

Marine Asset Protection using AIS Data

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UltraMAP

Introduction

- UltraMAP manages and maintains a 24/7 service protecting subsea and surface based marine assets.

AssetMonitor™

- AssetMonitor was created in 2009 while part of EADS with its first user being Channel Islands Electricity Grid



- **ULTRAMAP** formed in 2013 to focus on the growth in demand for AssetMonitor.

Agenda

- Examples of the types of assets we help to protect
- Examples of the threats to those assets
- Introduction to the technologies involved
 - AIS
 - AssetMonitor
 - Virtual Beacon
- Live Example at NYPA

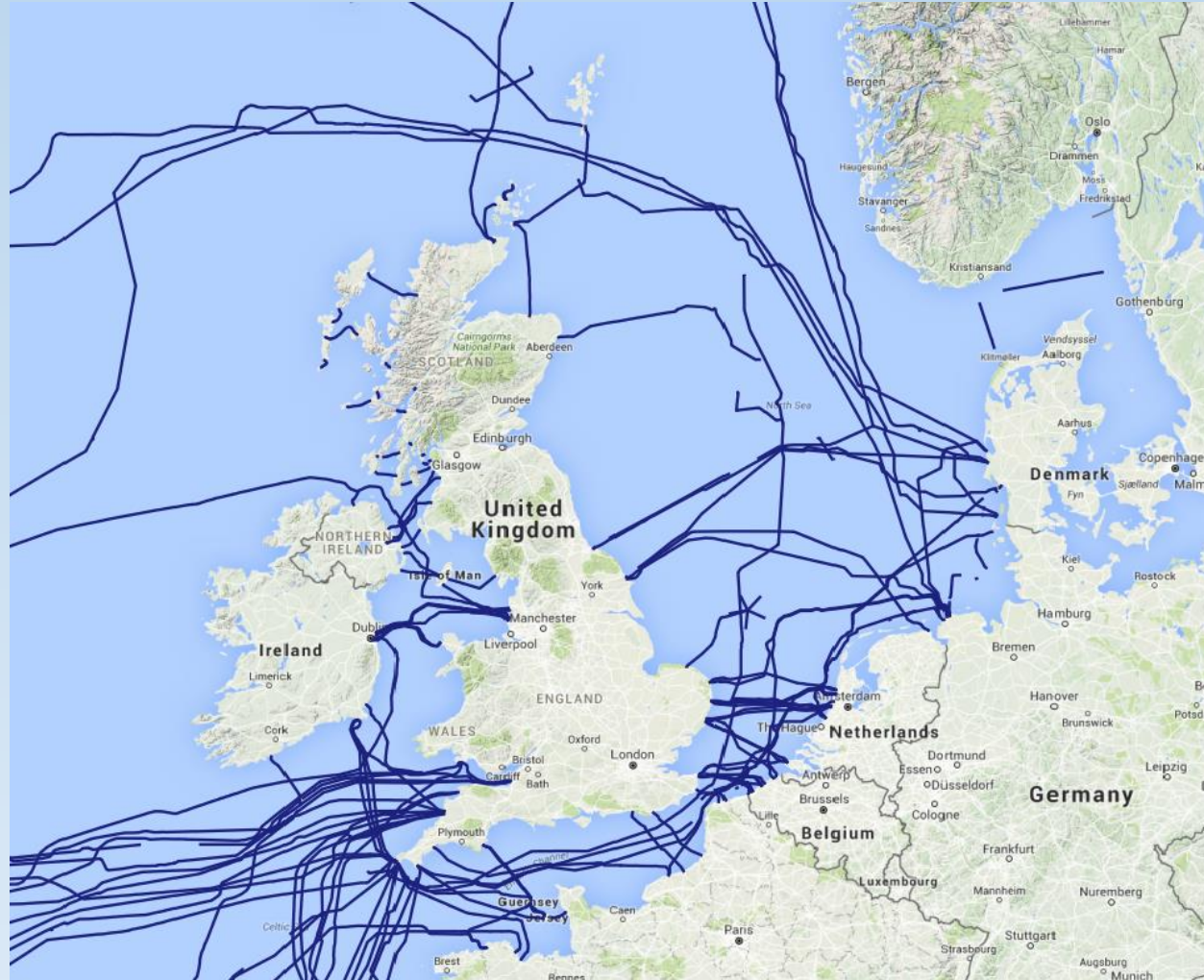


The Problem

- Critical Infrastructure in the marine environment
- Can be vulnerable to damage by shipping
- Measures protect assets from damage by shipping

Critical Marine Assets

Telecomms
Cables



Critical Marine Assets

Oil and
Gas



Critical Marine Assets

Power
Cables



Critical Marine Assets

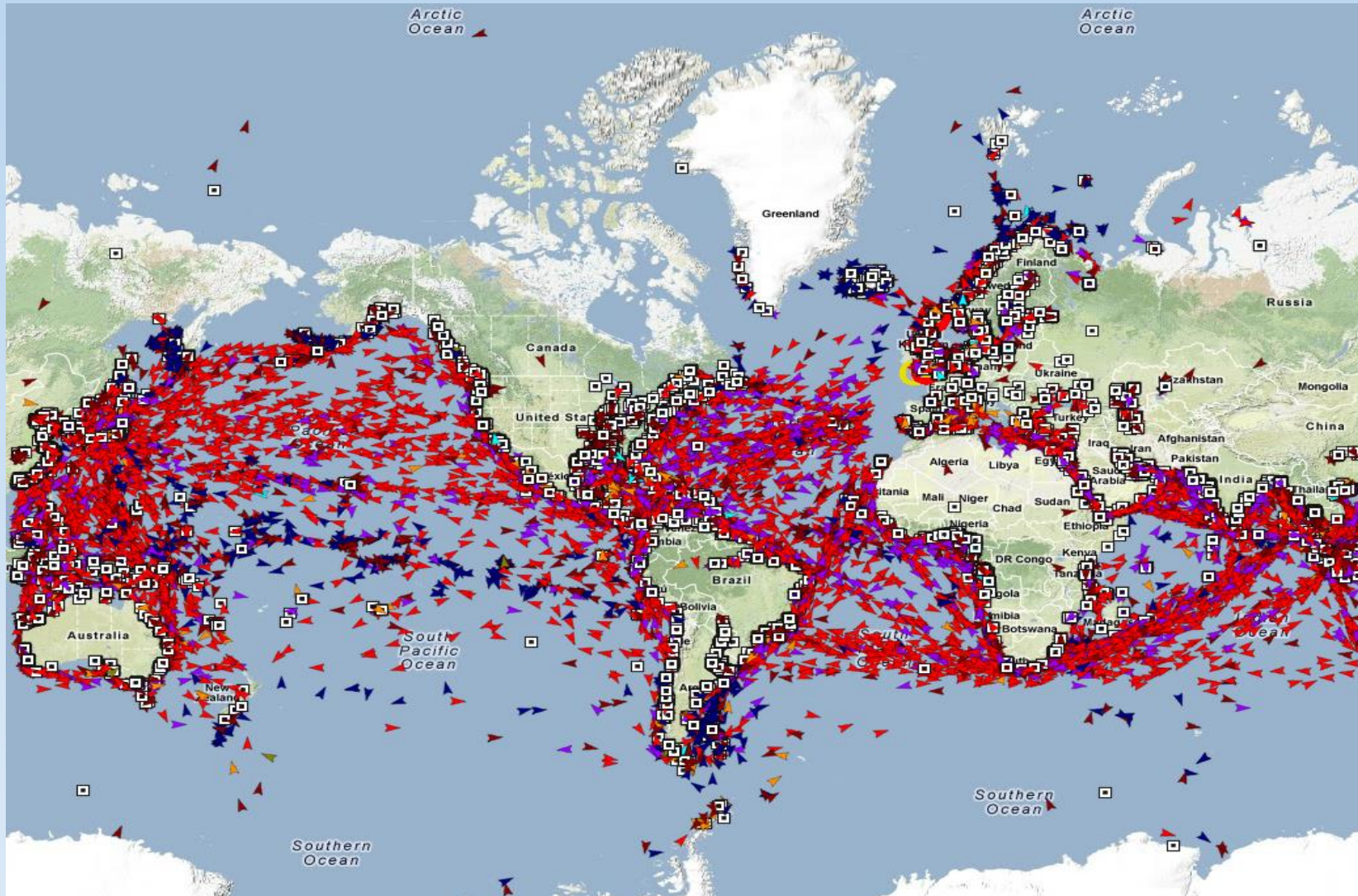
Renewables (Irish Sea)



