Liaison Note to ITU-R WP5B

Spectrum requirements for e-Navigation under WRC-12 Agenda Item 1.10 and Future WRC-16 Agenda Item for e-Navigation

# Introduction

IALA thanks ITU-R WP5B for the information provided in its liaison note Annex 30 to Document 5B/532. Resolution 357 (WRC-07) invites IALA (together with IMO and IEC) to contribute to studies for WRC-12 agenda item 1.10 on the future use of the spectrum. Noting that IMO is developing e-Navigation and has commenced a scoping exercise on the next generation of GMDSS, IALA proposes its initial requirements for e-Navigation under Agenda item 1.10.

# Discussion

IALA has developed a World Wide Radio Navigation Plan (WWRNP) and a Maritime Radio Communications Plan (MRCP) that addresses current and future e-Navigation requirements for maritime navigation and communication systems. ITU-R WP5B noted the WWRNP and MRCP plans at its May 2010 meeting. IALA envisages initial spectrum requirements for e-Navigation can be fulfilled under WRC-12 Agenda item 1.10. The recommendations listed below should be considered by ITU-R WP5B under agenda item 1.10 at WRC-12 to satisfy initial e-Navigation spectrum requirements. However, IALA believes a WRC-16 agenda item will be necessary to meet the spectrum requirements that will continue to evolve for e-Navigation and modernization of the GMDSS.

# Recommendation

‘e-Navigation’ as defined by IMO and envisioned by IALA requires appropriate provisions within the Radio Regulations as follows:

1. The protection of AIS1 and AIS2 channels for the safety of navigation as well as distress and safety communications. In addition, allow AIS transmissions by SAR aircraft. The Method A1 for Agenda item 1.10 in the draft CPM report satisfies this recommendation.
2. AIS channels for satellite tracking (channels 75 and 76). The Method B1 or B2 for Agenda item 1.10 in the draft CPM report satisfies this recommendation.
3. Additional channels for the next generation of AIS (AIS V2). The Annex to this document describes the rapid expansion of AIS and the importance of AIS in e-Navigation. IALA envisages the necessity of a next generation of AIS (AIS V2), which would require two additional channels for low volume TDMA digital communications using AIS techniques. IALA recommends selecting these channels from the digital bands defined in Method D1 for Agenda item 1.10 in the draft CPM report. \* The attached AIS channel plan defines the future use of AIS.
4. Spectrum resources for application of the VHF data service as described in Recommendation ITU-R M.1842-1 annexes 3 and 4. IALA envisages e-Navigation would require a minimum capacity of 150 kHz equivalent to six 25 kHz channels. The digital bands defined in Method D1 for Agenda item 1.10 in the draft CPM report satisfies this recommendation.
5. IALA supports Method C for Agenda item 1.10 in the draft CPM report for the retention of the spectrum around 500 kHz for future maritime digital data systems to support e-Navigation. IALA is of the view that allowing secondary use around 500 kHz by amateur service would impact the safety of navigation for the maritime mobile service.
6. WRC-16 new Agenda item for e-Navigation and GMDSS modernisation.

# Action requested

IALA invites ITU-R WP5B to consider the above recommendations.

1. Annex - AIS Channel Plan

# AIS for e-Navigation

* AIS is a proven technology suitable for playing a significant role in data communications for e-Navigation, however
  + By design AIS is not an ideal candidate for high speed and/or high volume data communications
  + High speed digital data communications for e-Navigation is better handled by using multiple 25KHz channels
  + The IMO ITU joint experts group has recognised that more than 200 Kbps will be necessary for e-Navigation
* This document proposes a vision for a future second generation AIS to efficiently handle new applications as well as low volume data communications for e-Navigation.

# AIS today

* AIS is technically defined by ITU-R M.1371, mandatory for SOLAS vessels and for other vessels on a regional basis, and used voluntarily
* AIS has proved to be a powerful tool for various applications in the field of navigation, and distribution of safety related information, however these applications have not yet fully been exploited
* Appendix 15 RR (WRC-07) defines the frequencies used for GMDSS, and it includes the frequencies AIS1 and AIS2 used by AIS SART stations.

