Paper for Consideration by TSMAD and DIPWG

AIS Aid to Navigation modelling in S-101

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Executive Summary:	This paper outlines further options available for the modelling of an AIS aid to navigation in S-101. These options are to be discussed by TSMAD and DIPWG to ensure the best solution for implementation in S-101.
Related Documents:	S-101 Appendix A - Data Classification and Encoding Guide, TSMAD25-4.10.2 rev1, TSMAD26 DCEG 7 20_AIS Proposals.doc
Related Projects:	S-101

Introduction / Background

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

Currently the Data Classification and Encoding Guide (DCEG) Baseline Version - January 2014 shows a generic **AIS aid to navigation** feature encompassing two different categories of AIS aid to navigation:

- physical (which includes synthetic) - where the physical aid to navigation exists
- virtual - where the physical aid to navigation does not exist

The following options for the modelling of an AIS aid to navigation in S-101 differentiate between the two categories, physical and virtual, thereby avoiding any confusion for the encoder.

The two options for the modelling of an AIS aid to navigation in S-101 outlined in this paper are to be discussed by TSMAD and DIPWG to determine the best solution for implementation in S-101.

Analysis/Discussion

The two options below show the modelling for an AIS aid to navigation in S-101.

Option 1 - Two features (Annex A)

The following two features are used to encode an AIS aid to navigation:

Physical AIS aid to navigation feature is used to encode physical and synthetic AIS aids to navigation.
Virtual AIS aid to navigation feature is used to encode virtual AIS aids to navigation.

The **Physical AIS aid to navigation** feature must be encoded, where required, using the geometry of the physical aid to navigation from which the AIS signal is transmitted or appears to be transmitted, whereas a supporting structure must not be encoded for the **Virtual AIS aid to navigation** feature.

Annex A shows the two features proposed for Option 1: **Physical AIS aid to navigation** and **Virtual AIS aid to navigation**.

Option 2 - One feature and one complex attribute (Annex B)

As for Option 1, a **Virtual AIS aid to navigation** feature is used to encode a virtual AIS aid to navigation.

For each relevant navigational aid feature the complex attribute **Physical AIS aid to navigation** is used to encode physical and synthetic AIS aids to navigation.

Annex B shows the proposals for Option 2, the **Virtual AIS aid to navigation** feature and an example of the **Buoy lateral** feature, with complex attribute **Physical AIS aid to navigation**.

Conclusions

Both options show a **Virtual AIS aid to navigation** feature, in order to clearly differentiate between the physical/synthetic AIS aids to navigation and virtual AIS aids to navigation.

Option 1 uses feature **Physical AIS aid to navigation** which provides more flexibility, whereas Option 2 uses complex attribute **Physical AIS aid to navigation** on the relevant aid to navigation features and is therefore more intuitive to the encoder.

With the use of the two features, **Physical AIS aid to navigation** and **Virtual AIS aid to navigation**, in Option 1 and the use of the complex attribute feature **Physical AIS aid to navigation** and feature **Virtual AIS aid to navigation,** in Option 2, the attribute **Category of AIS aid to navigation** is no longer required.

An introduction to AIS aids to navigation at the beginning of section 20 Geo features - Radar, Radio would be beneficial to the encoder in highlighting the different categories of AIS aids to navigation; an example introduction has been included for Options 1 and 2 in the Annexes.

Recommendations

It is recommended that TSMAD and DIPWG consider and discuss the two options above to ensure agreement on the best solution for implementation in S-101.

The values used for the **Status** attribute for the **Virtual AIS aid to navigation** feature are to be discussed by TSMAD and DIPWG to ensure agreement.

It is recommended that TSMAD and DIPWG discuss the values used for the **Status** attribute for the **Buoy emergency wreck marking** feature to ensure agreement and to provide an additional note for the encoder.

