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| **US Radiocommunications Sector****Fact Sheet** |
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| Document Title: Elements Toward a Working Document Toward Preliminary Draft New Recommendation ITU-R M.[DIGITAL-VOICE] Digital voice communications in the VHF maritime mobile band |
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| **Purpose/Objective:** This document provides “Elements Toward a Working Document Toward a Preliminary Draft New Recommendation ITU-R M.[DIGITAL-VOICE]” that describes the technical characteristics of a proposed new system for transmission of digital voice communications in the VHF maritime mobile band. |
| **Abstract:** Report ITU-R M.2530-0 describes candidate technologies and technical considerations for digital voice communications in the VHF maritime mobile band. Draft New Question ITU-R [DIGITAL VOICE]/5, Document 5-30 E, describes conditions intended to ensure compatibility with incumbent services that utilize the frequencies in Appendix 18 of the Radio Regulations (RR). To ensure compatibility with incumbent services, the new digital voice system should not use either Appendix 18 channels identified for GMDSS, AIS, VDES, and safety communications or overlapping frequencies allocated for other incumbent fixed or mobile services. It should also be interoperable with the legacy linear FM voice communications on a secondary basis.  |

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| **Radiocommunication Study Groups** |  |
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| **1 October 2024** |
| **English only** |
| United States of AmericaElements Toward a Working Document Toward Preliminary Draft New Recommendation ITU-R M.[DIGITAL-VOICE] Digital voice communications in the VHF maritime mobile band |
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| Digital voice communication in the VHF maritime mobile band |

 IntroductionThe United States of America proposes a new document to provide Elements Toward a Working Document Toward a Preliminary Draft New Recommendation ITU-R M.[DIGITAL-VOICE] that describes the technical characteristics of a proposed new system for transmission of digital voice communications in the VHF maritime mobile band. Report ITU-R M.2530-0 described candidate technologies and technical considerations for digital voice communications in the VHF maritime mobile band. To ensure compatibility with incumbent services, the new digital voice system should not use either Appendix 18 channels identified for GMDSS, AIS, VDES, and safety communications or overlapping frequencies allocated for other incumbent fixed or mobile services. It should also be interoperable with the legacy linear FM voice communications.

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**Attachment:** 1

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| ATTACHMENTElements Toward a Working Document Toward Preliminary Draft New Recommendation ITU-R M.[DIGITAL-VOICE] Digital voice communications in the VHF maritime mobile band |
| **Digital voice communication in the VHF maritime mobile band** |
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**Scope**

This recommendation describes a new technology that will permit the possible expansion of the number of VHF maritime voice channels. Studies are underway concerning operational reliability, impacts to the GMDSS, mode of operation (simplex/duplex), bandwidth, range, etc. which are the necessary objectives to determine the feasibility of implementation of digital voice radio telephony in the VHF maritime mobile band.

Keywords

Analogue communications, digital communications, migration, GMDSS, VHF radio, DSC

Abbreviations/Glossary (including terms used in the referenced Report ITU-R M.2530-0)

ACELP Algebraic code-excited linear prediction

ADPCM Adaptive differential pulse-code modulation

AIS Automatic identification system

AMBE Advanced multi-band excitation

AMR-WB Adaptive multi-rate wideband

ATIS Automatic transmitter identification system

CIRM Comité International Radio-Maritime

CEPT European Conference of Postal and Telecommunications Administrations

CODEC Coder-decoder

CS-ACELP Conjugate-structure algebraic-code excited linear prediction

DSC Digital selective call

DMR Digital mobile radio

DPMR Digital private mobile radio

ETSI European Telecommunications Standards Institute

EU European Union

FDMA Frequency division multiple access

FEC Forward error correction

FRAND Fair, reasonable and non-discriminatory

FSK Frequency shift keying

GNSS Global navigation satellite service

GMDSS Global maritime distress and safety system

HF High frequency

IALA International Association of Marine Aids to Navigation and Lighthouse Authorities