Renewables (North Sea)



Busy Oceans



Shipping Activity and Damage to Assets

Main threats are from vessels where their activity can impact on infrastructure which is on the sea bed or suspended in the water column...

Activity	Depth
Fishing	Up to 1500m
Anchoring	Less than 200m
Dredging	Less than 200m

Shipping Activity and Damage to Assets

Telecommunications

- Records extending back to 1959 suggest fishing and shipping activities account for at least 60 per cent of all cable faults
- Recent studies suggest that in some regions, cable faults caused by anchors and fishing is 77 per cent of all faults
- Global estimates for faults from fishing are 50 to 100 each year

Shipping Activity and Damage to Assets

Oil and Gas

PARLOC 2001 (Pipeline & Riser loss of containment) details 44 incidents of anchor damage (nearly 25000km of offshore pipeline)

- 11 incidents to operating steel pipelines caused by construction vessels (8 within platform safety zone, 5 of these <100m of platform)
- 18 incidents caused by supply boats (11 of these in safety zone)
- 11 resulted in loss of containment; 22 required some degree of repair

Shipping Activity and Damage to Assets

Costs of Repair

- Reports of cable repair costs averaging 1 to 3 million \$
- Repairs involve specialised cable ships (thousands of \$/day)
- Replacement costs of damaged equipment
- Suggested historical average repair period is 20.6 days
- Further costs may arise because of the need to re-route and restore communications using unaffected cable systems

Marine Asset Protection

Range of measures taken to protect assets

Trenching

Burial

Safety Zones

Protection Zones

Guard Vessels

Dissemination of Information (e.g. Navigational Charts)

Fisheries Liaison Officers

and now.... vessel monitoring using AIS

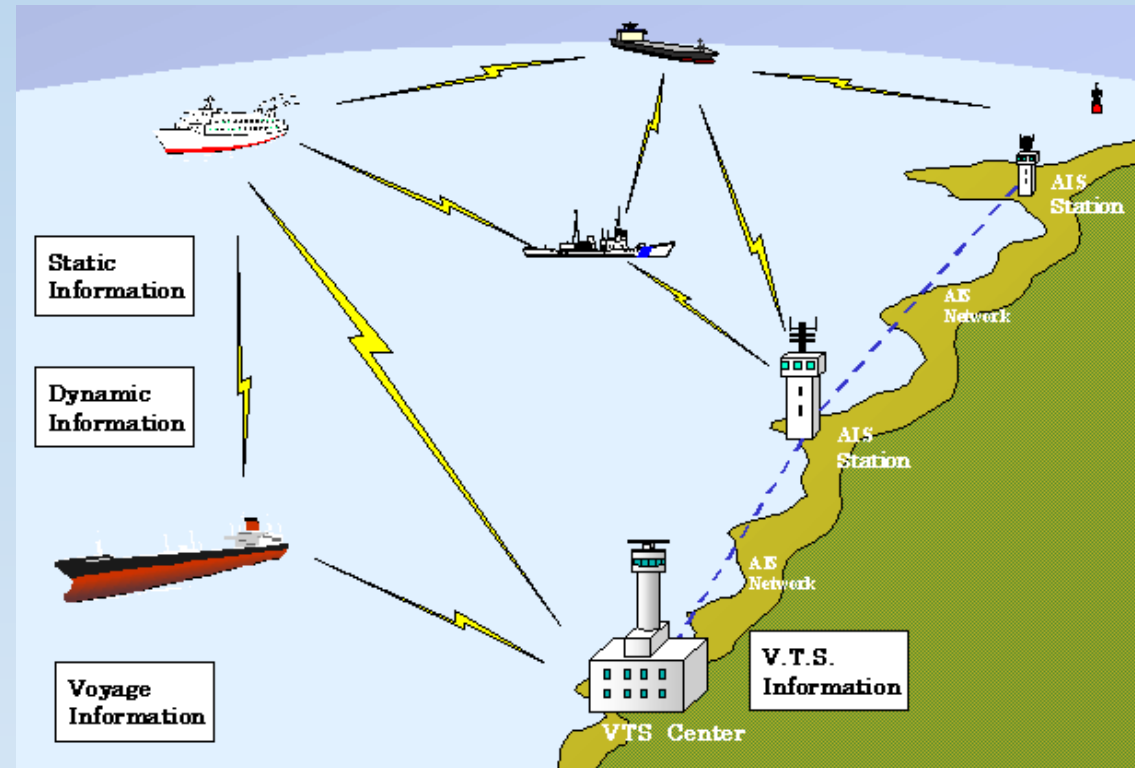
What is AIS (Automatic Identification System)

Communication system using VHF to exchange navigational information....

- between vessels
- between vessels and shore stations

Designed to be....

