European Satellite AIS under Joint EMSA/ESA Integrated Applications Programme

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http://telecom.esa.int/artes21
1. SAT-AIS Concept
2. European Framework - ESA/EMSA Cooperation
3. User Requirements
4. SAT-AIS Activities & Roadmap
Introduction

What is AIS?

- is a short range coastal tracking system used on ships
- developed to provide identification and location information to vessels and shore stations with the aim of exchanging different types of data including position, identification, course, speed and others
- allows vessels to anticipate and thus avoid collisions at sea by means of continuous traffic monitoring
- additionally it offers important ship monitoring services to coastal guards as well as search and rescue organizations.

Main problem of space-based AIS is occurrence of message collisions:
In terrestrial AIS, the SOTDMA concept organizes the shipping traffic into cells of about 40 NM in size. As every vessel is assigned its own slot within its respective cell, no message collisions occur.
Main problem in space-based AIS is collision between messages, because multiple cells are in field-of-view:
   a. Type I: Same slot, but different cells
   b. Type II: Different slots, but due to difference in signal travel time intrusion into other slot occurs

In worst case, number of collisions in same slot can rise as high as 30!
SAT-AIS Initiative
Coverage provided by the terrestrial AIS

Coverage of IALA-Net

Map of AIS shore based stations
[EMSA]

Coastal coverage in all MS

727 AIS shore stations
Envisaged Integrated Application
EO, Nav, Satcom & Airborne

SAR detected ships
SAR ships & AIS tracks
Correlation SAR & AIS
Remaining uncorrelated ships for identification (e.g. UAS)
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SAT-AIS preparatory steps
Overview

1. EMSA and ESA have started in 2007 (and renewed in July 2010) a mutual collaboration agreement for the Use of space-based Systems and Data in support of Maritime Activities;

2. In a coordinated agreed approach with EC, ESA has undertaken actions to assess the capabilities offered by satellite based AIS to provide a solution answering user needs;

3. A Steering Committee for Evaluation of Pilot Projects (DG MARE: PASTAMARE) and preparatory Actions (ESA: 2x Phase-A) on maritime Surveillance was set up 2008;

4. The SC was co-chaired by DG-MARE and ESA with participants representatives of interested Directorate Generals of the Commission and EU Agencies;

Steering Committee Members:

- DG-MARE (Co-Chair)
- DG-TREN
- DG-ENV
- DG-JLS
- DG-TAXUD
- DG-INFSO
- DG-ENTR
- DG-JRC
- EDA
- EMSA
- FRONTEX
- ESA (Co-Chair)
SAT-AIS Initiative

Content

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4. SAT-AIS Activities & Roadmap
European SAT-AIS
Towards ARTES 21
SAT-AIS user requirements have been gathered, processed and endorsed through the following process:

1. Questionnaires to major European future SAT-AIS users
2. Compilation SAT-AIS DRAFT User Requirements Document
3. Presented to and commented by the Steering Committee
4. Updated version endorsed by the Steering Committee

- Phase A Feasibility Study (OHB-System)
- User Benefit Analysis (EMSA in cooperation with ESA)
- User Requirement Consolidation Meeting 27th January 2011 Lisbon
- First User Group Meeting 4th May 2011 ESTEC
- User Requirement Document (URD) Updated Ref.: SAI-EST-URD-1001
- Phase B Study
- Group Meetings 2011/2012 ESTEC
User Group representing 14 European Organizations was set up 14\textsuperscript{th} May 2011, for updating and endorse the URD through Phase-B1 activities.

1. **Scenario 1** addressing:
   
   a. *Maritime Security services*: support of security operations, maritime security threats
   
   b. *Law-enforcement services*: anti-piracy, illegal fishing, enforcement of international/national regulations, support of enforcement operations
   
   c. *Search and Rescue (SAR)*

2. **Scenario 2** addressing:
   
   a. *Maritime surveillance services*: monitoring of vessels in sensitive areas (international waters), anti-drug smuggling, border control
   
   b. *Environmental services*: hazardous cargos monitoring, prevention of pollution caused by ships, pollution response

3. **Scenario 3** addressing:
   
   a. *Maritime Safety services*: vessel traffic/navigation monitoring, vessel traffic management, support of safety operations

4. **Scenario 4** addressing:
   
   a. *Fleet management services for commercial users* (shipping companies, owners,...)
### Summary Table of USR-PER-090 and -100

