United States Coast Guard
Office of Navigation Systems

Providing navigation safety information for America’s waterways

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U.S. Coast Guard Headquarters
Washington, DC
Automatic Identification System (AIS)

- Background...Why?
- Regulations...Who? Where? When?
- What is it?
- How it works?
- USCG AIS efforts
  - Nationwide AIS Project
    - What, where, when & how
Shipboard AIS
AIS Timeline

- **WRC’97**
  - AIS1 Ch.87B
  - AIS2 Ch.88B

- **SOLAS V/19.2.4**

- **2002 IMO Diplomatic Conference**

- **IMO MSC 74 (69) Performance**

- **ITU-R M.1371-1 Technical**

- **IEC 61993-2 Testing & Certification**


- **OPA ’90**

- **ADSSE ITU-R M.825-3**

- **National Dialog Group**

- **Marine Board Ports & Waterways Study**

- **VTS LMR Public Meeting**

- **105th Congress**

- **FCC Notice DA-02-1362**

- **MTSA - 11/02**
  - Interim - 7/03
  - Final - 10/03
  - Deadline - 1/04

- **1990**
  - ADSSE
  - ITU-R M.825-3

- **1994**
  - National Dialog Group

- **1997**
  - Marine Board Ports & Waterways Study

- **1998**
  - VTS LMR Public Meeting

- **1999**

- **2000**

- **2001**

- **2002**

- **2003**

- **2004**
What started the USCG on AIS?

In 1990, Congress passed the Oil Pollution Act which participation in VTS mandatory and directed the USCG to seek ways to have ‘dependent surveillance’ of all tankers bound for Valdez, Alaska.

To that end, in 1993 the USCG developed Automated Dependent Surveillance Shipboard Equipment (ADSSE), based on Digital Selective Calling (DSC) protocol.
AIS Timeline

WRC’97
AIS1 Ch.87B
AIS2 Ch.88B

SOLAS
V/19.2.4

2002 IMO
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105th
Congress

105th Congress
Congress supports/mandates AIS!

In 1997, Congress...stated that AIS “technology should be the foundation of any future VTS system” and that it “strongly believes that this technology will significantly improve navigational safety, not just in select VTS target ports, but throughout the navigable waters of the U.S”, and, that we “continue working with stakeholders…”

AIS Timeline


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Industry endorses AIS!

In 1999, the National Dialog Group, comprised of the marine private and public representatives, stated they:

“strongly endorse the widespread use of AIS employing dGPS and onboard transponder technologies…that national use of AIS technology on the greatest number of vessels is essential both as a foundation of a VTS system…improving navigation safety…strongly urge the USCG to take the lead…in developing equipment and procedural standards that will promote universal use of AIS technology”, which will “be less intrusive and distracting to the mariner than will a voice-based control system...”
Marine Board recommends AIS

To achieve the committee's vision of the future, all major vessels must be required to carry certain advanced navigation information systems so they can participate in traffic management schemes and navigate safely in and out of all U.S. ports.

The USCG should work toward the implementation of international carriage requirements for electronic navigation and identification/location systems on board all major vessels using U.S. ports and should continue to take steps to provide necessary communications frequencies to ensure the international compatibility of AIS.

Applying Advanced Information Systems to Ports and Waterways Management (1999), Marine Board
AIS Timeline

OPA '90

WRC’97
AIS1 Ch.87B
AIS2 Ch.88B

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Public Meeting to establish AIS carriage

September 1998, the USCG conducted a public meeting to solicit comments on the establishment of a new Vessel Traffic Service in the Lower Mississippi River area and a potential Automatic Identification System (AIS) carriage requirement for certain vessels operating in the new VTS area.

The primary purpose of the meeting was to discuss which vessels should carry AIS and what performance, technical, testing, and certification standards the systems should meet.

• Ref: 63 FR 49939, Sep. 18, 1998
Towards an AIS-based VTS

In an effort to facilitate vessel transits, enhance good order, promote safe navigation, and improve upon existing operating measures on the waterway. The USCG proposed to establish a Vessel Traffic Service (VTS) on the Lower Mississippi River and transfer certain vessel traffic management provisions on the river.

By implementing a proposed transition to VTS in a phased manner which would allow for the orderly transition from existing regulations and practices to operating procedures appropriate to an AIS-based VTS.

• Ref: 65 FR 24616, Apr. 24, 2000
AIS Timeline

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- AIS2 Ch.88B
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Maritime Transportation Security Act

46 U.S.C. 70114 - Automatic identification system

On the navigable waters of the United States, each...

- Self-propelled commercial vessel of at least 65 feet,
- Towing vessel of more than 26 feet and 600 hp,
- Passenger vessels as determined by the USCG,
- Any other vessel deemed necessary for the safe navigation of the vessel.

shall be equipped with and operate an AIS under regulations prescribed by the USCG.
The following must have a properly installed, operational, type-approved AIS:

- **On international voyage:**
  - Tankers, Passenger > 150 GT, all others > 300 GT
  - Per SOLAS Regulation V/19.2.4
  - Self-propelled commercial vessels > 65 feet
    - Except fishing and small passenger vessels (<150 passengers)

- **Within a VTS area:**
  - Self-propelled commercial vessel 65+ feet
    - Except fishing & small passengers vessels
  - Towing vessel > 26 feet and > 600 hp
  - Vessel certificated to carry > 150 passengers
AIS Regulatory History...recap

- Oil Pollution Act of 1990, precursor AIS (ADSSE) on Alaskan tankers
- CG Authorization Act ’97, Congress seeks AIS-based VTS and AIS carriage
- NPRM VTS Lower Mississippi River (2000), towards an AIS-Based VTS
- Safety of Life at Sea Convention (SOLAS) V/19.2.4 (2000), 12/02 (amended)
- Marine Transportation & Security Act of 2002
- USCG AIS Temporary Final Rule: 07/01/03
  - Implements SOLAS (Int’l) & MTSA (domestic) in VTS areas
- USCG AIS Final Rule: 10/22/03, effective 11/24/03, deadline: 12/31/04
  - Deferred requirements on F/V and small passenger vessels
  - Request for Comments: 10 questions on AIS Expansion prior to 1/9/04
    - 3 Public Meetings, 180+ commenter's
- CG&MT’04 mandates electronic charts on same population as MTSA AIS
- CG expanding carriage beyond VTS
  - NPRM published 12/16/08, comments NLT 4/15/09
Proposed AIS Rule Changes

