

## AGENDA ITEM 1.16

*1.16 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);*

**Resolution 360 (WRC-12):** *Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication*

### **3/1.16/1 Executive summary**

The goal of this agenda item is to consider potential new and enhanced applications of the automatic identification system (AIS) technology for improvement of the maritime radiocommunication. New applications using AIS technology are intended to improve the safety of navigation and applications depending on information that is to be exchanged between ships, and between ships and shore. Due to the importance of AIS it has to be ensured that these applications will not degrade the current AIS operations and other existing services. New applications for improved maritime data exchange are envisaged within maritime mobile service (MMS) allocations.

According to the complexity four issues have been identified to develop methods to satisfy the agenda item. For each of these issues methods to satisfy the agenda item have been developed. The issues are complementary to each other.

#### Issue A: Application-specific messages

- Method A1 identifies the channels 2027 and 2028 of RR Appendix 18 for the application-specific message (ASM) not necessary for the safety of navigation and ensure protection of AIS1, AIS2, 2027 and 2028 by not allowing ships to transmit on channels 2078, 2019, 2079 and 2020.
- Method A2 identifies alternate channels 87 and 88 for the ASM channels and ensures the protection of AIS 1 and AIS 2 by power limitation on channels 2078, 2019, 2079 and 2020.
- Method A3 identifies the channels 2027 and 2028 of RR Appendix 18 for the application-specific message (ASM) not necessary for the safety of navigation and ensure protection of AIS1, AIS2, 2027 and 2028 by appropriate actions including not allowing ships to transmit on channels 2078, 2019, 2079 and 2020.

#### Issue B: New applications for the maritime radiocommunication – terrestrial component

- Method B1 identifies the channels 24, 84, 25 and 85 for the terrestrial component of the VDE.
- Method B2 identifies the possibility to use the channels 24, 84, 25, 85, 26 and 86 for the terrestrial component of the VDE.

#### Issue C: New applications for the maritime radiocommunication – satellite component

- Method C1-A identifies a secondary allocation for the maritime mobile-satellite service (MMSS) (Earth-to-space) on the VDES channels 1024, 1084, 1025, 1085, 1026, 1086, 2027 and 2028. It also identifies a secondary allocation for the MMSS (space-to-Earth) on the VDES channels 2024, 2084, 2025, 2085, 2026 and 2086. To ensure protection of mobile and fixed services, it is proposed that a new pfd mask be introduced in a new

footnote to RR Article 5. To ensure protection of the nearest frequency band allocated to the radio astronomy service (RAS), modifications of RR No. **5.208A** and No. **5.208B** are proposed.

- Method C1-B identifies a secondary allocation for the maritime mobile-satellite service (MMSS) (Earth-to-space) on the VDES channels 1024, 1084, 1025, 1085, 1026, 1086, 2027 and 2028. It also identifies a primary allocation for the MMSS (space-to-Earth) on the VDES channels 2024, 2084, 2025, 2085, 2026 and 2086. To ensure protection of mobile and fixed services, it is proposed that a pfd mask be introduced in Annex 1 to RR Appendix 5. To ensure protection of the nearest frequency band allocated to the radio astronomy service (RAS), modification of RR No. **5.208A** and No. **5.208B** are proposed. To ensure coordination with the terrestrial service provision of RR No. **9.14** shall apply, this is done by the modification of RR No. **5.226B**.
- Method C2 identifies the frequency band 148-150 MHz (Earth-to-space) for the VDES satellite uplink, which is currently allocated to the mobile satellite service. It also identifies the frequency band 137-138 MHz (space-to-Earth) for the VDES satellite downlink, which is currently allocated to the mobile satellite service. No additional allocations or RR changes are required.

Issue D: VDES regional solution

- Method D provides a regional VDES solution, utilizing channels 80, 21, 81, 22, 82, 23 and 83.

The suppression of Resolution **360 (Rev.WRC-12)** is also part of the described methods.

## **3/1.16/2 Background**

### **3/1.16/2.1 With regard to *resolves 1* of Resolution 360 (WRC-12)**

Carriage of the shipborne AIS is mandatory for safety of navigation under Chapter V of the International Convention for the Safety of Life at Sea (SOLAS) and has become well accepted by the maritime community. It is also being used by ships not subject to the SOLAS Convention.

AIS is used in the ship movement service for safety of navigation. It enables the identification of stations using this system, provides information about a ship and its cargo. It provides a means for ships to exchange ship data, including identification, position, course and speed, with other nearby ships and coast stations.

The outcome of the maritime agenda item from WRC-12 was as follows:

- Identification of channels 75 and 76 of RR Appendix **18** for AIS and secondary allocation to the MSS (Earth-to-space) for these frequency bands in order to improve satellite detection of AIS Message 27 (long-range AIS broadcast).
- Improvement of the communication environment for port operations and ship movement including VHF data transmission capability, including identification of six channels (24, 25, 26, and 84, 85, 86) for worldwide use as potential data exchange systems. In addition a number of others channels have been identified for regional usage (see RR Appendix **18**).

AIS is supported by a terrestrial-based VHF component as well as being detectable by satellite, but its effectiveness is unacceptably limited where VHF data link (VDL) loading is high. The need for separate dedicated channels was recognized by WRC-12 and two additional channels were designated. This new designation solves the problem for satellite detection.

AIS VDL loading remains an issue to an increasing degree in many parts of the world due to the proliferation of AIS applications, message types, services and equipment types plus the unanticipated increase in user volume.

In order to protect the integrity of the AIS VDL, it is considered beneficial to move ASM to two of the four channels identified for data exchange in RR Appendix **18** by WRC-12. The AIS VDL is designed mainly for safety of navigation, and assists with vessel collision avoidance. The ship's position is continuously transmitted on the VDL and the other vessels in close proximity to the ship have the highest probability of reception. This ensures that, even during high VDL loading, the ship will receive all position reports from the other closest vessels but fewer position reports from the more distant vessels.

When the AIS VDL is used for data communications, it performs poorly with higher loads of VDL message traffic resulting in higher loss of AIS messages, and a higher number of retransmissions. This situation culminates with the breakdown of data communications on the AIS VDL.

An increasing number of ASM will also reduce the available time slots for the intended AIS messages. With increasing demand for maritime VHF data communications, AIS will become more heavily used which will lead to an overloading of the existing AIS1 and AIS2 channels.

The decision of WRC-12 to assign new channels of the RR Appendix **18** to digital communication makes the implementation and use of new digital communication means possible. The establishment of the maritime AIS technology, the VHF data exchange and certain satellite communication components on these new frequencies offers potential enhancements to VHF maritime safety communications on a global basis to satisfy the increasing need for maritime radiocommunications for enhanced maritime safety.

Taking into account the channels identified by WRC-12 as described above, new digitalized channels could be used with modulation techniques described in Recommendation [ITU-R M.1842](#), and could be used for future VHF digital data, and ship-to-shore data exchange.

Where a number of the 25 kHz channels are combined, a typical scheme might have a 100 kHz bandwidth, allowing a much higher data throughput than a single 25 kHz channel. The use of the six VHF data channels plus two further channels (which have been identified for "possible testing of future AIS applications") for an international scheme to be known as VDES.

### **3/1.16/2.2 With regard to *resolves 2 of Resolution 360 (WRC-12)***

"Increased traffic, the need to adapt to technological changes in the maritime sector (e.g. professional mariners demanding greater access to electronic navigation information), climate change impacts such as fluctuating water levels and the extension of shipping seasons, are expected to place increasing demands on Coast Guard programs."<sup>23</sup>

Traditional communication methods (i.e. voice) have been shown to be inadequate for the transfer of the information required to improve the safety of navigation particularly in adverse conditions. More information (such as weather, ice charts, status of aids to navigation, water levels and rapid changes of port status) is required in real-time to improve operational decisions on land and on ship that will lead to safer and more efficient voyages.

Shore authorities have also demonstrated interest in increasing the quantity of information retrieved from ships in real-time (such as voyage information, passenger manifest and pre-arrival reports) in a more efficient way to transmit and process this information as digital information. Similar projects with similar requirements have been initiated around the world, such as the Mona Lisa and Mona

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<sup>23</sup> [Canadian Coast Guard Business Plan 2011-2014](#).

Lisa2 projects<sup>24</sup> and the EfficienSea project<sup>25</sup>. As a result of these additional requirements on maritime communications, the channels identified by WRC-12 would be used by maritime authorities across the world to respond to increased data transfer and improve maritime safety and efficiency in the growing maritime environment.

Increasing use of satellite networks has resulted in the development of new applications which can support and enhance safety and navigation.

### **3/1.16/3 Summary of technical and operational studies, including a list of relevant ITU-R Recommendations**

Studies were conducted into the development of new applications for improved maritime data exchange envisaged within MMS and MMSS allocations.

The main ideas that drive the VDES concept are:

- Protection of the integrity of the AIS VDL.  
AIS 1 and AIS 2 should be reserved for “Navigation Safety/Collision Avoidance” purposes (as a SOLAS requirement) and therefore the ASM and other “non-critical communications” should be moved to new channels of RR Appendix **18** to avoid deleterious loading of the AIS VDL. This problem increases as more different types of equipment using AIS technology are developed, more vessels are equipped and more AIS applications are developed and implemented.
- Increased visibility (capability to see more ships on the AIS VDL on high loading).  
AIS 1 and AIS 2 can support more load (future expansion) without a reduction in range if “non-critical communications” are moved to the new channels.
- Improved communications capacity.  
The new channels provide opportunity for more capacity, efficiency and a more robust communications system to support new application.
- Efficient use of the spectrum for communications (vs. Navigation).  
9.6 kbps Gaussian minimum shift keying (GMSK) modulation and a special network protocol were chosen for AIS as a “safety of navigation system”. However, for “communications” purposes, Recommendation [ITU-R M.1842](#) provides more efficient system options; for example, where a multi-slot AIS binary message can be reduced to 1-slot. In addition, the network protocol can be designed specifically for communications so that an ASM can be transmitted with much better confidence of reception.

In February 2014 a VDES channel sounding campaign was conducted by the United Kingdom and Australia. The study examined radio propagation conditions for channels under consideration for ship-to-shore and shore-to-ship VDE and ASM communications. System components and deployment were consistent with real world maritime use in the context of the IMO Maritime Service Portfolio area categories. The results of this campaign are available in the Report ITU-R M.2317.

As this agenda item addresses both the terrestrial and satellite components, some channels have been considered for communications between the satellite and the ship.

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<sup>24</sup> <http://www.sjofartsverket.se/en/MONALISA/>

<sup>25</sup> <http://www.ufficiensea.org/>

### **3/1.16/3.1 AIS channel overloading**

#### **3/1.16/3.1.1 Study on VHF data link loading**

Report ITU-R [M.2287](#) includes studies by administrations on AIS VDL channel loading which indicates that increased loading in high traffic areas is nearing or has already exceeded the critical limiting factor of 50 per cent.