IMO International Maritime Organization

LD-CELP Low delay code excited linear prediction

MF Medium frequency

MMSI Maritime mobile service identity

MoU Memorandum of understanding

MSC Maritime Safety Committee

NXDN Next generation digital narrowband

PAMR Public access mobile radio

PESQ Perceptual evaluation of speech quality

PMR Private mobile radio

POTS Plain old telephone service

PSTN Public switched telephone network

RAINWAT Regional Arrangement on the Radiocommunication Service for Inland Waterways

RALCWI Robust advanced low complexity waveform interpolation

RR Radio Regulations

SB-ADPCM Sub-band adaptive differential pulse code modulation

SMS Short message service

SNR Signal to noise ratio

SOLAS Safety of Life at Sea

TETRA Trans-European trunked radio system

TDMA Time division multiple access

TCP/IP Transmission control protocol/internet protocol

TWELP Tri-wave excited linear prediction

Tx Transmission

VDES VHF data exchange system

VHF Very high frequency

VTS Vessel traffic service

WRC World Radiocommunication Conference

Related ITU Recommendations and Reports

Recommendations:

ITU-R [M.493](https://www.itu.int/pub/R-REC-M.493) Digital selective-calling system for use in the maritime mobile service

ITU-R [M.541](https://www.itu.int/pub/R-REC-M.541) Operational procedures for the use of digital selective-calling equipment in the maritime mobile service

ITU-R [M.585](https://www.itu.int/pub/R-REC-M.585) Assignment and use of identities in the maritime mobile service

ITU-R [M.1084](https://www.itu.int/pub/R-REC-M.1084) Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service

ITU-R [M.1171](https://www.itu.int/pub/R-REC-M.1171) Radiotelephony procedures in the maritime mobile service

ITU-R [M.1309](https://www.itu.int/pub/R-REC-M.1309) Digitally coded speech in the land mobile service

ITU-R [M.1808](https://www.itu.int/pub/R-REC-M.1808) Technical and operational characteristics of conventional and trunked land mobile systems operating in the mobile service allocations below 869 MHz to be used in sharing studies in bands below 960 MHz

Reports:

ITU-R [BT.2140](https://www.itu.int/pub/R-REP-BT.2140) Transition from analogue to digital terrestrial broadcasting

ITU-R [M.2010](https://www.itu.int/pub/R-REP-M.2010) Improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service

ITU-R [M.2231](https://www.itu.int/pub/R-REP-M.2231) Use of Appendix **18** to the Radio Regulations for the maritime mobile service

ITU-R [M.2288](https://www.itu.int/pub/R-REP-M.2288) Digital voice communication system on MF/HF radio channels of the maritime mobile service for shore-to-ship/ship-to-shore applications

ITU-R [M.2474](https://www.itu.int/pub/R-REP-M.2474) Conventional digital land mobile radio systems

ITU-R [M.2530](https://www.itu.int/pub/publications.aspx?lang=en&parent=R-REP-M.2530-2023Digital%20voice%20communication%20in%20the%20VHF%20maritime%20frequency%20band) Digital voice communication in the VHF maritime frequency band

ITU-R [SM.2022](https://www.itu.int/pub/R-REP-SM.2022) The effect on digital communications systems of interference from other modulation schemes

The ITU Radiocommunication Assembly,

considering

*a)* that the International Maritime Organization (IMO) has established performance standards for shipborne radio equipment:

 – Resolution A.694(17): General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids;

 – Resolution MSC.511(105): Performance standards for shipborne VHF radio installations capable of voice communication and digital selective calling;

 – SOLAS Convention Chapter IV/5.1.3;

 – SOLAS IV 7.1.1;

 – SOLAS IV 7.1.2;

*b)* that the main performance standard for VHF shipborne radio installations is IMO Resolution MSC.511(105) which defines the minimal requirements for the use, availability, installation, robustness, etc. of VHF radios on board ships;

*c)* that the Radio Regulations (RR Appendix 18) have incorporated ITU technical standards that apply to VHF marine radios: ITU-R M.493; ITU-R M.541; ITU-R M.585; ITU-R M.1084;