- 31-Oct-2005, USCG announced its intent to extend AIS carriage to all U.S. navigable waters (70 FR 64171)
- 16-Dec-2008, USCG publishes Notice of Proposed Rulemaking (73 FR 78295)
- Potentially could effect 17,000 vessels:
  - Commercial self-propelled vessels of ≥ 65 feet
  - **No exceptions**
    - Towing vessels ≥ 26 feet and ≥ 600 hp
    - Vessels with ≥ **50** passengers (vice 150 for hire)
    - **Hi-Speed vessels with ≥ 12 passengers for hire**
    - **Certain dredges & floating plants, and**
    - **Vessel moving certain dangerous cargoes**
- Proposed compliance date: NLT 7 month after Final Rule
- Waiver process already exist for certain circumstances
<table>
<thead>
<tr>
<th>Document ID</th>
<th>Title</th>
<th>Date Posted</th>
<th>Type</th>
<th>Views</th>
<th>Add Comments</th>
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<tr>
<td>USCG-2005-21869-0001</td>
<td>Vessel Requirements for Notices of Arrival and Departure, and Automatic Identification System</td>
<td>12/16/2008</td>
<td>RULES</td>
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<tr>
<td>USCG-2005-21869-0002</td>
<td>Regulatory Analysis &amp; Initial Regulatory Flexibility</td>
<td>12/16/2008</td>
<td>SUPPORTING &amp; RELATED MATERIALS</td>
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<td>USCG-2005-21869-0002.1</td>
<td>Regulatory Analysis &amp; Initial Regulatory Flexibility</td>
<td>12/16/2008</td>
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<td>USCG-2005-21869-0004</td>
<td>Environmental Checklist</td>
<td>12/16/2008</td>
<td>SUPPORTING &amp; RELATED MATERIALS</td>
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<td>USCG-2005-21869-0004.1</td>
<td>Environmental Checklist</td>
<td>12/16/2008</td>
<td>SUPPORTING &amp; RELATED MATERIALS</td>
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<td></td>
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<tr>
<td>USCG-2005-21869-0005</td>
<td>AIS Regulations - Now and Proposed</td>
<td>01/05/2009</td>
<td>SUPPORTING &amp; RELATED MATERIALS</td>
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<td></td>
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</tbody>
</table>
## U.S. AIS Carriage Population

<table>
<thead>
<tr>
<th>Vessel Service</th>
<th>SOLAS</th>
<th>IR 7/1/02</th>
<th>FR 11/23/03</th>
<th>NPRM 12/16/08</th>
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</thead>
<tbody>
<tr>
<td>Fishing Boat</td>
<td>1</td>
<td>749</td>
<td>-</td>
<td>5,520</td>
</tr>
<tr>
<td>Cargo Ship</td>
<td>154</td>
<td>77</td>
<td>77</td>
<td>298</td>
</tr>
<tr>
<td>Industrial Vessel</td>
<td>21</td>
<td>11</td>
<td>11</td>
<td>748</td>
</tr>
<tr>
<td>MODU</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>210</td>
</tr>
<tr>
<td>Offshore Supply Vessel</td>
<td>55</td>
<td>433</td>
<td>432</td>
<td>553</td>
</tr>
<tr>
<td>Passenger Vessel</td>
<td>81</td>
<td>576</td>
<td>171</td>
<td>3,235</td>
</tr>
<tr>
<td>Public/Research/School</td>
<td>10</td>
<td>18</td>
<td>16</td>
<td>116</td>
</tr>
<tr>
<td>Tank Ship</td>
<td>102</td>
<td>15</td>
<td>15</td>
<td>122</td>
</tr>
<tr>
<td>Towboat/Tug</td>
<td>13</td>
<td>2,215</td>
<td>2,212</td>
<td>4,560</td>
</tr>
<tr>
<td>Dredge</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>35</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>11</td>
<td>13</td>
<td>385</td>
</tr>
<tr>
<td>Unknown</td>
<td>-</td>
<td>16</td>
<td>16</td>
<td>541</td>
</tr>
<tr>
<td>Foreign &gt;65' &lt;300GT</td>
<td></td>
<td></td>
<td></td>
<td>1,119</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>438</td>
<td>4,121</td>
<td>2,963</td>
<td>17,442</td>
</tr>
</tbody>
</table>
Shipboard AIS
What is AIS?

An Autonomous Continuous Non-Proprietary Ship-to-Ship Navigation Broadcast System

Internationally adopted (ITU-R M.1371) & required (IMO SOLAS Regulation V/ 19.2.4) on all tankers & passenger vessels irrespective of size, ships of 300 gross tonnage or greater on international voyage; of 500 gross tonnage or greater on domestic voyage.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>3 Modes of Operation</th>
<th>Frequency agile</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ collision avoidance</td>
<td>➢ self-reporting (autonomous)</td>
<td>➢ any 2 VHF-FM Marine Channels</td>
</tr>
<tr>
<td>➢ vessel traffic service tool</td>
<td>➢ polling (interrogation)</td>
<td>➢ Ch. 87B &amp; 88B world-wide</td>
</tr>
<tr>
<td>➢ coastal surveillance</td>
<td>➢ tele-command (assignment)</td>
<td>➢ 2250 reports/ min./ channel</td>
</tr>
</tbody>
</table>

Multiple standard interfaces (NMEA 183) & display options (e.g. ECDIS/ radar/ PC)
What’s inside the box?
*1) The external keyboard/display may be e.g. a radar, ECDIS or dedicated devices.
*2) The internal keyboard/display may optionally be external.
AIS how...

Time-Division Multiple Access (TDMA)

GNSS
- GPS
- Loran
- Manual

Gyro/Heading
- Rate of Turn

Rate of Turn per SOLAS requirements

Speed Log (optional)

Inputs

1 VHF Transceiver
- AIS1 Ch.87B
- AIS2 Ch.88B
- DSC Ch.70

3 VHF Receivers

NMEA-0183/IEC61162

!AIVDM,2,2,7,A,2220<5<PTq2r7P2222220p4q@T<tdE2rP0,2*4E...

READ
AIS data sentences may be read/sent on/to multiple devices

COMMUNICATE
Broadcasts and manages the flow of AIS data sentences

ASSEMBLE
Gathers positioning, heading, vessel data and assembles it into an AIS compliant data sentences

!ECBBM,2,2,0,0,8,>@fQp0PPPPP>1>D93?;5@fb80,0*64→
time-division multiple access protocol (TDMA)

- SO-TDMA self-organizing
- RA-TDMA random access
- I-TDMA incremental
- CS-TDMA carrier sense

Each time slot represents 26.6 milliseconds.

The AIS of ship A sends the position message in one time slot. At the same time it reserves another time slot for the next position message.

The same procedure is repeated by all other AIS-equipped ships.

Ship A

Ship B

Ship C
What’s AI S Look Like?

!AI VDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0* 24
!AI VDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0* 24
!AI VDM,2,1,7,A,8030ot1?0P65inC<CO<l5nsv` Tst5P22220lT hTr0d4l4e2q90222222,0*12
!AI VDM,2,2,7,A,2220<5<PTq2r7P2222220p4q@T<tdE2r` P0 ,2*4E
!AI VDM,2,1,9,A,8030ot1?0P65inC<CO<lGnsvJ 4st5P22220` 4pF04pr0UK2qM022210E,0*47
!AI VDM,2,2,9,A,@U@F0Hu9@G30gP220HD@E84j1UDdts31o 00,2*78
<table>
<thead>
<tr>
<th>ID#</th>
<th>ITU-R M.1371 AIS Message Descriptions</th>
<th>A</th>
<th>U</th>
<th>A</th>
<th>S</th>
<th>I</th>
<th>N</th>
<th>Slots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3</td>
<td>Position Reports – autonomous (au), assigned (as), or interrogated (in)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Base Station Report – UTC/date, position, slot nr.</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Class A Report - static and voyage related data</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6, 7, 8</td>
<td>Binary Message – addressed, acknowledge or broadcast</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>SAR aircraft position report</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10, 11</td>
<td>UTC/Date - enquiry and response</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12, 13, 14</td>
<td>Safety Text Message – addressed, acknowledge or broadcast</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Interrogation – request for specific messages</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Assignment Mode Command</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Binary Message – DGNSS Correction</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18, 19</td>
<td>Class B Reports – position &amp; extended</td>
<td>x</td>
<td>x</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Data Link Management – reserve slots</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>ATON Report – position &amp; status</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Channel Management</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Group Assignment</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Class B-CS Static Data</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Binary Message - single-slot</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Binary Message - multi-slot (STDMA)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### AIS Position Report

