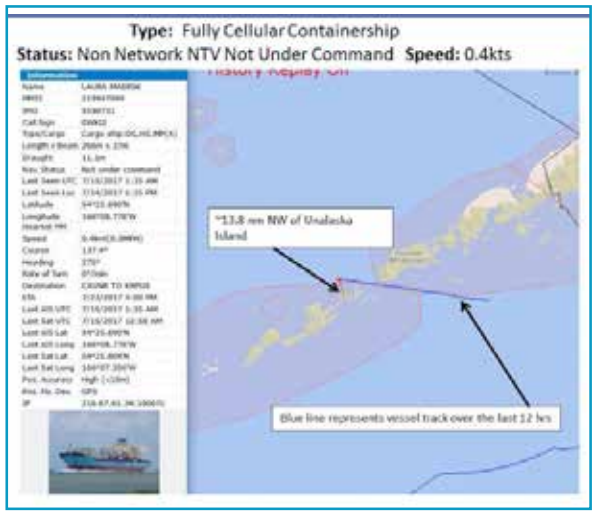
THE MOST IMPACTFUL ADVANCE IN E-NAV OVER THE PAST 20 YEARS has been the implementation of AIS technology to dramatically expand MDA and MDM beyond the reach of terrestrial-based radios and radars to offshore waters where vessels operate without oversight or monitoring.

The implementation of ECDIS aids dissemination of clear and relevant information to mariners, including the presentation of accurate charts, navigational information, safety notices and AIS data on a display screen located on a vessel's navigational bridge.

Examples of how e-NAV has been applied to enhance environmental protection in the wake of prior maritime accidents are provided on the facing page. ECDIS harmonizes navigational safety and environmental data with accurate, updated charts on a digital display along with digital messages transmitted via AIS, radar imagery and data on nearby vessels transmitted by their AIS.

> *"ECDIS harmonizes navigational safety and environmental data with accurate, updated charts on a digital display along with digital messages transmitted via AIS, radar imagery and AIS data on nearby vessels transmitted by other vessels."*

Maritime Events that Incentivized e-NAV Applications in Alaska



SELENDANG AYU: In December 2004, the cargo vessel *Selendang Ayu* incurred an engine casualty in the Aleutian Islands during a winter storm, drifted towards shore and grounded. The accident resulted in the loss of six mariners' lives, a major oil spill and the loss of the vessel and cargo.

As no vessel tracking/monitoring system was in place at the time of the incident it was not until the master called for assistance 17 hours after the vessel lost power that the Coast Guard became aware of the casualty and initiated a response.

A multi-year Aleutian Island Risk Assessment identified the need to implement e-NAV capabilities to provide MDA and MDM in Western Alaska waters to reduce the risk of marine casualties. As a result, a comprehensive AIS tracking system was developed that encompassed over 1.5 million square miles, offshore routing measures were established, and a 24-hour Vessel Compliance Monitoring and Response System was implemented by the Marine Exchange of Alaska and the Alaska Maritime Prevention and Response Network. This initiative could be implemented only because of advances in e-NAV technologies.