# Increasing use of AIS

The use of AIS is increasing rapidly, threatening to degrade the performance or to overload the current AIS frequencies AIS1 and AIS2.

### Number of ships

* Full implementation of SOLAS requirement for AIS is completed
* Increased use of mandatory AIS on non-SOLAS vessels is evident
  + USA (USA commercial vessels)
  + Europe (EU Directive for fishing vessels requiring Class-A AIS )
  + Europe (EU Directive for inland vessels requiring Inland AIS (Class-A derivative)
  + Korea
  + India
  + Mexico
  + Australia
* Increased voluntary use of AIS
  + Both Class-A and Class-B units used on smaller vessels including rapidly increasing numbers of pleasure vessels
* Class-B increasing use
  + Class-B (CSTDMA) visibility will eventually be reduced due to polite behaviour

### AIS Base stations

* Coastal and inland AIS infrastructure continues to grow
  + Driven by safety, security, and environmental protection considerations
  + EU Directive 59 requires all member countries to maintain coastal AIS coverage

### Airborne AIS

* More SAR aircraft are being fitted with AIS stations

### AIS AtoN, real or virtual, and AtoN monitoring

* AIS AtoN - real and virtual – are being used or approved by competent authorities
* A separate message for AtoN monitoring (often Message 6) is being used in most cases where an AIS AtoN station is deployed
* In addition, AIS AtoN stations are being deployed by commercial organisations to mark offshore platforms, wind farms, etc.

### AIS SART

* IMO carriage option for the AIS SART starts in January 2010
  + Broadcasts eight times per minute on AIS1 and AIS2

### Application Specific messages

##### International

* IMO SN/Circ. 236 international messages trial is now complete
* Recommendations of the IMO CG on application specific messages
  + Recommended retention of most of these international application specific messages and the addition of new messages
    - E.g. a new meteorological-hydrological message with a dynamic length of 2 to 5 slots
    - E.g. an area message for navigational warnings

##### Regional

* Extensive use of safety-related application specific messages for AtoN monitoring
* Application specific messages being used in certain waterways
  + E.g. St Lawrence seaway
* IALA is maintaining a registry of these regional application specific messages

##### Mandatory application specific messaging in certain regions

* Additional application specific messages are being used for inland AIS in Europe
  + Dedicated ship stations are type approved and in use

### New AIS messages (23, 24, 25, 26 and 27)

* Messages 23, 24, 25, and 26 were added in recent editions of ITU-R.M1371
* Message 27 was added in the IALA Technical Clarifications on ITU-R M.1371-3

### GNSS differential corrections

* Use of Message 17 for GNSS correction data dissemination is increasing
  + E.g. already being broadcast in Gulf of Finland, Tokyo Bay
  + E.g. Germany, Netherlands, England are planning

### FATDMA usage

* Competent authorities are increasingly using FATDMA slot allocations for various uses
  + AIS AtoN
  + Base Station slot reservation broadcasts (Message 20)
  + Base Station regular broadcasts (Message 17)
  + Reserved slots for ship replies
  + Safety text messages
  + Meteorological and hydrological messages (Message 8)
* There is an indication that the VHF Data Link will become more crowded and competent authorities resort to FATDMA reservations to ensure that their services are protected

# Additional future use of AIS

### Increased use of AIS shore to ship data transmissions

* In a future e-Navigation scenario, the transmission of AIS data from shore to ship is expected to increase significantly with the advent of mandatory ECDIS
  + Examples
    - Ship off track warning
    - Territorial water advice
    - Environmental area warning
    - Navigational hazards
    - Weather warnings
    - Military test ranges and submarine exercises
* Some of the present voice communications between shore and ship will move to AIS messaging
  + E.g. ship reporting
  + Route information

### Increased use of ship-shore data transfer

* Ship reporting by AIS
* Requesting data
  + Weather data
  + Docking data
  + Route information

### Increased use of ship-ship data transmissions

* Reduced use of voice communications in favour of AIS messages

### Limited Base station

* There will be more fixed stations, some of these being private
* Development of limited base stations will be driven by
  + Private ports
  + Bridges and locks
  + Canals
  + Offshore commercial facilities

