Executive Summary

Automatic Identification System (AIS) is a mandatory navigation safety communications system under the provisions of the Safety of Life at Sea (SOLAS) Conventions which requires ships of more than 300 gross tons engaged on international voyages, cargo ships of more than 500 gross tons not engaged on international voyages, and all passenger ships irrespective of size to be fitted with AIS. exactEarth, Ltd (www.exactearth.com) is a private data services company delivering real-time global location-based maritime vessel tracking information for government and commercial agencies through its exactAIS® service. The ability to decode such AIS messages using a constellation of satellites, or Satellite AIS (S-AIS), has been exactEarth’s focus since 2010 as they have exploited big data management expertise to deliver clear, global, real-time maritime vessel tracking information to government authorities when, where and how they have needed it. The superior detection technology of these satellites supports the rapid build-up of verifiable Maritime Domain Awareness (MDA), which is now used to support 100s of maritime safety, security, and commercial applications including monitoring the remote waters of our planet like the Arctic.

Background

The Arctic Region is warming at roughly twice the global average rate with the reduction in summer sea ice being both one of the clearest indicators and one of the most dramatic effects of this trend.

Alongside the transformation in physical and biological processes across the whole region, we are witnessing the rise of a wide number of interconnected social transformations driven by the increased accessibility to this once remote Ocean environment. Nation States are disputing territorial claims as the economic and strategic potential of the Arctic emerges; the International community demands coordinated research activities; the oil and gas industry wishes access to the sea bed for exploration; the shipping industry as a whole examines the potential for new and economically important shipping lanes.

According to the Intergovernmental Oceanographic Commission “never has accurate information been more important, yet at present we know very little about the Arctic Ocean”.  

1) SOLAS Ch. 5 Regulation 19 Para 2.3 www.navcen.uscg.gov/pdf/AIS/AIS_Regs_SOLAS_MTSA_FR.pdf accessed 14 Sep 12
2) Why Monitor the Arctic Ocean? (The Intergovernmental Oceanographic Commission), 2010
Arctic Shipping

Shipping in the Arctic is on the increase as the sea ice retreats further each year and the region opens to further industrial development.

In addition, the retreating ice is opening the Canadian Northwest Passage and the Russian Northern Sea Route to regular commercial shipping, which could have perhaps the largest impact on shipping in the region.

Both routes offer viable alternatives to established sea routes. The journey by ship from North America’s Pacific Coast to Western Europe is one-third shorter using the Northwest Passage than by using the traditional Panama Canal route. Using the Russian Northern Sea Route offers shipping an alternative for the Asian/Western Europe Route avoiding the potentially dangerous Suez Canal route or the incredibly long voyage around the African Cape.

In August 2010, a super tanker navigated through the Northern Sea Route for the first time carrying 70,000 tonnes of gas from Murmansk in Russia to Ningbo in China. In 2013, the first cargo ship crossed the Northwest Passage, heralding a new era of commercial activity in the Arctic.  

Ship traffic is set to grow in this most remote of Ocean regions and now includes commercial ships, tourist cruises, research ships, coastguard icebreakers, exploration survey ships and fishing fleets.

It is evident that there is heightened risk to safety of life and damage to the sensitive environment due to increased numbers of vessels involved in Arctic tourism, mineral extraction, fishing and transportation of goods. Furthermore, the ability to monitor traffic and respond to incidents is severely restricted because of the climatic conditions and limited rescue resources.

The Arctic region is perhaps the harshest for vessels on the planet, however the area is rich in tourism, mineral resources, aquaculture, and provides for sea routes joining Asia to Europe and North America. Passenger vessels provide access to the spectacle of sea ice, research vessels search for minerals, supply vessels serve mineral extraction installations, tankers and bulkers transport minerals and extracted resources, and an increasing number of vessels are escorted through the Northern Sea Route each year.

Monitoring and understanding the changes in ship traffic is vital in order to not only provide reliable information to safely guide Arctic Shipping in the future, but also to understand the impact of this increased activity on this pristine, fragile, and rapidly changing ecosystem.

**Satellite AIS—The Game Changer**

Monitoring Arctic shipping is a challenge as the Arctic Coastline is remote and uninhabited with little or no industrial development. Infrastructure and systems are simply not in place as they are elsewhere in the world.

Satellite-AIS (S-AIS) is ideally suited to monitoring such a remote region and provides a unique insight into Arctic Shipping. Such data provides safety agencies, national authorities, commercial companies and research institutes with an unparalleled view into ship traffic movements in this remote region allowing the analysis of risk to vessels, the environment and safety of life.

With an expansive S-AIS data archive dating back to July 2010, exactEarth have a wealth of information already gathered to help organisations interested in Arctic Shipping. With available datasets specifically aimed at providing archived data for just the Arctic region, exactEarth S-AIS data captures every vessel movement in this traditionally unmonitored remote area.

**Historical Implications**

Understanding the changes in ship traffic in the Arctic over time is vital in order to not only provide reliable information to safely guide future practices but also to understand the impact of this increased activity on this pristine, fragile and rapidly changing environment.