Action Required of TSMAD and DIPWG

The TSMAD and DIPWG are invited to:

a. discuss the proposed options for the modelling of an AIS aid to navigation in S-101.
b. agree the option to be used for the modelling of an AIS aid to navigation in S-101.
c. discuss the values to be used for the **Status** attribute for the **Virtual AIS aid to navigation** feature.
d. agree the values to be used for the **Status** attribute for the **Virtual AIS aid to navigation** feature.
e. discuss the values to be used for the **Status** attribute for the **Buoy emergency wreck marking** feature.
f. agree the values to be used for the **Status** attribute for the **Buoy emergency wreck marking** feature.
g. agree an additional note for the **Status** attribute for the **Buoy emergency wreck marking** feature.
h. S-101 DCEG Sub-WG to amend the DCEG accordingly.

20 Geo Features - Radar, Radio

20.1 AIS aid to navigation

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

If it is required to encode an AIS aid to navigation, it must be done as follows:

- Physical AIS aids to navigation must be encoded, where required, using the geometry of the physical aid to navigation, with a **Physical AIS aid to navigation** feature.
- Synthetic AIS aids to navigation must be encoded, where required, using the geometry of the physical aid to navigation from which the AIS signal appears to be transmitted, with a **Physical AIS aid to navigation** feature. If it is required to encode the actual location from which the signal is transmitted, it must be done using a **Radio Station** feature (see clause X.X), with attribute **category of radio station** = *20* (AIS base station).
- Virtual AIS aids to navigation should only be encoded where it is known that the Virtual aid is intended to be permanent, or deployed for a specified fixed period. Where it is known that a Virtual AIS aid to navigation is moved or withdrawn on a regular basis and/or at short notice, such that implementing these changes through the application of ENC Updates is impractical, the Virtual aid should not be encoded. Virtual AIS aids to navigation must be encoded, where required, using a **Virtual AIS aid to navigation** feature. Supporting structures must not be encoded for this feature.
- The unique Maritime Mobile Service Identity (MMSI) code for the AIS aid to navigation should be encoded, where known, using the attribute **MMSI code**.

20.2 Physical AIS aid to navigation

IHO Definition: **PHYSICAL AIS AID TO NAVIGATION**. An Automatic Identification System (AIS) message 21 transmitted from a physical Aid to Navigation which physically exists. (Adapted from IALA Recommendation A-126).

S-101 Geo Feature: Physical AIS aid to navigation

Primitives: Point

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
AIS aid to navigation type		1 : north cardinal 2 : east cardinal 3 : south cardinal 4 : west cardinal 5 : port lateral 6 : starboard lateral 7 : preferred channel to port 8 : preferred channel to starboard 9 : isolated danger 10 : safe water 11 : special purpose 12 : emergency wreck marking	EN	1,1
Estimated range of transmission	(ESTRNG)		RE	0,1
Feature name			C	0,*
Display name			(S) BO	0,1
Language		ISO 639-3	(S) TE	0,1
Name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
Fixed date range			C	0,1
Date end	(DATEND)	ISO 8601: 2004	(S) DA	0,1
Date start	(DATSTA)	ISO 8601: 2004	(S) DA	0,1
MMSI code			IN	0,1
Periodic date range			C	0,*
Date end	*(PEREND)*	ISO 8601: 2004	(S) DA	1,1
Date start	*(PERSTA)*	ISO 8601: 2004	(S) DA	1,1
Status	(STATUS)	1 : permanent 5 : periodic/intermittent 7 : temporary	EN	0,1
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Scale minimum	(SCAMIN)	See clause X.X	IN	0,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

Association	Acronym	Role	Multiplicity
Structure/equipment	**Physical AIS Aid to Navigation**	Supported by	1,1

INT 1 Reference: S ??

20.2.1 Automatic Identification System (AIS) aids to navigation (see S-4 – B-480-484)

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

If it is required to encode a physical AIS aid to navigation, it must be done using the feature **Physical AIS aid to navigation**.

Remarks:

- Physical AIS aids to navigation must be encoded, where required, using the geometry of the physical aid to navigation, with a **Physical AIS aid to navigation** feature.
- Synthetic AIS aids to navigation must be encoded, where required, using the geometry of the physical aid to navigation from which the AIS signal appears to be transmitted, with a **Physical AIS aid to navigation** feature. If it is required to encode the actual location from which the signal is transmitted, it must be done using a **Radio Station** feature (see clause X.X), with attribute **category of radio station** = *20* (AIS base station).
- The unique Maritime Mobile Service Identity (MMSI) code for the AIS aid to navigation should be encoded, where known, using the attribute **MMSI code**.

