



European Radiocommunications Committee (ERC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

CURRENT AND FUTURE USE OF FREQUENCIES IN THE LF- MF AND HF BANDS

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EXECUTIVE SUMMARY

In general new digital technologies providing new applications and markets is expected to be realised within the LF, MF and HF frequency bands during the next 5-10 years. This will change the stagnating and decreasing use of these bands that has been seen for some years. In general the radio communication services within the LF, MF and HF frequency bands are currently used to a limited extent for commercial civil purposes. The technology has been analogue and over the past years the use of the LF, MF and HF frequency bands decreased and this decrease seems to continue. With the introduction of digital technologies and frequency adaptive systems these bands will experience a renaissance.

Within the Maritime Mobile Service the commercial use is decreasing and particular services and applications such as morse telegraphy has in general been closed down both in the MF and in the HF bands. The Maritime Mobile Service, however, also includes distress and safety of life services and it is expected that this part of the service supported by social public correspondence may continue for a number of years.

The Aeronautical HF radiocommunication services continue to be the only means of communications for some aircrafts on the intercontinental routes even if the mobile satellite communication has overtaken some of the HF traffic. There is an extensive use of HF communications for domestic communications (RDARA), meteorological information (VOLMET) and Aeronautical Operational Control (AOC).

The Radionavigation and Radiolocation services both within the Aeronautical Radionavigation Service and the Maritime Radionavigation Service continue to be in operational use in Europe. It is not foreseen that those services are closed down within the next 10-15 years.

The above services all have safety of life elements and the necessary protection of those services from interference from other services and technologies must be ensured.

The Broadcasting service both in the LF, MF and HF bands has been facing some decrease over the past years but a number of national operators are now using MF as well as HF bands for radio broadcasting.

It is expected that the development of a global digital standard (DRM) with higher quality and new markets and services will further support and accelerate the development of the Broadcasting Service in particular in the LF and MF bands but also in the slightly longer term in the HF bands.

It may be expected that the digital technology within the broadcasting service could be adapted by other commercial radiocommunication services such as the Fixed and Mobile services and the Maritime Mobile service.

The civil Fixed and Land Mobile Services have decreased over the past years and there is no indication that these services will develop further in Europe in future. There are, however, particular applications such as low data rate services, which might be developed in the LF and MF bands. MF and HF fixed and mobile applications are still used to some extent in large countries in the eastern part of Europe for very long-range national communications.

The Radio Amateur Service has been facing some stagnation in certain countries within the recent years because of computer and Internet opportunities. The service is, however, expected to continue with active use of all the frequency bands made available for the service. The removal of A1A morse telegraphy requirement for radio amateurs is expected to increase further the amateur activity.

The military frequency requirements within the LF MF and HF bands are still increasing. The technologies used and the propagation conditions for those bands provide a lot of military communication opportunities both for the Land, Air and Maritime forces. The Combined Joint Task Forces concept adopted by NATO has extensive and increasing frequency requirements in these frequency bands.

It is important that this use of digital technology and new applications as well as market developments are not in any way hampered by interference from other sources and technologies such as ADSL, xDSL, cable communications and power line transmissions.

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1 BACKGROUND TO THE STUDY

The Frequency Management working group has tasked the ERO to study and develop a report on the actual and future use of the LF, MF and HF frequency bands within the range 9 kHz – 29.7 MHz.

The objective of the report is to provide information about the current and future use of frequency spectrum within the LF, MF and HF frequency bands including introduction of digital technology with new services and applications in those bands. Introduction of new technologies in cable networks and power line communications including xDSL technology require detailed studies of the compatibility issues with existing and future radio services. This issue is under study within the SE35 Project Team. The current report is intended to support this work. Even if the frequency bands below 10-12 MHz would be of particular interest for PLC this report describes the general use of the frequency bands below 29.7 MHz as far as information is available.

A study could also lead to development of Common European Allocations for the LF, MF and HF bands for a possible inclusion in the ERC Report 25.