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message ID</td>
<td>6</td>
<td>Identifier for this message 1, 2 or 3</td>
</tr>
<tr>
<td>Repeat indicator</td>
<td>2</td>
<td>Used by the repeater to indicate how many times a message has been repeated. Refer to 1.4.6.1: 0-3: 0 = default; 3 = do not repeat any more</td>
</tr>
<tr>
<td>User ID</td>
<td>30</td>
<td>MMSI number</td>
</tr>
<tr>
<td>Navigational status</td>
<td>4</td>
<td>0 = under way using engine, 1 = at anchor, 2 = not under command, 3 = restricted maneuverability, 4 = constrained by draught, 5 = moored, 6 = aground, 7 = engaged in fishing, 8 = underway sailing, 9 = reserved for future amendment of navigational status for ships carrying DG, H5, or MP, or IMO hazard or polluting category C (HSC), 10 = reserved for future amendment of navigational status for ships carrying DG, H5, or MP, or IMO hazard or polluting category C (HSC), 11-14 = reserved for future use, 15 = not defined = default</td>
</tr>
<tr>
<td>Rate of turn (ROTn)</td>
<td>8</td>
<td>±127° (-128 = 1022 knots or higher) Coded by ROTBD = 4.723 SQRTROTBDXATED) degrees/minute. ROTBDXATED is the rate of turn (720°/min), as indicated by an external sensor. ±127° = turning right at 720°/min or higher; -127° = turning left at 720°/min or higher</td>
</tr>
<tr>
<td>SOG</td>
<td>10</td>
<td>Speed over ground in 1 knot steps (0-1022 knots) 1023 = not available; 1022 = 1022 knots or higher</td>
</tr>
<tr>
<td>Position accuracy</td>
<td>1</td>
<td>1 = high (&gt;10 m; differential mode of e.g. DG/NSS receiver) 0 = low (&lt;10 m; autonomous mode of e.g. global navigation satellite system (GNSS) receiver or of other electronic position fixing device), 0 = default</td>
</tr>
<tr>
<td>Longitude</td>
<td>28</td>
<td>Longitude in 110 0000 min (180°). East = positive. West = negative. 181° (679/16) = not available = default</td>
</tr>
<tr>
<td>Latitude</td>
<td>27</td>
<td>Latitude in 110 0000 min (±90°). North = positive. South = negative. 91° (341/24) = not available = default</td>
</tr>
<tr>
<td>COG</td>
<td>12</td>
<td>Course over ground in 110° (0-359); 3600 (E100) = not available = default. 3601-4095 should not be used</td>
</tr>
<tr>
<td>True heading</td>
<td>9</td>
<td>Degrees (0-359) (511 indicates not available = default)</td>
</tr>
<tr>
<td>Time stamp</td>
<td>6</td>
<td>UTC second when the report was generated (0-59) or 60 if time stamp is not available, which should also be the default value. 0 or 62 if electronic position fixing system operates in estimated (dead reckoning) mode or 61 if positioning system is in manual input mode or 63 if the positioning system is inoperative</td>
</tr>
<tr>
<td>Reserved for regional</td>
<td>4</td>
<td>Reserved for definition by a competent regional authority. Should be set to zero, if not used for any regional application. Regional applications should not use zero</td>
</tr>
<tr>
<td>applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>1</td>
<td>Not used. Should be set to zero</td>
</tr>
<tr>
<td>RAIM-flag</td>
<td>1</td>
<td>RAIM (Receiver autonomous integrity monitoring) flag of electronic position fixing device. 0 = RAIM not in use = default; 1 = RAIM in use</td>
</tr>
<tr>
<td>Communication state</td>
<td>19</td>
<td>See below</td>
</tr>
<tr>
<td>Total number of bit</td>
<td>168</td>
<td></td>
</tr>
</tbody>
</table>
### Message 5: Ship static and voyage related data

Should only be used by Class A shipborne mobile equipment when reporting static or voyage related data.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message ID</td>
<td>6</td>
<td>Identifier for this Message 5</td>
</tr>
<tr>
<td>Repeat indicator</td>
<td>2</td>
<td>Used by the repeater to indicate how many times a message has been repeated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Refer to § 4.6.1, Annex 2; 0-3 = do not repeat; 3 = do not repeat any more.</td>
</tr>
<tr>
<td>User ID</td>
<td>30</td>
<td>MMSI number</td>
</tr>
<tr>
<td>AIS version indicator</td>
<td>2</td>
<td>0 = station compliant with Recommendation ITU-R M.1371-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = station compliant with Recommendation ITU-R M.1371-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-3 = station compliant with future editions</td>
</tr>
<tr>
<td>IMO number</td>
<td>30</td>
<td>1-999999999; 0 = not available = default</td>
</tr>
<tr>
<td>Call sign</td>
<td>42</td>
<td>7 x 6 bit ASCII characters, @@@@@ not available = default</td>
</tr>
<tr>
<td>Name</td>
<td>120</td>
<td>Maximum 20 characters 6 bit ASCII, as defined in Table 44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“@@@&quot; = not available = default</td>
</tr>
<tr>
<td>Type of ship and cargo type</td>
<td>8</td>
<td>0 = not available or no ship = default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1-99 = as defined in § 3.3.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100-190 = reserved, for regional use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200-255 = reserved, for future use</td>
</tr>
<tr>
<td>Overall Dimension</td>
<td>30</td>
<td>Reference point for reported position. Also indicates the dimension of ship</td>
</tr>
<tr>
<td>Reference For Position</td>
<td></td>
<td>(m) see Figure 41 and § 3.3.3</td>
</tr>
<tr>
<td>Type of electronic position fixing device</td>
<td>4</td>
<td>0 = undefined (default)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = GPS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 = GLONASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 = combined GPS/GLONASS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = Loran-C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 = Chayka</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 = integrated navigation system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 = surveyed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 = Galileo, 9-15 = not used</td>
</tr>
<tr>
<td>ETA</td>
<td>20</td>
<td>Estimated time of arrival; MMDDHHMM UTC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bits 19-16: month, 1-12; 0 = not available = default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bits 15-11: day; 1-23; 0 = not available = default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bits 10-6: hour, 0-23; 24 = not available = default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bits 5-0: minute, 0-59; 60 = not available = default</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In 1/10 m, 255 = draught 25.5 m or greater, 0 = not available = default;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In accordance with IMO Resolution A.851</td>
</tr>
<tr>
<td>Maximum present</td>
<td>8</td>
<td>Static draught</td>
</tr>
<tr>
<td>Static Draught</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination</td>
<td>120</td>
<td>Maximum 20 characters using 6-bit ASCII;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;@@@&quot; = not available = default</td>
</tr>
<tr>
<td>DTE</td>
<td>1</td>
<td>Data terminal ready (0 = available, 1 = not available = default) (see § 3.3.1)</td>
</tr>
<tr>
<td>Spare</td>
<td>1</td>
<td>Spare. Not used. Should be set to zero. Reserved for future use.</td>
</tr>
<tr>
<td>Number of bits</td>
<td>42</td>
<td>Occiples 2 slots</td>
</tr>
</tbody>
</table>
SSD – AIS Ship static data

This sentence is used to enter static parameters into a shipboard AIS unit. The parameters in this sentence support a number of the ITU-R M.1371 messages.