Distinction: Virtual AIS aid to navigation, Radar station; radio station; radio calling-in point.

20.3 Virtual AIS aid to navigation

IHO Definition: **VIRTUAL AIS AID TO NAVIGATION**. An Automatic Identification System (AIS) message 21 transmitted from an AIS station for an Aid to Navigation which does not physically exist. (Adapted from IALA Recommendation A-126).

S-101 Geo Feature: Virtual AIS aid to navigation

Primitives: Point

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
AIS aid to navigation type		1 : north cardinal 2 : east cardinal 3 : south cardinal 4 : west cardinal 5 : port lateral 6 : starboard lateral 7 : preferred channel to port 8 : preferred channel to starboard 9 : isolated danger 10 : safe water 11 : special purpose 12 : emergency wreck marking	EN	1,1
Estimated range of transmission	(ESTRNG)		RE	0,1
Feature name			C	0,*
Display name			(S) BO	0,1
Language		ISO 639-3	(S) TE	0,1
Name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
Fixed date range			C	0,1
Date end	(DATEND)	ISO 8601: 2004	(S) DA	0,1
Date start	(DATSTA)	ISO 8601: 2004	(S) DA	0,1
MMSI code			IN	0,1
Periodic date range			C	0,*
Date end	*(PEREND)*	ISO 8601: 2004	(S) DA	1,1
Date start	*(PERSTA)*	ISO 8601: 2004	(S) DA	1,1
Status	(STATUS)	1 : permanent 5 : periodic/intermittent 7 : temporary	EN	0,1
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Scale minimum	(SCAMIN)	See clause X.X	IN	0,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

INT 1 Reference: S ??

20.3.1 Automatic Identification System (AIS) aids to navigation (see S-4 – B-480-484)

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

If it is required to encode a virtual AIS aid to navigation, it must be done using the feature **Virtual AIS aid to navigation**.

Remarks:

- Virtual AIS aids to navigation should only be encoded where it is known that the Virtual aid is intended to be permanent, or deployed for a specified fixed period. Where it is known that a Virtual AIS aid to navigation is moved or withdrawn on a regular basis and/or at short notice, such that implementing these changes through the application of ENC Updates is impractical, the Virtual aid should not be encoded. Virtual AIS aids to navigation must be encoded, where required, using a **Virtual AIS aid to navigation** feature. Supporting structures must not be encoded for this feature.
- The unique Maritime Mobile Service Identity (MMSI) code for the AIS aid to navigation should be encoded, where known, using the attribute **MMSI code**.

Distinction: Physical AIS aid to navigation; Radar station; radio station; radio calling-in point.

19.1 Lateral buoys

IHO Definition: **BUOY LATERAL MARKS**. A buoy is a floating object moored to the bottom in a particular place, as an aid to navigation or for other specific purposes. (IHO Dictionary – S-32).
A lateral buoy is used to indicate the port or starboard hand side of the route to be followed. They are generally used for well defined channels and are used in conjunction with a conventional direction of buoyage. (UKHO NP 735, 5th Edition).

S-101 Geo Feature: Buoy lateral (BOYLAT)

Primitives: Point

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Buoy shape	(BOYSHP)	1 : conical (nun, ogival) 2 : can (cylindrical) 3 : spherical 4 : pillar 5 : spar (spindle) 6 : barrel (tun) 7 : superbuoy 8 : ice buoy	EN	1,1
Category of lateral mark	(CATLAM)	1 : port-hand lateral mark 2 : starboard-hand lateral mark 3 : preferred channel to starboard lateral mark 4 : preferred channel to port lateral mark	EN	1,1
Colour	(COLOUR)	1 : white 2 : black 3 : red 4 : green 5 : blue 6 : yellow 7 : grey 8 : brown 9 : amber 10 : violet 11 : orange 12 : magenta 13 : pink	EN	1,* (ordered)
Colour pattern	(COLPAT)	1 : horizontal stripes 2 : vertical stripes 3 : diagonal stripes 4 : squared 5 : stripes (direction unknown) 6 : border stripe	EN	0,1
Feature name			C	0,*
Display name			(S) BO	0,1
Language		ISO 639-3	(S) TE	0,1
Name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
Fixed date range			C	0,1
Date end	(DATEND)	ISO 8601: 2004	(S) DA	0,1
Date start	(DATSTA)	ISO 8601: 2004	(S) DA	0,1
Marks navigational – system of	(MARSYS)	1 : IALA A 2 : IALA B 9 : no system 10 : other system 11 : CEVNI	EN	0,1
Nature of construction	(NATCON)	6 : wooden 7 : metal 8 : glass reinforced plastic (GRP)	EN	0,*

