Maritime wireless communications

Pacific Radiocommunication Workshop 2018 (PRW-18)

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CELEBRATING 25 YEARS OF ACHIEVEMENTS

Presentation structure

1. Overview of outcome of WRC-12 and WRC-15 relevant to maritime radiocommunications and the GMDSS

Presentation structure (cont'd)

2. Overview of WRC-19 agenda items relevant to maritime radiocommunications

Presentation structure (cont'd)

3. ITU guidance for administrations

Global Maritime Distress and Safety System

- Global Maritime Distress and Safety System (GMDSS) was fully implemented from 1 February 1999 after a seven-year phase-in period.
- GMDSS is defined in Chapter IV of SOLAS (there are also elements of GMDSS in Chapter III).
- GMDSS frequencies are listed in RR Appendix **15** – there is now only one system. GMDSS applies to SOLAS vessels, i.e. merchant vessels 300 GT and above on international voyages (vessels from Contracting Governments to SOLAS).
- National legislation may require GMDSS compliance or compatibility for certain non-SOLAS vessels venturing on long domestic voyages or between domestic states/provinces.

‘Non-SOLAS’ vessels or ‘Non-GMDSS vessels’

- ‘SOLAS’ ships are often discussed as the primary responsibility at IMO, but in reality, SOLAS ships are[1] in the minority of vessels that exist, when one considers that fishing fleets of the world and recreational vessels is estimated to total four million[1].
- The number of SOLAS ships is estimated to be approximately 91,000.[2]
- These are sometimes also described as ‘non-Convention’ vessels. Ensuring compatibility between SOLAS and non-SOLAS vessels for GMDSS purposes is therefore a major challenge.

[1] Mok IS, 2017, *Why do we need to pay attention to Non-Convention Vessels?* In: International Safety@Sea Conference 2017, Singapore. Retrieved from http://www.safetyatseaweek.com/pdf/Keynote%20Speaker%202%20-%20Mr%20Ick-Soo%20Mok.pdf

[2] World total propelled seagoing merchant vessels of 100 gross tons and above = 90,917 as at 1 January 2016, (Source: Table 2.6, p.45, *Review of maritime transport*, 2016, UNCTAD)

ITU Radio Regulations (GMDSS)

- Under ITU Radio Regulations, there is no longer any distinction between GMDSS and non-GMDSS vessels. However, there are provisions for initiating distress, urgency and safety communications using 156.8 MHz (Channel 16) in Radio Regulations Chapter VII.
- GMDSS and ITU Radio Regulations shall not prevent the use by any vessel (mobile unit, or person) in distress of any means at their disposal to attract attention and obtain help.

International Maritime Organization (IMO)

- The IMO has issued MSC Circular 803, PARTICIPATION OF NON-SOLAS SHIPS IN THE GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS), so non-SOLAS ships safety radio installations can be compatible with the GMDSS, though not necessarily in full compliance with the provisions of the GMDSS.
- The IMO has issued Resolution A.954(23), PROPER USE OF VHF CHANNELS AT SEA.
- Significant activities at ITU are in support of the maritime community's work on an IMO initiative called 'e-Navigation'.
- A GMDSS modernization project is under way at the IMO.

E-navigation

- IMO definition of E-navigation:

  "the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."

http://www.imo.org/en/OurWork/safety/navigation/pages/enavigation.aspx

Current ITU activities

- A useful summary of the current ITU activities relating to spectrum for GMDSS and e-Navigation was presented by Mr. Karlis Bogens, ITU BR Terrestrial Services Department, at a workshop at ETSI[1] in "Future Evolution of Marine Communication", 7-8 November 2017, Sophia Antipolis, France.