To address the concern of the AIS channel overloading there are a number of channels (27, 28, 87, 88) identified by WRC-12. In accordance with Note *z*) of RR Appendix **18**, these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services.

One option being considered is to take the upper legs of channels 27 and 28 (channels 2027 and 2028) as ASM channels based on the fact that these channels are close to the existing AIS 1 and AIS 2 channels.

Another proposed option is to identify channels 87 and 88 as ASM channels based on the Note *z*) of the RR Appendix **18**.

The analysis of Master International Frequency Register showed that the designations of channels 87 and 88 as additional ASM channels will provide the following positive aspects:

- 1) The existing frequency assignments to the fixed, land mobile and maritime mobile services will be affected to a lesser extent.
- 2) The existing duplex channels 27 and 28 to the maritime mobile service will be kept.
- 3) Potential use of channels 27 and 28 in accordance with Notes *t*), *u*), *v*) of RR Appendix **18**.

#### **3/1.16/3.1.2 AIS and ASM blocking**

The preliminary draft new Report ITU-R M.[AIS PROTECT] provided a technical analysis which shows the potential harmful interference effects to AIS, i.e. receiver blocking, from the simplex shipborne use of the upper legs of four duplex channels as designated by WRC-12 in RR Appendix **18**.

RR Appendix **18** is structured in two sections with a 4.6 MHz separation between the lower section (156.025 MHz to 157.425 MHz) and the upper section (160.625 MHz to 162.025 MHz). This arrangement permits the implementation of duplex channels in which ships stations transmit on the lower section and shore stations transmit on the upper section. Because of this arrangement, prior to WRC-12, ships' voice radios have been designed to transmit only in the lower section of the RR Appendix **18** frequency band, which provides sufficient frequency separation to prevent (by filtering) AIS receiver blocking.

Since AIS 1 and AIS 2 are very close in frequency to channels 2078, 2019, 2079 and 2020, which are located in the upper section, the use of these channels for radio communications by ships will block the AIS receiver, consequentially causing the AIS to be unable to update the location of other ships nearby, resulting in a navigation safety hazard and possible collision. The proposed new ASM channels 161.950 MHz (channel 2027) and 162.000 MHz (channel 2028) are adjacent to AIS 1 and AIS 2 and allocated 25 kHz closer than existing AIS 1 and AIS 2 to interfering channels 2078, 2019, 2079, 2020.

The use of these four channels by ships will block the ASM channels.

It may be solved by a different approach, either choosing other ASM channels or returning to usage of 2078, 2019, 2079, 2020 as duplex pairs with Note *m*) as it was before WRC-12, or forbidding

transmission from ships on these channels. Not allowing transmission from ships seems inefficient in respect to spectrum usage by ship stations.

### 3/1.16/3.2 New applications for enhanced maritime radiocommunication

VDES considers both WRC-15 agenda item 1.16 and WRC-12 revisions to RR Appendix 18, including both terrestrial and satellite components, which address the need to protect the integrity of the AIS VDL by moving AIS applications and ASM to other channels and the designation of some of the duplex channels previously designated for public correspondence for digitally modulated emissions in accordance with Recommendation ITU-R [M.1842](#) (which describes various VHF data systems which could be used for terrestrial component of VDES). The VDES integrates the functions of AIS, ASM and VDE and includes the channels used for these functions.

The preliminary draft new Report ITU-R M.[VDES-SELECT] describes the various channel plans. Table 3/1.16/3-1 “VDES Communications including AIS, ASM and VDE” provides a summary of the technical assignment of various VHF channels for communication including protocol and types of messages to meet the functionalities required by user needs.

TABLE 3/1.16/3-1

VHF data exchange system communications including AIS, ASM, and VDE

|                                       | VHF data communications<br>(including ASM and VDE)                                                                                                                                                                 |                                                                                                                                                                | AIS                                                                                                                                                                                                             |                                                                                                                      |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Sub-group                             | Data communications<br>for ASM                                                                                                                                                                                     | Data communications<br>for VDE                                                                                                                                 | AIS for safety of<br>navigation                                                                                                                                                                                 | AIS long range                                                                                                       |
| <b>Radio channels</b>                 | <ul style="list-style-type: none"> <li>Channels ASM1 and ASM2 (from RR App. 18)</li> <li>Worldwide dedicated channels (WRC-15 target)</li> </ul>                                                                   | <ul style="list-style-type: none"> <li>VDE 1 (channels from RR App. 18)</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>AIS-1 &amp; AIS-2 (simplex)</li> </ul>                                                                                                                                   | <ul style="list-style-type: none"> <li>Channels 75 and 76 (simplex)</li> </ul>                                       |
| <b>Functionality</b>                  | <ul style="list-style-type: none"> <li>Marine safety information</li> <li>Marine security information</li> <li>Short Safety related Messages (SSRMs)</li> <li>General purpose information communication</li> </ul> | <ul style="list-style-type: none"> <li>General purpose data exchange</li> <li>Robust high-speed data exchange</li> <li>VDE satellite communications</li> </ul> | <ul style="list-style-type: none"> <li>Safety of navigation</li> <li>Maritime locating devices</li> </ul>                                                                                                       | <ul style="list-style-type: none"> <li>Satellite detection of AIS</li> <li>Possible support of future SAR</li> </ul> |
| <b>Message types for AIS protocol</b> | <ul style="list-style-type: none"> <li>IMO SN.1/ Circ.289 international application specific messages</li> <li>Regional application specific messages</li> <li>Base station</li> </ul>                             |                                                                                                                                                                | <ul style="list-style-type: none"> <li>Vessel identification</li> <li>Vessel dynamic data</li> <li>Vessel static data</li> <li>Voyage related data</li> <li>Aids to navigation</li> <li>Base station</li> </ul> | <ul style="list-style-type: none"> <li>Satellite detection of AIS</li> <li>Possible support of future SAR</li> </ul> |

|                          | VHF data communications<br>(including ASM and VDE)                                                                                                                                                                 |                                                                                                          | AIS                                                                                                                                                                                        |                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Sub-group                | Data communications<br>for ASM                                                                                                                                                                                     | Data communications<br>for VDE                                                                           | AIS for safety of<br>navigation                                                                                                                                                            | AIS long range                                                                                                                     |
| <b>Radio channels</b>    | <ul style="list-style-type: none"> <li>Channels ASM1 and ASM2 (from RR App. 18)</li> <li>Worldwide dedicated channels (WRC-15 target)</li> </ul>                                                                   | <ul style="list-style-type: none"> <li>VDE 1 (channels from RR App. 18)</li> </ul>                       | <ul style="list-style-type: none"> <li>AIS-1 &amp; AIS-2 (simplex)</li> </ul>                                                                                                              | <ul style="list-style-type: none"> <li>Channels 75 and 76 (simplex)</li> </ul>                                                     |
| <b>Sub functionality</b> | <ul style="list-style-type: none"> <li>Area warnings and advice</li> <li>Meteorological and hydrographic data</li> <li>Traffic management</li> <li>Ship-shore data exchange</li> <li>Channel management</li> </ul> | <ul style="list-style-type: none"> <li>High message payload</li> <li>Satellite communications</li> </ul> | <ul style="list-style-type: none"> <li>Ship to ship collision avoidance</li> <li>VTS</li> <li>Tracking of ships</li> <li>Locating in SAR</li> <li>VDL control (by base station)</li> </ul> | <ul style="list-style-type: none"> <li>Detection of vessels by coastal states beyond range of coastal AIS base stations</li> </ul> |

Additionally it is noted that more channels are available in some Regions, see RR Appendix 18 Notes w), x), y). An example of the possible utilization of these channels is given in Table 3/1.16/3-2.

TABLE 3/1.16/3-2  
VHF data exchange – Table of regional frequencies (MHz)

|               | Regional VDE (Regions 1 and 3)                                                                                                                                                                            |                 |                               |                 |                 |                                                 |                 |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------------------|-----------------|-----------------|-------------------------------------------------|-----------------|
| Ship transmit | 1080<br>157.025                                                                                                                                                                                           | 1021<br>157.050 | 1081<br>157.075               | 1022<br>157.100 | 1082<br>157.125 | 1023<br>157.150                                 | 1083<br>157.175 |
| Ship received | 2080<br>161.625                                                                                                                                                                                           | 2021<br>161.650 | <b>2081</b><br><b>161.675</b> | 2022<br>161.700 | 2082<br>161.725 | 2023<br>161.750                                 | 2083<br>161.775 |
|               | Can be used separately and/or as 50 kHz channel(s) or as one 100 kHz channel                                                                                                                              |                 |                               |                 |                 | Can be used separately or as one 50 kHz channel |                 |
|               | NOTE – The VHF channels shown above are a contiguous set in RR Appendix 18. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver. |                 |                               |                 |                 |                                                 |                 |

The regional frequencies could be used by different types of VDES which are designed for regional or national applications.

### 3/1.16/3.3 Study for terrestrial component of VHF data exchange system

The preliminary draft new Report ITU-R M.[VDES-SELECT] demonstrate four channel plans (A, B, C and D) for VDES.

The relative merits and limitations will be assessed in the final version of the report due in July 2015. Annex 1 contains the results of studies conducted by China for Channel plan D, Annex 2 currently contains a study conducted in Canada examining in detail, Channel Plans A, B and C.

The Report ITU-R M.2317 examined radio propagation conditions for all channels intended for use in ship-to-shore and shore-to-ship VDES and application-specific message (ASM) communications.

The propagation conditions of the radio waves between ship and shore have been characterized in line-of-sight and non-line-of-sight conditions. Observed channel effects were consistent with theoretical expectation and may be managed via several waveform design approaches. Results show that spectrum currently being considered for the terrestrial component of VDE and ASM use is well suited to the purpose. This Report is of field trials conducted by certain administrations, and was approved at the November 2014 session of Study Group 5.

Current identification in accordance with RR Appendix **18** for transmitting in VHF maritime mobile bands allows for this purpose channels with bandwidth 25 kHz. New applications to provide appropriate performance for data exchange need wider channels. Separate VHF channels can be merged as 50 kHz channel(s) or 100 kHz channel. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver.

### **3/1.16/3.4 Study on possible frequencies for satellite component of VHF data exchange system**

The satellite components of VDES include:

- Satellite detection of the AIS VDL on AIS1 and AIS2 which includes all AIS equipment classes and AIS-equipped devices.
- Long-range detection by satellite of AIS message 27 on channels 75 and 76 in accordance with WRC-12 designations.
- Reception of ASM1 (SAT Up1) and ASM2 (SAT Up2) for reception of ASM.
- Reception of SAT Up3 which is the uplink from ships to satellite.
- Transmission of SAT downlink which is the downlink from satellite to ships.