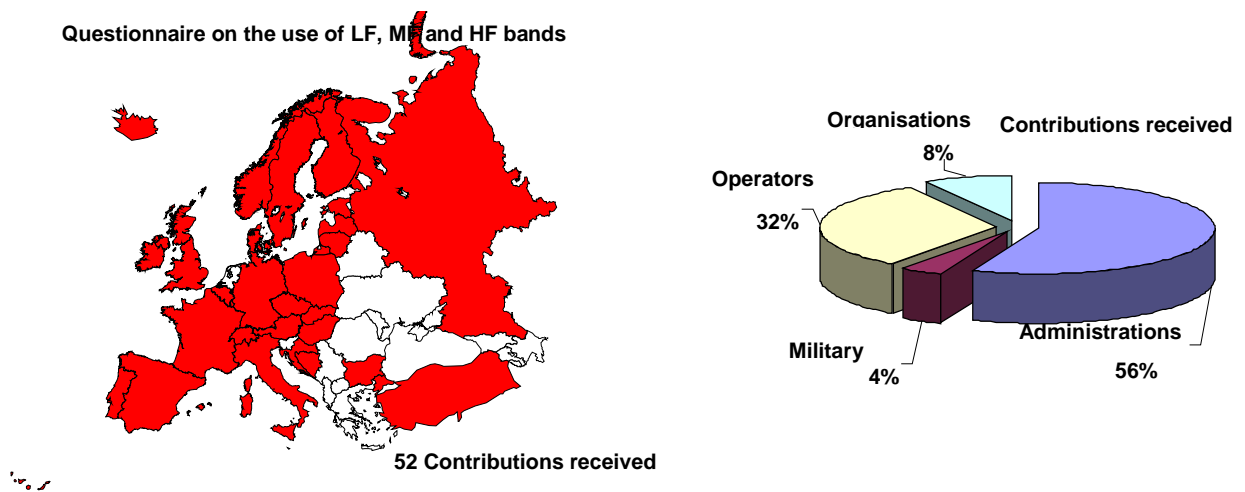
The WRC 2000 also agreed to consider a number of MF and HF issues at future ITU conferences as reflected in Res GT Plen-2/4 and 2/6 of WRC 2000. Thus the adequacy of frequency allocations for HF Broadcasting within the band 4-10 MHz is planned to be considered at the WRC2003 and WRC2006. A more general review of the frequency and channel arrangements in the maritime MF and HF bands concerning the use of new digital technologies as well as other related issues are planned for the WRC2003 and future conferences.

The current study includes contributions from a variety of users and service providers for which frequency allocations are reflected in the Radio Regulations of the ITU. User organisations have been invited to contribute to the study in order to achieve the most correctly reflection of the actual and future use of the spectrum.

The information in this report is based on information received in response of a general questionnaire to Administrations and interested parties. In the questionnaire in particular the following types of questions have been asked:

- Which bands are currently used within the LF, MF and HF radiocommunication services and what is the typical traffic load ?
- Is the use within rural or urban areas ?
- Is the service confined within Europe or does it provide communications outside Europe in international networks?
- When will new digital technologies be introduced?
- Will existing services be closed down within the next 5-10 years?
- New markets and services envisaged within the next 5-10 years?

The ERO has received 50 contributions in response of a general questionnaire.



2 CURRENT AND FUTURE USE OF THE LF, MF AND HF BANDS

Annex 1 to this document contains an overview of the actual frequency allocations within Europe in accordance with the Radio Regulations. The current use and general trends for the future use of the frequency bands are indicated based on the contributions received.

This report does not contain any analysis of the current use of frequency bands based on the ITU Master International Frequency Register, as this information is not considered sufficiently updated.

3 GENERAL TRENDS FOR RADIO SERVICES WITHIN THE LF MF AND HF FREQUENCY BANDS

The radiocommunication services within the LF MF and HF frequency bands are in general used to a limited extent for civil purposes. The technology used is still analogue and digitisation of the civil Fixed, Mobile, Maritime mobile and Aeronautical mobile civil services is not planned in the near future. For data transmission both analogue and digital transmissions are used. In general the LF, MF and HF frequency bands are used in accordance with the relevant international plans or agreed procedures but the traffic itself is limited. For the civil radiocommunication services new means of communication such as the satellite services have taken over large parts of the communication requirement.

Digitisation of the broadcasting service and may be other services within the LF, MF and HF ranges is expected to be introduced and this will lead to change of the existing use of spectrum and sharing conditions between services.

The power levels in the MF and HF bands are normally rather high. HF transmitters are typically supported by directional antennas with considerable gain. On the receiver side HF radiocommunication is often using very low signal to noise ratios and for some services a general raise of the noise floor because of interference from new services such as cable communications etc. could be detrimental to the intended radiocommunication service.

The special propagation conditions for in particular the HF bands often require a family of frequencies, in different frequency bands, for each user in order to ensure reliable communication during day and night as well as summer and winter time and of course during periods with low and high sunspot activity.

4 AERONAUTICAL MOBILE (R) SERVICE

This service is covering a total of 1301 kHz within the band 2850-22000 kHz. The frequency allotment plan in the Radio Regulations Appendix S27 is used for the civil on route HF radiocommunication (R) with aeroplanes and for flight communications where VHF communication systems are not practical.

The base stations are typically situated at major civil airports, which may be in sub-urban or rural areas. The power levels are comparable to the maritime mobile service with base stations in the order of 1 kW and mobile stations using 400 Watt output power.

The HF traffic within the Aeronautical Mobile (R) Service has decreased in Europe and the Mobile Satellite Service provides an alternative communication. The HF service is, however, still the only means of long distance communication for some aeroplanes. The HF service is extensively used for Air Traffic Control (ATC), weather and airline communications over North Atlantic routes, where European fleet and ATS are importantly involved. The service is also used over remote areas or northern land when VHF service is not available. Furthermore the services is used for long distance operational control with communication company communication to aircrafts. Information from Eurocontrol indicates that the voice frequencies over North Atlantic are already congested with a yearly 9% traffic increase, due to the implementation of reduced vertical separation. As recognised at the ITU WRC-2000 there is also increasing cases of harmful interference due to unauthorised sources all over the world, including North Atlantic.

