

<b>Title</b>	MEDIN data guideline for the presentation of AIS Derived Vessel Spatial Data
<b>MEDIN Discipline</b>	
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<b>Summary</b>	This guideline defines the format of Automatic Identification System (AIS) derived vessel spatial data and its representation within mapped products.
<b>Keywords</b>	AIS, Vessel, Shipping

## 1.0 Scope and data format for submission to DAC

This guideline covers the format of Automatic Identification System (AIS) derived vessel data and the spatial representation of these datasets within mapping products. This information will be used to better understand spatial and temporal trends in shipping activity, with potential for use in economic, social and environmental studies. Collection and decoding of AIS data are not included in the scope of this guidance.

To submit data to a Data Archive Centre (DAC) or transfer to other organisations the raw data is to be provided in a file type format which can be read by a Geographic Information System (GIS).

### 1.1 Background to Data Guidelines

The Marine Environmental Data and Information Network (MEDIN) is working towards creating a framework of consistent standards covering the major types of data collected and used to describe the marine environment around the UK. The principle benefits of this suite of standards are:

- Allows contracting organisation to easily specify a format that data should be returned in that can be readily used and includes all relevant attributes;
- Provides a consistent format for contractors to work to (rather than a different format for each contract);
- Data can be readily exported to Data Archiving Centres and other users; and
- Instils good practice amongst users.

Each standard defines the data and information that must be stored with a particular data type to ensure it can be readily used and reused. As this type of information is specific for different data types, guidelines are developed for each type. This document describes the format used for AIS derived spatial data and its representation within mapped products.

MEDIN provides standards for data and products. This product guideline describes the necessary information which should be provided when a product has been derived from raw data. The information in the tables below should be included in a MEDIN discovery metadata record.

## 1.2 Definition List

A number of terms used in the guideline are specific to shipping and have been drawn from commonly used Nautical Terms. Whilst these terms can differ between commercial, recreational and naval use, where possible the most commonly accepted variant has been presented. Table 1 provides definitions for specific terms need to understand the context of this MEDIN Guideline, this is not an exhaustive list and will be added to over time as the Guideline is revised.

**Table 1            Definition List**

<b>Term</b>	<b>Meaning</b>
Call sign	A unique designation for a transmitting station normally associated with a broadcasting and radio communications.
Draught	The minimum depth of water a vessel requires to float (without any allowance for under keel clearance) and is a measure from the bottom of the keel to the waterline. This parameter is entered into the AIS user interface on board the vessel by an operator, and can be changed to match the vessel draught. The closely related term 'trim' is defined as the difference between the forward and aft draughts.
IMO Number	The International Maritime Organization (IMO) number is a unique identifier for ships and for registered ship management companies. The IMO vessel identification number scheme was introduced in 1987; the number remains unchanged upon transfer of the ship to other flag(s) and is inserted in the ship's certificates.
MMSI Number	A Maritime Mobile Service Identity (MMSI) is a series of nine digits which are sent in digital form over a radio frequency channel to uniquely identify ship stations, ship earth stations, coast stations, coast earth stations and group calls.
Ship Type	<p>AIS ship type definition is based on the combination of a two digit type code (XX) and this includes:</p> <p><b>Type</b>  1X - Reserved for future use  2X - Wing In Ground (WIG)  3X - Vessel [Sub-type list shown below]  4X - High Speed Craft (HSC)  5X - Special Craft [list shown below]  6X - Passenger ships  7X - Cargo ships  8X - Tanker(s)  9X - Other types of ship</p> <p><b>3X - Vessel [Sub-type]</b>  30 - Vessel Fishing  31 - Vessel Towing  32 - Vessel Towing and length of the tow exceeds 200m or breadth exceeds 25m  33 - Vessel Engaged in dredging or underwater operations  34 - Vessel Engaged in diving operations  35 - Vessel Engaged in military operations  36 - Sailing Vessel  37 - Pleasure craft Vessel</p>