These VHF applications could be introduced under the mobile-satellite service in the frequency bands allocated to this service for Earth-to-space and space-to-Earth directions.

#### **3/1.16/3.4.1 Frequency already allocated for MSS**

An analysis of RR Article **5** shows that close to the 160 MHz the following frequency bands are already allocated to MSS:

- 137-138 MHz (space-to-Earth)
- 148-150 MHz (Earth-to-space)
- 156.7625-156.7875 MHz (Earth-to-space)
- 156.8125-156.8375 MHz (Earth-to-space)
- 161.9625-161.9875 MHz (Earth-to-space)
- 162.0125-162.0375 MHz (Earth-to-space).

In accordance with Notes *p*) and *s*) of RR Appendix **18**, the last four listed allocations to MSS are already used for the reception of AIS by satellite (156.775 MHz, 156.825 MHz) as well as for AIS exploiting satellite component (161.975 MHz, 162.025 MHz) therefore two MSS allocations 137-138 MHz (space-to-Earth) and 148-150 MHz (Earth-to-space) could be considered for introduction of new applications for maritime radiocommunications in VHF.

The frequency bands 137-138 MHz (space-to-Earth) and 148-150 MHz (Earth-to-space) was allocated to MSS under condition that only NGSO MSS systems could be introduced in these frequency bands (see RR Nos. **5.208** and **5.209**). At the same time the VDES concept also considers only the use of NGSO (LEO) satellites. These existing MSS allocations may give a possibility to



introduce satellite component of VHF data exchange system. It is noted that all regulatory provisions for MSS in the frequency bands 137-138 MHz (space-to- Earth) and 148-150 MHz (Earth-to-space) are already established in the RR and therefore no additional regulatory studies in these frequency bands are required.

These two frequency bands were not part of the four channel plans which are compared and assessed in the preliminary draft new Report ITU-R M.[VDES-SELECT].

### **3/1.16/3.4.2 Possible new frequency allocation for MMSS**

The satellite component could be considered in the frequency band 156-162 MHz which is covered by RR Appendix 18. In this case new MMSS allocation in all or part of the frequency band 156-162 MHz in addition to the MSS allocations introduced by WRC-12 could be considered.

When introducing new maritime satellite applications in the frequency band 156-162 MHz protection in adjacent band and protection of mobile and fixed service in the same band should be guaranteed.

In order to determine conditions for possible new MMSS allocation of all or parts of the frequency band 156-162 MHz compatibility studies between satellite component of VHF data exchange system (uplink and downlink) and mobile as well as fixed stations are required.

Moreover adjacent frequency band compatibility between the MMSS in the frequency band 156-162 MHz and the RAS in the frequency band 150.05-153 MHz needs to be performed. Report ITU-R [SM.2091](#) which proposes compatibility analysis between mobile-satellite service (MSS) (space-to-Earth) systems operating in the frequency band 137-138 MHz and RAS systems operating in the frequency band 150.05-153.0 MHz, may be used for similar calculations.

#### **3/1.16/3.4.2.1 Compatibility for MMSS downlink in 156-162 MHz**

##### **3/1.16/3.4.2.1.1 Mobile service (primary basis, all Regions) and MMSS downlink**

Based on the typical characteristics for stations of the mobile service (MS) in the frequency band 138-174 MHz from Recommendation ITU-R [M.1808](#), the required level of power flux-density to provide protection of the MS was calculated.

It was shown that a pfd mask should be more appropriate than a fixed pfd level. It was concluded that the following pfd mask should be used to protect MS as primary service:

$$pfd(\theta^{\circ})_{((dBW/m^2 \cdot 4kHz))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

##### **3/1.16/3.4.2.1.2 Fixed service (primary basis, all Regions) and MMSS downlink**

Based on characteristics of FS stations in the frequency band 148.0-149.9 MHz (contained in RR Appendix 7) and in the frequency band 150.5-168.7 MHz (data provided to ITU-R) the required level of power flux-density to provide protection of FS was calculated.

It was shown that a pfd mask should be more appropriate than a pfd fixed level. It was concluded that the following pfd mask should be used to protect FS as primary service:

$$pfd(\theta^{\circ})_{((dBW/m^2 \cdot 4kHz))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

### 3/1.16/3.4.2.1.3 MMSS downlink in the frequency band 156-162 MHz and radio astronomy service in the frequency band 150.05-153 MHz (primary basis, Region 1)

Unwanted emissions of MMSS space stations operating in all or parts of the frequency band 156-162 MHz should not create interference to RAS stations in the frequency band 150.05-153 MHz. RR provisions currently guarantee protection for RAS stations operating in the frequency band 150.05-153 MHz from unwanted emission of MSS stations operating in the frequency band 137-138 MHz. In accordance with Resolution **739 (Rev.WRC-07)** for MSS stations operating in the frequency band 137-138 MHz unwanted emissions in the frequency band 150.05-153 MHz for single dish and continuum observations should not exceed epfd value  $-238 \text{ dB(W/m}^2\text{)/2.95 MHz}$  (see Resolution **739 (Rev.WRC-07)** Annex 1 Table 1-2).

For any new MMSS downlink allocations in VHF frequency band, the same requirements for unwanted emissions of MMSS stations as mentioned above should be considered due to the same frequency difference between MSS and RAS allocations. This could be done by applying RR No. **5.208A** and relevant amendment of Table 1-2 in Annex 1 of Resolution **739 (Rev.WRC-07)** and RR No. **5.208B**.

### 3/1.16/3.4.2.2 Compatibility for MMSS uplink in 156-162 MHz

The Report ITU-R [M.2084](#) describes satellite detection of AIS as one means of accomplishing long-range ship detection. The report addresses its technical feasibility, examines satellite capacity under various conditions and examines possible methods for improving satellite capacity around 161 MHz. Moreover, Report ITU-R [M.2169](#) addresses further studies which were not completed in the previous report.

### 3/1.16/3.4.2.3 Use of non-GSO satellite systems to enhance maritime safety

The preliminary draft new Report ITU-R M.[MAR.MSS] describes the use of a non-geostationary satellite system to provide reliable communications in regions where traditional terrestrial maritime radiocommunication is not feasible, and where geostationary satellite networks may not be able to provide reliable coverage.

This Report does not identify any regulatory changes required at this stage, but highlights that the introduction of these systems may require modifications to the Radio Regulations in due course.

### 3/1.16/3.5 Relevant ITU-R Reports and Recommendations

Recommendations ITU-R [M.1084](#), ITU-R [M.1371](#), ITU-R [M.1808](#) and ITU-R [M.1842](#).

Reports ITU-R [M.2084](#), ITU-R [SM.2091](#), ITU-R [M.2169](#), ITU-R [M.2231](#), ITU-R [M.2287](#) and ITU-R [M.2317](#).

PDN ITU-R Recommendations and Reports:

- Recommendation ITU-R M.[VDES].
- Reports ITU-R M.[MAR.MSS], ITU-R M.[AIS.PROTECTION] and ITU-R M.[VDES-SELECT].

### **3/1.16/4 Analysis of the results of studies**

#### **3/1.16/4.1 AIS overloading**

##### **3/1.16/4.1.1 Study on VHF data link loading**

Results of studies are as follows:

- AIS VDL channel loading studies have concluded that channel loading levels in some high traffic areas have already exceeded the critical level of 50% and many more are expected to exceed this level in the foreseeable future. An identified solution to this problem is the designation of RR Appendix **18** channels for ASM.

##### **3/1.16/4.1.2 AIS blocking**

- Studies for AIS Channel protection indicated that since AIS 1 and AIS 2 are in close proximity to channels 2078, 2019, 2079 and 2020, the use of these four channels by ships for maritime radio communications may block the ship's own AIS receiver, consequentially causing the ship's AIS safety of navigation capabilities to be negatively impacted. One solution to this problem is modification of the provisions of channels 2078, 2019, 2079 and 2020 in RR Appendix **18** to indicate those channels are not available for transmitting from ships.

##### **3/1.16/4.1.3 ASM blocking**

- The solution mentioned in the paragraph above in order to avoid the blocking of AIS1 and AIS2, will also ensure the protection of ASM1 and ASM 2 on channels 2027 and 2028, if these channels would be identified for this purpose.
- If ASM1 and ASM2 would be decided to be on channels 87 and 88, as in Method A2, additional measures are necessary to protect the AIS channels due to potential the blockage of these channels caused by ships station transmission on nearby channels.

#### **3/1.16/4.2 Study of review (re-identification) of channels for terrestrial component of VHF data exchange system**

- Adjacent VHF channels can be merged as 50 kHz channel(s) or 100 kHz channel. They comprise a contiguous frequency block, and thus are amenable to protection by a single selective filter in the receiver.
- Studies for sharing the RR Appendix **18** channels proposed for the VDES terrestrial component between maritime terrestrial and non-maritime terrestrial services have indicated that coordination levels that are already in use are sufficient to permit sharing by these services.

In accordance with the outcomes of WRC-12, channels 24, 84, 25, 85, 26 and 86 in RR Appendix **18** are designated for global harmonized VDE applications which will be part of the VDES. In accordance with the outcomes of WRC-12, channels 80, 21, 81, 22, 82, 23 and 83 in RR Appendix **18** are designated for regional or national VDE applications which will be part of a regional VDES.

An early version of this preliminary draft new Report ITU-R M.[VDES SELECT] compared the relative merits and limitations of channel plan A, B and C against an agreed set of criteria. It was concluded in this working document that the channel plan A was the most suitable channel plan among channel plans A, B and C.

A new channel plan has been provided, this channel plan D (Annex 1 of the PDNR ITU-R M.[VDES SELECT]) has to be evaluated against the agreed set of criteria.

Final conclusion to the most suitable channel plan will be considered at the relevant ITU-R meeting and be drawn in this Report ITU-R M.[VDES SELECT].