No new technologies are planned in these bands. For information purposes, ICAO has adopted in 1998 Standards and Recommendations Practices for HF Data link, operating in the bands covered by Appendix S27. Data links are, however, not expected to replace HF voice over the next 5-10 years. Growing data traffic and further development of the HF Data Link system may result in further frequency requirements above 5 MHz.

There is a continued need for the Aeronautical Mobile (R) Service frequencies. The ATC- service is a safety of life service and must be protected. The operational control service is important for the airline companies and should be protected.

The frequency 3023 kHz is used for search and rescue operations in accordance with RR ART38 and as such a safety of life frequency, which require protection.

5 AERONAUTICAL MOBILE (OR) SERVICE

This service is covering a total of 1125 kHz within the frequency range 3025-23350 kHz. The frequency allotment plan in the Radio Regulations, Appendix S26 (3025-18030 kHz) is used for the off route service (OR) which typically covers non-civil aviation communication requirements but also civil use in for instance helicopter operations.

The base stations are situated close to military installations and airports, which would typically be in rural areas. The power levels are expected to be comparable to the civil (R) service.

In addition to the frequencies in Appendix S26 the frequency band 23200-23350 kHz is also allocated to the Aeronautical Mobile (OR) Service. This band is also allocated to the Aeronautical Fixed Service but is not used for this purpose.

The HF frequencies within the (OR) are still in use for both civil and military air-ground-air communications. The service includes elements of safety of life service and should be protected.

6 AERONAUTICAL RADIONAVIGATION SERVICE

This service is covering a total of 191 kHz within the band 255–526.5 kHz.

Within the frequency bands 415–435 kHz and 510–526.5 kHz the frequencies for the Aeronautical Radionavigation Service are in Europe used in accordance with the frequency assignment plan RARC (Region 1)GE85. The international standards and recommended practices are described in the Convention on International Civil Aviation, Annex 10. The service is still in use on a continuous basis in Europe.

The aeronautical radiobeacons (NDB) are situated in both rural and urban areas with a power level of around 100 Watts. The NDB's have a typical range of 25–100 nautical miles (NM) and locators a typical range of 15 NM. In the bands 415–526.5 kHz the use of aeronautical radiobeacons is limited but the frequencies in the lower bands 255–405 kHz are in use. The service is used over sea and land routes and is used by general aviation at aerodrome. A large number of general aviation aircrafts are equipped with automatic direction finders (ADF) and adequate accuracy can be achieved with low-cost equipment.

The aviation strategy is to require Non Directional Beacons (NDB) for international operations until at least 2010 to 2015. ICAO has retained 2015, while globally ECAC expects to continue the use of NDB's in international operation until 2010. Some countries may for cost reasons wish to continue national operation of NDB's until 2015.

No new markets or applications within the Aeronautical Radionavigation Services are envisaged. The Aeronautical Radionavigation Service is, however, a safety of life service and must be protected until sufficiently reliable means of radionavigation can provide the service.

7 THE MARITIME RADIONAVIGATION SERVICE

This service is covering a total of 31 kHz within the band 283.5–325 kHz. The band 315–325 kHz is allocated on a secondary basis in Europe.

The frequencies are in service in Europe in accordance with the frequency assignment plan for the European Maritime Area RARC(GE85). In accordance with footnote S5.73 the maritime radionavigation service may be used to transmit supplementary navigational information using narrow-band techniques, on condition that no harmful interference is caused to radiobeacon stations operating in the radionavigation service. In Europe the maritime radionavigation stations are primarily used for Differential GPS. The IALA organisation has revised the frequency plan, which is under frequency co-ordination and expected to be implemented in Europe by September 2001.

The maritime radionavigation land stations are typically situated at the coastlines. The system may, however, be used in urban areas as well for precise positioning better than 30 cm. The Maritime Radionavigation service is basically a safety of life service and will have to be protected.

8 THE RADIOLOCATION SERVICE

The Radiolocation Service is covering 30 kHz in bands between 1625–2170 kHz but the service also uses a number of other frequency subbands within the MF bands between 1610–3025 kHz. The use of the Radiolocation service is co-ordinated amongst administrations in Europe based on the Brussels 67 Agreement.

The land stations are typically situated in rural areas but the use may also cover sub urban and even urban areas. The services need to be protected.

9 THE RADIONAVIGATION SERVICE

The Radionavigation Service covers 75 kHz of bandwidth within the range 9–130 kHz and in the band 405–415 kHz. The service has basically been used for the Decca, Omega and LORAN C systems for radionavigation purposes.

The DECCA and Omega systems have been closed down and substituted by the other means of radionavigation including satellite radionavigation systems. The LORAN C system has limited use and applications as some countries have withdrawn from the co-operation. The system is, however, expected to continue until 2010 in the North Atlantic region.