 *d)* that the International Electrotechnical Commission (IEC) has established test standards for compliance with technical requirements defined by IMO, ITU, and the Radio Regulations, and that these IEC standards have been incorporated in IMO carriage requirements for ships,

recognizing

1. that the RR Appendix 18 VHF maritime band covers the frequency ranges 156.025 to 157.425 MHz and 160.625 to 162.025 MHz and is channelized consistent with Recommendation ITU-R M.1084-5;
2. that RR Appendix 18 channels between 156.025 MHz and 157.425 MHz host ship station transmissions or both ship and coast operations transmissions;
3. that RR Appendix 18 channels between 160.625 MHz and 162.025 MHz host coast station transmissions;
4. that the implementation of digital voice communications should not impair the functions of safety systems that operate in RR Appendix 18, i.e., digital selective calling (DSC) (Channel 70), automatic identification system (AIS) (AIS 1, channel 2087 and AIS 2, channel 2088), VHF data exchange system (VDES) (refer to Appendix 18 footnote *w)*) and voice distress, safety and calling communication (Channel 16), bridge-bridge communication (Channel 13), and other safety-related communications (e.g., Channel 9);
5. that some frequencies in the band used by MMS in Appendix 18 are allocated to the fixed and mobile services on a co-primary basis;
6. that a need exists to protect existing and planned in-band and adjacent-band services with no additional regulatory or technical constraints on these co-primary incumbent services when considering any potential modifications to MMS channelling arrangements.

recommends

**1** that general elements of VHF digital voice communication should be in accordance with Annex 1;

**2** that VHF digital voice communications for coast stations should not use RR Appendix 18 channels 156.025 MHz to 157.425 MHz and 160.625 MHz to 162.025 MHz if an administration has allocated these frequencies for non-maritime fixed and/or mobile services;

**3** that the operations of VHF digital voice communications should be compatible with and should not interfere with the operations of IMO/ITU/IEC certified marine equipment;

**4** that equipment that utilizes VHF digital voice communication should comply with IMO/ITU/IEC requirements;

**5** that equipment that utilizes VHF digital voice communication should use DSC for calling in accordance with IMO/ITU/IEC standards;

**6** that technical characteristics of VHF digital voice communication should be in accordance with Annex 1.

Annex 1

Technical characteristics of the VHF digital voice communication operating system

# 1 General description of VHF digital voice communication system

In essence, the VHF digital voice communication system provides a means for increasing the number of available voice channels in RR Appendix 18 by multiplexing an available 25 kHz voice channel to provide four 6.25 kHz voice subchannels. The system senses the 25 kHz channel to determine availability. If the 25 kHz channel is occupied by 25 kHz voice communications, then the system considers that channel unavailable. If the 25 kHz channel is in use by digital voice communications, then the system determines which, if any, of the 6.25 kHz subchannels is available and selects an unused subchannel. The system will not implement digital voice communications on channels that are designated for safety systems in RR Appendix 18, such as digital selective calling (DSC), automatic identification system (AIS), applications specific messages (ASM), VHF data exchange system (VDES), voice distress, safety and calling communication (Channel 16), bridge-bridge communication (Channel 13), and other safety-related communications,

1. **Key technical characteristics**

**2.1 Simplex and duplex operation**

The VHF digital voice communication system may operate in either simplex or duplex mode in accordance RR Appendix 18.

**2.2 Channel usage**

The VHF digital voice communication system will use only those channels that are not designated for safety systems in RR Appendix 18, such as digital selective calling (DSC), automatic identification system (AIS), applications specific messages (ASM), VHF data exchange system (VDES), voice distress, safety and calling communication (Channel 16), bridge-bridge communication (Channel 13), and other safety-related communications. VHF digital voice communications for coast stations should not use RR Appendix 18 channels 156.025 MHz to 157.425 MHz and 160.625 MHz to 162.025 MHz if an administration has allocated these frequencies for non-maritime fixed and/or mobile services. RR Appendix 18 may in the future update an existing footnote to elaborate on which channels are not available for VHF digital voice communication.

### 2.2.2 Performance standards

The main performance standards for VHF shipborne radio installations are contained in IMO Resolution MSC.511(105) and in Recommendation ITU-R M.493.

These performance standards define the minimal requirements for the use, availability, installation, robustness, etc. of VHF radios on board ships.

## 2.2.3 Channel access and channel numbering

 1 Channel number assignments for implementing digital voice communications with 6.25 kHz channel spacing between the four subchannels on 25 kHz channels in the VHF maritime frequency band should be in accordance with Table 1.