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Time Update Interval (world wide)</th>
<th>Time Update Interval (HTZ)</th>
<th>Timeliness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario-1</td>
<td>1hr – 95%</td>
<td></td>
<td>1hr – 95%</td>
</tr>
<tr>
<td>Scenario-2</td>
<td>2hr – 95%</td>
<td>2hr – 80%</td>
<td>1hr – 95%</td>
</tr>
<tr>
<td>Scenario-3</td>
<td>3hr – 95%</td>
<td></td>
<td>1,5hr – 95%</td>
</tr>
<tr>
<td>Scenario-4</td>
<td>6hr – 95%</td>
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</tbody>
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- **Guaranteed operational Service for 15 years**
- **70,000 – 110,000 ship detections every 1-6 hours**
- **Redundancy, Spares, Data Integrity/Encryption, User Authentication, ...**
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4. ESA SAT-AIS Activities & Roadmap
The ARTES 21 SAT-AIS Design Element defines a space-based system consisting of a set of space and ground elements that will provide AIS data to European user communities, including European Institutions and possibly private entities.
Data Processing Center: ESA Element (Block 2), EMSA Element (Block-3) providing 6 services, e.g. enhanced, missing & predicted AIS messages, and EO data service

Short term demo projects using SAT-AIS for areas of interest, e.g. support of EMSA BlueBelt project (2011/12)

Medium term Operational Demo Mission (ODEM): 4x studies on data services and/or demo satellites on-going for service in 2013-2015

System Design Element: 2x Phase-B1 studies for full system (2015/16)

Technologies:
- Advanced Algorithm Patented by ESA
- Receiver Designs – Algorithm Improvement
- Testbed (8-12 channels, beam forming)
- Comparative Performance Assessment, performing blind testing of proposed solutions

Implementation Options:
- Private public partnership – business model evaluation
- Hybrid / Alternative Solutions
The SAT-AIS server is implemented through a jointed EMSA-ESA Data Processing Centre activity.

**Functional Modules**

- **Data Retrieval** is the function by which input (SAT-AIS, ancillary information and EO) data enters into the system;
- **Data Processing and Validation** generates and validates the final products;
- **Data Prediction** is the function providing prediction of future visibility of detected ship by the satellites;
- **Data Distribution and Archiving** is the function in charge of transferring the data products to EMSA;

**SAT-AIS end-to-end architecture**

1. **Data Retrieval**: Input data (SAT-AIS, ancillary information and EO) enters into the system.
2. **Data Processing and Validation**: Generates and validates the final products.
3. **Data Prediction**: Predicts future visibility of detected ships.
4. **Data Distribution and Archiving**: Transfers data products to EMSA.

**Diagram**

- **ESA** and **EMSA** collaborate through a Data Processing Centre (DPC) to process and distribute SAT-AIS data.

**Data Processing Centre**

- **Data Retrieval**
- **Data Processing & Validation**
- **Data Prediction**
- **Data Distribution & Archiving**

**Value-added services**

- For users and stakeholders.
SAT-AIS

Support for the Blue Belt Project

THE BLUE BELT PILOT PROJECT

The aim of the Blue Belt pilot project is to explore new ways to promote and to facilitate Short Sea Shipping in the European Union by reducing the administrative burden for intra-Community trade.

BENEFITS

Customs will benefit from an added degree of certainty with regard to the ship’s voyage concerning participating vessels. This will be possible by using existing customs tools in combination with information from the EU vessel traffic monitoring and information system SafeSeaNet.

Customs authorities will receive reliable information on the current and past voyages of blue ships.

Ships’ masters and agents will benefit from faster processing of goods through Customs when arriving at port.

SAT-AIS support to Blue Belt

Ships sailing outside the coverage zone of terrestrial AIS (until 40 nautical miles from the coast) can still be tracked by Satellite based AIS and this voyage information will be provided to customs.

www.emsa.europa.eu
SAT-AIS Initiative

- User Requirement Document (URD)
  Updated Ref.: SAI-EST-URD-1001

- Commercial existing/planned SAT-AIS

- SAT-AIS Design Element

- SAT-AIS DPC

- National existing/planned SAT-AIS

PPP Scheme

Hybrid European SAT-AIS Service

Hybrid SAT-AIS Initiative – towards a sustainable service
European SAT-AIS
Towards ARTES-21 and MC2012 Proposal

- Steering Committee SAT-AIS Phase A (DG Mare / ESA, ...)
- EMSA / ESA Agreement, (July 2010)
- JCB approved ARTES 21 and SAT-AIS work plan (Sep 2010)
- 1st EMSA/ESA MS Information Meeting (Jan 2010)
- 2nd EMSA/ESA MS Information Meeting (Jan 2011)
- User Group 2011/12 (DG Move, EMSA, SGMER, WSA, NCG, LUX, ...)
- SAT-AIS High Level EC Steering Committee
- MC2012 – SAT-AIS Programme Proposal ESA / EC / EMSA
Thanks!

For further information:

http://telecom.esa.int/artes21