$--SSD,c—c,—c,—c,xxx,xxx,xx,xx,c,aa*hh<CR><LF>

- Source identifier
- DTE indicator flag
- Pos. ref., point dist. “D,” from starboard beam, 0 to 63 metres
- Pos. ref., point dist. “C,” from port beam, 0 to 63 Metres
- Pos. ref., point dist. “B,” from stern, 0 to 511 Metres
- Pos. ref., point dist. “A,” from bow, 0 to 511 metres
- Ship’s Name, 1 to 20 characters
- Ship’s Call Sign, 1 to 7 characters
Work sheet for decoding and interpreting encapsulated string:

1P000Oh1T1svTP2r:43grwb0Eq4

<table>
<thead>
<tr>
<th>VDM bit positions (reference diagram)</th>
<th>Encapsulation Symbol String</th>
<th>Bits represented by encapsulation symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>7</td>
<td>P</td>
<td>1 0 0 0 0 0 1</td>
</tr>
<tr>
<td>13 14 15 16</td>
<td>O</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>19 20 21 22</td>
<td>Q</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>25 26 27 28</td>
<td>R</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>31 32 33 34</td>
<td>S</td>
<td>0 1 1 1 0 1 1</td>
</tr>
<tr>
<td>37 38 39 40</td>
<td>T</td>
<td>1 0 0 1 0 1 0</td>
</tr>
<tr>
<td>43 44 45 46</td>
<td>I</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>50 51 52 53</td>
<td>J</td>
<td>1 1 1 1 0 1 1</td>
</tr>
<tr>
<td>56 57 58 59</td>
<td>K</td>
<td>1 0 0 1 0 0 0</td>
</tr>
<tr>
<td>63 64 65 66</td>
<td>F</td>
<td>1 0 0 0 0 0 0</td>
</tr>
<tr>
<td>70 71 72 73</td>
<td>G</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>79 80 81 82</td>
<td>H</td>
<td>1 1 1 0 0 0 0</td>
</tr>
<tr>
<td>89 90 91 92</td>
<td>I</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>99 100 101 102</td>
<td>J</td>
<td>1 1 1 1 0 1 1</td>
</tr>
<tr>
<td>107 108 109 110</td>
<td>K</td>
<td>1 0 0 1 0 0 0</td>
</tr>
<tr>
<td>119 120 121 122</td>
<td>L</td>
<td>1 0 0 0 0 0 0</td>
</tr>
<tr>
<td>129 130 131 132</td>
<td>M</td>
<td>1 1 1 0 1 0 1</td>
</tr>
<tr>
<td>139 140 141 142</td>
<td>N</td>
<td>1 1 1 0 1 0 0</td>
</tr>
<tr>
<td>146 147 148 149</td>
<td>O</td>
<td>0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>154 155 156 157</td>
<td>P</td>
<td>0 1 0 1 0 0 1</td>
</tr>
<tr>
<td>164 165 166 167</td>
<td>Q</td>
<td>1 1 1 0 0 1 1</td>
</tr>
<tr>
<td>168 169 170 171</td>
<td>R</td>
<td>0 0 0 0 1 0 0</td>
</tr>
</tbody>
</table>

**Binary conversion of symbol**

**Notes:**
- Bits 1-6 = Identifier for this message
- 000001 = message 1 (Reference table 15 of ITU-R M.1371-1 to interpret following bits 7-168.)
- Bits 7-8 = Repeat Indicator
  - 2 = message repeated twice
- Bits 9-32 = MMSI number of broadcasting unit
  - 000000000000000000000000001111111 = 127
- Bits 33-42 = Navigational status
  - 0000 = underway using engine
- Bits 43-50 = Rate of turn (equation used)
  - 00000101 = +1.1 degrees/minute
- Bits 51-60 = Speed over ground
  - 1001100100 = 61.2 knots
- Bits 61 = Position accuracy
  - 0 = low (greater than 10 metres)
- Bits 62-69 = Longitude in 1/10000 minutes
  - 00011101101111111010101010 = 27 degrees 5 minutes East
- Bits 70-77 = Latitude in 1/10000 minutes
  - 0000110010010100100100101 = 4 degrees, 5 minutes North
- Bits 78-83 = Course over ground in 1/10 degrees
  - 0011110111111 = 95.9 degrees true
- Bits 84-90 = True Heading
  - 101011111 = 361 degrees true
- Bits 91-96 = UTC second when report generated
  - 110101 = 53 seconds past the minute
- Bits 97-102 = Regional Application
  - 0 = no regional application
- Bits 103-108 = Spare
- Bits 109 = RAIM Flag
  - 0 = RAIM not in use
- Bits 109-111 = Communications State
  - 00 = UTC Direct
  - 101 = 5 frame remaining until a new slot is selected, UTC hour and minute follow,
  - 0111110100100 = 01111:001001 = 19:17 UTC
AIVDM & AIVDO NMEA sentence decoder

AIS receivers and transponders report received messages over the NMEA protocol in AIVDM sentences. They look something like this:

```
!AIVDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0*24
```

AIVDM messages are AIS position reports from other vessels, and AIVDO messages contain your own ship's position.

Below is a very simple decoder for NMEA AIVDM sentences. Currently it only decodes message types 1, 2, 3 and 4 - i.e. position reports for class A shipborne equipment and base station reports. Some less interesting data is left out from the result, but the interesting stuff is there. You will also be rewarded with a link to Google Maps where you can check the sender's position.

Insert your AIVDM or AIVDO string into the text field below and press "Decode".

```
!AIVDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0*24
```
AIS receivers and transponders report received messages over the NMEA protocol in AIVDM sentences. They look something like this:

```
!AIVDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0*24
```

AIVDM messages are AIS position reports from other vessels, and AIVDO messages contain your own ship’s position.

Below is a very simple decoder for NMEA AIVDM sentences. Currently it only decodes message types 1, 2, 3 and 4 - i.e. position reports for class A shipborne equipment and base station reports. Some less interesting data is left out from the result, but the interesting stuff is there. You will also be rewarded with a link to Google Maps where you can check the sender’s position.

Insert your AIVDM or AIVDO string into the text field below and press “Decode”.

```
!AIVDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0*24
```

```
!AIVDM,1,1,,A,13u?etPv2;0n:dDPwUM1U1Cb069D,0*24
```

Message sent (UTC) : 17:21:53
MMSI : 265547250
Latitude : 57.660353'
Longitude : 11.832977'
Speed : 13.9 knots
Heading : 41'
Course over ground : 40'
Rate of turn : -2'/min
Navigational status : 0
Show position in Google Maps
RL.SE AIVDM/AIVDO Web $Revision: 1.10 $
See's around bends

← Aids encounter zones

calculations
# What Shipboard AIS broadcasts...