- autonomous (little or no interaction with personnel)
- continuous (automatic and frequent transmission of data)



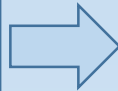
Purpose of AIS

Improves navigational safety and environmental protection by...

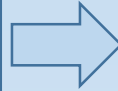
- Avoiding collision
- Coastal states obtain information about ships
- Traffic management
- Rapid response to incidents

AIS Regulation

IMO SOLAS Convention (Regulation 19, Chapter 5) sets out navigational equipment to be carried on ships



IMO adopted new requirement (*revised Chapter 5*) in 2000 for ships to carry AIS



By end of 2004 the following categories of ship to be fitted with AIS:

- All ships 300 gross tonnage or above engaged on international voyages
- Cargo ships 500 gross tonnage not engaged on international voyages
- Passenger ships irrespective of size



Ships shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information

AIS Regulation

Local implementations extending AIS usage beyond SOLAS vessels

In the EU....Directive 2002/59/EC of the European Parliament.....

“Any ship calling at a port of a Member State must, in accordance with the timetable set out in Annex II(I), be fitted with an AIS which meets the performance standards drawn up by the IMO.”

and.... importantly....

Fishing vessels with a length of more than 15 metres shall be fitted with AIS not later than 31 May 2014

AIS – Data Types

Dynamic data from sensors such as gyro compass, Global Navigation Satellite System (GNSS), rate of turn indicator. Reporting interval depends on speed and changes in course (see table)

- Ship position
- Position Timestamp
- Course over ground
- Speed
- Heading
- Navigational status
- Rate of turn

AIS – Data Reporting Intervals

Class A shipborne

Vessel Behaviour	Reporting Interval
At anchor or moored and not moving faster than 3 knots	3 min
0-14 knots	10 s
0-14 knots and changing course	3 1/3 s
14-23 knots	6 s
14-23 knots and changing course	2 s
>23 knots	2 s
>23 knots and changing course	2 s

AIS – Data Types

Static (reporting interval 6 minutes or when amended)

- MMSI (Maritime Mobile Service Identity)
- Vessel name
- Radio call sign
- IMO number
- Length and breadth
- Vessel type

Voyage-related (reporting interval 6 minutes or when amended)

- Destination

Why Use AIS to Monitor Marine Assets

Near real-time monitoring of vessels operating near assets.

“Who, What, Where, When”

Who: Vessel Name and IDs (MMSI, IMO, Radio Call Sign)

What: Vessel Type, Length and Breadth, navigational status

Where: Vessel location, speed, rate of turn, destination

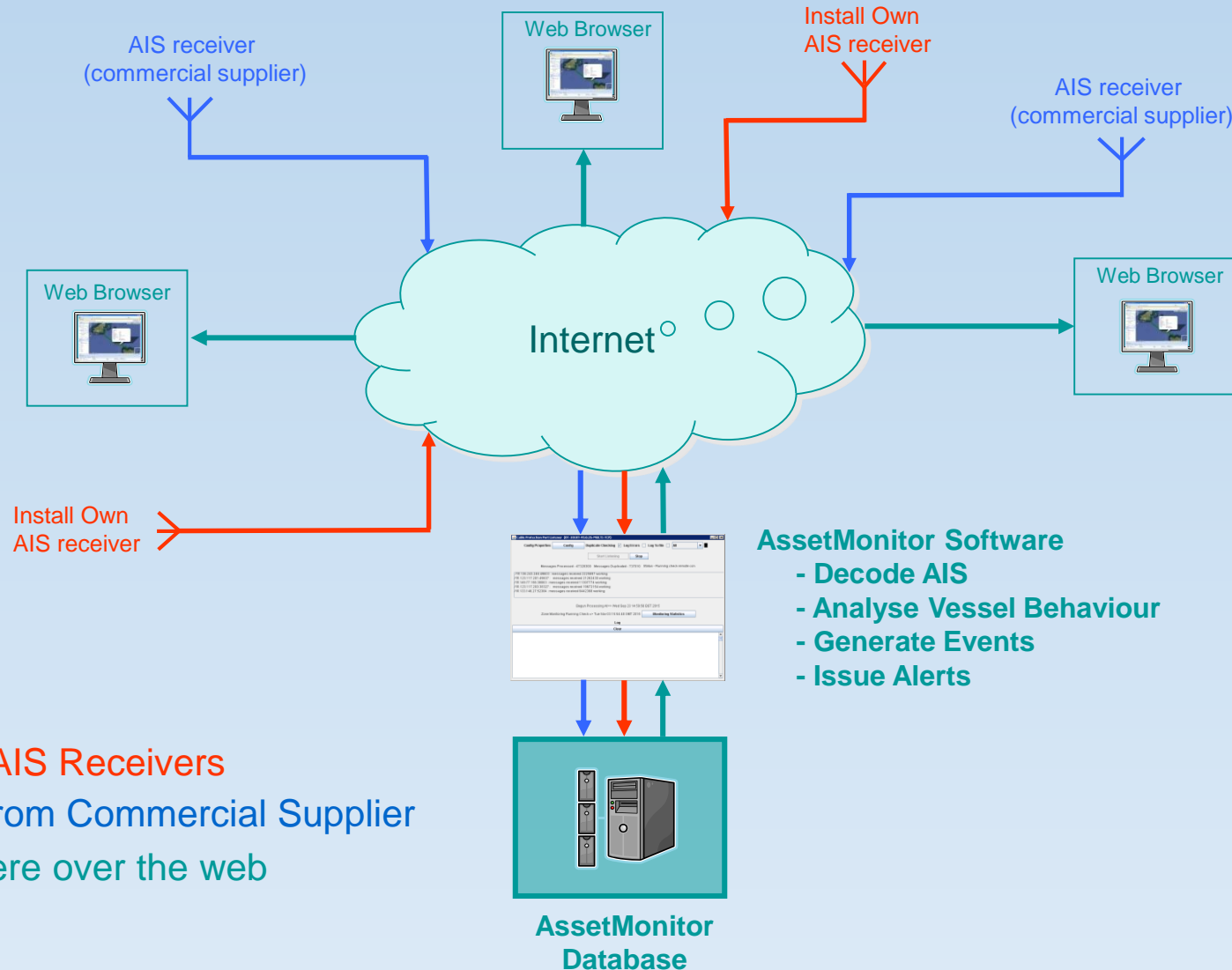
When: AIS messages time-stamped

A Monitoring System Using AIS

Components:

- AIS data (commercial source, install own AIS receiver)
- Database containing AIS data, asset locations, protection zones
- Software to analyse vessel activity against rules and identify potentially damaging behaviour (fishing, anchoring, dredging)
- User Interface (web site) so users can view/interact with system
- Alerts raised to warn users of potentially damaging activity
- Logging of AIS messages (for use as evidence)