		11 : latticed		
Periodic date range			C	0,*
Date end	*(PEREND)*	ISO 8601: 2004	(S) DA	1,1
Date start	*(PERSTA)*	ISO 8601: 2004	(S) DA	1,1
Radar conspicuous	(CONRAD)		BO	0,1
Status	(STATUS)	1 : permanent 2 : occasional 5 : periodic/intermittent 7 : temporary 8 : private 18 : existence doubtful	EN	0,*
Topmark	*(TOPMAR)*		C	0,1
Colour	(COLOUR)	1 : white 2 : black 3 : red 4 : green 5 : blue 6 : yellow 7 : grey 8 : brown 9 : amber 10 : violet 11 : orange 12 : magenta 13 : pink	(S) EN	0,1
Topmark/daymark shape	(TOPSHP)	1 : cone, point up 2 : cone, point down 3 : sphere 4 : 2 spheres 5 : cylinder (can) 6 : board 7 : x-shape (St. Andrew's cross) 8 : upright cross (St George's cross) 9 : cube, point up 10 : 2 cones, point to point 11 : 2 cones, base to base 12 : rhombus (diamond) 13 : 2 cones (points upward) 14 : 2 cones (points downward) 15 : besom, point up (broom or perch) 16 : besom, point down (broom or perch) 17 : flag 18 : sphere over rhombus 19 : square 20 : rectangle, horizontal 21 : rectangle, vertical 22 : trapezium, up 23 : trapezium, down 24 : triangle, point up 25 : triangle, point down 26 : circle 27 : two upright crosses (one over the other) 28 : T-shape 29 : triangle pointing up over a circle 30 : upright cross over a circle 31 : rhombus over a circle 32 : circle over a triangle pointing up 33 : other shape (see **information**)	(S) EN	1,1
Information			(S) C	0,*
Language		ISO 639-3	(S) TE	0,1

Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Physical AIS aid to navigation			C	0,1
AIS aid to navigation type		1 : north cardinal 2 : east cardinal 3 : south cardinal 4 : west cardinal 5 : port lateral 6 : starboard lateral 7 : preferred channel to port 8 : preferred channel to starboard 9 : isolated danger 10 : safe water 11 : special purpose 12 : emergency wreck marking	(S) EN	1,1
Estimated range of transmission	(ESTRNG)		(S) RE	0,1
Feature name			(S) C	0,*
Display name			(S) BO	0,1
Language		ISO 639-3	(S) TE	0,1
Name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
Fixed date range			(S) C	0,1
Date end	(DATEND)	ISO 8601: 2004	(S) DA	0,1
Date start	(DATSTA)	ISO 8601: 2004	(S) DA	0,1
MMSI code			(S) IN	0,1
Periodic date range			(S) C	0,*
Date end	*(PEREND)*	ISO 8601: 2004	(S) DA	1,1
Date start	*(PERSTA)*	ISO 8601: 2004	(S) DA	1,1
Status	(STATUS)	1 : permanent 5 : periodic/intermittent 7 : temporary	(S) EN	0,1
Information			(S) C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Textual description			(S) C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1
Vertical length	(VERLEN)		RE	0,1
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Pictorial representation	(PICREP)		TE	0,1
Scale minimum	(SCAMIN)	See clause X.X	IN	0,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1
Association	**Acronym**	**Role**	**Multiplicity**	
Structure/equipment	**Buoy Lateral**	Supports	0,1	

Add to the Remarks: If it is required to encode a physical AIS aid to navigation, it must be done using the complex attribute **physical AIS aid to navigation**.