Available here:

https://docbox.etsi.org/Workshop/2017/20171107_FUTURE_EVOL_MARINE_COM/GMDSS_MODERNISATION_ENAV_SPECTRUM_NEEDS_ITUR_BOGENS.pdf

[1] European Telecommunications Standards Institute (ETSI), www.etsi.org

WRC-12 Appendix **17** (HF maritime mobile service)

- ***WRC-12 Agenda item 1.9 – Appendix 17***

  New digital technologies for MMS[1]

  *to revise frequencies and channelling arrangements of Appendix **17** to the Radio Regulations, in accordance with Resolution **351 (Rev.WRC-07)**, in order to implement new digital technologies for the maritime mobile service.*

[1] *maritime mobile service*

Some of the following sides are adapted from:

https://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/International-planning-ITU-and-other-international-planning-bodies/wrc12-industry-debrief-acma

WRC-12 Appendix **17** outcome

No change to:

- Oceanographic data channels
- Digital selective calling channels
- Radiotelephony (Appendix **25**), but digitally modulated emissions can be used under certain conditions
- Protection for GMDSS including maritime safety information.
- GMDSS channels (voice[1], DSC[2] and NBDP[3]).

[1] Radiotelephony (voice)
[2] Digital selective-calling (DSC)
[3] Narrow-band direct-printing (NBDP) often known as (radio) telex.

WRC-12 Appendix **17** outcome (cont'd)

***However, changes were made to*:**

- NBDP (a reduction in non-GMDSS channels)[1]
- Morse (some residual capability retained)
- New provisions for digitally-modulated emissions (extensive)
- Provision to use digitally modulated emissions in radiotelephony channels under certain conditions
- Channelization based on 3 kHz in key parts with suitable channel pairing
- One portion in each sub-band is unchanneled.

WRC-12 Appendix **17** outcome (cont'd)

Changes to RR Article 52

- A new Section VII, *Data transmission,* has been added to Article **52**, *Special Rules relating to the use of frequencies:*
- Required emission mode to be J2D
- Max. transmit power for coast stations is 15 kW PEP[1]
- Max. transmit power for ship stations is 1.5 kW PEP
- Coast station details to be published
- Recommendation ITU-R M.1798[2] to be used for coast stations and ship stations.

[1] *Peak envelope power (PEP)*

WRC-12 Appendix **17** Outcome (cont'd)

Digitally modulated emissions

- The new dedicated bands for digitally modulated emissions (denoted under Note *p).*
- These emissions may combine multiple 3 kHz contiguous channels under Note *i).*
- The radiotelephony bands can also be used for digitally modulated emissions under Notes *ff), hh), ii)* and *jj)* under certain conditions, such as occupied bandwidth ≤ 2 800 Hz.

WRC-12 Appendix **17** outcome (cont'd)

Transition dates and notes

- Transition date of 1 January 2017 was agreed.
- Administrations can implement digitally modulated emissions prior to 1 January 2017, but not claim protection. See Annex 2, Note *kk).*
- 2016 Radio Regulations contain Annexes 1 and 2, but Annex 1 will be removed following WRC-19, and Annex 2 will form the Appendix **17** channelling arrangements thereafter.

WRC-12 Appendix **18** outcome

Conversion of duplex to simplex channels (total of up to 21 "new" channels)

- Number of former public correspondence channels have been identified for one-frequency operation:
- In Recommendation ITU-R M.1084[1], where two-frequency channels are operated in single-frequency mode, four-digit numbering is used:
  - If the single-frequency is the *ship* station tx frequency, a '10' is added in front of the Appendix **18** channel number, e.g. 1078.
  - If the single-frequency is the *coast* station tx frequency, a '20' is added in front of the Appendix **18** channel number, e.g. 2078.

[1] Recommendation ITU-R M.1084, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service.*

WRC-12 Appendix **18** outcome (cont'd)

160.900 MHz (Channel 2006)

- Specific Note *r),* In the maritime mobile service, this frequency is reserved for experimental use for future applications or systems (e.g. new AIS[1] applications, man over board systems, etc.). If authorized by administrations for experimental use, the operation shall not cause harmful interference to, or claim protection from, stations operating in the fixed and mobile services.