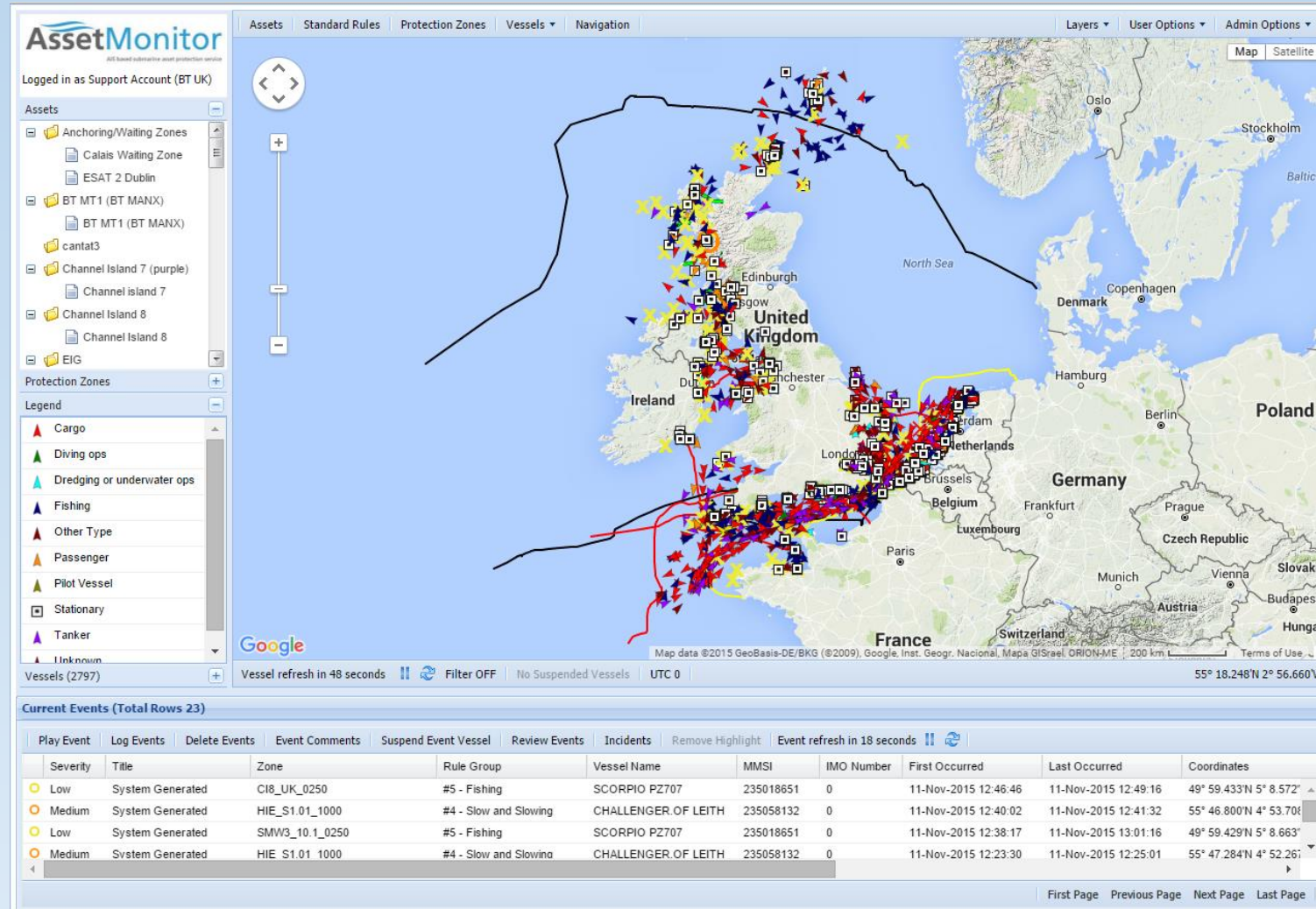
A Monitoring System Using AIS



- Connect Own AIS Receivers
- Use AIS data from Commercial Supplier
- Access anywhere over the web