The Arctic region is generally defined as being the area in which the average temperature for the warmest month is below 10°C. For exactEarth data we have defined an area as shown to the right covering the full extent of the Arctic Ice Pack and including all of the Northwest Passage and Northern Sea Route including the Bering Sea, the Sea of Okhotsk and the Northern Atlantic Region around Iceland. This represents approximately –50o to 90o N Latitudes / -180o to 180o Longitudes.

Arctic datasets contain all shipping data from July through to October to provide

- Investigation and analysis of individual ship tracks
- Pattern analysis for insight into activities and trends
- Traffic counting on specified routes or channels
- Density plots for input into environmental models and impact research studies
- A single source of information to aid administrations, commerce and safety agencies with detailed insight of risk to vessels, the environment, and safety of life.

Figure 1: exactAIS Arctic Archive Coverage
Live Monitoring of Shipping in the Arctic

The Arctic is one of the most hostile maritime environments on our planet, causing hazards such as ice accretion on vessels, which can lead to instability, or collisions with icebergs and growlers. Although sea ice is receding, it is subject to piling up in summer months preventing a complete ice-free passage. Due to these problems, an International Code of Safety for Ships in Polar Waters (The Polar Code) has been developed, with support from the International Maritime Organisation (IMO). According to the Polar Code and Safety of Life at Sea (SOLAS) all vessels traversing in Arctic waters are required to be equipped with AIS to help monitor vessels in these dangerous waters. With limited search and rescue, and few, if any, other vessels in the area, it is crucial to provide accurate and up-to-date surveillance of all ships in the Arctic Region to prevent accidents and potential loss of life. Due to the extended range of surveillance of Satellite AIS from exactEarth, the icy waters are monitored consistently in the Arctic. All ships travelling through this vast remote area are now detected with exactEarth’s dedicated Polar coverage. Real-time positions of the vessels allows for faster location and reaction in case of accident. With the increase in commercial shipping and passenger vessels in the area, this crucial information can help in the rescue of crew aboard vessels and assist in preventing environmental damage, or potential loss of life.

exactAIS provides a global capability for monitoring all AIS-equipped vessels using the exactEarth satellite constellation and global network of ground stations. exactAIS streams the data securely, quickly and continuously. This real-time data enables the monitoring of vessel traffic in any area of the ocean allowing authorities to monitor even the remotest of regions such as the Arctic.

Density Maps from exactEarth

Plotting shipping density is especially useful for environment modelling and other macro analysis where more generalized forms of traffic patterns are required. Density Maps can be easily created from the exactAIS Archive to provide information across any part of the Arctic Region. Such maps show clearly the concentration of shipping and can be used to assess human impact in a form that is easily assimilated and readily understood.

Density Maps from exactEarth deliver in-depth vessel pattern analysis by transforming thousands to millions of AIS messages into individual geospatial data points. Users receive only the data they request and exactEarth eliminates the complexity and time it takes to turn AIS messages into actionable map data.

Figure 2- Shipping Density Map – Arctic Region
To learn more visit, www.exactearth.com/products/exactais-density-maps

In August 2014 the HANSEATIC sailed the Northeast Passage, becoming the first non-Russian ship to do so. This cruise ship set a new record for passenger ships in this area, the vessel reached the northernmost point at 85°, 40.7° North and 135°, 39.6° East (480 kilometers from the North Pole). This trip was made possible due to large ice free zones north of the New Siberian Islands in the Russian Arctic.
exactAIS Features

- Data is easily integrated with weather and ice prognosis data to ease implementation with other communication systems

- Critical tracking of passenger ships in Arctic waters to ensure compliance with safety measures and facilitate faster response times in the event of accident. Data enables the monitoring of other vessels in the vicinity of passenger ships in case they may be required to assist taking on passengers in a rescue scenario

- Minute-by-minute Satellite coverage over Polar areas, delivering an unparalleled understanding of maritime traffic trends to allow for proper analysis into the most efficient security measures and safest shipping routes
Conclusion

The Arctic sea area covers vast regions of the Earth’s surface and is becoming ever more important as the ice cover reduces making these areas more accessible to fishing, tourism, mineral exploitation and a viable shipping route. While this can be very beneficial for commercial tankers there are still risks associated with this voyage. Conditions are still harsh, which can lead to oil spills and environmental disasters. The lack of communication infrastructure in the region also hinders Search and Rescue operations making it critical to establish safety regulations. The region is not only covered with ice, but also is liable to poor visibility for vessel traffic. As such it is one of the most hostile maritime environments on our planet.

With complete global coverage, exactAIS accurately monitors all vessels in the Arctic region. Now all polar shipping traffic can be monitored in real-time to provide safety and security to vessels traversing these treacherous waters. Authorities can also gain better insight into the realities of Arctic shipping traffic and trends with detailed historical data from the summer months dating back to 2010 with exactAIS Archive.

With the receding ice opening these waters, shipping companies are eager to explore the new routes and new possibilities. While the increase in shipping is understandable, vessels traversing the Arctic waters need to ensure they follow the best practices and acquire the latest technology to avoid major incidents in this fragile ecosystem.