20 Geo Features - Radar, Radio

20.1 AIS aid to navigation

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

If it is required to encode an AIS aid to navigation, it must be done as follows:

- Physical AIS aids to navigation must be encoded, where required, using the relevant navigational aid feature, with complex attribute **physical AIS aid to navigation**.
- Synthetic AIS aids to navigation must be encoded, where required, using the relevant navigational aid feature from which the AIS signal appears to be transmitted, with complex attribute **physical AIS aid to navigation**. If it is required to encode the actual location from which the signal is transmitted, it must be done using a **Radio Station** feature (see clause X.X), with attribute **category of radio station** = *20* (AIS base station).
- Virtual AIS aids to navigation should only be encoded where it is known that the Virtual aid is intended to be permanent, or deployed for a specified fixed period. Where it is known that a Virtual AIS aid to navigation is moved or withdrawn on a regular basis and/or at short notice, such that implementing these changes through the application of ENC Updates is impractical, the Virtual aid should not be encoded. Virtual AIS aids to navigation must be encoded, where required, using a **Virtual AIS aid to navigation** feature. Supporting structures must not be encoded for this feature.
- The unique Maritime Mobile Service Identity (MMSI) code for the AIS aid to navigation should be encoded, where known, using the attribute **MMSI code**.

20.2 Virtual AIS aid to navigation

IHO Definition: **VIRTUAL AIS AID TO NAVIGATION**. An Automatic Identification System (AIS) message 21 transmitted from an AIS station for an Aid to Navigation which does not physically exist. (Adapted from IALA Recommendation A-126).

S-101 Geo Feature: Virtual AIS aid to navigation

Primitives: Point

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
AIS aid to navigation type		1 : north cardinal 2 : east cardinal 3 : south cardinal 4 : west cardinal 5 : port lateral 6 : starboard lateral 7 : preferred channel to port 8 : preferred channel to starboard 9 : isolated danger 10 : safe water 11 : special purpose 12 : emergency wreck marking	EN	1,1
Estimated range of transmission	(ESTRNG)		RE	0,1
Feature name			C	0,*
Display name			(S) BO	0,1
Language		ISO 639-3	(S) TE	0,1
Name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
Fixed date range			C	0,1
Date end	(DATEND)	ISO 8601: 2004	(S) DA	0,1
Date start	(DATSTA)	ISO 8601: 2004	(S) DA	0,1
MMSI code			IN	0,1
Periodic date range			C	0,*
Date end	*(PEREND)*	ISO 8601: 2004	(S) DA	1,1
Date start	*(PERSTA)*	ISO 8601: 2004	(S) DA	1,1
Status	(STATUS)	1 : permanent 5 : periodic/intermittent 7 : temporary	EN	0,1
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Scale minimum	(SCAMIN)	See clause X.X	IN	0,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

INT 1 Reference: S ??

20.2.1 Automatic Identification System (AIS) aids to navigation (see S-4 – B-480-484)

AIS signals used as an aid to navigation may:

- actually be transmitted from a physical aid to navigation (physical AIS aid to navigation);
- appear to be transmitted from a physical aid to navigation but is actually transmitted from an AIS base station (synthetic AIS aid to navigation); or
- be transmitted from an AIS base station to represent an aid to navigation where a physical aid to navigation does not exist (virtual AIS aid to navigation).

If it is required to encode a virtual AIS aid to navigation, it must be done using the feature **Virtual**

AIS aid to navigation.

Remarks:

- Virtual AIS aids to navigation should only be encoded where it is known that the Virtual aid is intended to be permanent, or deployed for a specified fixed period. Where it is known that a Virtual AIS aid to navigation is moved or withdrawn on a regular basis and/or at short notice, such that implementing these changes through the application of ENC Updates is impractical, the Virtual aid should not be encoded. Virtual AIS aids to navigation must be encoded, where required, using a **Virtual AIS aid to navigation** feature. Supporting structures must not be encoded for this feature.
- The unique Maritime Mobile Service Identity (MMSI) code for the AIS aid to navigation should be encoded, where known, using the attribute **MMSI code**.

Distinction: Radar station; radio station; radio calling-in point.