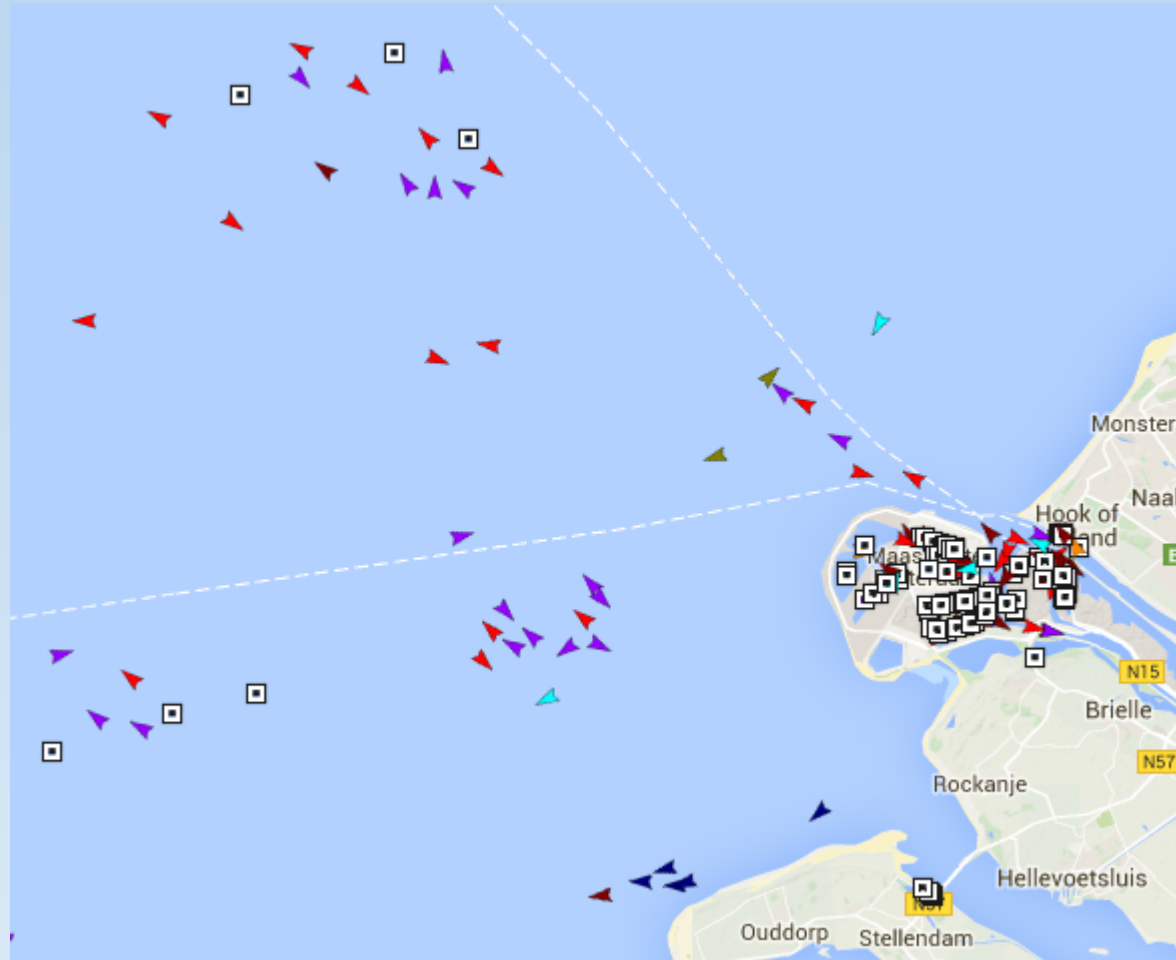
A Live Monitoring System - AssetMonitor

User Interface



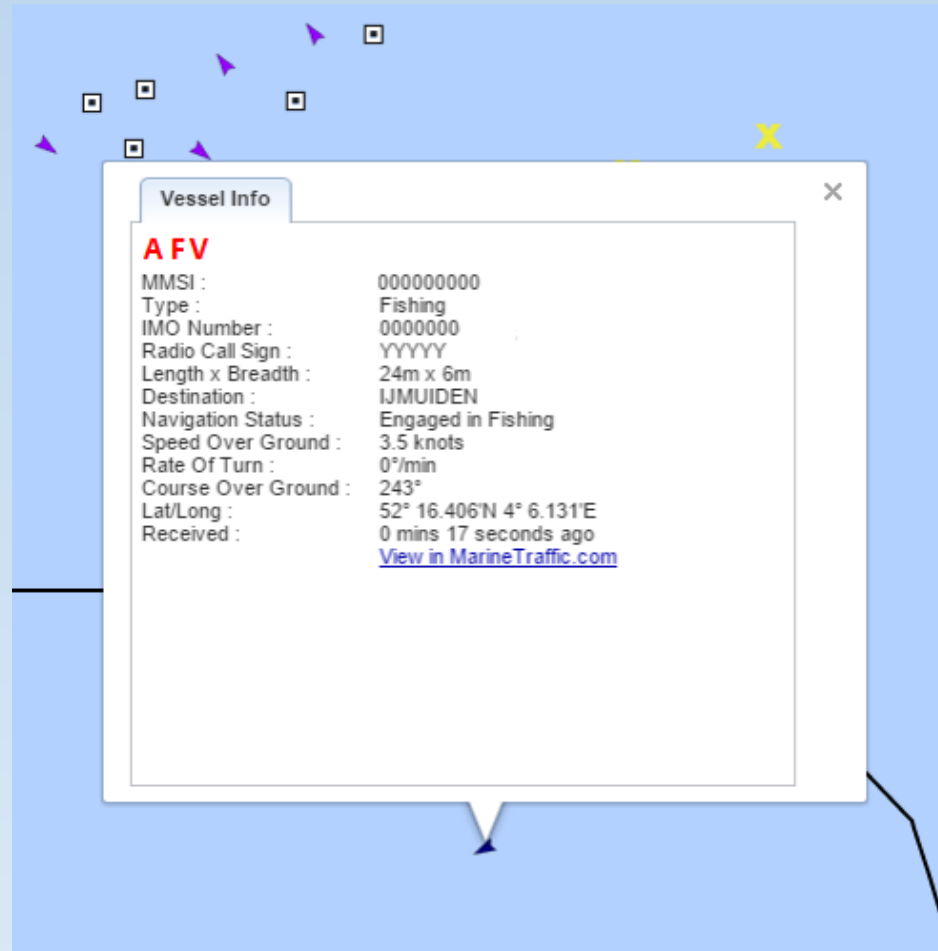
A Live Monitoring System - AssetMonitor

Vessels
(Rotterdam)