Bulk carrier Selendang Ayu *aground off Unalaska Island.*

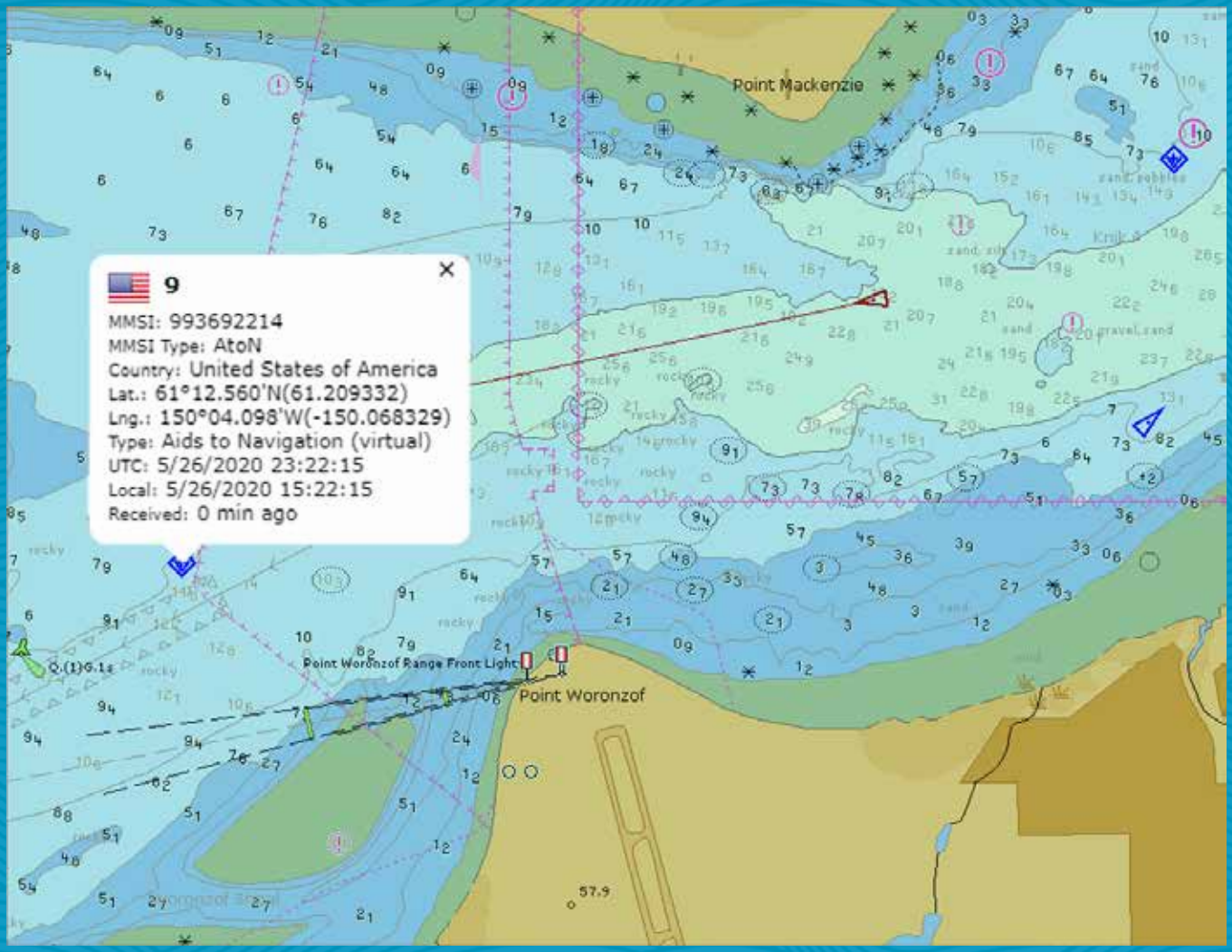
Photo credit: Micheal Edenfield

Arctic Next Generation Navigational Safety Information System

THE COAST GUARD ENTERED A COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT (CRADA) WITH THE MARINE EXCHANGE OF ALASKA from 2014–2018 called the "Arctic Next Generation Navigational Safety Information System." The project tested Marine Exchange's AIS transmitters, called AIS ATONS, to determine their effectiveness in disseminating safety and environmental information to vessels operating in Arctic waters where availability of conventional communications and aids to navigation is limited. The Coast Guard offered the following explanation for the project.

"There is concern with increasing maritime activity in the Arctic, along with potential for maritime accidents and serious environmental harm to the fragile Arctic environment, warranting the need to implement enhanced maritime safety measures. One challenge is the dynamic, constantly changing environment of the Arctic; another challenge is the minimal Arctic infrastructure, as compared to other, less harsh maritime regions. The goal is to provide important safety information, to allow the mariner to better identify, assess, and mitigate the risks of operating in the Arctic. The maritime community and other stakeholders look to the USCG to provide important oversight of expanding maritime activity, as well as critical tools required to ensure safe, efficient and environmentally sound maritime operations."