### 3/1.16/4.3 Study on possible frequencies for satellite component of VHF data exchange system

- Frequencies already allocated for MSS (137-138 MHz) will not require additional studies and any regulatory actions to introduce VDES satellite component.  
These frequency bands are already allocated for MSS and were not part of the four channel plans which have been considered in the Report ITU-R M.[VDES-SELECT].
- Sharing frequencies in the frequency band 156-162 MHz for the VDES satellite component between satellite downlink and terrestrial services shows that compatibility could be feasible if a pfd mask is established in order to protect primary services:

To protect MS and FS stations, the following mask is defined:

$$pfd(\theta^\circ)_{((dBW/m^2 \cdot 4kHz))} = \begin{cases} -149 + 0.16 * \theta^\circ & 0^\circ \leq \theta < 45^\circ; \\ -142 + 0.53 * (\theta^\circ - 45^\circ) & 45^\circ \leq \theta < 60^\circ; \\ -134 + 0.1 * (\theta^\circ - 60^\circ) & 60^\circ \leq \theta \leq 90^\circ. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

In addition to protect radio astronomy stations operating in the frequency band 150.05-153 MHz in Region 1 and some countries in Region 3 from unwanted emissions of MSS space stations operating in all or parts of the frequency band 156-162 MHz efd thresholds  $-238 \text{ dB(W/m}^2\text{)/2.95 MHz}$  should be guaranteed.

## 3/1.16/5 Methods to satisfy the agenda item

### 3/1.16/5.1 Issue A – Application specific message designation

#### 3/1.16/5.1.1 Method A1

Channels 27 and 28 of RR Appendix 18 will be split into four simplex channels, channels 1027, 1028, 2027 and 2028. Channels 2027 and 2028 will be identified for the ASM application. To prevent blocking of the reception of the channels AIS1, AIS 2, 2027 and 2028, the transmission from ship on channels 2078, 2019, 2079 and 2020 will not be permitted. This will be achieved through a transitional period and an effective implementation date.

#### 3/1.16/5.1.2 Method A2

RR Appendix 18 simplex channels 87 and 88 will be assigned for ASM applications with an effective date.

To prevent the potential blocking of the reception of the channels AIS1, AIS2 appropriate regulatory measures to restrict power limit for the transmission from ship on channels 2078, 2079, 2019, 2020 should be applied.

#### 3/1.16/5.1.3 Method A3

Channels 27 and 28 of RR Appendix 18 will be split into four simplex channels, channels 1027, 1028, 2027 and 2028. Channels 2027 and 2028 will be identified for the ASM application. This will be achieved through a transitional period and an effective implementation date.

Administrations should take appropriate actions to prevent blocking of the reception of the channels AIS1, AIS 2, 2027 and 2028. One of the options would be that transmission from ships on channels 2078, 2019, 2079 and 2020 will not be permitted.

### **3/1.16/5.2 Issue B – New applications for maritime radiocommunication – terrestrial component**

#### **3/1.16/5.2.1 Method B1**

In order to introduce the terrestrial component of the VDES, it is proposed to identify the duplex channels 24, 84, 25 and 85 of RR Appendix **18** for this purpose. It is further proposed that the merging of these channels will permit a better data rate for the VDE terrestrial component. This is achieved through a new Note AAA) in the RR Appendix **18**.

#### **3/1.16/5.2.2 Method B2**

Channels 24, 84, 25, 85, 26 and 86 in RR Appendix **18** could be used for testing and experiments of global harmonized terrestrial component of the VDE.

### **3/1.16/5.3 Issue C – New application for maritime radiocommunication – satellite component**

#### **3/1.16/5.3.1 Method C1-A**

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space) for frequency band 161.9375-161.9625 MHz (channel 2027) and frequency band 161.9875-162.0125 MHz (channel 2028) for improved ASM communication capacity and coverage. The usage of these frequencies enables that the same equipment as for the terrestrial VDES communication can be used.

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space) for the frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086).

The Method proposes a new secondary allocation for the maritime mobile-satellite service (space-to-Earth) for frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085, 2026 and 2086), for improved VDE communication capacity and coverage.

To ensure protection of mobile, fixed services and radio astronomy service, it is proposed that a pfd mask be introduced in RR No. **5.226B**.

The Method proposes to modify provisions RR No. **5.208A** and No. **5.208B** in order to ensure the protection of the RAS in the nearest frequency band.

In order to protect the RAS, Annex 1 to Resolution **739 (Rev.WRC-07)** would be revised to include MMSS in the frequency band 161.7875-161.9375 MHz.

The Method proposes to use an ITU-R Recommendation describing the concept and characteristics of VDES.

#### **3/1.16/5.3.2 Method C1-B**

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space) for frequency band 161.9375-161.9625 MHz (channel 2027) and frequency band 161.9875-162.0125 MHz (channel 2028) for improved ASM communication capacity and coverage. The usage of these frequencies enables that the same equipment as for the terrestrial VDES communication can be used.

The Method proposes a new secondary allocation for the maritime mobile-satellite service (Earth-to-space), for frequency band 157.1875-157.3375 MHz (channels 1024, 1084, 1025, 1085, 1026 and 1086).

The Method proposes a new primary allocation for the maritime mobile-satellite service (space-to-Earth) for frequency band 161.7875-161.9375 MHz (channels 2024, 2084, 2025, 2085, 2026 and 2086), for improved VDE communication capacity and coverage.

Coordination of VDE space stations of the MMSS (space-to-Earth) with respect to terrestrial services is described in modification of RR Appendix 5, proposing a pfd mask.

It is proposed also to clarify that the coordination between MMSS and terrestrial services is subject to the application of the provisions of RR No. 9.14.

The Method proposes to modify provisions RR Nos. 5.208A and 5.208B in order to ensure the protection of the RAS in the nearest frequency band. In order to protect the RAS, Annex 1 to Resolution 739 (Rev.WRC-07) would be revised to include MMSS in the frequency band 161.7875-161.9375 MHz.

The Method proposes to use an ITU-R Recommendation describing the concept and characteristics of VDES.

### 3/1.16/5.3.3 Method C2

It is proposed to use the frequency band 148-149 MHz (Earth-to-space) (or another appropriate frequency band allocated MSS) for the purpose of the VDES satellite uplink (improvement of VDE communication capacity and coverage, ASM communication capacity and coverage) as the frequency band already allocated for MSS.

It is proposed to use the frequency band 137-138 MHz (space-to-Earth) for the purpose of the VDES satellite downlink as the band already is allocated for MSS.

These frequency bands are restricted to NGSO systems in accordance with provisions of RR No. 5.209.

Furthermore, for the frequency band 137-138 MHz, RR Nos. 5.208 and 5.208A apply, in addition to Resolution 739 (Rev.WRC-07) (see RR No. 5.208B).

No additional allocations and RR changes are required to MSS for this method.

### 3/1.16/5.4 Issue D – VDES regional solution – Method D

Channels 80, 21, 81, 22, 82, 23 and 83 are available in some Regions as follows (see Table 3/1.16/3-2 in section 3/1.16/3.2):

- Channels 80, 21, 81 and 22 can be used using multiple 25 kHz contiguous channels for both ship and coast station transmission as regional use.
- Channel 82 can be used for both ship and coast station transmission as regional use.
- Channels 23 and 83 can be used using multiple 25 kHz contiguous channels for both ship and coast station transmission as regional use.

### 3/1.16/6 Regulatory and procedural considerations

#### 3/1.16/6.1 Example of a regulatory presentation of Method A1

MOD

### APPENDIX 18 (REV.WRC-1215)

#### Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

.../....

| Channel designator | Notes         | Transmitting frequencies (MHz) |                     | Inter-ship                   | Port operations and ship movement |               | Public correspondence |
|--------------------|---------------|--------------------------------|---------------------|------------------------------|-----------------------------------|---------------|-----------------------|
|                    |               | From ship stations             | From coast stations |                              | Single frequency                  | Two frequency |                       |
| 15                 | g)            | 156.750                        | 156.750             | x                            | x                                 |               |                       |
| 75                 | n), s)        | 156.775                        | 156.775             |                              | x                                 |               |                       |
| 16                 | f)            | 156.800                        | 156.800             | DISTRESS, SAFETY AND CALLING |                                   |               |                       |
| 76                 | n), s)        | 156.825                        | 156.825             |                              | x                                 |               |                       |
| 17                 | g)            | 156.850                        | 156.850             | x                            | x                                 |               |                       |
| 77                 |               | 156.875                        |                     | x                            |                                   |               |                       |
| 18                 | m)            | 156.900                        | 161.500             |                              | x                                 | x             | x                     |
| 78                 | t), u), v)    | 156.925                        | 161.525             |                              | x                                 | x             | x                     |
| 1078               |               | 156.925                        | 156.925             |                              | x                                 |               |                       |
| 2078               | t), u), v)    | <del>161.525</del>             | 161.525             |                              | x                                 |               |                       |
| 19                 | t), u), v)    | 156.950                        | 161.550             |                              | x                                 | x             | x                     |
| 1019               |               | 156.950                        | 156.950             |                              | x                                 |               |                       |
| 2019               | t), u), v)    | <del>161.550</del>             | 161.550             |                              | x                                 |               |                       |
| 79                 | t), u), v)    | 156.975                        | 161.575             |                              | x                                 | x             | x                     |
| 1079               |               | 156.975                        | 156.975             |                              | x                                 |               |                       |
| 2079               | t), u), v)    | <del>161.575</del>             | 161.575             |                              | x                                 |               |                       |
| 20                 | t), u), v)    | 157.000                        | 161.600             |                              | x                                 | x             | x                     |
| 1020               |               | 157.000                        | 157.000             |                              | x                                 |               |                       |
| 2020               | t), u), v)    | <del>161.600</del>             | 161.600             |                              | x                                 |               |                       |
| .../...            | .../...       | .../...                        | .../...             | .../...                      | .../...                           | .../...       | .../...               |
| 27                 | z)            | 157.350                        | 161.950             |                              |                                   | x             | x                     |
| <del>1027</del>    | <del>z)</del> | <del>157.350</del>             |                     |                              |                                   |               |                       |
| <del>2027</del>    | <del>z)</del> | <del>161.950</del>             | <del>161.950</del>  |                              |                                   |               |                       |
| 87                 | ⇒             | 157.375                        | 157.375             |                              | x                                 |               |                       |
| 28                 | z)            | 157.400                        | 162.000             |                              |                                   | x             | x                     |
| <del>1028</del>    | <del>z)</del> | <del>157.400</del>             |                     |                              |                                   |               |                       |
| <del>2028</del>    | <del>z)</del> | <del>162.000</del>             | <del>162.000</del>  |                              |                                   |               |                       |
| 88                 | ⇒             | 157.425                        | 157.425             |                              | x                                 |               |                       |
| AIS 1              | f), l), p)    | 161.975                        | 161.975             |                              |                                   |               |                       |
| AIS 2              | f), l), p)    | 162.025                        | 162.025             |                              |                                   |               |                       |

**Reasons:** Introduction of the VDES in the RR Appendix 18 as follows:

ASM 1 (161.950) and ASM 2 (162.000) are non-navigation ASM.

SAT Up1 (161.950) and SAT Up2 (162.000) are used for receiving ASM by satellite.