The LORAN C system is a safety of life system and must be protected where authorised by administrations.

10 THE MARITIME MOBILE SERVICE

The service is covering a total of 5342 kHz within the frequency range from 14 kHz to 26175 kHz out of which 534 kHz is allocated within the range 14–2650 kHz.

The maritime mobile service within the band 14–130 kHz is for non-civil use and not subject to any official plan. The service within the bands 415–526 kHz and 1606–2194 kHz is covered by the frequency assignment plan RARC (Region 1) GE85. It includes the GMDSS channels around 500 kHz and 2182 kHz.

The service within the bands 4000–26175 kHz is covered by the frequency channelling arrangement in specified in the Radio Regulations article S52 and Appendix S17. Those bands also include GMDSS channels.

MF and HF coast station transmitters and transmitting antennas as well as the receiving antenna systems are typically situated in rural areas. The power levels for cost station transmitters are typically 1–10 kW with substantial antenna gains.

10.1 Distress and safety applications and needs

The civil maritime mobile service contains both the commercial radiocommunication services and the international maritime distress and safety services. The International Maritime Satellite Organisation (Inmarsat) offering maritime services for distress and safety as well as public correspondence was created in 1979. The new Global Maritime Distress and Safety System (GMDSS), as defined in Chapter IV of the IMO Convention on Safety of Life at Sea includes:

- a radiocommunication service utilising geostationary satellites in the maritime mobile-satellite service
- a radiocommunication service utilising polar orbit satellites in the mobile-satellite service,
- the maritime mobile service in the bands between 156 and 174 MHz,
- the maritime mobile service in the bands between 4 and 27.5 MHz,
- the maritime mobile service in the bands between 415 and 535 kHz and between 1605 and 4000 kHz.

Morse telegraphy for distress and safety communications on 500 kHz has never formed part of the GMDSS. The international requirements for use of 500 kHz for distress and safety communications ceased on 1.2.1999. It is envisaged that some countries still maintain the 500 kHz watch-keeping on a national basis. This will probably be terminated within a couple of years as 500 kHz equipment is substituted by other means of communication onboard ships.

The frequencies 518 kHz and 490 kHz are used for international Navtex service and for Navtex transmissions in national languages respectively. These services continue and the use of the frequencies needs continued protection.

The distress and safety calling in the MF, HF and VHF bands in the GMDSS is based on use of digital selective calling (DSC). Thus it is possible to replace the aural watch-keeping on the maritime distress and calling frequencies 2182 kHz and VHF channel 16 at ship and coast stations by automatic digital selective calling watch on dedicated DSC calling frequencies for GMDSS.

The MF/HF DCS distress and calling frequencies are: 2187.5 kHz, 4207.5 kHz, 6312 kHz, 8414.5 kHz, 12577 kHz and 16804.5 kHz

The Telephony distress traffic is conducted on: 2181 kHz, 3023 kHz, 4125 kHz, 5680 kHz 6215 kHz, 8219 kHz 12290 kHz and 16420 kHz.

The Telex distress traffic uses: 2174.5 kHz, 4177.5 kHz, 6268 kHz, 8376.5 kHz, 12520 kHz and 16695 kHz.

These frequencies are by nature safety of life frequencies and must be protected.

The GMDSS satellite services are cornerstones in the GMDSS, and it is expected that they will play an ever-increasing role in maritime distress and safety communications. The GMDSS is developed with 3 independent radio systems to ensure coverage and availability.

The frequencies 4125 kHz and 6215 kHz are the supplementary frequencies to the distress and safety frequency 2182 kHz in accordance with art 33 of the Radio Regulations.

The frequency 4209.5 kHz is used exclusively for the transmissions by coast stations of meteorological and navigational warnings. The frequencies 4210 kHz, 6314 kHz 8416.5 kHz 12579 kHz, 16806.5 kHz 19680.5 kHz 22376 kHz and 26100.5 kHz are the international frequencies for the transmission of Maritime Safety Information (MSI). The above frequencies are or have safety elements and should be protected.

A fundamental element for all seafarers is, however, the collective responsibility of ships and seafarers to assist each other if they are in distress or dangerous situations at sea. Ship-to-ship alerting by DSC and on-scene communications on MF and VHF are therefore also vital functions of the GMDSS.

In order to preserve this fundamental collective principle it is of vital importance that ships are equipped with common radio communication systems. With such systems they can alert all other ships in the area, listen and talk to each other and make it possible for all to follow and participate in the distress communications. Point-to-point systems such as mobile satellite systems do not offer this possibility, and it is therefore foreseen that the MF and VHF communication systems will play a vital role in the GMDSS for many years ahead.

The GMDSS services are by nature safety of life services and need protection.

10.2 Commercial public correspondence in the Maritime Mobile Service

The use of frequencies for the civil Maritime Mobile Service in the MF and HF bands has decreased and is in some areas only used to a very limited extent. It is expected that the civil Maritime Mobile Service within the MF and HF bands will decrease further and ultimately be overtaken by the mobile satellite service and in coastal waters also cellular systems for land mobile communications. There may, however, still be a growth potential for electronic message exchange to and from ships. Some coast stations have closed down all or some of their public correspondence maritime services in the MF and/or HF bands.