<table>
<thead>
<tr>
<th>Dynamic Data</th>
<th>Safety Related &amp; Binary Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>-every 2-10 seconds per speed and course change</td>
<td>- SHORT TEXT MESSAGING &lt; 156 characters</td>
</tr>
<tr>
<td>• POSITION &amp; ACCURACY (+/-10m)</td>
<td>• DATA MESSAGING &amp; BINARY APPLICATIONS</td>
</tr>
<tr>
<td>• COURSE OVER GROUND</td>
<td></td>
</tr>
<tr>
<td>• SPEED OVER GROUND</td>
<td></td>
</tr>
<tr>
<td>• HEADING</td>
<td></td>
</tr>
<tr>
<td>• RATE OF TURN</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Static &amp; Voyage Data</th>
<th>Weather &amp; Hydrological Information-</th>
</tr>
</thead>
<tbody>
<tr>
<td>-every 6 minutes or upon change</td>
<td>• NOAA Physical Oceanographic Real Time System</td>
</tr>
<tr>
<td>• VESSEL IMO NUMBER</td>
<td>• NWS-Real-time weather buoy (C-MAN station)</td>
</tr>
<tr>
<td>• COLREG NAVIGATION STATUS</td>
<td>• USACE Real-time Current Meter System (RTCM)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other possible uses-</th>
<th>Vessel Traffic Service (VTS)-</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aids to Navigation</td>
<td>• ATON Discrepancies</td>
</tr>
<tr>
<td>• Search and Rescue</td>
<td>• Distress Alerts</td>
</tr>
<tr>
<td>• Port Partners</td>
<td>• Urgent Notices &amp; Warnings</td>
</tr>
<tr>
<td>• Lock/Canal operations</td>
<td>• Traffic Advisories</td>
</tr>
<tr>
<td>• … endless opportunities!</td>
<td>• Radar Overlay / Pseudo-targets</td>
</tr>
<tr>
<td></td>
<td>• Additional Hydro &amp; Meteorological Information</td>
</tr>
<tr>
<td>ID#</td>
<td>ITU-R M.1371 AIS Message Descriptions</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1,2,3</td>
<td>Position Reports – autonomous (au), assigned (as), or interrogated (in)</td>
</tr>
<tr>
<td>4</td>
<td>Base Station Report – UTC/date, position, slot nr.</td>
</tr>
<tr>
<td>5</td>
<td>Class A Report - static and voyage related data</td>
</tr>
<tr>
<td>6,7,8</td>
<td>Binary Message – addressed, acknowledge or broadcast</td>
</tr>
<tr>
<td>9</td>
<td>SAR aircraft position report</td>
</tr>
<tr>
<td>10,11</td>
<td>UTC/Date - enquiry and response</td>
</tr>
<tr>
<td>12,13,14</td>
<td>Safety Text Message – addressed, acknowledge or broadcast</td>
</tr>
<tr>
<td>15</td>
<td>Interrogation – request for specific messages</td>
</tr>
<tr>
<td>16</td>
<td>Assignment Mode Command</td>
</tr>
<tr>
<td>17</td>
<td>Binary Message – DGNSS Correction</td>
</tr>
<tr>
<td>18,19</td>
<td>Class B Reports – position &amp; extended</td>
</tr>
<tr>
<td>20</td>
<td>Data Link Management – reserve slots</td>
</tr>
<tr>
<td>21</td>
<td>ATON Report – position &amp; status</td>
</tr>
<tr>
<td>22</td>
<td>Channel Management</td>
</tr>
<tr>
<td>23</td>
<td>Group Assignment</td>
</tr>
<tr>
<td>24</td>
<td>Class B-CS Static Data</td>
</tr>
<tr>
<td>25</td>
<td>Binary Message - single-slot</td>
</tr>
<tr>
<td>26</td>
<td>Binary Message - multi-slot (STDMA)</td>
</tr>
<tr>
<td>ID#</td>
<td>ITU-R M.1371 AIS Message Descriptions</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1,2,3</td>
<td>Position Reports – autonomous (au), assigned (as), or interrogated (in)</td>
</tr>
<tr>
<td>4</td>
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<td>12,13,14</td>
<td>Safety Text Message – addressed, acknowledge or broadcast</td>
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<td>Assignment Mode Command</td>
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</tr>
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<td>Channel Management</td>
</tr>
<tr>
<td>23</td>
<td>Group Assignment</td>
</tr>
<tr>
<td>24</td>
<td>Class B-CS Static Data</td>
</tr>
<tr>
<td>25</td>
<td>Binary Message - single-slot</td>
</tr>
<tr>
<td>26</td>
<td>Binary Message - multi-slot (STDMA)</td>
</tr>
</tbody>
</table>
AIS ATON’s

- Monitors ‘health’ & position
- Improves availability by reducing time to respond to outages because of near real time monitoring.
- Improves “visibility” to AIS equipped vessels.
<table>
<thead>
<tr>
<th>ID#</th>
<th>ITU-R M.1371 AIS Message Descriptions</th>
<th>AU</th>
<th>AS</th>
<th>IN</th>
<th>Slots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3</td>
<td>Position Reports – autonomous (au), assigned (as), or interrogated (in)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Base Station Report – UTC/date, position, slot nr.</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Class A Report - static and voyage related data</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>6,7,8</td>
<td><strong>Binary Message – addressed, acknowledge or broadcast</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>5/2</td>
</tr>
<tr>
<td>9</td>
<td>SAR aircraft position report</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>10,11</td>
<td>UTC/Date - enquiry and response</td>
<td>x</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>12,13,14</td>
<td>Safety Text Message – addressed, acknowledge or broadcast</td>
<td>x</td>
<td>x</td>
<td></td>
<td>5/2</td>
</tr>
<tr>
<td>15</td>
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<td>x</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>Assignment Mode Command</td>
<td>x</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Binary Message – DGNSS Correction</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>18,19</td>
<td>Class B Reports – position &amp; extended</td>
<td>x</td>
<td>x</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>Data Link Management – reserve slots</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td><strong>ATON Report – position &amp; status</strong></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>22</td>
<td>Channel Management</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td>Group Assignment</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td>Class B-CS Static Data</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>25</td>
<td>Binary Message - single-slot</td>
<td>x</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>26</td>
<td>Binary Message - multi-slot (STDMA)</td>
<td>x</td>
<td></td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>
AIS can transfer data via binary messages...

- Provides a means to use other applications
  - Encode application on the transmission side
  - Decode application on the receive side
  - Sent as either General or Addressed broadcast
    - Addressed messages (MMSI-to-MMSI) receives an acknowledgement that the binary message was received
3.3.8.2.6 Message 8: Binary broadcast message

This message will be variable in length, based on the amount of binary data. The length should vary between 1 and 5 slots.