### Notes referring to the Table

#### General notes

#### NOC

Notes a) to e)

#### Specific notes

#### NOC

Notes f) to s)

#### MOD

- t) ~~Until 1 January 2017, in Regions 1 and 3, the existing duplex channels 78, 19, 79 and 20 can continue to be assigned.~~ These channels may be operated as single-frequency channels, subject to coordination with affected administrations. ~~From that date, these channels shall only be assigned as single frequency channels. However, existing duplex channel assignments may be preserved for coast stations and retained for vessels, subject to coordination with affected administrations.~~ Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)

**Reasons:** To prevent blocking of the reception of AIS and ASM transmissions from other stations the transmission from ships on 2078, 2019, 2079 and 2020 are prohibited. Due to the rising number of AIS installations also of voluntary fittings an exemption of ships not fitted with AIS to use these frequencies also with lower power has been discarded because this requires reprogramming of the communication equipment on board the vessel and a high administrative burden to ensure this.

#### MOD

- u) In Region 2, these channels may be operated as single-frequency channels, subject to coordination with affected administrations. Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)
- v) After 1 January 2017, in the Netherlands, these channels may continue to be operated as duplex frequency channels, subject to coordination with affected administrations. Channels 2078, 2019, 2079 and 2020 are not available for transmitting from ships. (WRC-1215)

**Reasons:** The split of the channels 78, 19, 79, 20 and the use of the upper legs of these channels could block the AIS equipment. Therefore it is proposed that channels 2078, 2019, 2079 and 2020 will not be available for transmitting from ships.

#### NOC

Notes x) and y)

#### MOD

- z) ~~Until 1 January 2019,~~ these channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services. ~~(WRC-12)~~

From 1 January 2019, these channels are split into two simplex channels. The upper legs, 2027 and 2028, respectively designated as ASM 1 and ASM 2, are used for non-navigation ASM (application specific messages) as described in the most recent version of Recommendation ITU-R M.[VDES].

The channels 2027 and 2028 are also allocated to the maritime mobile-satellite service (Earth-to-space) for the reception of ASM messages from ships, as described in the most recent version of Recommendation ITU-R M.[VDES], in which they are denominated respectively as SAT Up1 and SAT Up2. (WRC-15)



**Reasons:** Identification of two channels dedicated to the ASM applications non necessary for the security of the navigation in order to secure the VDL of the channels AIS1 and AIS2.

**SUP**

## RESOLUTION 360 (WRC-12)

### **Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (WRC-12)** since it will become superfluous after the studies are completed and the identification of frequencies in order to enhance maritime radiocommunication has been made by WRC-15 Conference.

#### **3/1.16/6.2 Example of a regulatory presentation for Method A2**

**MOD**

## APPENDIX 18 (REV. WRC-~~12~~15)

### **Table of transmitting frequencies in the VHF maritime mobile band**

(See Article 52)

.../...

| Channel designator | Notes             | Transmitting frequencies (MHz) |                     | Inter-ship                   | Port operations and ship movement |               | Public correspondence |
|--------------------|-------------------|--------------------------------|---------------------|------------------------------|-----------------------------------|---------------|-----------------------|
|                    |                   | From ship stations             | From coast stations |                              | Single frequency                  | Two frequency |                       |
| 15                 | <i>g)</i>         | 156.750                        | 156.750             | x                            | x                                 |               |                       |
| 75                 | <i>n), s)</i>     | 156.775                        | 156.775             |                              | x                                 |               |                       |
| 16                 | <i>f)</i>         | 156.800                        | 156.800             | DISTRESS, SAFETY AND CALLING |                                   |               |                       |
| 76                 | <i>n), s)</i>     | 156.825                        | 156.825             |                              | x                                 |               |                       |
| 17                 | <i>g)</i>         | 156.850                        | 156.850             | x                            | x                                 |               |                       |
| 77                 |                   | 156.875                        |                     | x                            |                                   |               |                       |
| 18                 | <i>m)</i>         | 156.900                        | 161.500             |                              | x                                 | x             | x                     |
| 78                 | <i>t), u), v)</i> | 156.925                        | 161.525             |                              | x                                 | x             | x                     |
| 1078               |                   | 156.925                        | 156.925             |                              | x                                 |               |                       |
| 2078               | <i>ZZZZ)</i>      | 161.525                        | 161.525             |                              | x                                 |               |                       |
| 19                 | <i>t), u), v)</i> | 156.950                        | 161.550             |                              | x                                 | x             | x                     |
| 1019               |                   | 156.950                        | 156.950             |                              | x                                 |               |                       |
| 2019               | <i>ZZZZ)</i>      | 161.550                        | 161.550             |                              | x                                 |               |                       |
| 79                 | <i>t), u), v)</i> | 156.975                        | 161.575             |                              | x                                 | x             | x                     |
| 1079               |                   | 156.975                        | 156.975             |                              | x                                 |               |                       |
| 2079               | <i>ZZZZ)</i>      | 161.575                        | 161.575             |                              | x                                 |               |                       |
| 20                 | <i>t), u), v)</i> | 157.000                        | 161.600             |                              | x                                 | x             | x                     |
| 1020               |                   | 157.000                        | 157.000             |                              | x                                 |               |                       |
| 2020               | <i>ZZZZ)</i>      | 161.600                        | 161.600             |                              | x                                 |               |                       |
| ...                | ...               | ...                            | ...                 | ...                          | ...                               | ...           | ...                   |
| 27                 | <i>z), ZZZ)</i>   | 157.350                        | 161.950             |                              |                                   | x             | x                     |
| 87                 | <i>z)</i>         | 157.375                        | 157.375             |                              | x                                 |               |                       |
| 28                 | <i>z)</i>         | 157.400                        | 162.000             |                              |                                   | x             | x                     |
| 88                 | <i>z), ZZZ)</i>   | 157.425                        | 157.425             |                              | x                                 |               |                       |
| AIS 1              | <i>f), l), p)</i> | 161.975                        | 161.975             |                              |                                   |               |                       |
| AIS 2              | <i>f), l), p)</i> | 162.025                        | 162.025             |                              |                                   |               |                       |

.../...

**ADD**

*ZZZ)* From 1 January 2019, these channels may be used for ASM application. These channels could be continuously used for simplex voice applications subject to coordinating with ASM application, and not claiming protection. (WRC-15)

**Reasons:** The existing duplex channel 27 and 28 will be kept as a duplex for MMS. The existing simplex channels will be identified for ASM.

**ADD**

*ZZZZ)* While using these channels (2078, 2079, 2019 and 2020) all precautions should be taken to avoid harmful interference to channels AIS1 and AIS2, by limiting the output power to 1 W. (WRC-15)

**Reasons:** The following channels (2078, 2079, 2019 and 2020) will be kept for voice transmission in MMS. This approach is in similar to measures to protect 16 channel (footnote *n*) Appendix 18).

3/1.16/6.3 Example of a regulatory presentation for Method A3

MOD

APPENDIX 18 (REV.WRC-1215)

**Table of transmitting frequencies in the VHF maritime mobile band**

(See Article 52)

.../...

| Channel designator | Notes      | Transmitting frequencies (MHz) |                     | Inter-ship                   | Port operations and ship movement |               | Public correspondence |
|--------------------|------------|--------------------------------|---------------------|------------------------------|-----------------------------------|---------------|-----------------------|
|                    |            | From ship stations             | From coast stations |                              | Single frequency                  | Two frequency |                       |
| 15                 | g)         | 156.750                        | 156.750             | x                            | x                                 |               |                       |
| 75                 | n), s)     | 156.775                        | 156.775             |                              | x                                 |               |                       |
| 16                 | f)         | 156.800                        | 156.800             | DISTRESS, SAFETY AND CALLING |                                   |               |                       |
| 76                 | n), s)     | 156.825                        | 156.825             |                              | x                                 |               |                       |
| 17                 | g)         | 156.850                        | 156.850             | x                            | x                                 |               |                       |
| 77                 |            | 156.875                        |                     | x                            |                                   |               |                       |
| 18                 | m)         | 156.900                        | 161.500             |                              | x                                 | x             | x                     |
| 78                 | t), u), v) | 156.925                        | 161.525             |                              | x                                 | x             | x                     |
| 1078               |            | 156.925                        | 156.925             |                              | x                                 |               |                       |
| 2078               | t), u), v) | 161.525                        | 161.525             |                              | x                                 |               |                       |
| 19                 | t), u), v) | 156.950                        | 161.550             |                              | x                                 | x             | x                     |
| 1019               |            | 156.950                        | 156.950             |                              | x                                 |               |                       |
| 2019               | t), u), v) | 161.550                        | 161.550             |                              | x                                 |               |                       |
| 79                 | t), u), v) | 156.975                        | 161.575             |                              | x                                 | x             | x                     |
| 1079               |            | 156.975                        | 156.975             |                              | x                                 |               |                       |
| 2079               | t), u), v) | 161.575                        | 161.575             |                              | x                                 |               |                       |
| 20                 | t), u), v) | 157.000                        | 161.600             |                              | x                                 | x             | x                     |
| 1020               |            | 157.000                        | 157.000             |                              | x                                 |               |                       |
| 2020               | t), u), v) | 161.600                        | 161.600             |                              | x                                 |               |                       |
| ...                | ...        | ...                            | ...                 | ...                          | ...                               | ...           | ...                   |
| 27                 | z)         | 157.350                        | 161.950             |                              |                                   | x             | x                     |
| <u>1027</u>        |            | <u>157.350</u>                 | <u>157.350</u>      |                              |                                   |               |                       |
| <u>2027</u>        |            | <u>161.950</u>                 | <u>161.950</u>      |                              |                                   |               |                       |
| 87                 | z)         | 157.375                        | 157.375             |                              | x                                 |               |                       |
| 28                 | z)         | 157.400                        | 162.000             |                              |                                   | x             | x                     |
| <u>1028</u>        |            | <u>157.400</u>                 | <u>157.400</u>      |                              |                                   |               |                       |
| <u>2028</u>        |            | <u>162.000</u>                 | <u>162.000</u>      |                              |                                   |               |                       |
| 88                 | z)         | 157.425                        | 157.425             |                              | x                                 |               |                       |
| AIS 1              | f), l), p) | 161.975                        | 161.975             |                              |                                   |               |                       |
| AIS 2              | f), l), p) | 162.025                        | 162.025             |                              |                                   |               |                       |

MOD

- t) Until 1 January 2017, in Regions 1 and 3, the existing duplex channels 78, 19, 79 and 20 can continue to be assigned. These channels may be operated as single-frequency channels, subject to coordination with affected

administrations. ~~From that date, these channels shall only be assigned as single frequency channels. However, existing duplex channel assignments may be preserved for coast stations and retained for vessels, subject to coordination with affected administrations. Administrations should take appropriate actions, including not allowing channels 2078, 2019, 2079 and 2020 to transmit from ships, to prevent blocking of the reception of the channels AIS 1, AIS 2, 2027 and 2028.~~ (WRC-1215)

## MOD

- z) These channels may be used for possible testing of future AIS applications without causing harmful interference to, or claiming protection from, existing applications and stations operating in the fixed and mobile services. ~~(WRC-12)~~

These channels are split into two simplex channels. The upper legs, 2027 and 2028, respectively designated as ASM 1 and ASM 2, are used for non-navigation ASM (application specific messages) as described in the most recent version of Recommendation ITU-R M.[VDES].