### Repeater station

* Repeaters will be used to extend coverage of shore AIS base station networks, and ship-ship AIS communications, and AIS AtoN range
  + Requiring double the VDL slot count to transfer data
  + And are deployed to extend base station coverage when the usual base station to base station data links are unavailable

### Future messaging

* Will be required as the suite of ITU-R M.1371 messages increases
  + Originally 22 message types, now 27 are proposed
* Improved set of messages are expected:
  + Replacement for some old messages, when they have proved not to support proper data modelling (e.g. static ship data)
  + Reduction of tailored messages to essentially needed messages (“statements of the AIS device of its own”), while increasing the proportion of the transparent data container messaging (“passing information of other components/entities”): properly designed application specific message realm (e.g. also “safety related texts” would be some application specific messages)
* New flexibility for applications

### Satellite detection of AIS

* Research continues on enhanced methods of detecting AIS signal, and hence monitoring shipping, by satellite
* Satellite detection of AIS messages has been requested by administrations.
* Separate frequencies for satellite detection of AIS should be selected from within Appendix **18** because the tuning range of the shipborne AIS Class A is limited to these frequencies. Report ITU-R M.2084 indicated that the interference environment resulting from the existing services in those bands must be taken into account in determining the feasibility of accommodating satellite AIS, due to the large satellite antenna footprint that overlaps both land and sea. Separate operating frequencies in addition to AIS 1 and AIS 2 are needed that are not subject to terrestrial use.
* Appendix **18** contains only 3 frequencies (channels 16, 75 and 76) that are exclusively dedicated to maritime use (channels 75 and 76 are proposed to be shared with this service). This proposal meets the intent of footnote *n)* to Appendix **18** for interference mitigation.

### Future GMDSS platform

* COMSAR has been tasked to modify the performance standard for the 406 MHz EPIRB to include use of AIS. This suggests the use of AIS as a GMDSS alerting device.
* IMO has recognised AIS-SART as part of GMDSS. The potential for additional use of AIS as a part of GMDSS such as the future replacement of VHF DSC should be brought to the attention of IMO

### PLB (Personal Locating Beacon)

* There are initiatives to develop a PLB based on the AIS SART technology

### Use of AIS for PNT (Position, Navigation and Timing) and Ranging

* Improved time transfer capabilities shore to ship by using high precision time bases has been proposed.
* The e-Navigation Committee envisages a “Ranging” mode for AIS
  + Where the timing of AIS messages are used for position determination
  + By ship and shore

### Coordinated channel management for future e-Navigation VHF digital data communications

* Designation of additional AIS frequencies may enhance the coordination of regional channel management.
* Using TDMA protocol on channel 70 to coordinate the usage of the VHF Data Link will enable channel management for other e-Navigation data services as well as AIS.

# Strategy for future AIS

### General thoughts

* AIS is a proven maritime data system, with ships equipped and shore infrastructure established, the full potential of AIS is yet to be achieved
* AIS is the quickest path for handling the increasing low volume data exchange needs described above.
* Therefore, in order to meet the data communications needs set out above, IALA envisages that the present AIS system will need to develop into a future second generation AIS.

### AIS Channel plan

* Safety of Navigation purposes
  + The AIS-1 and AIS-2 are internationally allocated on a sharing basis. These frequencies should be retained and protected for safety of navigation purposes.
* Satellite detection of AIS and future GMDSS
  + Since the satellites have very wide footprint, the frequencies for satellite detection of AIS should be exclusive for maritime mobile service. The preliminary draft report ITU-R M.[SAT-AIS] proposes to use CH75 and CH76. These channels are guard band channels of CH16 and are only maritime dedicated channels except CH16 and CH70.
  + In the future GMDSS should be based on AIS technologies. The distress alerting, urgency and safety communications should be by both terrestrial and satellite communications; therefore the maritime exclusive frequencies are needed. The satellite detection of AIS is one way system (from earth to satellite); however in the GMDSS, the acknowledgement (from satellite to earth) is essential as the two way system. The CH75 and CH76 will be used for this purpose.
* Data communication purposes