**TABLE 22**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of bits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message ID</td>
<td>6</td>
<td>Identifier for Message 8; always 8</td>
</tr>
<tr>
<td>Repeat indicator</td>
<td>2</td>
<td>Used by the repeater to indicate how many times a message has been repeated. See § 3.3.8.2.1.1</td>
</tr>
<tr>
<td>Source ID</td>
<td>30</td>
<td>MMSI number of source station</td>
</tr>
<tr>
<td>Spare</td>
<td>2</td>
<td>Not used. Should be set to zero</td>
</tr>
<tr>
<td>Binary data</td>
<td>Maximum 968</td>
<td>Application identifier 16 bits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Application data Maximum 952 bits Application specific data</td>
</tr>
<tr>
<td>Total number of bits</td>
<td>Maximum 1008</td>
<td>Occupies 1 to 5 slots</td>
</tr>
</tbody>
</table>
Meteorological & Hydrological Reporting

- Improves the overall safety & efficiency of marine traffic
- Some in place since 2002
USACE
Real-time
Current Velocity
Meters
Lock Order

- Used by Saint Lawrence Seaway since 2002
- Improves efficiency, lock utilization, mitigates racing & wait time
Novel Uses of AIS

Malaysia Dredge Monitoring Project
Malaysia Dredge Monitoring Project

Remote Name: RAMANYA
MMSI Number: 5050
Call Sign: XYIV
Latitude: 34° 31' 12.66” N
Longitude: 133° 40' 14.77” E
Range: 6879.388 Nm
Bearing: 092.1° T
COG: 223.4° T
SOG: 0.000 Kts
ETA to Cursor Local: N/A
Nav Status: Under Way Engine
Destination: N/A
Channel: Own Position
DTE Status: Connected
Positional Accuracy: Low
Time Since Last Update: 00h 00m 02s
Operating Mode: Autonomous
Door Status: Closed
Time Since Last Update: 00h 00m 44s

UTC 13:24:05 RAMANYA Hopper doors are closed.
UTC 13:24:08 RAMANYA Hopper doors are open outside of dumping area.
UTC 13:24:09 RAMANYA Hopper doors are closed.
Industry is using AIS - Washington St. Ferries

Seattle Area Vessel Watch

Seattle / Bainbridge Island

Most Requested
- Reservations to Sidney B.C.
- Traveling to Victoria
- WSF Security
- Visitors Center
- Fares
- Route Maps
- Find Terminals
- Ferry Cameras

Commuter Center
- Bulletins
- Wait Times
  - Vessel Watch
- Ferry Cams
- Public Outreach
- Vashon Low Tides
- ADA & Medical Emergency
  - Travel
- Weather

Customer and Community Relations
- The Largest Ferry System in the Nation 197k pdf
- Press Releases
  - Transportation Commission

Seattle

Map Creation date:time 10/09/06 09:43 P.M

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evergreen</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Issaquah</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Kalama</td>
<td>10/09/06</td>
<td>9:21 PM</td>
</tr>
<tr>
<td>Kaleetan</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Kitsap</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Nisqually</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Puyallup</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
<tr>
<td>Tillikum</td>
<td>10/09/06</td>
<td>9:42 PM</td>
</tr>
</tbody>
</table>

Homeland Security
Commercial applications of AIS

Passage line notification when a vessel enter/leave the harbour area

ATA for the vessel MAX Mols entering Berth D - acknowledge required (indicated by small man-icon)
AIS Event Detection

Automatic event detection

- User specified event types
- Flag to indicate status of event
- Find vessel involved in event
- Forward event information via:
  - System Integration Module
  - SMS or email
- Speech integrated

PETROPAVLOVSK has left Great Belt Passage, duration = 00:00:30
AIS used for Vessel Traffic Management

Traffic Density

• Traffic density coloured according to amount of ships over a defined period of time.

• Independent cell variable: #targets, average speed, length, draught.
AIS Traffic Analysis & Vessel Traffic Management

The before and after implementation of traffic separation scheme.
ECS - AIS Display Tailored for Hi-Speed Craft
AIS Timeline


OPA '90

ADSSE ITU-R M.825-3

National Dialog Group

Marine Board Ports & Waterways Study

105th Congress

VTS LMR Public Meeting

ITU-R M.1371-1 Technical

IMO MSC 74 (69) Performance

IEC 61993-2 Testing & Certification

SOLAS V/19.2.4

2002 IMO Diplomatic Conference

SOLAS V/19.2.4

WRC'97 AIS1 Ch.87B AIS2 Ch.88B

MTSA - 11/02
Interim - 7/03
Final - 10/03
Deadline - 1/04

FCC Notice DA-02-1362
Maritime Transportation Security Act of 2002

Title 46, U.S. Code, Sec. 70113 – Marine Intelligence

“...shall implement a system to collect, integrate, and analyze information concerning vessels operating on or bound for waters subject to the jurisdiction of the United States, including information related to crew, passengers, cargo, and inter-modal shipments.

To deter a transportation security incident, the [Coast Guard] may collect information from public and private entities to the extent that the information is not provided by other Federal departments and agencies.”
Maritime Domain Awareness

National Strategy for Combating Terrorism

Key to defending our Nation is the effective knowledge of all activities, events, and trends within any specified domain (air, land, sea, cyber) ...

This “domain awareness” enables identification of threats as early and as distant from our borders... as possible, to provide maximum time to determine the optimal course of action.

Current Maritime Domain Awareness Definition

Maritime Domain Awareness is the effective understanding of objects and activities in or near the marine environment that could affect America’s security, safety, economy, or environment.
## Maritime Domain Awareness

### Information
- Vessels
- People
- Facilities
- Cargo
- Infrastructure
- Sea lanes
- Threats
- Friendly forces
- Weather
- etc.

### Collect
- Sensors - NAIS
- Operators & field personnel
- Intel. agencies
- Open source
- Private sector data
- etc.

### Analyze
- Collate
- Fuse
- Analyze
- Assess
- etc.

### Disseminate
- **Common Operating Picture**
  - Indications & Warnings
  - Assessments
  - Estimates
  - etc.

### Decisions
- Strategic
- Operational
- Tactical

### Processes

**Products**

- Strategic
- Operational
- Tactical
Nation-wide AIS Project Conceptual Overview

- Automatic reception of AIS information (vessel ID, location, status, and other navigational information) nationwide out to 2000nm
- Transmission out to 24nm from shore
- Correlation with other database systems for intelligence and operational decision makers
- Shared with others & displayed on a Common Operational Picture
NAIS Status & Other USCG AIS on goings...

Nation-wide AIS Project (NAIS)

- Increment 1 – Completed Oct’07
- Increment 2 – Awarded Dec’08, IOC ’11, FOC ‘14
- Increment 3 – Long range reception of AIS
  - Satellite reception tests in progress

VTS AIS Binaries Project

- Trials ongoing in:
  - Tampa (NOAA PORTS)
  - Stellwagen Bank (Right Whale Notifications)
Maritime Domain Awareness

Information
- Vessels
- People
- Facilities
- Cargo
- Infrastructure
- Sea lanes
- Threats
- Friendly forces
- Weather
- etc.

Collect
- Sensors - NAIS
- Operators & field personnel
- Intel. agencies
- Open source
- Private sector data
- etc.

Analyze
- Collate
- Fuse
- Analyze
- Assess
- etc.

Disseminate
- Common Operating Picture
- Indications & Warnings
- Assessments
- Estimates
- etc.