Thus the Maritime Mobile Service has ceased the use of Morse-telegraphy both within the MF and the HF bands and telex communication as well as voice telephony communication within the bands is very limited.

This tendency is expected to continue and some coast stations have already closed down the NBDP service.

It is, however, foreseen that especially the maritime mobile MF and VHF services will continue to be used for several years ahead because of the lower price of these services compared to the mobile-satellite services.

The HF telephony traffic will continue to decline but will be used for several years ahead may be in particular for social communications such as crew members calling their family, mainly due to the lower price per minute for HF communications compared to the price of mobile satellite services.

The use of each of the channels within the HF bands is dependent upon the actual sunspot number, time of the day and year as well as the typical area to be covered. In contributions administrations had indicated that a typical load of the HF channels would be 2000–4000 minutes per month for the Maritime mobile HF service.

The Maritime Mobile service uses analogue technology and there are no plans available for digitisation of the service. Introduction of new (digital) technologies in the maritime mobile MF and HF services for public correspondence have been considered for example by ITU-R and coast station operators for some years. However, the general trend of satellite and cellular systems being increasingly used instead of maritime mobile MF and HF services for public services seems to make it somewhat difficult to introduce viable new digital services and technologies in the maritime MF and HF services. Administrations indicate that they are awaiting the decisions of WRC-03 regarding introduction of digital technologies and access schemes in the MF and HF maritime bands.

11 THE FIXED SERVICE

The service is covering a total of 14296 kHz within the frequency range from 14 kHz to 28000 kHz.

This service has allocated a major part of the HF bands – more that 50 % - but only a very limited amount of spectrum is used for civil Fixed links.

In central and western Europe the international civil Fixed (HF) Service has decreased over the past years and the frequency bands are only used to a limited extent for embassy communication, the world wide networks for Interpol or back up systems to the wired Interpol communication network with encrypted transmission of speech and data, Red Cross and a few other similar international networks. The traffic load on such channels varies between 300 and 700 hours per

months. In large countries in the eastern part of Europe the MF and HF bands are probably used for civil fixed applications to a larger extent. This is also the case just outside the European area.

In Germany data-distribution services are developed on frequencies around 130 kHz with nation-wide distribution of data signals and telegrams to a very high number of fixed receivers all over Germany. It is argued that the LF bands in general have some strong advantages including countrywide coverage and very economical services for low bit-rate data services. It is further argued that the use of LF frequency bands can not be replaced by other means of communications. This may imply that more services might be developed within this frequency range. In Germany also point to multipoint distribution is in use within the HF - Fixed Service with news from agencies, weather reports etc.

The existing fixed service is in general still using analogue technology and there are no plans available for the introduction of digital technology in these bands. In some countries both digital and analogue services are currently used for data transmissions. For propagation reasons it is expected that in particular frequencies below 10-12 MHz be used in countries where national Fixed Service communication is still in operation. As indicated in Annex 2 the Fixed Service allocations are to some extent evenly spread in all the HF bands. The Fixed and Mobile Service allocations are intensively used by military in Europe, see chapter 16.

12 THE LAND MOBILE SERVICE

The service is covering a total of 2784 kHz within the frequency range 1606 to 24890 kHz.

There is very limited or no civil land mobile services in these bands within Europe. In large countries in the eastern part of Europe the MF and HF bands are probably used for civil mobile applications to a larger extent. This is also the case just outside the European area.

13 RADIOASTRONOMY

The Radioastronomy services covers 170 kHz in the LF, MF and HF bands in particular in the 13 MHz and the 25 MHz bands. The stations are by nature used in rural areas. Needs continued protection.

14 THE BROADCASTING SERVICE

The Broadcasting service is covering a total of

- 1414 kHz in the LF and MF bands
- 4370 kHz in the HF bands.

The bands are in use for the Broadcasting service and as such a large portion of the LF, MF and HF bands are used for the service. It is noted that the Broadcasting Service is also using a large part of the frequency bands between 30 MHz and 1 GHz and as well satellite bands.

The LF and MF frequency bands are covered by the Region 1 and Region 3 Frequency Assignment Plan GE75 and the use of the HF bands by the Article S12 procedure of the ITU Radio Regulations. This procedure was improved by the WRC97 conference and the new Article S12 procedure now encourages also the broadcasters and other authorised organisations to participate in the process. The monitoring service in Europe provides monitoring programs on specific broadcasting bands in support of the ongoing frequency planning process.

Whilst FM radio is the primary outlet for many radio services, a number of the radio services in the UK and in other countries as well are only available on MF. The MF band is also widely used to extend the diversity and coverage of services such as local radio and national regional broadcasting services.

Some programs are transmitted on LF only and surveys indicate that the LF and MF services have a very big number of listeners even if the programs are made available by other means as well.