The channels 2027 and 2028 are also allocated to the maritime mobile-satellite service (Earth-to-space) for the reception of ASM messages from ships, as described in the most recent version of Recommendation ITU-R M.[VDES], in which they are denominated respectively as SAT Up1 and SAT Up2. (WRC-15)

### 3/1.16/6.4 Example of a regulatory presentation of Method B1

## MOD

### APPENDIX 18 (REV.WRC-1215)

#### Table of transmitting frequencies in the VHF maritime mobile band

(See Article 52)

.../...

| Channel designator | Notes                          | Transmitting frequencies (MHz) |                     | Inter-ship | Port operations and ship movement |               | Public correspondence |
|--------------------|--------------------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
|                    |                                | From ship stations             | From coast stations |            | Single frequency                  | Two frequency |                       |
| ...                | ...                            | ...                            | ...                 | ...        | ...                               | ...           | ...                   |
| 80                 | w), y)                         | 157.025                        | 161.625             |            | x                                 | x             | x                     |
| 21                 | w), y)                         | 157.050                        | 161.650             |            | x                                 | x             | x                     |
| 81                 | w), y)                         | 157.075                        | 161.675             |            | x                                 | x             | x                     |
| 22                 | w), y)                         | 157.100                        | 161.700             |            | x                                 | x             | x                     |
| 82                 | w), x), y)                     | 157.125                        | 161.725             |            | x                                 | x             | x                     |
| 23                 | w), x), y)                     | 157.150                        | 161.750             |            | x                                 | x             | x                     |
| 83                 | w), x), y)                     | 157.175                        | 161.775             |            | x                                 | x             | x                     |
| 24                 | w), ww), x), <del>y)AAA)</del> | 157.200                        | 161.800             |            | x                                 | x             | x                     |
| <u>1024</u>        | <u>BBB)</u>                    | <u>157.200</u>                 |                     |            |                                   |               |                       |
| <u>2024</u>        | <u>CCC)</u>                    | <u>161.800</u>                 | <u>161.800</u>      | <u>x</u>   |                                   |               |                       |
| 84                 | w), ww), x), <del>y)AAA)</del> | 157.225                        | 161.825             |            | x                                 | x             | x                     |
| <u>1084</u>        | <u>BBB)</u>                    | <u>157.225</u>                 |                     |            |                                   |               |                       |
| <u>2084</u>        | <u>CCC)</u>                    | <u>161.825</u>                 | <u>161.825</u>      | <u>x</u>   |                                   |               |                       |
| 25                 | w), ww), x), <del>y)AAA)</del> | 157.250                        | 161.850             |            | x                                 | x             | x                     |
| <u>1025</u>        | <u>BBB)</u>                    | <u>157.250</u>                 |                     |            |                                   |               |                       |
| <u>2025</u>        | <u>CCC)</u>                    | <u>161.850</u>                 | <u>161.850</u>      | <u>x</u>   |                                   |               |                       |
| 85                 | w), ww), x), <del>y)AAA)</del> | 157.275                        | 161.875             |            | x                                 | x             | x                     |
| <u>1085</u>        | <u>BBB)</u>                    | <u>157.275</u>                 |                     |            |                                   |               |                       |
| <u>2085</u>        | <u>CCC)</u>                    | <u>161.875</u>                 | <u>161.875</u>      | <u>x</u>   |                                   |               |                       |
| 26                 | w), ww), x), <del>y)</del>     | 157.300                        | 161.900             |            | x                                 | x             | x                     |
| <u>1026</u>        | <u>BBB)</u>                    | <u>157.300</u>                 |                     |            |                                   |               |                       |
| <u>2026</u>        | <u>CCC)</u>                    | <u>161.900</u>                 | <u>161.900</u>      | <u>x</u>   |                                   |               |                       |
| 86                 | w), ww), x), <del>y)</del>     | 157.325                        | 161.925             |            | x                                 | x             | x                     |
| <u>1086</u>        | <u>BBB)</u>                    | <u>157.325</u>                 |                     |            |                                   |               |                       |
| <u>2086</u>        | <u>CCC)</u>                    | <u>161.925</u>                 | <u>161.925</u>      | <u>x</u>   |                                   |               |                       |
| ...                | ...                            | ...                            | ...                 | ...        | ...                               | ...           | ...                   |

**Reasons:** Introduction of the VDES in the RR Appendix 18 as follows:

VDE 1 lower legs (channels 1024, 1084, 1025 and 1085) are ship-shore VDE.

VDE 1 upper legs (channels 2024, 2084, 2025 and 2085) are shore-ship and ship-ship VDE.

SAT Up3 (channels 1024, 1084, 1025, 1085, 1026 and 1086) is a ship-satellite VDE uplink.

SAT Downlink (channels 2024, 2084, 2025, 2085, 2026 and 2086) is the satellite-ship VDE downlink.

#### Notes referring to the Table

General notes

#### NOC

Notes a) to e)

*Specific notes*

**NOC**

Notes *f)* to *s)*

**MOD**

*w)* In Regions 1 and 3:

Until 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, and 86) may be used for new technologies, subject to coordination with affected administrations. Stations using these channels or frequency bands for new technologies shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.

From 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, and 83, 24, 84, 25, 85, 26, 86) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842. These frequency bands could 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 claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations.

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, 86) are identified for the utilization of the VHF Data Exchange System (VDES) described in the most recent version of Recommendation ITU-R M.[VDES]. (WRC-1215)

**Reasons:** The date of 1 January 2017 has been defined by WRC-12.

**NOC**

Note *ww)*

**ADD**

*AAA)* From 1 January 2019 the channels 24, 84, 25 and 85 may be merged in order to form a unique duplex channel with a bandwidth of 100 kHz in order to operate the VDES described in the most recent version of Recommendation ITU-R M.[VDES]. (WRC-15)

**Reasons:** The merge of these channels will permitted a better data rate for the VDE terrestrial.

**ADD**

*BBB)* From 1 January 2019 the combination of the channels 1024, 1084, 1025, 1085, 1026 and 1086, which are also allocated to the maritime mobile-satellite service (Earth-to-space), shall be used for the reception of VDES messages from ships as described in the most recent version of Recommendation ITU-R M.[VDES]. (WRC-15)

**Reasons:** The channels are identified for the satellite uplink of the VDES.

**ADD**

*CCC)* From 1 January 2019 the combination of the channels 2024, 2084, 2025, 2085, 2026 and 2086, which are also allocated to the maritime mobile-satellite service (space-to-Earth), shall be used for the reception of VDES messages from satellites as described in the most recent version of Recommendation ITU-R M.[VDES], in which this combination is denominated as SAT downlink. (WRC-15)

**Reasons:** The channels are identified for the satellite downlink of the VDES.

**NOC**

Notes *x)* and *y)*

**SUP**

**RESOLUTION 360 (WRC-12)**

**Consideration of regulatory provisions and spectrum allocations for enhanced Automatic Identification System technology applications and for enhanced maritime radiocommunication**

**Reasons:** It is proposed to suppress Resolution **360 (WRC-12)** since it will become superfluous after the studies are completed, and the identification of frequencies in order to enhance maritime radiocommunication has been made by WRC-15 Conference.

**3/1.16/6.5 Example of a regulatory presentation of Method B2**

**MOD**

**APPENDIX 18 (REV. WRC-~~12~~15)**

**Table of transmitting frequencies in the VHF maritime mobile band**

(See Article 52)

.../...

| Channel designator | Notes                                | Transmitting frequencies (MHz) |                     | Inter-ship | Port operations and ship movement |               | Public correspondence |
|--------------------|--------------------------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
|                    |                                      | From ship stations             | From coast stations |            | Single frequency                  | Two frequency |                       |
| ...                | ...                                  | ...                            | ...                 | ...        | ...                               | ...           | ...                   |
| 80                 | w), y)                               | 157.025                        | 161.625             |            | x                                 | x             | x                     |
| 21                 | w), y)                               | 157.050                        | 161.650             |            | x                                 | x             | x                     |
| 81                 | w), y)                               | 157.075                        | 161.675             |            | x                                 | x             | x                     |
| 22                 | w), y)                               | 157.100                        | 161.700             |            | x                                 | x             | x                     |
| 82                 | w), x), y)                           | 157.125                        | 161.725             |            | x                                 | x             | x                     |
| 23                 | w), x), y)                           | 157.150                        | 161.750             |            | x                                 | x             | x                     |
| 83                 | w), x), y)                           | 157.175                        | 161.775             |            | x                                 | x             | x                     |
| 24                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.200                        | 161.800             |            | x                                 | x             | x                     |
| 84                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.225                        | 161.825             |            | x                                 | x             | x                     |
| 25                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.250                        | 161.850             |            | x                                 | x             | x                     |
| 85                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.275                        | 161.875             |            | x                                 | x             | x                     |
| 26                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.300                        | 161.900             |            | x                                 | x             | x                     |
| 86                 | w), ww),<br>x), y),<br><i>dddd</i> ) | 157.325                        | 161.925             |            | x                                 | x             | x                     |
| ...                | ...                                  | ...                            | ...                 | ...        | ...                               | ...           | ...                   |

## MOD

w) In Regions 1 and 3 ([except China](#)):

Until 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, ~~and~~ 86) may be used for new technologies, [or testing and experiment of VDE terrestrial component](#), subject to coordination with affected administrations. Stations using these channels or frequency bands for new technologies shall not cause harmful interference to, or claim protection from, other stations operating in accordance with Article 5.