Term	Meaning
	<b>Special craft</b> 50 - Pilot vessel 51 - Search and rescue vessels 52 - Tugs 53 - Port tenders 54 - Vessels with anti-pollution facilities or equipment 55 - Law enforcement vessels 56 - Spare for assignments to local vessels 57 - Spare for assignments to local vessels 58 - Medical transports (as defined in the 1949 Geneva Conventions and Additional Protocols) 59 - Ships according to RR Resolution No.18 (Mob-83)
Transit	Transit starts when the Speed Over the Ground (SOG) is greater than 0.5 knots and continues until the vessel SOG falls below 0.2 knots for more than 5mins (or reception of the AIS signal has been lost or compromised).
Underway	Underway means that a vessel is not at anchor, or made fast to the shore, or aground.
Vessel	Vessel includes every description of water craft, including non-displacement craft, wing-in-ground-effect (WIG) vehicle, and seaplanes, used or capable of being used as a means of transportation on water.
Wing-In-Ground (WIG)	Wing-In-Ground (WIG) craft means a multimodal craft which, in its main operational mode, flies in close proximity to the surface by utilizing surface-effect action.

### 1.3 Using this Product Guideline

This guideline is split into sections which refer to the process states of AIS data transfer to describe mapped products. These are identified as:

- **AIS Data** – a summary of AIS data format and types;
- **Spatial Accuracy** – provides a qualitative description of expected spatial accuracy of AIS positional data;
- **AIS Processing** – a summary of AIS processing steps to arrive at derived data for spatial representation; and
- **AIS Derived Data** – provides the details table layout of AIS derived products within a database structure for use in a GIS environment.

The AIS Data, Spatial Accuracy and AIS Processing are common to all derived AIS products. The processing steps can be varied to achieved the required level of confidence in the accuracy of the AIS data, ultimately, the only way to verify spatial records is through corroboration with a secondary data source (typically, a radar survey to positively identify targets/AIS records). Comparisons can be carried out between AIS datasets and third party databases to compare record fields, and provide missing fields with additional values.

### 1.4 AIS Data

AIS is a maritime navigation safety communications system standardized by the International Telecommunication Union (ITU) and adopted by the International Maritime Organization (IMO) to provide vessel information.

AIS data provides an accessible source of spatial information which can be used to depict vessel movements within receiving range of the transmission. The technology works with transponders which automatically broadcast information at regular intervals via a Very High Frequency (VHF) transmitter. Vessel transmitted AIS signals are broadly classified as 'Class A' or 'Class B'. AIS-A is carried by international voyaging ships with gross tonnage (GT) of 300 or more tonnes, and all passenger ships regardless of size. AIS-B is carried by smaller vessels and is aimed at the leisure and fishing sector. This MEDIN standard does not deal with the decoding of AIS data, the focus is the display of derived products from processed data. The following section provides information on the message content, relevant to post-processing and display.

There are currently 27 AIS message types; these are identified in Table 2.

**Table 2 AIS Message Types**

Message ID	Name	Description
1	Position report	Scheduled position report; (Class A shipborne mobile equipment)
2	Position report	Assigned scheduled position report; (Class A shipborne mobile equipment)
3	Position report	Special position report, response to interrogation; (Class A shipborne mobile equipment)
4	Base station report	Position, UTC, date and current slot number of base station
5	Static and voyage related data	Scheduled static and voyage related vessel data report; (Class A shipborne mobile equipment)
6	Binary addressed message	Binary data for addressed communication
7	Binary acknowledgement	Acknowledgement of received addressed binary data
8	Binary broadcast message	Binary data for broadcast communication
9	Standard SAR aircraft position report	Position report for airborne stations involved in SAR operations, only
10	UTC/date inquiry	Request UTC and date
11	UTC/date response	Current UTC and date if available
12	Addressed safety related message	Safety related data for addressed communication
13	Safety related acknowledgement	Acknowledgement of received addressed safety related message
14	Safety related broadcast message	Safety related data for broadcast communication
15	Interrogation	Request for a specific message type (can result in multiple responses from one or several stations)(4)
16	Assignment mode command	Assignment of a specific report behaviour by competent authority using a Base station
17	DGNSS broadcast binary message	DGNSS corrections provided by a base station