A Live Monitoring System - AssetMonitor

Vessel Information

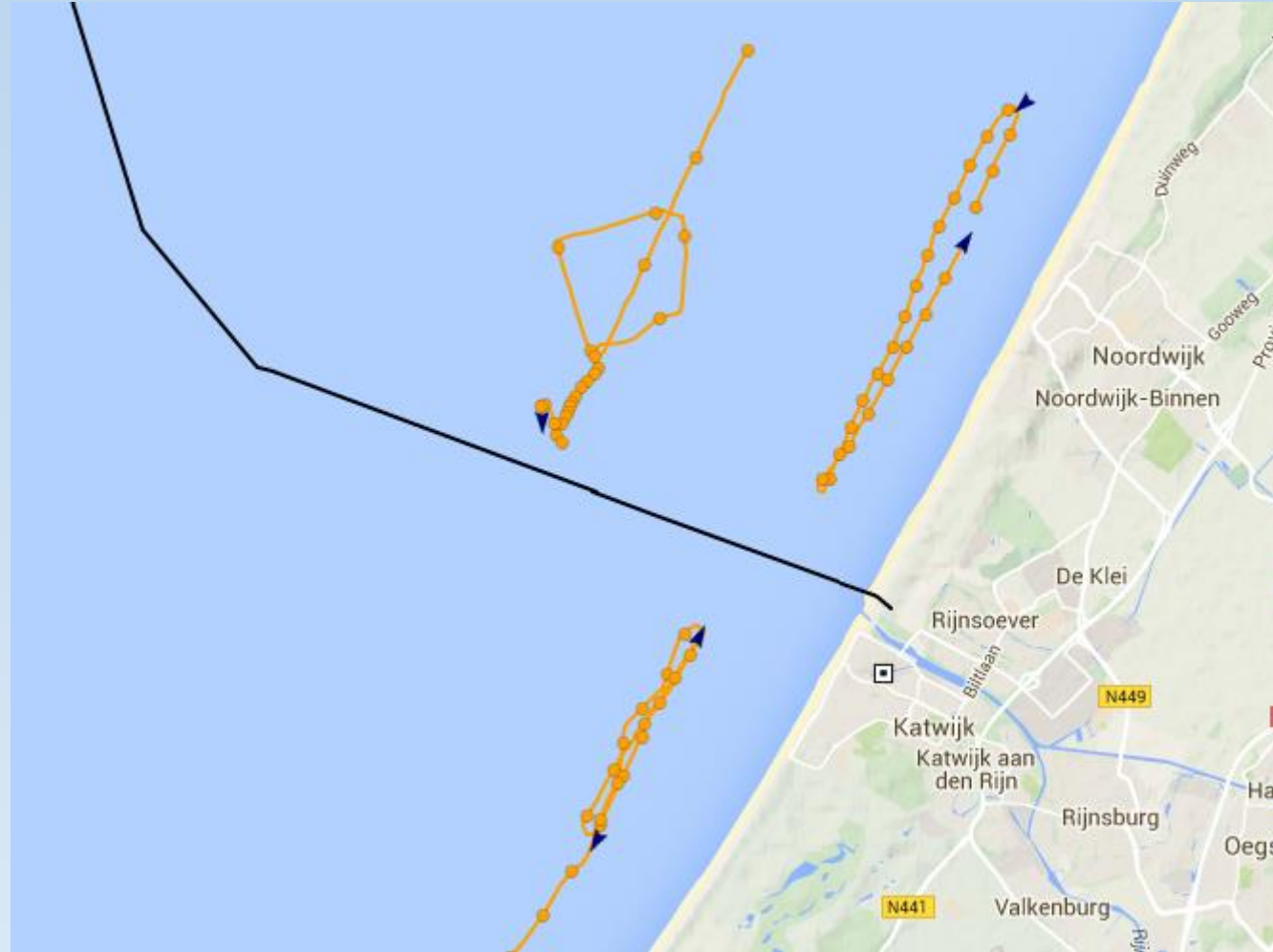


The screenshot shows a map interface with several vessel icons (small squares with arrows) and a yellow 'X' icon. A white popup window titled 'Vessel Info' is open, displaying the following details for vessel 'AFV':

AFV	
MMSI :	000000000
Type :	Fishing
IMO Number :	0000000
Radio Call Sign :	YYYYY
Length x Breadth :	24m x 6m
Destination :	IJMUIDEN
Navigation Status :	Engaged in Fishing
Speed Over Ground :	3.5 knots
Rate Of Turn :	0°/min
Course Over Ground :	243°
Lat/Long :	52° 16.406'N 4° 6.131'E
Received :	0 mins 17 seconds ago
	View in MarineTraffic.com

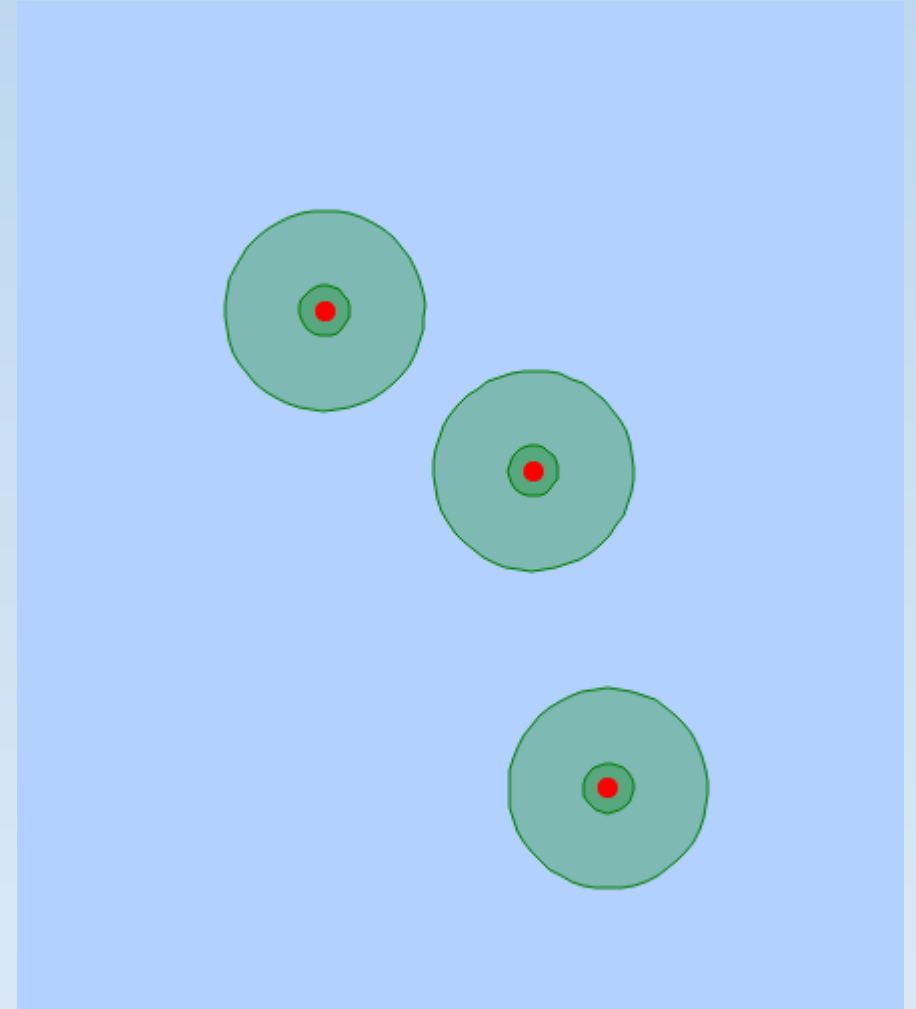
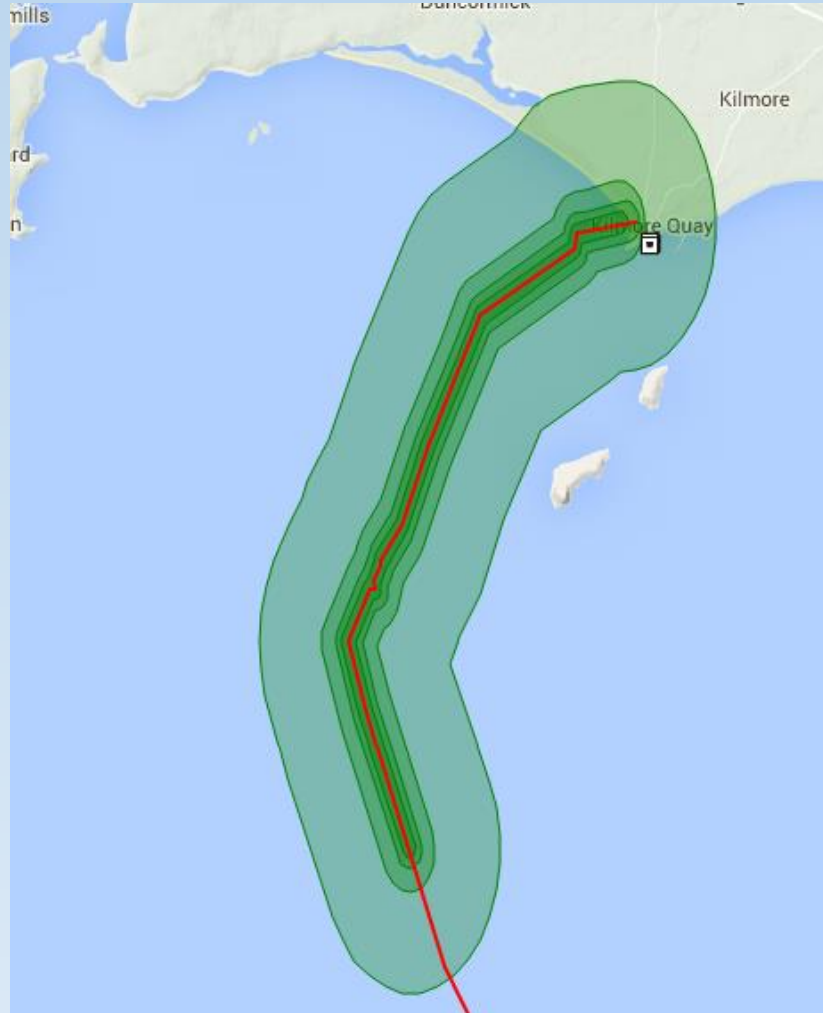
A Live Monitoring System - AssetMonitor