 2 The channel centre frequency retains its channel number in the VHF maritime frequency band, and it is used exclusively for 25 kHz voice communications. Digital voice communications should not be used when the 25 kHz channel is being utilized for normal 25 kHz voice communications.

Table 1

Example of channel number assignments with 6.25 kHz channel spacing

|  |  |  |  |
| --- | --- | --- | --- |
| Channel No.(6.25 kHz spacing between subchannels) | Ship | Ship and coast | Coast |
|  |  | 801 |  |  | 156.059375 |  | 160.659375 |
|  | 701 |  |  |  | 156.053125 |  | 160.653125 |
| 01 |  |  |  |  | 156.050 |  | 160.650 |
|  | 601 |  |  |  | 156.046875 |  | 160.646875 |
|  |  | 501 |  |  | 156.040625 |  | 160.640625 |

1. **Technical characteristics of marine VHF radios**

Marine VHF radios with DSC (DSC, digital selective calling, is used for distress calling and general automated calling purposes, and it is required by most administrations) capability are divided into three main classes:

* Class A, mandatory carriage for SOLAS ships under GMDSS SOLAS Chapter IV.
* Class D, voluntary carriage by non-SOLAS vessels.
* Class H, handheld radios for non-SOLAS voluntary carriage.

Some of these have integral Global Navigation Satellite System (GNSS)NSS, and some also have texting capability (RTCM SC123 standard).

Digital voice-capable radios would need to meet the current requirements of their respective classes.

1. **Technical characteristics of the VHF maritime band, RR Appendix 18**

The VHF maritime band covers the frequency ranges 156.025 to 157.425 MHz and 160.625 to 162.025 MHz with a gap in the middle frequency range between 157.425 and 160.625 MHz, and it is channelized in 25 kHz channels with channel numbers in two digits and four digits in accordance with Recommendation ITU-R M.1084-5.

RR Appendix 18 contains simplex and duplex channels, and some of the duplex channels may be used in simplex mode, designated by four-digit channel numbers.

Footnotes are used in RR Appendix 18 to designate how the channels are used, for example:

* For DSC, channel 70, footnotes *j)* and *f)*.
* For AIS, channels AIS 1 and AIS 2, footnotes *f), l),* and *p)*.
* For VDES, numerous channels in both the lower and upper frequency ranges, footnote *w)*.

# 5 Technical parameters

The technical parameters of the transmitting apparatus should comply with the ITU regulations.

# 6 Technical requirements for voice communication and associated digital selective calling in the VHF maritime mobile band

The following requirements should be based on the regulations for VHF DSC radios (the sources of the regulations are given in brackets):

– Should be capable of operating on single-frequency channels or on single- and two frequency channels (IMO);

– Operating in the bands 156.025 MHz to 157.425 MHz and 160.625 MHz to 162.025 MHz on single-frequency and two-frequency channels (ITU/IMO), except coast stations should not use bands 156.025 MHz to 157.425 MHz and 160.625 MHz to 162.025 MHz if an administration has allocated these frequencies for non-maritime fixed and/or mobile services;

– Should provide at least three priorities of communications using voice (IMO);

– A dedicated DSC watchkeeping facility to maintain a continuous watch on channel 70 (IMO);

– DSC facility should be capable of operating on Channel 70 (IMO).

# 7 Voice coder-decoders (CODECs)

Appendix 18 of the Radio Regulations offers channels with a spectrum bandwidth of 25 kHz for analogue speech communications. Using technologies available today this can be split up to improve the spectral efficiency by applying digital encoding techniques to the speech signals.

The VHF digital communication system uses a frequency division multiple access (FDMA) approach, splitting the 25 kHz radio channel into four separate radio channels to yield a channel bandwidth of 6.25 kHz. This technology allows for an over air data rate of 4800 bps, using 4 FSK modulation and still remaining within the adjacent channel power limits. Removing the signalling overhead, this results in a speech channel of 3600 bps, of which approx. 1/3 is used for error correction, so that the data channel available for encoding the speech waveform is approx. 2 400 bps.

Numerous voice CODECs are available to perform this function, and one should be selected for this application. The selected CODEC should also conform to the patent policy of ITU.