Message ID	Name	Description
18	Standard Class B equipment position report	Standard position report for Class B shipborne mobile equipment to be used instead of Messages 1, 2, 3(8)
19	Extended Class B equipment position report	Extended position report for class B shipborne mobile equipment; contains additional static information
20	Data link management message	Reserve slots for Base station(s)
21	Aids-to-navigation report	Position and status report for aids-to-navigation
22	Channel management(6)	Management of channels and transceiver modes by a Base station
23	Group assignment command	Assignment of a specific report behaviour by competent authority using a Base station to a specific group of mobiles
24	Static data report	Additional data assigned to an MMSI. Part A: Name. Part B: Static Data
25	Single slot binary message	Short unscheduled binary data transmission (Broadcast or addressed)
26	Multiple slot binary message with Communications State	Scheduled binary data transmission (Broadcast or addressed)
27	Position report for long range applications	Scheduled position report (Class A shipborne mobile equipment outside base station coverage)
28-63	Undefined; Reserved for future use	N/A
Source: United States Coastguard, 2013		

Class A Messages are comprised of the following message types:

- Message Type 1, 2 and 3 – Positional Report
- Message Type 5 – Voyage Message

Class B Messages are comprised of the following message types:

- Message Type 14 – Safety Related Message
- Message Type 18 – Standard Class B CS Position Report
- Message Type 19 – Extended Class B Equipment Position Report
- Message Type 24 – Class B CS Static Data Report

The AIS coded message string needs to be associated with the time and date of message reception.

Tables 3 and 4 provide the decoded data fields from each message type. It is through the position reports that the spatial aspect of AIS is established.

**Table 3                      Position Report Fields (Message Type 1, 2 and 3)**

Parameter	Number of Bits	Description
Message ID	6	Identifier for this message 1, 2 or 3
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated.
User Identification	30	MMSI number
Navigational status	4	0 = under way using engine, 1 = at anchor, 2 = not under command, 3 = restricted manoeuvrability, 4 = constrained by her draught, 5 = moored, 6 = aground, 7 = engaged in fishing, 8 = under way sailing, 9 = reserved for future amendment of navigational status for ships carrying dangerous goods (DG), harmful substances (HS), or marine pollutants (MP), or International Maritime Organization (IMO) hazard or pollutant category C, high speed craft (HSC), 10 = reserved for future amendment of navigational status for ships carrying DG, HS or MP, or IMO hazard or pollutant category A, wing in grand (WIG); 11-13 = reserved for future use, 14 = AIS-SART (active), 15 = not defined = default (also used by AIS-SART under test)
Rate of turn (ROT) <sub>AIS</sub>	8	0 to +126 = turning right at up to 708 deg per min or higher 0 to -126 = turning left at up to 708 deg per min or higher Values between 0 and 708 deg per min coded by $ROT_{AIS} = 4.733 \text{ SQRT}(ROT_{sensor})$ degrees per min where $ROT_{sensor}$ is the Rate of Turn as input by an external Rate of Turn Indicator (TI). $ROT_{AIS}$ is rounded to the nearest integer value. +127 = turning right at more than 5 deg per 30s -127 = turning left at more than 5 deg per 30s -128 (80 hex) indicates no turn information available (default).
Speed over the Ground (SOG)	10	Speed over ground in 1/10 knot steps (0-102.2 knots) 1 023 = not available, 1 022 = 102.2 knots or higher
Position Accuracy	1	The position accuracy (PA) flag 1 = high (> 10 m) 0 = low (< 10 m) 0 = default
Longitude	28	Longitude in 1/10 000 min (+/-180°, East = positive, West = negative). 181 = not available = default
Latitude	27	Latitude in 1/10 000 min (+/-90°, North = positive, South = negative). 91° = not available = default
COG	12	Course over ground in 1/10 = (0-3599). 3600 = not available = default. 3 601-4 095 should not be used.
True heading	9	Degrees (0-359) (511 indicates not available = default)
Time stamp	6	UTC second when the report was generated by the electronic position system (EPFS) (0-59, or 60 if time stamp is not available, which should also be the default value, or 61 if positioning system is in manual input mode, or 62 if electronic position fixing system operates in estimated (dead reckoning) mode, or 63 if the positioning system is inoperative)
special manoeuvre indicator	2	0 = not available = default 1 = not engaged in special manoeuvre 2 = engaged in special manoeuvre
Spare	3	Not used. Should be set to zero. Reserved for future use
Source: United States Coastguard, 2013		