Thus it is indicated in contributions to this report that the LF and MF bands are of significant importance to the Broadcasters. Medium wave outlets are also used to augment broadcast coverage or to extend programs choice to the Local Radio listeners.

For local MF services powers are typically several hundreds of watts although some operate in the range 1-5 kW. Many MF Broadcasting stations are using transmitting antennas with some directivity, especially to allow multiple frequency re-use within the country. The Broadcasting stations normally operate with 18 or 24 hour's service.

14.1 EBU Contribution

A survey had been conducted with 11 members of the EBU in contribution to the current report.

Most broadcasters - public as well as private/commercial - are operating broadcasting station close to 24 hours a day and the transmissions on LF and MF are typically nationwide and European coverage while the HF bands are used for international and world wide coverage. In general Broadcasters are active in the development and implementation of digital technology in the field of broadcasting in particular within the DRM. Thus it is expected that digital technology be introduced at least in the MF and HF bands.

Although based on a limited number of responses, it can be concluded from the survey that broadcasters in general will continue to heavily use the LF, MF, and HF bands for the foreseeable future. An increased demand in the spectrum requirement can also be expected when new digital techniques (e.g., DRM) are introduced in the next 5 – 10 years, when there will be an increase in number of programs and new services. Both national and international broadcasters, within Europe and beyond will implement the new digital techniques. Interference from cable and power line systems would be very detrimental to the existing analogue services and to the future development of digital services in any part of the LF, MF, HF bands. It is important that the potential interference from cable and power line systems does not deteriorate the existing broadcasting usage of the LF, MF and HF bands. In particular the possibility to reduce e.r.p. for new digital transmissions may be thwarted by resulting increased ambient noise levels.

14.2 Introduction of new technologies in LF and MF-bands

The long and medium wave bands are subject to dramatic changes triggered by the introduction of digital technology. It is estimated that there are currently over 2-billion AM receivers in use throughout the world.

The valuable radio spectrum at LF/MF has particular advantages for true wireless systems — in particular the ability to cover large areas in a cost-effective way while serving both fixed and portable/mobile receivers. Broadcasters are therefore making a substantial investment in the development of a digital broadcasting system for these bands to replace the analogue AM (amplitude modulation) currently used. This development has been carried out by a worldwide consortium called Digital Radio Mondiale (DRM), with the intention of establishing a single world standard.

DRM aims to establish a digital system for the AM bands, which serves as a flexible, non-proprietary evolutionary world standard. It will be market driven; consumer oriented and will facilitate the spread of AM digital technology around the world.

It is further expected that the development of a digital broadcasting system will offer enhanced flexibility of content provision and delivery, whilst offering to listeners the prospect of considerably improved, FM-like audio quality, together with greater ease of use.

Digital broadcasting is intended to allow the use of lower power levels than those presently used for AM broadcasting. However if interference levels were not controlled worldwide this would not be possible.

Based on inputs from DRM and others the ITU-R Study Group 6 adopted a new Recommendation (ITU-R BS 1514) entitled "Systems for digital sound broadcasting bands below 30 MHz".

14.3 HF Broadcasting

The HF Broadcasting is used all over the world to provide international Broadcasting services. The propagation characteristics require that a family of frequencies be used in order to provide sufficient coverage of particular areas internationally. Thus the BBC world service makes use of 176 HF frequencies which are co-ordinated in accordance with the procedures described in Article S12 of the Radio Regulations.

A typical HF traffic load for big broadcasters such as the BBC World Service is approximately 6,000 transmitted hours per week (26,000 per month) while the figure for LF/MF is 2,000 hours per week (9,000 per month). It is basically intended to cover all parts of the world urban as well as rural areas. As the HF receivers are available relatively cheaply in all parts of the world the general public will have an easy access to HF transmitted programs.

The HF Broadcasting community is keen to introduce new digital technologies to its HF services as soon as a viable format is available. HF transmissions have unique propagation advantages but it is clear the HF audience is being eroded by competing services in other frequency bands that offer both higher quality and easier access. Many Broadcasters were

actively participating in the DRM (Digital Radio Mondiale) consortium and in ITU Task Group 6/6 in their attempt to define a unified standard for digital broadcasting in the LF, MF and HF bands. It is anticipated that transmitters and first-generation receivers will be available in the second half of 2001. Mounting actual services, beyond test broadcasts, will depend on the regulatory process and it is anticipated that the matter will be addressed at WRC2003.

The requirements for LF, MF and HF Broadcasting will continue. Some international broadcasters have reduced their transmissions while others have launched major investment programs in HF and MF transmission plants. Such plants would be expected to have a service life of at least 25 years and operate with both analogue and digital formats.

Digital formats provide higher quality and open up new market possibilities for HF transmissions including possibilities for data transmission adding value to the existing broadcast services.