Decisions
- Strategic
- Operational
- Tactical

Processes

Products

Homeland Security
One known need: Common Operating Picture "plus"

- News Media
- Port Security Plans
- Unclassified Weather Data
- Unclassified Satellite Photos
- Unclassified Automatic Identification System data
- Unclassified Cargo, Crew Data
- Unclassified Vessel Tracking Data
- Maps & Charts
- Models (e.g. radiological dispersion)
- Port Security Assessments
- Maritime Information for Safety and Law Enforcement (MISLE) data
- Customs Information
- Law Enforcement Operations Plans
- Force Deployments
- National Assets
- Common Intelligence Picture
- FBI Information
- Defense Operations Plans
- Homeland Security

Sensitive

Classified
AIS information displayed on a Common Operational Picture (COP) which is shared with other agencies.
AIS on USCG’s Marine Information for Safety & Law Enforcement (MISLE) GIS Interface
AIS on USCG’s Marine Information for Safety & Law Enforcement (MISLE) GIS Interface
AIS on USCG’s Marine Information for Safety & Law Enforcement (MISLE) GIS Interface
AIS units logged/tracked each day by USCG network

1997: USCG adopts a Vessel Traffic Services AIS strategy
- Ports & Waterways Safety System (PAWSS) acquisition project

1998: USCG R&D Center and CGHQ seek to expedite AIS technology development and certification

2000: SOLAS Chp. V AIS carriage requirements adopted
- Phased deployment from 2002 - 2008

2002: Post 9/11, IMO advances (Int’l) AIS carriage to 12/31/04
- Congress mandates AIS (MTSA 2002)

2003: USCG RDC prototype AIS network commences

2004: USCG Nationwide AIS (NAIS) deployment

2005: SOLAS and MTSA requirements in effect

2007: USCG NAIS Increment-1 deployed
NAIS Status & Other USCG AIS on goings...

Nation-wide AIS Project (NAIS)

• Increment 1 – Completed Oct’07
• Increment 2 – Awarded Dec’08, IOC ’11, FOC ‘14
• Increment 3 – Long range reception of AIS
  • Off-shore reception on buoys & oil platforms
  • Satellite reception tests in progress

VTS AIS Binaries Project

• Trials ongoing in:
  • Tampa (NOAA PORTS)
  • Stellwagen Bank (Right Whale Notifications)
AIS on NOAA Weather Buoys 3 meter disc buoys
AIS on NOAA Weather Buoys

- Typical detection range from 3-meter buoy with 20-foot antenna height was 30 nm
- Approximately 40% > 40 nm
- Maximum range during test period > 340 nm
- Maximum range > 400 nm prior to test period
- Range expected to be 2 or more times the above from 10- and 12-meter buoys, the same on 6-meter buoys
NAIS Status & Other USCG AIS on goings...

Nation-wide AIS Project (NAIS)

- Increment 1 – Completed Oct’07
- Increment 2 – Awarded Dec’08, IOC ’11, FOC ’14
- Increment 3 – Long range reception of AIS
  - Off-shore reception on buoys & oil platforms
  - Satellite reception tests in progress

VTS AIS Binaries Project

- Trials ongoing in:
  - Tampa (NOAA PORTS)
  - Stellwagen Bank (Right Whale Notifications)
Satellite Reception of AIS

05:22:38 NOV 08 UTC / Vessel count: 11703
Nation-wide AIS Project (NAIS)

- Increment 1 – Completed Oct’07
- Increment 2 – Awarded Dec’08, IOC ’11, FOC ’14
- Increment 3 – Long range reception of AIS
  - Off-shore reception on buoys & oil platforms
  - Satellite reception tests in progress

VTS AIS Binaries Project

- Trials ongoing in:
  - Tampa - NOAA PORTS
  - PORTS - Physical Oceanographic Real-time System
  - Stellwagen Bank (Right Whale Notifications)
<table>
<thead>
<tr>
<th>Sensor</th>
<th>Wind (Gust)</th>
<th>Tide</th>
<th>Current</th>
<th>Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORT MANATEE</td>
<td>4 (7)kts @142°</td>
<td>2.7ft/v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ST. PETERSBURG</td>
<td>7 (8)kts @148°</td>
<td>3.1ft/v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OLD PORT TAMPA</td>
<td>5 (8)kts @128°</td>
<td>3.3ft/v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MCKAY BAY ENTR</td>
<td>8 (10)kts @130°</td>
<td>3.2ft/v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BERTH 223</td>
<td>5 (7)kts @126°</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OLD PORT TAMPA</td>
<td>- (-)kts @-</td>
<td>-</td>
<td>1.2kts @214°</td>
<td>-</td>
</tr>
<tr>
<td>SEABULK</td>
<td>5 (7)kts @118°</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SUNSHINE SKYWA</td>
<td>- (-)kts @-</td>
<td>-</td>
<td>1.3kts @238°</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>- (-)kts @-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>- (-)kts @-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Ships' Position
- Via PPU
- Via AIS

½nm error!

WYSIWYG
Trust But Verify
Ship's Position
- Via PPU
- Via AIS

WYSIWYG
Trust But Verify
WYSIWYG
Trust But Verify

AIS Reported Position

Actual Position

GPS Multi-path Error

DGPS
HDG: 208.0°
COG: 217.8°
SOG: 3.7 kt

NEXT: CalRiv271
BRG: 229.1°
TTG: 11
DIST: 68 ft
DEST: Buoy #8

ETA: 05:14
DIST: 41.8 nm

CLOSEST AIS DIST/BRG SOG/COG
CARL 0.1/221° 3.8/209°
EDITH 0.1/201° 3.5/209°
NAVION SCOTI 0.3/202° 0.0/000°
JO ANN EDWA 0.4/043° 0.1/075°
CREOLE PASS 0.7/053° 0.0/000°

17:52:06
3/27/2006
Log File Ref: 20113

Menu
Layout: LCH 09
# AIS and VMS Comparison

<table>
<thead>
<tr>
<th></th>
<th>Automatic Identification System (AIS)</th>
<th>Vessel Monitoring System (VMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Type</strong></td>
<td>International (ITU-IMO) Digital VHF-FM Radio Broadcast (Ch. 87B &amp; 88B)</td>
<td>Proprietary Digital Satellite Network, primarily INMARSAT-C</td>
</tr>
<tr>
<td><strong>Service Provider</strong></td>
<td>Open, non-proprietary protocol; not protected</td>
<td>Closed, proprietary protocols; strict data usage rules under Magnuson</td>
</tr>
<tr>
<td><strong>Reporting Mode(s)</strong></td>
<td>Two-way autonomous &amp; continuous Can also be polled or assigned &gt; rate Class A: 2-10 seconds, Class B: 30s Both at 3min &lt;3kt. Static Report: 6min.</td>
<td>Primarily, one-way (ship-shore) Reports via polling or scheduled (usually every 10-60 min.)</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Line of sight from each station ~40 nm</td>
<td>Line of sight within satellite coverage</td>
</tr>
<tr>
<td><strong>Applicability Population</strong></td>
<td>REQUIRED for navigation safety per: • SOLAS (V/19.2.4) – 60,000 vessels • MTSA (46 USC 70114) — 19,000</td>
<td>REQUIRED by Fishery Management Councils (FMC) FMC: 2000 Atlantic, 1500 Pacific</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Class A (SOLAS): $2,800 - $5,000 Class B: $700 - 1,500 No additional transmission costs</td>
<td>Approx $3,000 – 5,000, plus additional transmission costs/message</td>
</tr>
</tbody>
</table>
*1) The external keyboard/display may be e.g. a radar, ECDIS or dedicated devices.

*2) The internal keyboard/display may optionally be external.
LRF - AIS Long-Range Function

This sentence is used in both long-range interrogation requests and long-range interrogation replies. The LRF-sentence is the second sentence of the long-range interrogation request pair, LRI and LRF (see the LRI-sentence).