**Table 4 Ship Static and Voyage Fields (Message Type 5)**

Parameter	Number of Bits	Description
Message ID	6	Identifier for this Message 5; always 5
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated.
User ID	30	MMSI number
AIS version indicator	2	0 = station compliant with Recommendation ITU-R M.1371-1 1 = station compliant with Recommendation ITU-R M.1371-3 2-3 = station compliant with future editions
IMO number	30	1-999999999; 0 = not available = default
Call sign	42	7 bit ASCII characters, @@@@@@@@ = not available = default
Name	120	Maximum 20 characters 6 bit ASCII
Type of ship and cargo type	8	0 = not available or no ship = default 1-99 = as defined in 'MEDIN definition list' 100-199 = reserved, for regional use 200-255 = reserved, for future use
Overall dimension	30	Reference point for reported position. Also indicates the dimension of ship (m)
Type of electronic fixing device	4	0 = undefined (default) 1 = GPS 2 = GLONASS 3 = combined GPS/GLONASS 4 = Loran-C 5 = Chayka 6 = Integrated Navigation System 7 = Surveyed 8 = Galileo, 9-15 = not used
Expected Time of Arrival (ETA)	20	Estimated time of arrival; MMDDHHMM UTC Bits 19-16: month; 1-12; 0 = not available = default Bits 15-11: day; 1-31; 0 = not available = default Bits 10-6: hour; 0-23; 24 = not available = default Bits 5-0: minute; 0-59; 60 = not available = default
Maximum present static draught	8	In 1/10 m, 255 = draught 25.5 m or greater, 0 = not available = default; in accordance with IMO Resolution A.851
Destination	120	Maximum 20 characters using 6-bit ASCII; @@@@@@@@@@@@@@@@@@@@ = not available
Data terminal equipment (DTE)	1	Data terminal equipment (DTE) ready (0 = available, 1 = not available = default)
Spare	1	Spare. Not used. Should be set to zero. Reserved for future use.

Source: United States Coastguard, 2013

AIS-B units autonomously transmit Messages 18 and 24, these message types are defined in Table 5 for position fields, and Table 6 for static data fields (which is split into Part 1 and Part B). AIS-B positional and voyage data is used to provide AIS-B derived data products which can then be spatially represented.