From 1 January 2017, the frequency bands 157.025-157.325 MHz and 161.625-161.925 MHz (corresponding to channels: 80, 21, 81, 22, 82, 23, 83, 24, 84, 25, 85, 26, ~~and~~ 86) are identified for the utilization of the digital systems described in the most recent version of Recommendation ITU-R M.1842. These frequency bands could 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 claiming protection from other stations in the maritime mobile service using digitally modulated emissions and subject to coordination with affected administrations. (WRC-[15](#))

## NOC

Notes ww), x), y) and z)

## ADD

*dddd*) [From 1 January 2019,] the frequency bands 157.200-157.325 and 161.800-161.925 MHz (corresponding to channels: 24, 84, 25, 85, 26 and 86) are designated for digitally modulated emissions in accordance with the most recent version of Recommendation ITU-R M.1842. (WRC-15)



3/1.16/6.6 Example of a regulatory presentation of Method C1-A

ARTICLE 5

Frequency allocations

Section IV – Table of Frequency Allocations  
(See No. 2.1)

MOD

148-223 MHz

| Allocation to services                                                                                                                                                                                                                    |                                                                                                                                                                                                 |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Region 1                                                                                                                                                                                                                                  | Region 2                                                                                                                                                                                        | Region 3 |
| .../...                                                                                                                                                                                                                                   |                                                                                                                                                                                                 |          |
| <del>156.8375-161.9625</del> <u>157.1875</u><br>FIXED<br>MOBILE except aeronautical mobile<br>5.226                                                                                                                                       | <del>156.8375-161.9625</del> <u>157.1875</u><br>FIXED<br>MOBILE<br>5.226                                                                                                                        |          |
| <del>156.8375</del> <u>157.1875-</u><br><del>161.9625</del> <u>157.3375</u><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                 | <del>156.8375</del> <u>157.1875-161.9625</u> <u>157.3375</u><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                 |          |
| <del>156.8375</del> <u>157.3375-</u><br><del>161.9625</del> <u>161.7875</u><br>FIXED<br>MOBILE except aeronautical mobile<br>5.226                                                                                                        | <del>156.8375</del> <u>157.3375-161.9625</u> <u>161.7875</u><br>FIXED<br>MOBILE<br>5.226                                                                                                        |          |
| <del>156.8375</del> <u>161.7875-</u><br><del>161.9625</del> <u>161.9375</u><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A</u><br><u>MOD 5.208B</u><br>5.226 <u>ADD 5.226B</u> | <del>156.8375</del> <u>161.7875-161.9625</u> <u>161.9375</u><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (space-to-Earth) MOD 5.208A</u><br><u>MOD 5.208B</u><br>5.226 <u>ADD 5.226B</u> |          |
| <del>156.8375</del> <u>161.9375-161.9625</u><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                                                | <del>156.8375</del> <u>161.9375-161.9625</u><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                                 |          |

148-223 MHz (end)

| Allocation to services                                                                                                                                       |                                                                                                                              |                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Region 1                                                                                                                                                     | Region 2                                                                                                                     | Region 3                                                                                                                               |
| <b>161.9625-161.9875</b><br>FIXED<br>MOBILE except aeronautical mobile<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 5.228A 5.228B                 | <b>161.9625-161.9875</b><br>AERONAUTICAL MOBILE (OR)<br>MARITIME MOBILE<br>MOBILE-SATELITE (Earth-to-space)<br>5.228C 5.228D | <b>161.9625-161.9875</b><br>MARITIME MOBILE<br>Aeronautical mobile (OR) 5.228E<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 |
| <b>161.9875-162.0125</b><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u> 5.229 | <b>161.9875-162.0125</b><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>  |                                                                                                                                        |
| <b>162.0125-162.0375</b><br>FIXED<br>MOBILE except aeronautical mobile<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 5.228A<br>5.228B 5.229        | <b>162.0125-162.0375</b><br>AERONAUTICAL MOBILE (OR)<br>MARITIME MOBILE<br>MOBILE-SATELITE (Earth-to-space)<br>5.228C 5.228D | <b>162.0125-162.0375</b><br>MARITIME MOBILE<br>Aeronautical mobile (OR) 5.228E<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 |
| .... / ...                                                                                                                                                   |                                                                                                                              |                                                                                                                                        |

**ADD**

**5.226A** The use of the frequency bands 157.1875-157.3375 MHz, 161.9375-161.9625 MHz and 161.9875-162.0125 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to the systems which operate in accordance with Appendix 18. (WRC-15)

**ADD**

**5.226B** The use of the frequency band 161.7875-161.9375 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the systems which operate in accordance with Appendix 18.

The power flux-density at the Earth's surface produced by emissions from a maritime mobile-satellite service space station operating in the frequency band 161.7875-161.9375 MHz shall not exceed the following mask in dB(W/(m<sup>2</sup> · 4 kHz)):

$$\begin{array}{ll}
 -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ} \\
 -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ} \\
 -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}
 \end{array}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane, in degrees. (WRC-15)

**Reasons:** The above modifications of RR Article 5 identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in the preliminary draft new Recommendation ITU-R M.[VDES].

## MOD

**5.208A** In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, ~~and 400.15-401 MHz~~ and for the maritime-mobile-satellite service (space-to-Earth) in the band 161.7875-161.9375 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in the relevant ITU-R Recommendation. (WRC-0715)

**Reasons:** The frequency range 161.7875-161.9375 MHz is a new allocation to the maritime mobile-satellite service (space-to-Earth). To ensure protection of the RAS this frequency range has to be added to RR No. **5.208A**.

## MOD

**5.208B\*** In the bands:  
137-138 MHz,  
387-390 MHz,  
161.7875-161.9375 MHz,  
400.15-401 MHz,  
1 452-1 492 MHz,  
1 525-1 610 MHz,  
1 613.8-1 626.5 MHz,  
2 655-2 690 MHz,  
21.4-22 GHz,

Resolution **739 (Rev.WRC-0715)** applies. (WRC-0715)

---

\* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.

MOD

RESOLUTION 739 (REV.WRC-~~0715~~)

**Compatibility between the radio astronomy service and the active space services  
in certain adjacent and nearby frequency bands**

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~0715~~)

**Unwanted emission threshold levels**

TABLE 1-2

epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system  
at a radio astronomy station

| Space service                        | Space service band       | Radio astronomy band | Single dish, continuum observations |                     | Single dish, spectral line observations |                     | VLBI                    |                     | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|--------------------------------------|--------------------------|----------------------|-------------------------------------|---------------------|-----------------------------------------|---------------------|-------------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
|                                      |                          |                      | epfd <sup>(2)</sup>                 | Reference bandwidth | epfd <sup>(2)</sup>                     | Reference bandwidth | epfd <sup>(2)</sup>     | Reference bandwidth |                                                                                                                  |
|                                      |                          |                      | (MHz)                               | (MHz)               | (dB(W/m <sup>2</sup> ))                 | (MHz)               | (dB(W/m <sup>2</sup> )) | (kHz)               |                                                                                                                  |
| MSS (space-to-Earth)                 | 137-138                  | 150.05-153           | -238                                | 2.95                | NA                                      | NA                  | NA                      | NA                  | WRC-07                                                                                                           |
| <u>MMSS (space-to-Earth)</u>         | <u>161.7875-161.9375</u> | <u>150.05-153</u>    | <u>-238</u>                         | <u>2.95</u>         | <u>NA</u>                               | <u>NA</u>           | <u>NA</u>               | <u>NA</u>           | <u>WRC-15</u>                                                                                                    |
| MSS (space-to-Earth)                 | 387-390                  | 322-328.6            | -240                                | 6.6                 | -255                                    | 10                  | -228                    | 10                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 400.15-401               | 406.1-410            | -242                                | 3.9                 | NA                                      | NA                  | NA                      | NA                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 525-1 559              | 1 400-1 427          | -243                                | 27                  | -259                                    | 20                  | -229                    | 20                  | WRC-07                                                                                                           |
| RNSS (space-to-Earth) <sup>(3)</sup> | 1 559-1 610              | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 525-1 559              | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 613.8-1 626.5          | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-03                                                                                                           |

**NOC**

**APPENDIX 5 (REV.WRC-12)**

**Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9**

**3/1.16/6.7 Example of a regulatory presentation of Method C1-B**

**ARTICLE 5**

**Frequency allocations**

**Section IV – Table of Frequency Allocations**  
(See No. 2.1)

**MOD**

**148-223 MHz**

| Allocation to services                                                                                                                                                                                                          |                                                                                                                                                                                                   |          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Region 1                                                                                                                                                                                                                        | Region 2                                                                                                                                                                                          | Region 3 |
| .../...                                                                                                                                                                                                                         |                                                                                                                                                                                                   |          |
| <del>156.8375-161.9625</del> <u>157.1875</u><br>FIXED<br>MOBILE except aeronautical mobile<br>5.226                                                                                                                             | <del>156.8375-161.9625</del> <u>157.1875</u><br>FIXED<br>MOBILE<br>5.226                                                                                                                          |          |
| <del>156.8375</del> <u>157.1875-</u><br><del>161.9625</del> <u>157.3375</u><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                       | <del>156.8375</del> <u>157.1875-</u> <del>161.9625</del> <u>157.3375</u><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                       |          |
| <del>156.8375</del> <u>157.3375-</u><br><del>161.9625</del> <u>161.7875</u><br>FIXED<br>MOBILE except aeronautical mobile<br>5.226                                                                                              | <del>156.8375</del> <u>157.3375-</u> <del>161.9625</del> <u>161.7875</u><br>FIXED<br>MOBILE<br>5.226                                                                                              |          |
| <del>156.8375</del> <u>161.7875-</u><br><del>161.9625</del> <u>161.9375</u><br>FIXED<br>MOBILE except aeronautical mobile<br><u>MARITIME MOBILE SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B</u><br>5.226 <u>ADD 5.226B</u> | <del>156.8375</del> <u>161.7875-</u> <del>161.9625</del> <u>161.9375</u><br>FIXED<br>MOBILE<br><u>MARITIME MOBILE SATELLITE (space-to-Earth) MOD 5.208A MOD 5.208B</u><br>5.226 <u>ADD 5.226B</u> |          |
| <del>156.8375</del> <u>161.9375-</u> <del>161.9625</del><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                          | <del>156.8375</del> <u>161.9375-</u> <del>161.9625</del><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>                                       |          |

148-223 MHz

| Allocation to services                                                                                                                                       |                                                                                                                              |                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Region 1                                                                                                                                                     | Region 2                                                                                                                     | Region 3                                                                                                                               |
| <b>161.9625-161.9875</b><br>FIXED<br>MOBILE except aeronautical mobile<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 5.228A 5.228B                 | <b>161.9625-161.9875</b><br>AERONAUTICAL MOBILE (OR)<br>MARITIME MOBILE<br>MOBILE-SATELITE (Earth-to-space)<br>5.228C 5.228D | <b>161.9625-161.9875</b><br>MARITIME MOBILE<br>Aeronautical mobile (OR) 5.228E<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 |
| <b>161.9875-162.0125</b><br>FIXED<br>MOBILE except aeronautical mobile<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u> 5.229 | <b>161.9875-162.0125</b><br>FIXED<br>MOBILE<br><u>Maritime mobile-satellite (Earth-to-space)</u><br>5.226 <u>ADD 5.226A</u>  |                                                                                                                                        |
| <b>162.0125-162.0375</b><br>FIXED<br>MOBILE except aeronautical mobile<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 5.228A<br>5.228B 5.229        | <b>162.0125-162.0375</b><br>AERONAUTICAL MOBILE (OR)<br>MARITIME MOBILE<br>MOBILE-SATELITE (Earth-to-space)<br>5.228C 5.228D | <b>162.0125-162.0375</b><br>MARITIME MOBILE<br>Aeronautical mobile (OR) 5.228E<br>Mobile-satellite (Earth-to-space)<br>5.228F<br>5.226 |
| .../...                                                                                                                                                      |                                                                                                                              |                                                                                                                                        |

**ADD**

**5.226A** The use of the frequency bands 157.1875-157.3375 MHz, 161.9375-161.9625 MHz and 161.9875-162.0125 MHz by the maritime mobile-satellite (Earth-to-space) service is limited to the systems which operate in accordance with Appendix 18. (WRC-15)

**ADD**

**5.226B** The use of the frequency band 161.7875-161.9375 MHz by the maritime mobile-satellite (space-to-Earth) service is limited to the systems which operate in accordance with Appendix 18. Such use is subject to the application of the provisions of No. 9.14 for coordination with stations of terrestrial services. (WRC-15)

**Reasons:** The above modifications of RR Article 5 identify a MMSS allocation uplink and downlink for the VHF Data Exchange System which is described in the Recommendation ITU-R M.[VDES]. It is also clarified, in the footnote RR No. 5.226B, that the coordination between MMSS and terrestrial services is subject to the application of the provision of RR No. 9.14.