The CRADA evaluated the feasibility of using AIS transmitters to send information to vessels. This included transmitting the location of "virtual buoys" where ice-infested waters prevented physical buoys from being used and transmitting regionally relevant information from Broadcast Notice to Mariners regarding maritime safety and environmental protection.



Location of virtual buoy transmitted via AIS.

The technology was proven to work. However, there are hurdles to immediate widespread implementation. For instance, most vessels are not currently equipped with the type of AIS radios and software that is capable of displaying the information sent via AIS.

e-NAV Application: “Watchdogs” or Automated Alerts

THE MARINE EXCHANGE OF ALASKA DEVELOPED THE CAPABILITY TO AUTOMATICALLY GENERATE ALERTS when the operation of a vessel tracked by AIS incurs an elevated risk event. Such events can include but are not limited to entering a prohibited area, exceeding speed restrictions or evidence of loss of power.

These events trigger automatic alerts that are sent to the Marine Exchange’s operations center where the 7 x 24 hour watch investigates the situation and initiates appropriate action.

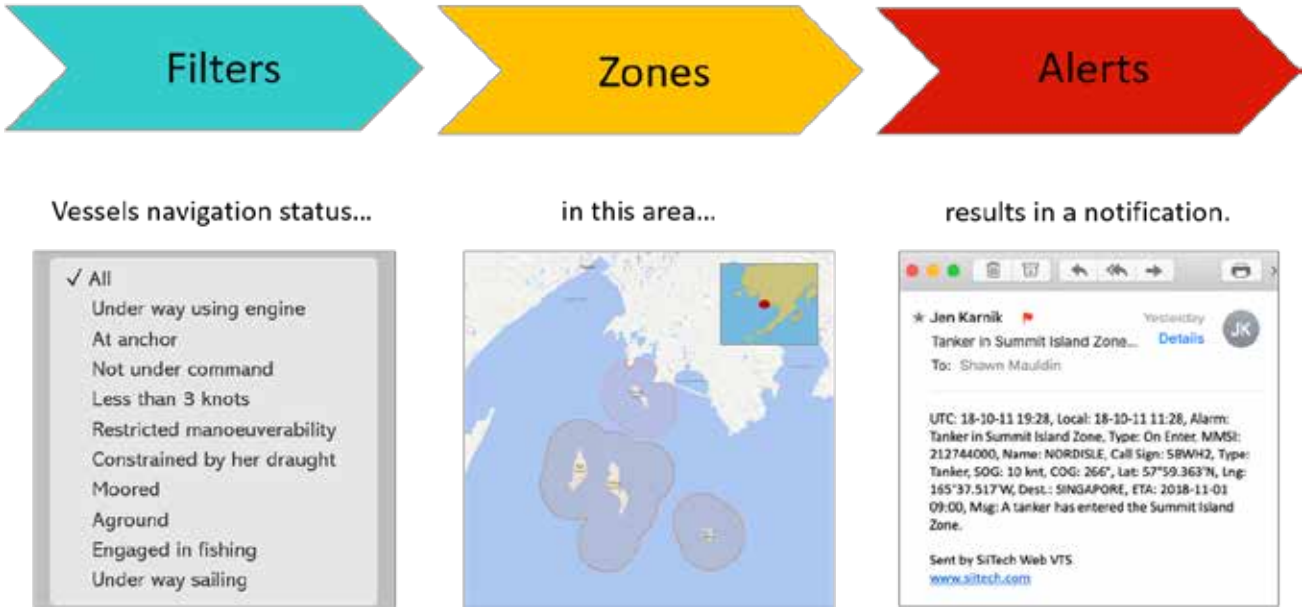


Photo credit: Adobe Stock

Providing Real Time Vessel Information to Arctic Communities

AS MARITIME TRAFFIC INCREASES ALONG THE ARCTIC COAST, the potential for interference with subsistence activities increases, which could lead to collisions with small vessels operated by residents in local communities. AIS technology has improved over time to the extent that portable AIS units can now be carried on small vessels, making them visible to larger commercial ships and helping to prevent collisions or disruption of whale hunts.