**Table 5 Standard Class B Equipment Position Fields (Message Type 18)**

Parameter	Number of Bits	Description
Message ID	6	Identifier for Message 18; always 18
Repeat indicator	2	Shall be 0 for "CS" transmissions
User ID	30	MMSI number
Spare	8	Not used. Should be set to zero. Reserved for future use
SOG	10	Speed over ground in 1/10 knot steps (0-102.2 knots) 1 023 = not available, 1 022 = 102.2 knots or higher
Position accuracy	1	1 = high (> 10 m) 0 = low (< 10 m) 0 = default
Longitude	28	Longitude in 1/10 000 min (180, East = positive, West = negative; 181= not available = default
Latitude	27	Latitude in 1/10 000 min (90, North = positive, South = negative; 91= not available = default
COG	12	Course over ground in 1/10= (0-3 599). 3 600 = not available = default; 3 601-4 095 should not be used
True heading	9	Degrees (0-359) (511 indicates not available = default)
Time stamp	6	UTC second when the report was generated by the EPFS (0-59 or 60 if time stamp is not available, which should also be the default value or 61 if positioning system is in manual input mode or 62 if electronic position fixing system operates in estimated (dead reckoning) mode or 63 if the positioning system is inoperative) 61, 62, 63 are not used by "CS" AIS
Spare	2	Not used. Should be set to zero. Reserved for future use
Class B unit flag	1	0 = Class B SOTDMA unit 1 = Class B "CS" unit
Class B display flag	1	0 = No display available; not capable of displaying Message 12 and 14 1 = Equipped with integrated display displaying Message 12 and 14
Class B DSC flag	1	0 = Not equipped with DSC function 1 = Equipped with DSC function (dedicated or time-shared)
Class B band flag	1	0 = Capable of operating over the upper 525 kHz band of the marine band 1 = Capable of operating over the whole marine band (irrelevant if "Class B Message 22 flag" is 0)
Class B Message 22 flag	1	0 = No frequency management via Message 22 , operating on AIS1, AIS2 only 1 = Frequency management via Message 22
Mode flag	1	0 = Station operating in autonomous and continuous mode = default 1 = Station operating in assigned mode
Receiver autonomous integrity monitoring (RAIM-flag)	1	RAIM (Receiver autonomous integrity monitoring) flag of electronic position fixing device; 0 = RAIM not in use = default; 1 = RAIM in use
Communication state selector flag	1	0 = SOTDMA communication state follows 1 = ITDMA communication state follows (always "1" for Class-B "CS")
Communication state	19	SOTDMA communication state. Because Class B "CS" does not use any Communication State information, this field shall be filled with the following value: 1100000000000000110.

Source: United States Coastguard, 2013



**Table 6                      Static Data Fields (Message Type 24)**

Parameter	Number of Bits	Description
<b>Part A</b>		
Message ID	6	Identifier for Message 24; always 24
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more
User ID	30	MMSI number
Part number	2	Identifier for the message part number; always 0 for Part A
Name	120	Name of the MMSI-registered vessel. Maximum 20 characters 6-bit ASCII, @@@@ = not available = default
<b>Part B</b>		
Message ID	6	Identifier for Message 24; always 24
Repeat indicator	2	Used by the repeater to indicate how many times a message has been repeated. 0 = default; 3 = do not repeat any more
User ID	30	MMSI number
Part number	2	Identifier for the message part number; always 1 for Part B
Type of ship and cargo type	8	0 = not available or no ship = default 1-99 = as defined in § 3.3.2 100-199 = reserved, for regional use 200-255 = reserved, for future use
Vendor ID	42	Unique identification of the Unit by a number as defined by the manufacturer (option; " = not available = default)
Call sign	42	Call sign of the MMSI-registered vessel. 7 X 6 bit ASCII characters, " = not available = default
Dimension of ship/reference for position. Or, for unregistered daughter vessels, use the MMSI of the mother ship.	30	Dimensions of ship in meters and reference point for reported position or for an unregistered daughter vessel, use the MMSI of the associated mother ship in this data field
Message ID	6	Identifier for Message 24; always 24
Source: United States Coastguard, 2013		

## 1.5 Spatial Accuracy

The underlying positional accuracy of the dataset is ultimately dependant on the accuracy of navigation equipment on each vessel. AIS-A will have a higher accuracy confidence level due to its installation, connection to ship board positioning technology and testing regime. The International Convention for the Safety of Life at Sea (SOLAS) Chapter V Regulation (19.2) requires ships to carry a receiver for a global navigation satellite system or a terrestrial radio-navigation system, or other means, suitable for use at all times throughout the intended voyage to establish and update the ship's position by automatic means. AIS transponders are connected to the vessel's positioning system, providing automated position fixing. SOLAS Chapter V Regulation (18.9) requires an annual test of shipborne AIS-A systems, which provides an annual check on spatial confidence associated with AIS transmission.

