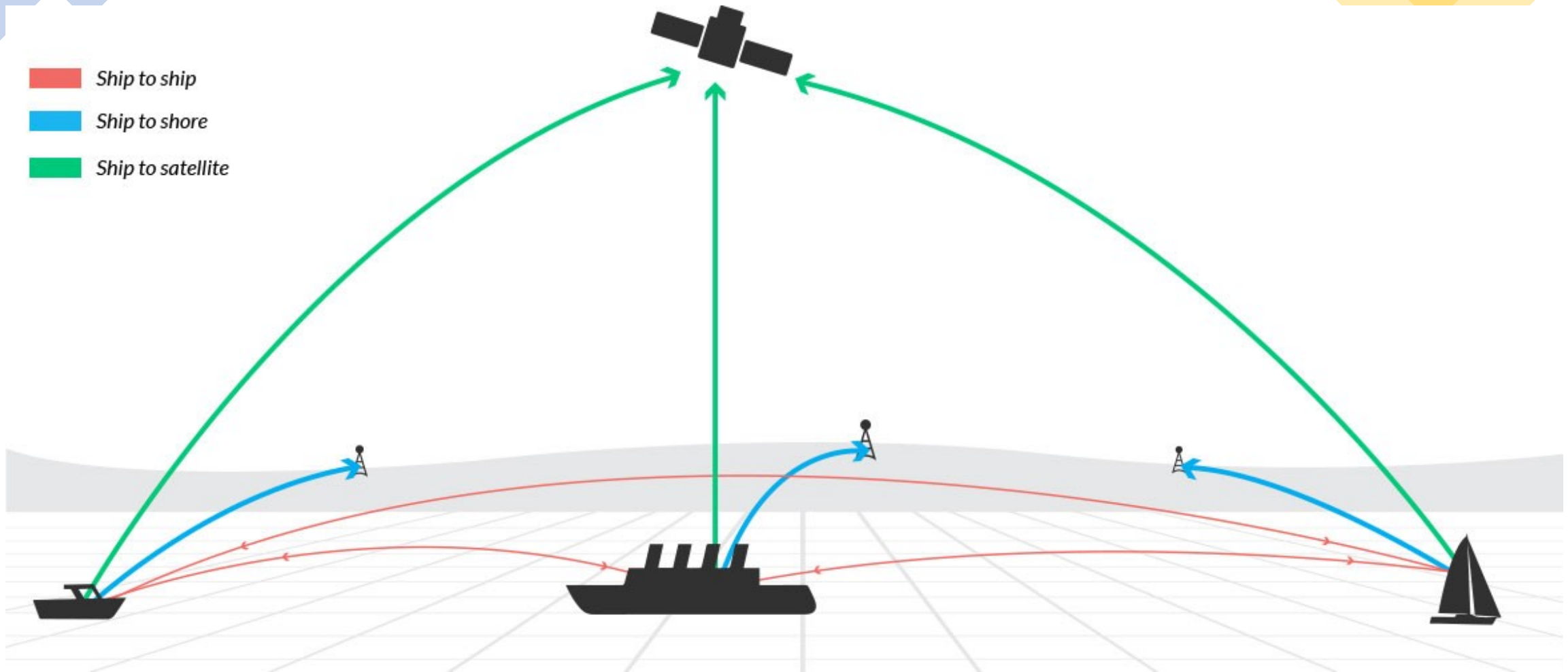


- Ship to ship
- Ship to shore
- Ship to satellite



# Automatic Identification System

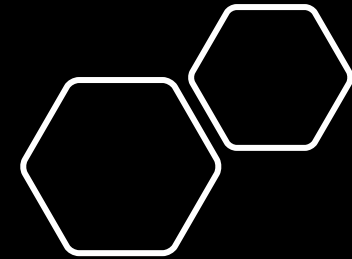
- Required on any international ship with gross tonnage of 300 or more tons.
- Required on ALL passenger ships regardless of size
- Tracking system for ships
  - Ship-to-ship communication in open-sea
- Some Applications:
  - Vessel Traffic Services
  - Collision Avoidance
  - Maritime Security
  - Search and rescue, Accident investigation
- AIS 1: Works on 161.975 MHz (ship to ship)
- AIS 2: 162.025 MHz (ship to shore)

# Automatic Identification System

- Static Information (Every 6 minutes and on request):
  - MMSI Number (Unique)
  - Name
  - Length
  - Ship Type
- Dynamic Information (Depends on speed and course alteration)
  - Position (GPS)
  - Speed

!AIVDM,1,1,,A,13aEOK?P00PD2wVMdLDRhgvL289?,0\*26

```
{
  'type': 1,
  'repeat': 0,
  'mmsi': '244670316',
  'status': <NavigationStatus.Undefined: 15>,
  'turn': -128,
  'speed': 0.0,
  'accuracy': True,
  'lon': 4.379285,
  'lat': 51.89475,
  'course': 70.60000000000001,
  'heading': 511,
  'second': 14,
  'maneuver': <ManeuverIndicator.NotAvailable: 0>,
  'raim': True,
  'radio': 33359
}
[Finished in 0.1s]
```



# Challenges

- There are many challenges with satellite AIS since the signals were never meant to be received from space.
- The biggest one is that the satellites will receive transmissions from many, many vessels - up to thousands of vessels - simultaneously. So the big challenge is the signal processing challenge of being able to make sense of all that information.
- Ship can turn off their AIS (Only a ship can tell whether its neighbour turned off its AIS or not, satellite cannot be sure when it is in crowded areas eg. signal interference, overloading.)
- Horizontal Range up to 74Km.



# Vessel Clustering

- Cluster ships into some groups.
- Each cluster has its own cluster head.
- Cluster head is responsible for communicating with satellite after processing its cluster members messages.
- Instead of processing thousands of signals, satellite is now processing fewer data.
- Clustering based on speed, type of vessels, position, transmission power...

# Applications Of S-AIS

- **Fishing fleet monitoring and control**

AIS is widely used by national authorities to track and monitor fishing activities depending on location and quality of coast based receivers/base stations with supplementary data from satellite-based networks.

- **Maritime security**

Improves maritime domain awareness – Vessel types – Pirating activities.

- **Search and rescue**



# AIS Classes – Class A

- Send and receive data over longer distance.
- Uses SOTDMA.
- The transmission of AIS data is also more frequent.
- SOTDMA requires a transceiver to maintain a constantly updated slot map in its memory such that it has prior knowledge of slots which are available for it to transmit. SOTDMA transceivers will then pre-announce their transmission, effectively reserving their transmit slot.

# AIS Classes – Class B

- Less expensive, short distances, lower reporting rate.
- Uses CSTDMA.
- Time slot allocation is not guaranteed (if not found it waits 30s)

# AIS Classes

- AIS information from a class A transponder will always be prioritized and, thus, be shown to other ships in the area.
- AIS information from a class B transponder will not be shown until or if there is room (free time slot) on the AIS channel.

- The fundamental challenge for AIS satellite operators is the ability to receive very large numbers of AIS messages simultaneously from a satellite. There is an inherent issue within the AIS standard; the TDMA radio access scheme defined in the AIS standard creates 2250 available time-slots in each minute but this can be easily overwhelmed by the large satellite reception footprints and the increasing numbers of AIS transceivers, resulting in message collisions, which the satellite receiver cannot process.
- Lost AIS Signal vs Dark Activity
- ***The original purpose of AIS was solely collision avoidance***