In considering the future AIS system for terrestrial (non satellite) low volume data communication purposes, an additional two frequencies will be needed. These frequencies should be selected within the Appendix 18. The Appendix 18 covers 156-162.025MHz; however the current channelling arrangements only apply to limited parts of the band. As shown in the figure below, the blue bands (sharing basis) and red bands (maritime exclusive) are channelized. The yellow bands (sharing basis) are not channelized. The yellow bands may be available for maritime mobile as well as terrestrial services and candidate frequencies may be selected on a sharing basis.



* Channel management purposes
  + In order to fully use available VHF spectrum there must be a worldwide channel dedicated to manage and coordinate usage of the VHF Data Link.
  + TDMA or other protocols may share Channel 70 with minor changes to Appendix 18, footnote j) according to ITU-R M.822-1.

Future requirements for AIS channels

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **AIS frequency pair** | ***AIS-1 & AIS-2***  ***Safety of Navigation*** | ***AIS-3 & AIS-4***  ***Vessel tracking and future GMDSS*** | ***AIS-5 & AIS-6***  ***Data Communication*** | ***Channel 70***  ***Channel Management for data communication*** |
| **Purpose** | * Safety of navigation * Maritime and inland distress and safety communications | * Space detection of AIS * Future GMDSS | * Marine safety information * General purpose information communication | * Management of VHF VDL in harmony with current ITU-R M. 822-1 |
| **Frequency allocation** | * Allocated / needs to be dedicated | * New / dedicated channels required | * New / shared channels required | * Allocated and dedicated |
| **AIS Message types** | * static and dynamic data | * space detection of AIS * Other messages for support of future GMDSS | * Regional AIS binary messages * S/N Circ 236 international AIS binary messages | * TDMA system management messages e.g Message 20, Message 22, * Other messages for support of coordinating channel sharing |
| **Typical applications** | * Ship to ship collision avoidance * VTS tools * Tracking of ships * Locating in GMDSS | * Detection of vessels by coastal states beyond range of coastal AIS base stations * Two way distress communications | * Area warnings and advice * Meteorological and hydrological data * Traffic management * Channel management of AIS channels and future VHF digital data channels * Ship-shore data exchange | * Channel switching * FATDMA allocation, * Assignment |
| **Proposed channels in Appendix 18** | * As now | * Channel 75 and 76 | * World-wide dedicated channels are preferred, but if this is not possible, then the non channelised band may be used for the candidate channels | * As now but requires Appendix 18, Footnote j), and ITU-R M. 822 modification |
| **Comments** |  | * IMO COMSAR has been tasked to study future GMDSS technology and timetable, and what changes in SOLAS are required. Two COMSAR sessions from 2010-03 are allocated (2 years). * The USA and other countries have proposed to IMO and ITU that a third AIS channel be designated to enhance the reception of AIS signals by satellite. |  | Expanded use of channel 70 to improve efficiency |

### Airborne AIS

* ITU Radio Regulations Article 51 Section III sets limits on aircraft VHF usage
  + This will be required to allow aircraft effective use for AIS message transmission in SAR cases
* It may also require change in the future to permit and/or prohibit certain AIS message transmission

### Legacy strategy

* Future advances in AIS will require updates to legacy systems
* Legacy functionality will be maintained
* Channel management, using Channel 70, already available internationally, should be maintained until it is replaced by another internationally agreed method of channel management

# Benefits of future AIS for the users

* Dedicated frequencies will provide for greater safety and integrity of data link, providing better protection for the transfer of safety related messages
* Use of AIS for maritime information dissemination will mean that Navtex will not be needed for ships navigating in Area A1
* The possibility will be created to support the future function of AIS in GMDSS, with the benefit of making distressed vessels visible to all resources (land sea and air) in the vicinity
* Existing shipboard AIS installations infrastructure could be upgraded
* Satellite detection of AIS will be facilitated

The rapidly increasing use of data transfer for the efficiency of navigation will be facilitated