AIS-B spatial accuracy is dependant on the vessels position system accuracy. Irrespective of AIS-A or AIS-B data reception, quality assurance steps should be built into any AIS data interpretation routine to ensure that derived data is checked for errors of positional accuracy, so far as this is possible.

## **1.6 AIS Processing**

AIS data, once decoded is processed to provide positional data records. Individual positional records can be further processed to provide vessel transit tracks. The following provides a summary of AIS decoding and processing steps prior to presenting the derived AIS data.

1. Decoding of AIS signal (positional reports / voyage information);
2. Joining ship static and voyage information with positional reports;
3. Identification of vessel transits;
4. Quality assurance of vessel transit lines;
5. Identification and reporting of vessel AIS processing statistics.

At the completion of the last stage of data processing, the resultant records (depending on record count) are stored within a database and passed into a GIS environment as AIS derived data to produce the required Spatial Data outputs.

## **1.7 AIS Derived Data**

AIS data can be provided in the following formats:

Vessel Positions (point data);  
Transit Lines (polyline data); and  
Density Grid (polygon data).

The tables below outline the data fields, a description and where available a term list and/or format given at the end of each field which should be used to store the data. Each field is either mandatory, conditional or optional as indicated by M, C, or O respectively. Conditional means that the field must be completed if a value is known. [MEDIN note: the following text may need amending/deleting - at the time of writing a spreadsheet has not been created] In the absence of an existing spreadsheet or database to hold the below information, it is recommended that the template available to download from the MEDIN website is used. Instructions are provided in the template.

## 2.0 Vessel Positions

Vessel Positions are used to construct Transit Lines. They contain a uniquely identifiable attribute named Transit ID, a Date Time attribute that contains the date and time the position was recorded, and Latitude and Longitude coordinates provided in the World Geodetic System 1984 (WGS84) geographic coordinate system. At least two Vessel Positions are required to successfully construct a single Transit Line..

Attribute	M, C, O	Description	Recommended Term List or Format
Transit identifier	M	A non-unique identifier which specifies which transit, multiple vessel positions relate to.	Number; (e.g. 1)
Date and time	M	The date and time of derivation.	Date; dd-mm-yyyy; (e.g. 01-10-2013 13:33:00)
Latitude of vessel position (WGS84 decimal degrees)	M	The latitude of the vessel position at the time of derivation. Units are positive north. Six decimal places are recommended.	Decimal degrees; minimum of four and maximum of seven decimal places. (50.798252)
Longitude of vessel position (WGS84 decimal degrees)	M	The latitude of the vessel position at the time of derivation. Units are positive east. Six decimal places are recommended.	Decimal degrees; minimum of four and maximum of seven decimal places. (0.937410)

## 2.1 Transit Lines

Transit Lines visually represent the routes taken by vessels. A single vessel can have multiple transits. Transit Lines are used to determine the values stored in the Density Grid.

Attribute	M, C, O	Description	Recommended Term List or Format
Transit identifier	M	A unique identifier for the transit.	Number; (e.g. 1)
Vessel Type	C	AIS signal derived ship type.	Number; (e.g. 8) – “Tanker”
Vessel Length (metres)	C	AIS signal derived. Derived from two values entered by operator onboard vessel, normally entered and left as a static value.	Number; (e.g. 177) Units = metres
Vessel Width (metres)	C	AIS signal derived. Derived from two values entered by operator onboard vessel, normally entered and left as a static value.	Number; (e.g. 31) Units = metres
Vessel Draught (metres)	C	AIS signal derived, entered by operator onboard vessel, could be changed every transit or during transit.	Number; (e.g. 7.4) Units = metres