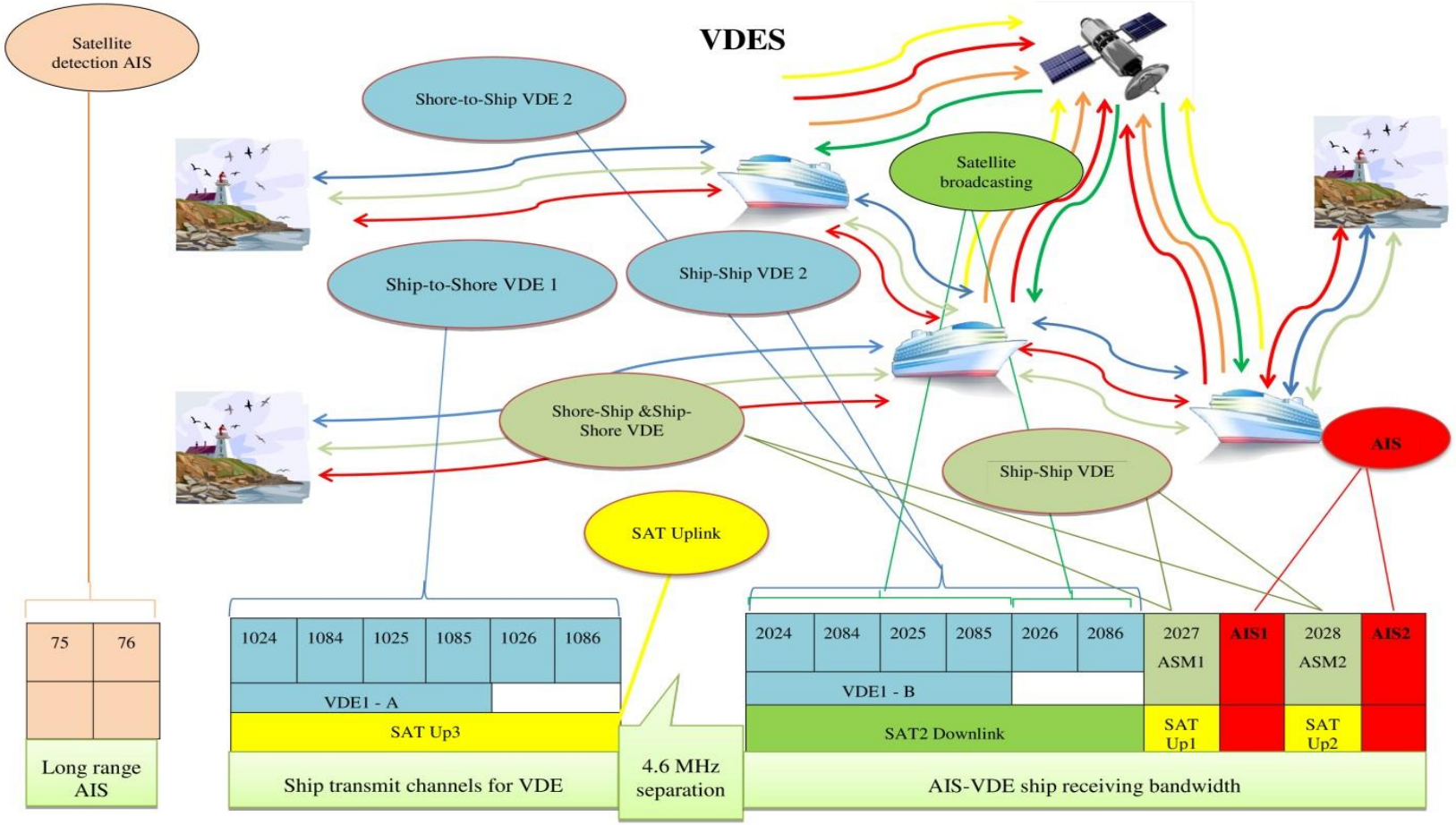
[1] Automatic identification system (AIS) is described in Recommendation ITU-R M.1371, *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile frequency band.*

WRC-12 Appendix **18** outcome (cont'd)

Provisions for data channels

- Significant changes were made which form the basis of what is known as the VHF data exchange system (VDES) and testing on certain channels approved (refer to WRC-015 outcome for VDES).
- These are also some regional differences for additional data channels outside (below) the 'international' VDES channels.