**MOD**

**5.208A** In making assignments to space stations in the mobile-satellite service in the bands 137-138 MHz, 387-390 MHz, ~~and~~ 400.15-401 MHz and for the maritime-mobile-satellite service (space-to-Earth) in the band 161.7875-161.9375 MHz, administrations shall take all practicable steps to protect the radio astronomy service in the bands 150.05-153 MHz, 322-328.6 MHz, 406.1-410 MHz and 608-614 MHz from harmful interference from unwanted emissions. The threshold levels of interference detrimental to the radio astronomy service are shown in the relevant ITU-R Recommendation. (WRC-0715)

**5.208B\*** In the bands:  
137-138 MHz,  
387-390 MHz,  
161.7875-161.9375 MHz,  
400.15-401 MHz,  
1 452-1 492 MHz,  
1 525-1 610 MHz,  
1 613.8-1 626.5 MHz,  
2 655-2 690 MHz,  
21.4-22 GHz,

Resolution **739 (Rev.WRC-0715)** applies. (WRC-0715)

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\* This provision was previously numbered as No. **5.347A**. It was renumbered to preserve the sequential order.



MOD

RESOLUTION 739 (REV.WRC-~~0715~~)

**Compatibility between the radio astronomy service and the active space services  
in certain adjacent and nearby frequency bands**

...

ANNEX 1 TO RESOLUTION 739 (REV.WRC-~~0715~~)

**Unwanted emission threshold levels**

TABLE 1-2

epfd thresholds<sup>(1)</sup> for unwanted emissions from all space stations of a non-GSO satellite system  
at a radio astronomy station

| Space service                        | Space service band       | Radio astronomy band | Single dish, continuum observations |                     | Single dish, spectral line observations |                     | VLBI                    |                     | Condition of application: the API is received by the Bureau following the entry into force of the Final Acts of: |
|--------------------------------------|--------------------------|----------------------|-------------------------------------|---------------------|-----------------------------------------|---------------------|-------------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
|                                      |                          |                      | epfd <sup>(2)</sup>                 | Reference bandwidth | epfd <sup>(2)</sup>                     | Reference bandwidth | epfd <sup>(2)</sup>     | Reference bandwidth |                                                                                                                  |
|                                      |                          |                      | (MHz)                               | (MHz)               | (dB(W/m <sup>2</sup> ))                 | (MHz)               | (dB(W/m <sup>2</sup> )) | (kHz)               |                                                                                                                  |
| MSS (space-to-Earth)                 | 137-138                  | 150.05-153           | -238                                | 2.95                | NA                                      | NA                  | NA                      | NA                  | WRC-07                                                                                                           |
| <u>MMSS (space-to-Earth)</u>         | <u>161.7875-161.9375</u> | <u>150.05-153</u>    | <u>-238</u>                         | <u>2.95</u>         | <u>NA</u>                               | <u>NA</u>           | <u>NA</u>               | <u>NA</u>           | <u>WRC-15</u>                                                                                                    |
| MSS (space-to-Earth)                 | 387-390                  | 322-328.6            | -240                                | 6.6                 | -255                                    | 10                  | -228                    | 10                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 400.15-401               | 406.1-410            | -242                                | 3.9                 | NA                                      | NA                  | NA                      | NA                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 525-1 559              | 1 400-1 427          | -243                                | 27                  | -259                                    | 20                  | -229                    | 20                  | WRC-07                                                                                                           |
| RNSS (space-to-Earth) <sup>(3)</sup> | 1 559-1 610              | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 525-1 559              | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-07                                                                                                           |
| MSS (space-to-Earth)                 | 1 613.8-1 626.5          | 1 610.6-1 613.8      | NA                                  | NA                  | -258                                    | 20                  | -230                    | 20                  | WRC-03                                                                                                           |

MOD

APPENDIX 5 (REV.WRC-125)

**Identification of administrations with which coordination is to be effected or agreement sought under the provisions of Article 9**

ANNEX 1

MOD

**1 Coordination thresholds for sharing between MSS (space-to-Earth) and terrestrial services in the same frequency bands and between non-GSO MSS feeder links (space-to-Earth) and terrestrial services in the same frequency bands and between RDSS (space-to-Earth) and terrestrial services in the same frequency bands** (WRC-1215)

MOD

**1.1 Below 1 GHz\***

...

1.1.4 In the band 161.7875-161.9375 MHz, coordination of a space station of the maritime mobile-satellite service (space-to-Earth) with respect to terrestrial services is required only if the power spectral and flux-density produced by this space station exceeds the following mask in dB(W/(m<sup>2</sup> · 4 kHz)) at the Earth's surface:

$$PFD(\theta^{\circ})_{((dBW/m^2 \cdot 4kHz))} = \begin{cases} -149 + 0.16 * \theta^{\circ} & 0^{\circ} \leq \theta < 45^{\circ}; \\ -142 + 0.53 * (\theta^{\circ} - 45^{\circ}) & 45^{\circ} \leq \theta < 60^{\circ}; \\ -134 + 0.1 * (\theta^{\circ} - 60^{\circ}) & 60^{\circ} \leq \theta \leq 90^{\circ}. \end{cases}$$

where  $\theta$  is the angle of arrival of the incident wave above the horizontal plane (degrees).

**Reasons:** It is proposed to extend the coordination threshold defined in Annex 1 of RR Appendix 5 for the VDES using the frequency band 161.7875-161.9375 MHz by using this new defined mask.

**3/1.16/6.8 Example for Method C2**

NOC to RR Article 5.

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\* These provisions apply only to the MSS.

3/1.16/6.9 Example for Method D

MOD

APPENDIX 18 (REV.WRC-1215)

**Table of transmitting frequencies in the  
VHF maritime mobile band**

(See Article 52)

.../...

| Channel designator | Notes                       | Transmitting frequencies (MHz) |                     | Inter-ship | Port operations and ship movement |               | Public correspondence |
|--------------------|-----------------------------|--------------------------------|---------------------|------------|-----------------------------------|---------------|-----------------------|
|                    |                             | From ship stations             | From coast stations |            | Single frequency                  | Two frequency |                       |
| ...                | ...                         | ...                            | ...                 | ...        | ...                               | ...           | ...                   |
| 80                 | w), y), <u>xx</u> )         | 157.025                        | 161.625             |            | x                                 | x             | x                     |
| <u>1080</u>        | w), y), <u>xx</u> )         | <u>157.025</u>                 | <u>157.025</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2080</u>        | w), y), <u>xx</u> )         | <u>161.625</u>                 | <u>161.625</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 21                 | w), y), <u>xx</u> )         | 157.050                        | 161.650             |            | x                                 | x             | x                     |
| <u>1021</u>        | w), y), <u>xx</u> )         | <u>157.050</u>                 | <u>157.050</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2021</u>        | w), y), <u>xx</u> )         | <u>161.650</u>                 | <u>161.650</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 81                 | w), y), <u>xx</u> )         | 157.075                        | 161.675             |            | x                                 | x             | x                     |
| <u>1081</u>        | w), y), <u>xx</u> )         | <u>157.075</u>                 | <u>157.075</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2081</u>        | w), y), <u>xx</u> )         | <u>161.675</u>                 | <u>161.675</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 22                 | w), y), <u>xx</u> )         | 157.100                        | 161.700             |            | x                                 | x             | x                     |
| <u>1022</u>        | w), y), <u>xx</u> )         | <u>157.100</u>                 | <u>157.100</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2022</u>        | w), y), <u>xx</u> )         | <u>161.700</u>                 | <u>161.700</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 82                 | w), x), y)                  | 157.125                        | 161.725             |            | x                                 | x             | x                     |
| <u>1082</u>        | w), x), y)                  | <u>157.125</u>                 | <u>157.125</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2082</u>        | w), x), y)                  | <u>161.725</u>                 | <u>161.725</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 23                 | w), x), y),<br><u>xxx</u> ) | 157.150                        | 161.750             |            | x                                 | x             | x                     |
| <u>1023</u>        | w), x), y),<br><u>xxx</u> ) | <u>157.150</u>                 | <u>157.150</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2023</u>        | w), x), y),<br><u>xxx</u> ) | <u>161.750</u>                 | <u>161.750</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| 83                 | w), x), y),<br><u>xxx</u> ) | 157.175                        | 161.775             |            | x                                 | x             | x                     |
| <u>1083</u>        | w), x), y),<br><u>xxx</u> ) | <u>157.175</u>                 | <u>157.175</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| <u>2083</u>        | w), x), y),<br><u>xxx</u> ) | <u>161.775</u>                 | <u>161.775</u>      | <u>x</u>   | <u>x</u>                          |               |                       |
| ...                | ...                         | ...                            | ...                 | ...        | ...                               | ...           | ...                   |

Notes referring to the Table

General notes

NOC

Notes a) to e)

*Specific notes*

**NOC**

Notes *f)* to *z)*

**ADD**

*xx)* Assignable for wideband digital system operation using multiple 25 kHz contiguous channels. (WRC-15)

**ADD**

*xxx)* Assignable for 50 kHz bandwidth digital system operation using two 25 kHz contiguous channels. (WRC-15)

**Reasons:** The channels are identified for regional use of the VDES.