Attribute	M, C, O	Description	Recommended Term List or Format
Start Time	M	The time the transit started.	Date; dd-mm-yyyy; (e.g. 01-10-2013 10:33:00)
End Time	M	The time the transit ended.	Date; dd-mm-yyyy; (e.g. 01-10-2013 12:31:00)
Vessel Transit Classification (VTC)	O	<p>Classification that identifies the complete route or combination of routes taken by a vessel in transit(s), from beginning to end.</p> <p>The classification is determined by intersecting the transits with a 0.5 nautical mile buffer of a high resolution UK Coastline layer. The coastline is measured at MHWS, and should be edited to include all anchorage sites.</p>	<p>Attribute domains should be used for enforcing data integrity. Domain type - Coded domain (specifies a valid set of options for the VTC).</p> <p>1 - UK to UK traffic - transits that originated <b>and</b> terminated at a UK port or anchorage;</p> <p>2 - UK to non-UK traffic - transits of vessels that have with in a week period (7 days of 24 hours), included at least one transit that originated <b>or</b> terminated at a UK port or anchorage; and</p> <p>3 - Transitory traffic - transits of vessels that have not in a week period (7 days of 24 hours) originated or terminated a transit at a UK port or anchorage.</p>
Position Density (positions / km)	M	The number of vessel position reports per km that are represented by the transit. A value of zero indicates an inferred transit (where the time interval between position reports exceeds 10 minutes).	Number; (e.g. 7)
Transit End Reason	C	Indicates the reason the transit was terminated.	<p>Attribute domains should be used for enforcing data integrity. Domain type - Coded domain (specifies a valid set of options for the Transit End Reason).</p> <p>0 - End of the period of the input dataset;</p> <p>1 - Position outside the area of interest;</p> <p>2 - Contact lost;</p> <p>3 - Intermittent contact (position reports greater than 10 minutes apart);</p> <p>4 - Intermittent contact finished, normal contact restored;</p> <p>5 - Normal transit termination. SOG falls below 0.2 knots for more than 5mins;</p>

Attribute	M, C, O	Description	Recommended Term List or Format
			6 - QA checks on consecutive positions result in repeated invalid points.
Voyage Data Source	M	This code indicates if the data for the vessel information (draught, etc) is derived from data associated with the mid point (in time) of the transit (code 1) or from a period of time before or after the transit duration (code 2).	Attribute domains should be used for enforcing data integrity. Domain type - Coded domain (specifies a valid set of options for the Voyage Data Source).  1 - Derived from mid point of transit;  2 - Derived before or after the duration of the transit.

## 2.2 AIS Density Grid

The primary purpose of the density grid is to map the density of vessel transits for the period of time represented within the data. This is achieved through a spatial join which intersects the transit lines with the grid, and counts the number of times a transit line passes through each individual cell. On completion of the join, each grid cell can be displayed as a different colour using the transit density attribute as the parameter. In addition to the density grid's primary use of storing transit density, further analysis can be undertaken on the transits resulting in a more comprehensive, detailed and more useful data product. The density grid can also be displayed using other attributes, such as type, dimension or Vessel Transit Classification to provide a more explicit density grid view.

Attribute	M, C, O	Description	Recommended Term List or Format
Cell ID	M	Unique key used to identify each grid cell.	Number; (e.g. 1)
Density	M	A value that holds the number of transits that intersect the grid cell. The depth of analysis undertaken and resultant attributes created depend on the requirements of the project. The attributes contained in the Transit Line allow for the following density variations: <ul style="list-style-type: none"> <li>Ship Type Density: Number of transits that intersect the grid cell, over a specified period of time; for example</li> </ul>	Number; (e.g. 200)

Attribute	M, C, O	Description	Recommended Term List or Format
		<p>where the vessel type is a 'Cargo'.</p> <ul style="list-style-type: none"> <li>▪ Dimension (draught, length, beam) Density: Number of transits that intersect the grid cell, over a specified period of time, for example, where the vessel draught is small.</li> <li>▪ VTC Density: Number of transits that intersect the grid cell, over a specified period of time; for example where the transit had a Vessel Transit Classification of 1.</li> </ul>	

## References

United States Coastguard, 2013. 'AIS Messages'. Accessed: 11 March 2013. <http://www.navcen.uscg.gov/?pageName=AISMessages>. Last Updated 17 March 2011