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| **US Radiocommunications Sector**  **Fact Sheet** | |
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| Document Title: 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:** The purpose of this document is to provide 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 described candidate technologies and technical considerations for digital voice communications in the VHF maritime mobile band. The new system should be designed such that it does not utilize the channels used for the GMDSS, AIS, VDES, and safety communications. It should also be interoperable with the legacy linear FM voice communications. | |

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| **Radiocommunication Study Groups** |  |
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| United States  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 | |

Purpose

The purpose of this document is to provide 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.

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**Abstract**

Report ITU-R M.2530-0 described candidate technologies and technical considerations for digital voice communications in the VHF maritime mobile band. The new system should be designed such that it does not utilize the channels used for the GMDSS, AIS, VDES, and safety communications. It should also be interoperable with the legacy linear FM voice communications.

**Attachment:** 1

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| ATTACHMENT  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

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

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

MMS I 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

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), automatic identification system (AIS), application specific messages (ASM), VHF data exchange system (VDES), and voice distress, safety and calling communication (Channel 16), bridge-bridge communication (Channel 13), and other safety-related communications,

recommends

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

**2** 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;

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

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

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

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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.

### 2.2.2 Performance standards

The main performance standards for VHF shipborne radio installations are IMO Resolution MSC.511(105).

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

Below is an overview of the most important requirements from IMO Resolution MSC.511(105).

General:

The installation, which may consist of more than one piece of equipment, should be capable of operating on single-frequency channels or on single- and two-frequency channels.

The equipment should provide for the following categories of calls using both voice and digital selective calling (DSC):

– distress, urgency and safety;

– ship operational requirements; and

– general radiocommunications.

The equipment should provide for the following categories of communications using voice:

– distress, urgency and safety;

– ship operational requirements; and

– general radiocommunications.

The equipment should comprise at least:

– a transmitter/receiver including an antenna;

– an integral control unit or one or more separate control units;

– a microphone with a press-to-transmit switch, which may be combined with a telephone in a handset;

– an internal or external loudspeaker;

– an integral or separate digital selective calling facility; and

– a dedicated DSC watchkeeping facility to maintain a continuous watch on channel 70.

The installation may also include additional receivers.

A distress alert should be activated only by means of a dedicated distress button. This button should not be any key of an ITU-T digital input panel or an ISO keyboard associated with the equipment and should be physically separated from functional buttons/keys used for normal operation. This button should be a single button for no other purpose than to initiate a distress alert.

The dedicated distress button should:

– be clearly identified;

– be protected against inadvertent operation.

The distress alert initiation should require at least two independent actions.

The equipment should indicate the status of the distress alert transmission.

It should be possible to interrupt and initiate distress alerts at any time.

Class of emission, frequency bands and channels:

– the equipment should be designated for operation on channels selected from and in accordance with Appendix **18** of the Radio Regulations;

– the radiotelephone facility should be capable of operating as follows:

• in the frequency band 156.025 MHz to 157.425 MHz on single-frequency channels as specified in Appendix **18** of the Radio Regulations;

• in the frequency band 156.025 MHz to 157.425 MHz for transmitting and the frequency band 160.625 MHz to 162.025 MHz for receiving on two-frequency channels as specified in Appendix **18** of the Radio Regulations;

– the digital selective calling facility should be capable of operating on Channel 70;

– class of emission should comply with Chapter IX of the Radio Regulations;

– the frequency tolerance for ship station transmitters should not exceed 10 parts in 106.

Controls and indicators:

– Channel control and switching:

• change of channel should be capable of being made as rapidly as possible, but in any event within five seconds;

• the time taken to switch from the transmit to the receive condition, and vice versa, should not exceed 0.3 seconds;

• an on/off switch should be provided for the entire installation with a visual indication that the installation is switched on;

• a visual indication that the carrier is being transmitted should be provided;

• the equipment should indicate the four-digit channel number, as given in the Radio Regulations Appendix **18**, to which it is tuned. It should allow the determination of the channel number under all conditions of external lighting. Where practicable, channels 16 and 70 should be distinctively marked;

• the equipment should not be able to transmit during a channel switching operation; and

• operation of the transmit/receive control should not cause unwanted emissions.

– Radiotelephone facility:

• provision should be made for changing from transmission to reception by use of a press-to-transmit switch. Additionally, facilities for operation on two-frequency channels without manual control may be provided;

• the receiver should be provided with a manual volume control by which the audio output may be varied; and

• a squelch (mute) control should be provided on the exterior of the equipment.

Permissible warming-up period:

– the equipment should be operational within five seconds after switching on.

Transmitter output power:

– the transmitter output power should be between 6 and 25 W;

– provision should be made for reducing the transmitter output power to a value of less than 1 W. However, this reduction of the power is optional on Channel 70.

Receiver parameters:

– Radiotelephone facility:

• the sensitivity of the receiver should be equal to or better than 2 μV e.m.f. for a signal-to-noise ratio of 20 dB.

Digital selective calling facility:

• with a DSC modulated input signal having a level of 1 μV e.m.f. to its associated VHF receiver, the DSC equipment should be capable of decoding the received message with a maximum permissible output character error rate of 10-2.

Immunity to interference:

• the immunity to the interference of the receiver should be such that the wanted signal is not seriously affected by unwanted signals.

## 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 25 kHz voice communications. Digital voice communications should not be used when the 25 kHz channel is in its normal 25 kHz use.

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 GNSS, 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 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 considered 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);

– 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);

– Should provide at least three categories of calls using both voice and DSC (IMO);

– Should be capable of disabling DSC capabilities (RAINWAT);

– Switch time between transmit and receive condition, and vice versa, should not exceed 0.3 seconds (IMO);

– Transmitter output power should be between 6 and 25 Watt for a fixed installation (IMO);

– Reducing the transmitter output power to a value of between 0.1 and 1 Watt (IMO);

– Reduction of the power is optional on Channel 70 (IMO);

– The sensitivity of the receiver should be equal to or better than 2 μV e.m.f. for a signal‑to‑noise ratio of 20 dB (IMO);

– DSC modulated input signal having a level of 1 μV e.m.f. to its associated VHF receiver, the DSC equipment should be capable of decoding the received message with a maximum permissible output character error rate of 10-2 (IMO);

– Should allow both the digital and analogue services to co-exist during the migration to future digital services (IALA/NL);

– Channel efficiency be a high priority by allowing four (4) or more digital voice channels for each 25 kHz maritime VHF voice channel. (IALA/NL);

– The ability to regularly transmit the location of the radio for the entire duration of the digital voice communication (IALA/NL);

– SMS without the need to set up a digital or other voice call (IALA/NL);

– Digital voice quality be similar to or better than the analogue voice service especially using weaker radio signals at the extents of the radio coverage (IALA);

– The capability of transmitting the identification (MMSI) of the radio for the entire duration of the digital voice conversation (ITU);

– Should be possible for Coastal stations to relay transmissions (with the same voice quality in digital mode) (NL);

# 7 Voice 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 an 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 commercially available to perform this function, and one should be selected for this application, ideally one that is unincumbered by patents.