Vessel Tracks
(showing
fishing
activity)



A Live Monitoring System - AssetMonitor

Protection
Zones



A Live Monitoring System - AssetMonitor

Monitoring Rules

New Rule

Rule:

- Angle of Drift
- Closest Point of Approach
- Time to Closest Point of Approach
- Rate of Turn
- Seconds Since Last Message
- Rate of Speed Decrease
- Enter Zone
- Exit Zone
- Not Member of Group
- Member of Group
- Navigation Status Equal
- Navigation Status Not Equal
- Speed Over Ground (knots)
- Vessel Type Not Equal
- Vessel Type Equal
- Vessel Type Group Equal
- Vessel Type Group Not Equal

Description:

Comparison:

Value:

Save Cancel

A Live Monitoring System - AssetMonitor

Monitoring Alerts (on Map)



A Live Monitoring System - AssetMonitor

Monitoring Alert (Details)

Severity	Title	Zone	Rule Group	Vessel Name	MMSI	IMO Number	First Occurred	Last Occurred	Coordinates	Vessel Type
High	System Generated	500m Buffer	Anchor risk (Rule Group)	TANKER 2	000000000	0	03-Nov-2013 10:34:34	03-Nov-2013 11:28:33	29° 44.614'S 31° 14.977'E	Tanker
High	System Generated	500m Buffer	Anchor risk (Rule Group)	TANKER 2	000000000	0	03-Nov-2013 08:40:45	03-Nov-2013 08:40:45	29° 44.610'S 31° 15.020'E	Tanker
High	System Generated	500m Buffer	Anchor risk (Rule Group)	TANKER 2	000000000	0	03-Nov-2013 05:28:34	03-Nov-2013 05:28:34	29° 44.606'S 31° 15.040'E	Tanker
High	System Generated	500m Buffer	Anchor Risk (Rule Group)	CARGO 1	000000001	0	17-Apr-2013 15:19:08	17-Apr-2013 15:19:08	54° 38.775'N 0° 1.234'E	Cargo
High	System Generated	500m Buffer	Anchor risk (Rule Group)	ANOTHER 1	000000002	0	03-Nov-2013 03:31:05	03-Nov-2013 04:16:04	29° 44.840'S 31° 11.320'E	Other Type
High	System Generated	500m Buffer	Anchor risk (Rule Group)	ANOTHER 1	000000002	0	02-Nov-2013 04:39:54	02-Nov-2013 05:42:49	29° 44.860'S 31° 11.300'E	Other Type

A Live Monitoring System - AssetMonitor

Playback
Vessel
Movements

The screenshot displays the 'Event Playback' window of the AssetMonitor system. The interface is divided into several sections:

- Playback Criteria:** Start Time: 12/11/2015 15:00, End Time: 12/11/2015 16:30.
- Selected Vessels:** MT. CARGO 1 is selected. There is a checkbox for 'Display Labels' which is currently unchecked.
- Playback Options:** Checkboxes for 'Display Other Vessels' (unchecked), 'Display Protection Zone' (checked), 'Display Asset Segments' (checked), and 'Display Incidents' (checked). A 'Create Manual Event' button is located below these options.
- Map:** A central map area with a green background. A red line indicates the vessel's path, starting from the top left and moving towards the bottom right. A blue icon representing the vessel is positioned at the end of the path. The map includes navigation controls (compass, zoom in/out) and a scale bar (5m).
- Vessel Attributes:** A panel on the right side of the map displaying details for MT. CARGO 1:
 - Vessel Name: MT. CARGO 1
 - MMSI: 000000000
 - Navigation Status: Under way using engine
 - Speed Over Ground: 0.3
 - Course Over Ground: 131
 - True Heading: N/A
 - Location: 1° 18.711'N 104° 15.476'E
 - Message Date/Time: 12-Nov-2015 16:28:57
- Player Time:** 12/11/2015 16:30:01 UTC +8
- Status:** Stopped

'Interesting' Vessel Behaviour

Fishing

The screenshot displays the ULTRAMAP interface for tracking vessel behavior. On the left, the 'Playback Criteria' section shows a start time of 06/05/2015 16:00 and an end time of 06/05/2015 23:59. Under 'Selected Vessels', 'MV FISHER 1' is selected with 'Display Labels' checked. The 'Playback Options' section includes checkboxes for 'Display Other Vessels' (unchecked), 'Display Protection Zone' (checked), 'Display Asset Segments' (checked), and 'Display Incidents' (checked). A 'Create Manual Event' button is located below these options.

The central map area shows a blue background with a large green circular protection zone for 'MV FISHER 1'. An orange line represents the vessel's track, showing a complex, irregular path around the protection zone. A second, smaller green circle is visible in the upper right. The map includes navigation controls (compass, zoom in/out) and a 'Layers' dropdown. At the bottom of the map, it shows 'Google' branding, 'Map data ©2015 Google', a 1 km scale bar, and 'Terms of Use' and 'Report a map error' links. The status bar at the bottom indicates 'Player Time: 06/05/2015 23:05:04 UTC +1' and 'Status: Fast-forwarding x60'.