In most radio markets FM has to be considered as the quality benchmark to which competing services (at least) aspire. Current experience with digital HF formats suggests that while the audio quality obtainable from a 9 or 10 kHz wide RF channel is remarkable, it is not able to compete with that available on FM. Good quality stereo, for example, is not possible using current compression coding techniques. If a digital HF format is to win FM audiences in significant numbers, it will probably need more than the current 9 or 10 kHz channel allowance to do it. A medium to long term aim must therefore be to operate in the HF band with wider channels. Clearly this will mean that these formats will tend to be somewhat more 'spectrum hungry' than the analogue services which they replace. On the other hand it should be noted that DRM is considered spectrum efficient, because of its significantly lower protection requirements, compared to analogue services. Furthermore, the ability offered by the DRM system to establish an SFN wins back what is lost by using a double-bandwidth mode (or even more, if the original analogue MFN used more than two frequencies).

The development of digital formats for LF, MF and HF is intended to make the bands more attractive to broadcasters and listeners alike and so to develop and build on the existing base of services. It must be anticipated that as digital services become more commonplace and the receiver base builds up, analogue services will gradually be replaced and eventually stopped altogether. It is to be expected that the markets served by digital services will have the existing, currently analogue, markets at their core.

As with any digital transmission system there will be scope to add extra data services to the primary broadcast service. Since bandwidths and therefore overall bit rates are limited there will be a trade off between the bit rate available for the primary service and the data. It is envisaged that any data stream will be used primarily for such things as automatic tuning and schedule information, however, the broadcaster will have the opportunity to enhance the service in other ways

Within the Russian Federation where both LF, MF and HF bands are used for national as well as international broadcasting experiments are being conducted on digital broadcasting in Moscow. These experiments will continue during 2001 in order to support the development of recommendations and standards. The use of digital technology would allow other data transmissions within the broadcasting bands and the Russian Federation may consider a widening of the existing broadcasting bands.

14.4 Transition periods and further activities

With introduction of digital transmissions in the LF, MF and HF-bands a long transition period may be expected from analogue to digital transmissions in view of

- the large current penetration of analogue LF, MF and HF receivers
- the large geographical and financial differences of the audience
- the possibilities within the DRM-standard to simulcast digital and analogue transmissions on the same transmitter
- pending availability of digital broadcasting receivers on the market.

It is underlined in contributions to this report from broadcasters that it is important that new allocations for broadcasting, analogue as well as digital is found in the HF-bands and special attention should be given to the lower part. It is argued that the growing number of participants in the ongoing global co-ordination of the use of HF broadcasting frequencies in accordance with art S12 of the Radio Regulations suffers from the lack of frequencies below 9 MHz. Furthermore the longstanding incompatibility in the 7 MHz bands between the Amateur Service and the Broadcasting Service should be solved as soon as possible.

15 THE AMATEUR SERVICE

The Amateur Service covers 3290 kHz within the range 1810 – 29700 kHz. In addition the band 135.7-137.8 kHz is in use on a secondary basis by the Amateur Service in CEPT countries in accordance with ERC Recommendation 62-01.

The frequency bands are all heavily used. The number of active radio amateurs has, however, not been increasing in Europe during the past few years. This is different from other parts of the world. Based on the number of QSL cards being forwarded between the amateur radio clubs - about 5 million cards every year from German amateur radio club – it is underlined that the radio amateurs are actively using the frequency band made available.

The amateur stations are typically used in urban areas where the amateurs live but installations in particular in HF band are also covering the rural areas. Indications of 70% urban areas have been mentioned.

The number and variety of modes of emission used by radio amateurs are expanding greatly, creating internal pressures within the amateur services for their accommodation at the expense of users of established modes such as single-sideband telephony and A1A Morse telegraph (CW) operations. These new modes include digital voice, data and image. Their use improves the efficiency of amateur operations, but also increases the popularity of Amateur Radio and therefore the amount of congestion.

Replacing analogue modulations with digital in the field of man-to-man communications like voice and Morse telegraphy will depend on future developments, and how digital modulations will cope with propagation effects on HF. It has also to be taken into account that the introduction of digital modulations must not lead to a de facto isolation of less developed countries. At present IARU is discussing a new form of HF bandplan which is no longer structured according to different modulation schemes but to three different classes of bandwidths (narrow: up to 500 Hz, medium: up to 1500 Hz and wide band: above 1500 Hz). This scheme should adapt well to the experimental character of amateur radio and will accept traditional as well as future modulation schemes, and all can be used in parallel to find out which will be the best solution to our future requirements

An agenda point of WRC 2003 will deal with a harmonisation of the 7 MHz amateur radio bands in all three-world regions. In contribution from Radio amateurs it is underlined that the 7 MHz band is extremely important in many parts of the world due to its propagation properties, and a large number of important support functions are established here. A minimum of 300 kHz worldwide allocation is required.

The trend towards no-code-licenses will lead to an increase in the number of radio amateurs on the HF bands and to a need for more spectrum. A possibly solution would be the extension of the WARC bands. As already mentioned, radio amateur experimenters are also interested in a MF allocation, to re-awake the nostalgic 500 kHz or another part of the former maritime radio band sufficiently separated from the intermediate frequency range of many radio receivers. There has for many years been a strong requirement by the Radio Amateur Service to investigate further the propagation characteristics in the LF bands.