The LRF-sentence is also the first sentence of the long-range interrogation reply. The minimum reply consists of a LRF-sentence followed by a LR1-sentence. The LR2-sentence and/or the LR3-sentence follow the LR1-sentence if information provided in these sentences was requested by the interrogation. When the AIS unit creates the LRF-sentence for the long-range interrogation reply, fields 1, 2, 3 and 4 should remain as received in the long-range interrogation request; and field 5 (function reply status) and the new checksum are added to the LRF reply sentence.

$LRF,x,xxxxxx,c,c,c,c^*hh<CR><LF>$

<table>
<thead>
<tr>
<th>Function reply status^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function request^2, 1 to 26 characters</td>
</tr>
<tr>
<td>Name of requestor, 1 to 20 character</td>
</tr>
<tr>
<td>MMSI of requestor</td>
</tr>
<tr>
<td>Sequence number^4, 0 to 9</td>
</tr>
</tbody>
</table>

NOTE 1 This is used to bind the contents of the LRI and LRF sentences together. The LRF sentence shall immediately follow the LRI sentence and use the same sequence number. The requestor process shall increment the sequence number each time a LRI/LRF pair is created. After 9 is used the process shall begin again from 0. The Long-range interrogation is not valid if the LRI and LRF sequence numbers are different.

NOTE 2 The Function request field uses alphabetic characters, based upon IMO Resolution A.851(20), to request specific information items. Specific information items are requested by including their function identification character in this string of characters. The order in which the characters appear in the string is not important. All characters are upper-case. Information items will not be provided if they are not specifically requested - even if available to the AIS unit. The IMO Resolution defines the use of all characters from A to Z, but not all defined information is available to the AIS unit. The following is a list of the function identification characters, with the information they request.
LRI - AIS Long-range Interrogation

The Long-range interrogation of the AIS unit is accomplished through the use of two sentences. The pair of interrogation sentence formaters, a LRI sentence followed by a LRF sentence, provides the information needed by a universal AIS unit to determine if it must construct and provide the reply sentences (LRF, LR1, LR2, and LR3). The LRI sentence contains the information that the AIS unit needs in order to determine if the reply sentence need to be constructed. The LRF sentence identifies the information that needs to be in the reply sentences.

```
$LRI,x,a,xxxxxxxxxxxx,xxxxxxxxxxx,illl.ill,a,yyyy.yy,a,illll.ill,a,yyyy.yy,a*hh<CR><LF>
```

**NOTE 1** This is used to bind the contents of the LRI and LRF sentences together. The LRF sentence shall immediately follow the LRI sentence and use the same sequence number. The requestor process shall increment the sequence number by 1 for each LRF reply that is transmitted.
Causes of Vessel Loss While Underway & Maneuvering
Calendar Years 1994 - 2000

<table>
<thead>
<tr>
<th>Cause</th>
<th>Vessels Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding</td>
<td>133</td>
</tr>
<tr>
<td>Allisions, Collisions &amp; Groundings</td>
<td>138</td>
</tr>
<tr>
<td>Fire &amp; Explosion</td>
<td>61</td>
</tr>
<tr>
<td>Capsized</td>
<td>49</td>
</tr>
<tr>
<td>Structural Failure</td>
<td>14</td>
</tr>
<tr>
<td>Loss of Power or Propulsion</td>
<td>14</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
</tr>
<tr>
<td>Weather</td>
<td>10</td>
</tr>
</tbody>
</table>

Vessels lost while Underway & Maneuvering = 423
Vessels lost from all operations = 907

Massive Freighter Ends Fishermen's Bountiful Excursion
By Brian Ballou
Monday, May 24, 2004

Until the time a mammoth 700-foot freighter sliced their puny boat in half Saturday morning, three Connecticut fishermen were grabbing quite a haul of monkfish off the coast of New York.

"It was looking pretty good for us," Geal Rodenick, 29, of Mystic, Conn., said yesterday. He and Benjamin Schober...
<table>
<thead>
<tr>
<th>AIS Class A &amp; B Comparison</th>
<th><strong>Class A</strong></th>
<th><strong>Class B/CS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmit Power</td>
<td>2w</td>
<td>12.5w / 2w (low-power)</td>
</tr>
<tr>
<td>Reporting Rate</td>
<td>2 - 10 sec - speed and/or course dependent</td>
<td>30 sec. fixed</td>
</tr>
<tr>
<td>Communication Protocol</td>
<td>SO-TDMA</td>
<td>CS-TDMA</td>
</tr>
<tr>
<td></td>
<td>Self-Organizing amongst Class A's</td>
<td>Carrier-Sense(s), polite to Class A's</td>
</tr>
<tr>
<td>Frequency Range &amp; Bandwidth</td>
<td>156.025 - 162.025 MHz @ 12/25 kHz DSC Required</td>
<td>161.500 - 162.025 MHz @ 25 kHz DSC &amp; 12.5 kHz Optional</td>
</tr>
<tr>
<td>Position Source</td>
<td>External GNSS &amp; Internal GPS</td>
<td>Internal GPS</td>
</tr>
<tr>
<td>Digital Interfaces</td>
<td>2 Input-Output Ports &amp; Multiple Outputs</td>
<td>Optional</td>
</tr>
<tr>
<td>Display</td>
<td>Multiple Keyboard Display (MKD)</td>
<td>Optional</td>
</tr>
<tr>
<td>Safety Text Messaging</td>
<td>Receive &amp; Transmit</td>
<td>Transmit Optional &amp; Pre-configured</td>
</tr>
<tr>
<td>Data</td>
<td>All</td>
<td>No Rate of Turn, Navigation Status, Destination, ETA, Draft, IMO#</td>
</tr>
<tr>
<td>CG Type-Approvals</td>
<td>22 Models - 16 Manufacturers</td>
<td>8 Models - 8 Manufacturers</td>
</tr>
<tr>
<td>Approximate Cost</td>
<td>$2,800 - 4,000</td>
<td>$700 - 1,500</td>
</tr>
</tbody>
</table>
AIS Advisory

The Coast Guard has noticed that many Automatic Identification System (AIS) users are not updating their unit to accurately reflect voyage related information—navigation status, static draft, destination, ETA, etc. Further, the Coast Guard has encountered AIS units that either do not transmit at all or improperly transmit the vessel’s dynamic data—position, course, speed, heading, etc. The former problem requires due diligence on behalf of the user, the latter is most likely due to the improper installation or operation of external sensors—gyro or heading device and vessel GPS system—inputted into the AIS. AIS users are compelled to properly operate their AIS at all times (33 CFR § 164.46). They should pay close attention to these matters, and are encouraged to make each other aware of AIS discrepancies they come upon. Improper operation of AIS could subject the user to civil penalties not to exceed $25,000.

Note, AIS data can be invaluable, however, as with any source of navigation information; it should not be solely relied upon in making navigational and collision-avoidance decisions. Further, while AIS allows for safety related ship-to-ship text messaging to communicate with others and make passing arrangements, these communications do not meet the requirements of the Vessel Bridge-to-Bridge Radiotelephone Act (33 U.S.C. 1201 et. seq.) for broadcasts on the designated bridge-to-bridge channel, nor do they relieve a vessel operator from the Navigation Rules requirement to sound whistle signals or display signals.

To report an AIS problem or for further information regarding AIS >>

For further information on AIS visit: www.navcen.uscg.gov
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