WRC-15 Agenda item 1.16 - VHF Data Exchange System (VDES)



VHF Data Exchange System (VDES)

Source: Recommendation ITU-R M.2092-0, *Technical characteristics for a VHF data exchange system in the VHF maritime mobile band* (October 2015)

WRC-15 Agenda item 1.16 - VHF Data Exchange System (VDES)

- "to consider regulatory provisions and spectrum allocations to enable possible new Automatic Identification System (AIS) technology applications and possible new applications to improve maritime radiocommunication in accordance with Resolution **360 (WRC-12)**."

APPENDIX 18 (REV.WRC-15)

Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

NOTE A – For assistance in understanding the Table, see Notes *a)* to *zz)* below. (WRC-15)

NOTE B – The Table below defines the channel numbering for maritime VHF communications based on 25 kHz channel spacing and use of several duplex channels. The channel numbering and the conversion of two-frequency channels for single-frequency operation shall be in accordance with Recommendation ITU-R M.1084-5 Annex 4, Tables 1 and 3. The Table below also describes the harmonized channels where the digital technologies defined in the most recent version of Recommendation ITU-R M.1842 could be deployed. (WRC-15)

Channel designator	Notes	Transmitting frequencies (MHz)		Inter-ship	Port operations and ship movement		Public corres-pondence
		From ship stations	From coast stations		Single frequency	Two frequency	
60	*m)*	156.025	160.625		x	x	x
01	*m)*	156.050	160.650		x	x	x

WRC-15 Appendix **18** outcome

Channels for application-specific messages (ASM)

- Application-specific messages (ASMs) are AIS messages where the data content is defined by the application. They are formed using ‘binary messages’ in the Automatic Identification System (AIS) standard.
- The International Maritime Organization has guidance on the use of AIS ASMs in SN/Circ.289.
- Examples of ASMs include weather observations from ship, clearance time to entre port, and hydrographic data.

WRC-15 Appendix **18** outcome (cont'd)

Channels for application-specific messages (ASM)

- From 1 January 2019, channels 2027 (161.950 MHz) and 2028 (162.000 MHz) will be designated ASM 1 and ASM 2 respectively.
- In addition, maritime mobile-satellite allocations (Earth-to-space) for the reception of ASM via satellites on 161.950 MHz (ASM 1) and 162.000 MHz (ASM 2) were approved.

WRC-15 Appendix **18** outcome (cont'd)

Channels for terrestrial component

- In Regions 1 and 3, from 1 January 2017, the frequency bands 157.200-157.325 MHz and 161.800-161.925 MHz (corresponding to channels 24, 84, 25, 85, 26 and 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.2092[1].
- These frequency bands may also be used for analogue modulation described in the most recent version of Recommendation ITU-R M.1084 by an administration that wishes to do so, subject to not causing harmful interference to, or claiming protection from other stations in the maritime mobile services using digitally modulated emissions and subject to coordination with affect administrations.

[1] Recommendation ITU-R M.2092, *Technical characteristics for a VHF data exchange system in the VHF maritime mobile band.*

WRC-15 Appendix **18** outcome (cont'd)

Channels for terrestrial component (cont'd)

- From 1 January 2019, channels 24, 84, 25 and 85 may be merged to form a unique duplex channel with a bandwidth of 100 kHz in order to operate the VDES terrestrial component described in the most recent version of Recommendation ITU-R M.2092.

WRC-15 Appendix **18** outcome (cont'd)

- It will be seen in the RR Appendix **18** Table, that for channels with specific notes *m)* and *mm),* there is a general restriction on use of the "upper leg" (or higher frequency channel of a duplex channel) to coast stations only. This is protect the AIS and ASM channels from desensitisation or blocking aboard ships (and AIS/ASM equipment ashore).
- However, to reinforce the potential harm that this may cause, if not done correctly, the transmit frequencies for channels 2078, 2019, 2079 and 2020 have been removed from the 'Ship transmit' column in the Table in RR Appendix **18**, and notes *m)* and *mm)* put against them.