Download on the App Store

Google play

The Marine Exchange of Alaska developed a free Arctic Vessel Tracking app residents can access with smartphones to provide them real-time information on the location of vessels equipped with AIS operating in their waters.

Photo credit: J.W.Aker

Gaps and Challenges in Implementing e-NAV Capabilities in the Arctic

E-NAV TECHNOLOGIES OFFER GREAT PROMISE IN ARCTIC WATERS, where harsh conditions and remoteness may preclude the use of other, more traditional safety tools and navigational aids. However, action is needed to take full advantage of the possibilities offered by e-NAV and to enable widespread implementation of e-NAV-based management measures in Arctic waters. Necessary steps include:

- ensuring all vessels operating in the Arctic are equipped with fully capable AIS hardware and software as well as ECDIS displays;
- expanding the network of AIS Aton transmitters in the Arctic and transmitting relevant information to vessels operating in Arctic waters;
- establishing procedures and protocols for agencies and authorized competent authorities to provide information that should be communicated to vessels to enhance maritime safety and minimize environmental harm;
- providing Arctic communities with access to vessel tracking systems so they are aware of potential conflicts with regional subsistence activities; and
- providing subsistence hunters on vessels with AIS transmitters to ensure their presence is visible to transiting vessels.

Maritime Governance and e-NAV Implementation

THROUGH PROMULGATION OF THE POLAR CODE IMO has played an active role in establishing international standards and has identified the Arctic as a maritime region where additional risk mitigating measures are warranted due to its remoteness, harsh climate and sensitive environment. However, in the area of addressing "safe navigation" IMO provides the following limited guidance:

> *All ships operating in polar waters must have means to receive up-to-date nautical and ice information and the ability to visually detect ice. The Code requires all ships to have the means of receiving and displaying information on ice conditions in its area of operation.*

IMO can and should do more to promote effective use of e-NAV technologies in Arctic waters.

Of course, governance of Arctic waters is not simply the purview of the IMO. Nations, states, various governmental agencies (including but not limited to the U.S. Coast Guard), ports and the maritime community all have some level of jurisdiction over vessels operating in Arctic waters, and all exercise some level of maritime governance. As explained in the recommendations below, all these entities have a role in facilitating the use of e-NAV technologies to promote vessel safety and environmental protection, especially in Arctic waters.

Recommendations

THERE ARE MARITIME REGIONS IN THE U.S. AND AROUND THE WORLD where e-NAV technologies are being employed. However, e-NAV in the U.S. Arctic has only been evaluated, not implemented. MDA and MDM of Arctic waters through existing e-NAV technology is the least costly and most efficient and effective way of minimizing the adverse impacts of increased maritime activity in the Arctic.

As vessels travel the world, it is critical that management entities—including IMO, government agencies, industry groups and other stakeholders work together to adopt and adhere to internationally accepted protocols for e-NAV technologies.

RECOMMENDATIONS

- IMO should amend the Polar Code to require vessels operating in Arctic waters to be equipped with the latest AIS and ECDIS technologies to ensure they can receive navigation, safety and environmental information transmitted by coastal states.
- Coastal states should take appropriate measures to ensure communications systems are capable of transmitting relevant and accurate safety and environmental information to vessels transiting their Arctic waters.
- The U.S. should allocate resources to implement the use of currently available e-NAV capabilities by funding the installation and operation of AIS ATONS in the Arctic and employing emerging e-NAV capabilities as they are developed.
- To minimize adverse environmental impacts, resource managers, including but not limited to National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service and Alaska Fish and Game should have the capability to monitor maritime activity in the Arctic and to communicate with vessels as appropriate regarding the location of established and dynamic marine protected areas and operating restrictions.

Photo credit: Brian Gauvin

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