On the right, the 'Vessel Attributes' panel provides details for 'MV FISHER 1':
Vessel Name: MV FISHER 1
MMSI: 000000002
Navigation Status: Engaged in Fishing
Speed Over Ground: 4.9
Course Over Ground: 313
True Heading: N/A
Location: Lat Long: 54.02330 -3.79606 (DM)
Message Date/Time: 06-May-2015 23:04:59

'Interesting' Vessel Behaviour

Slow
Moving

The screenshot displays the 'Event Playback' interface for vessel MT CARGO 2. The interface is divided into several sections:

- Playback Criteria:** Start Time: 07/08/2015 12:00, End Time: 07/08/2015 22:00.
- Selected Vessels:** MT CARGO 2 is selected, with 'Display Labels' checked.
- Playback Options:** 'Display Other Vessels' is unchecked, while 'Display Protection Zone', 'Display Asset Segments', and 'Display Incidents' are checked.
- Map:** A Google Map showing a green shaded protection zone. An orange track indicates the vessel's path, which is mostly straight but shows a significant loop and deviation from the protection zone.
- Vessel Attributes:**
 - Vessel Name: MT CARGO 2
 - MMSI: 000000000
 - Navigation Status: Under way using engine
 - Speed Over Ground: 1.8
 - Course Over Ground: 144
 - True Heading: 147
 - Location: Lat Long: 53.54687 2.375228 (DM)
 - Message Date/Time: 07-Aug-2015 18:55:59
- Player Controls:** Includes play, pause, stop, and navigation buttons. The status is 'Stopped' and the player time is 07/08/2015 18:56:31 UTC +1.

'Interesting' Vessel Behaviour

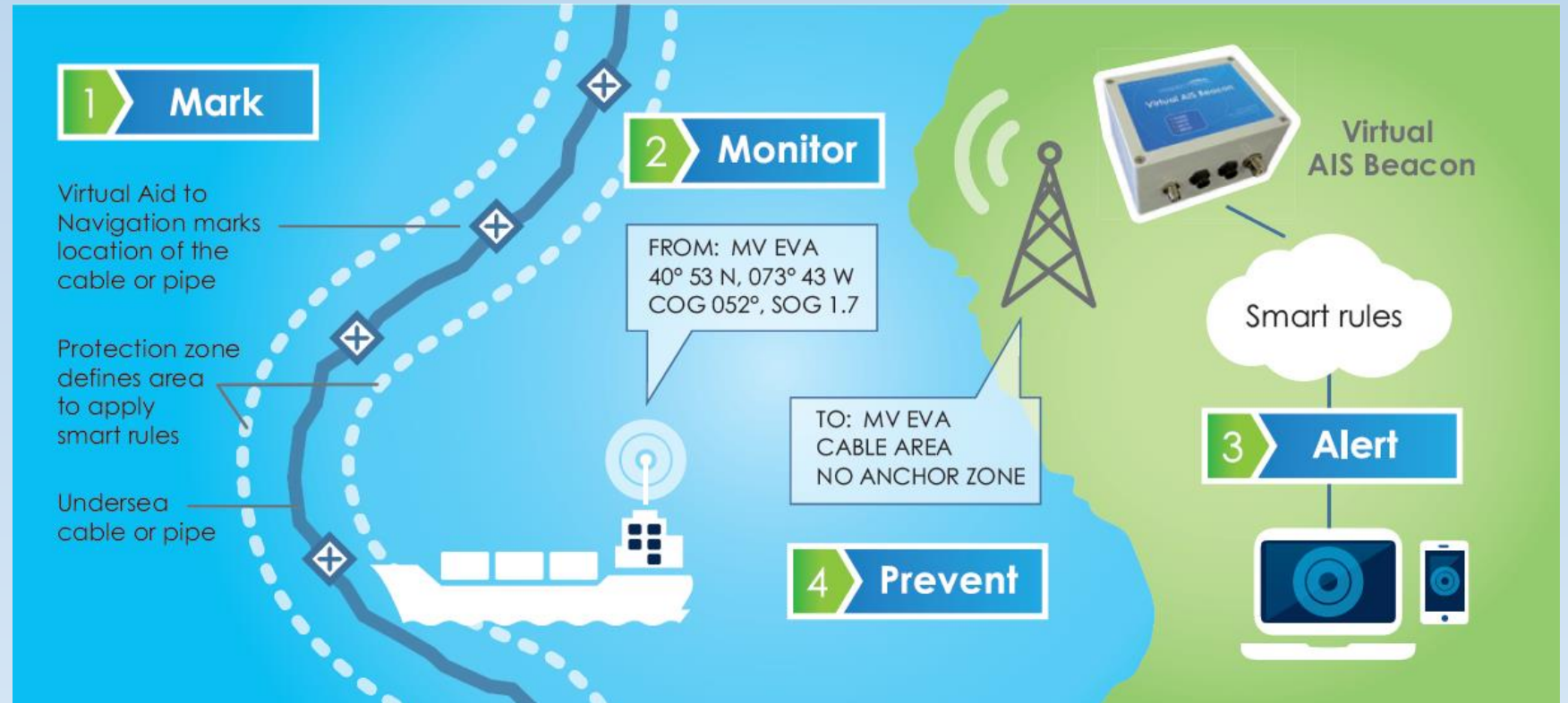
Safety Zone
Incursion

The screenshot displays the 'Event Playback' window of a maritime monitoring system. The interface is divided into several sections:

- Playback Criteria:** Start Time: 16/06/2015 14:30, End Time: 16/06/2015 16:05.
- Selected Vessels:** ATLAST is selected, with 'Display Labels' checked.
- Playback Options:** 'Display Protection Zone' and 'Display Incidents' are checked.
- Map:** A central map shows a large green circular safety zone. An orange line represents the vessel's path, which enters the zone from the bottom and moves in a zig-zag pattern towards the center. A blue dot marks the vessel's current position within the zone.
- Vessel Attributes:**
 - Vessel Name: ATLAST
 - MMSI: 000000000
 - Navigation Status: N/A
 - Speed Over Ground: 3.2
 - Course Over Ground: 197
 - True Heading: N/A
 - Location: Lat Long: 53.86121 -3.47395 (DMS)
 - Message Date/Time: 16-Jun-2015 15:27:59
- Player Controls:** At the bottom, the player time is 16/06/2015 15:31:09 UTC +1, and the status is 'Fast-forwarding x60'.

Further Developments - Virtual AIS Beacon

Improve visibility of assets on ship navigation equipment using Virtual AIS Beacons to mark asset locations/routes



Send alerts directly to vessels using special type of AIS message (Addressed Safety Message)

Further Developments - SeaGard

Taking asset protection logic and installing devices on vessels to raise alarms if they are in close proximity to assets.