WRC-15 Agenda item 1.16 outcome (cont'd)

- Satellite reception of application-specific message channels 2078 and 2078 was approved (to become known as ASM 1 and ASM 2 after 1 January 2019).
- A new Agenda item (1.9.2) to study this further, in accordance with a revised Resolution **360,** was adopted, as a new maritime agenda item for WRC-19.

HF interference, an ongoing issue

Issues include:

- HF interference from fishing vessels has been reported
- Amateur radio equipment incorrectly used for maritime mobile service
- Marine HF radio equipment should be type approved or otherwise approved by the administration
- Shortcomings in standards for small vessel MF/HF radios
- Regulations to regulate sale and importation of inappropriate radios
- Will assist search and rescue compatibility
- Radios on small vessels should be compatible with GMDSS
- Interference issue was an agenda item in WRC-03 (Agenda item 1.14) and Resolution **207 (REV-15)** still useful, as it gives some ways to address the issue.

VHF for small vessels

Issues include:

- Safety
- Vessel identification
- Vessel tracking
- Interoperability with other vessels in the vicinity (including SOLAS vessels).

VHF options for small vessels (cont'd)

- VHF DSC radios with Class-B AIS are available now, which even have the advantage of being to establish communications via AIS target selection without manually entering the nine-digit MMSI[1].
- DSC identification via the MMSI is set out in Recommendation ITU-R M.585[2], which requires a Maritime Identification Digit (MID) in the MMSI (first three digits).
- The same MMSI is used for AIS and DSC, since it is assigned to a vessel. Generally, MMSIs for VHF handheld radios are issued to a person (i.e. the radio itself), and not tied to a vessel.

[1] Maritime mobile service identity (MMSI)

[2] Recommendation ITU-R M.585, *Assignment and use of identities in the maritime mobile service.*

VHF options for small vessels (cont'd)

- In order to obtain a vessel's position via VHF DSC, the onboard VHF DSC must have either an internal GNSS[1] receiver or be connected to an external GNSS receiver. This creates extra installation challenges, especially on small craft.
- VHF DSC handheld radios with inbuilt GNSS are available (Recommendation ITU-R M.493 Class 'D') and a new simplified class 'H' DSC handheld with inbuilt GNSS is now described in Recommendation ITU-R M.493-14.

[1] Global Navigation satellite system (GNSS)

VHF options for small vessels (cont'd)

- With all these equipment options, training in the use of DSC is desirable, with operator certification.
- A ship identification database is necessary - ideally a single 'source of truth'.
- It is desirable that the same department issues callsign, MMSIs or other identifications, so that the database is kept up to date when a vessel changes ownership, a vessel no longer exists, or other details change.

WRC-19 items of maritime interest

Agenda item	Issues
1.8	to consider possible regulatory actions to support Global Maritime Distress Safety Systems (GMDSS) modernization and to support the introduction of additional satellite systems into the GMDSS, in accordance with Resolution **359 (Rev.WRC-15)**.
1.9.1	to consider, based on the results of ITU-R studies: regulatory actions within the frequency band 156-162.05 MHz for autonomous maritime radio devices to protect the GMDSS and automatic identifications system (AIS), in accordance with Resolution **362 (WRC-15)**.
1.9.2	to consider, based on ITU-R studies, modifications of the Radio Regulations, including new spectrum allocations to the maritime mobile-satellite service (Earth-to-space and space-to-Earth), preferably within the frequency bands 156.0125-157.4375 MHz and 160.6125-162.0375 MHz of Appendix **18**, to enable a new VHF data exchange system (VDES) satellite component, while ensuring that this component will not degrade the current terrestrial VDES components, applications specific messages (ASM) and AIS operations and not impose any additional constraints on existing services in these and adjacent frequency bands as stated in recognizing *d)* and *e)* of Resolution **360 (Rev.WRC-15)**.

ITU Guidance for Administrations

A comprehensive ITU guide for Administrations is available:

- General Information
- ITU Radio Regulations
- Service Publications
- Ship Radio License
- Notification of ship stations to the Radiocommunication Bureau
- MARS – Maritime Mobile Access and Retrieval System.

Available here:

- https://www.itu.int/en/itu-r/terrestrial/mars/documents/guidance.pdf

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