16 MILITARY USE OF SPECTRUM

NATO and Partners have a strong interest in the use of the HF band, in particular the range below 12 MHz. In this range, under review in preparation of WRC-2003 and WRC-2005/6, fixed and mobile applications belong to the main usage, the latter including land mobile, aeronautical mobile and maritime mobile military services. Of primary importance is the adequate spectrum support required for networks of NATO, NATO Nations and Partner Nations that operate on a continuous 24-hour-a-day basis. In this respect several essential military functions critically depend on the use of this part of the HF spectrum

Until recently, the HF band was questioned as a medium for strategic and tactical communications because of its unreliability and limitations. Modern technology, however, has redeemed these features and has made HF communications considerably more robust than in the past. Consequently, this band is now being utilised to provide reliable communications for many requirements, at both short-range and beyond-line-of-sight distances, and features strongly in the overall planning for communications

16.1 HF Utilisation

Land Forces.

Land Forces need HF communications to ensure effective Consultation, Command and Control, both within NATO and with PfP Nations. In addition, HF Combat Net Radio communications are used at lower echelons as primary or secondary means where terrain, distance, or mobility requirements preclude reliance on Tactical Area Communications Systems.

Air Forces.

HF radio is used in the Air environment as the primary beyond-line-of-sight communication means to aircraft, land and maritime mobile platforms. Information is exchanged via HF radio in voice, message, and data link formats.

- a) HF communications are used between Air command and control ground elements and aircraft for exchanging mission control and surveillance/sensor data at extended ranges and when other communications are not available due to equipment or interference. HF is also used for Air Traffic Control purposes when beyond the range of VHF facilities.
- b) HF communications are used between Air command and control elements and ground elements mainly in a back-up mode when primary and higher capacity means are not available.

This includes:

- backup to NATO Communications Systems
- links to PfP and non-NATO elements;
- links to deployed / mobile entities;
- links to tactical formations.

Maritime Forces.

The NATO maritime community, due to its mobility, uses HF for beyond-line-of-sight communication requirements. Consequently, NATO is modernising its Broadcast and Ship Shore systems.

- a. Air/Ground/Air HF communications within the maritime environment are supported by the NATO CIS infrastructure.
- b. Within the maritime community, HF is widely fitted throughout NATO and PfP nations, and is common to virtually all warships. Where HF equipment is already fitted, only inexpensive enhancements such as a modem and a PC are generally required to achieve near error-free communications at user data rates significantly better than those used prior to the development of digital signalling techniques.

16.2 Discussion of Military HF Needs below 12 MHz

The CJTF Concept of NATO

- a. A CJTF is a multinational (Combined) and multi-service (Joint) task force.

Components for the CJTF will be provided by a coalition of interested nations. The CJTF may be purely NATO or may contain non-NATO countries.

The primary mission of a CJTF is to conduct Non-Art. 5 (of the NATO Treaty) contingency operations¹, including those in accordance with United Nations Security Council Resolutions (UNSCR) or an Organisation for Security and Co-operation in Europe (OSCE) mandate.

However, the possible employment of a CJTF for Alliance Art. 5 missions (collective defence) are not excluded. Both roles are, therefore, part of the implementation, planning and training processes.

CJTF HQs must have the capability to exercise command and control of Peace Support Operations (PSO), involving up to corps-sized² land components and/or respective sized air and/or maritime/amphibious components.

¹ Other than collective defence

² 60,000 servicemen as typical size.

- b. A typical CJTF spectrum requirement covers a variety of HF/Short wave communications, using Standard 3 kHz channel with 1 kW ERP.

The use of the HF Spectrum consists of:

- land-based fixed as well as mobile applications using skywave and groundwave propagation;
- maritime applications for ship-ship and ship-shore including amphibious communications;
- aeronautical mobile applications including the Off-Route (OR) channels described in the Radio Regulations, Appendix S26.

Below 12 MHz a typical requirement for Voice and telegraphy applications could be as follows for army, air and navy/marine components:

- 140 frequencies (60 + 40 + 40) for long range distances of 1000 km or beyond in the frequency range 1.5 - 7 MHz
- 400 frequencies (300 + 50 + 50) for distances of between 80 and 100 km in the frequency range below 12 MHz.

In total this requirement would comprise 540 HF channels (3 kHz) below 12 MHz.

- c. In accordance with NAC guidance NATO should have the ability to establish at least two CJTF HQs simultaneously in order to provide the Alliance with the organisation and capabilities necessary to implement the full range of CJTF operations while retaining the capacity for collective defence. In addition CJTF could be made available, following a decision by the Council, for WEU-led operations, and would thus contribute to the development of a European Security and Defence Identity (ESDI) within the Alliance.

The independent operation of 2 Task Forces requires around 1000 HF standard (3 kHz) channels below 12 MHz (planning basis).

- d. For the long distance frequencies international registration and protection would be desirable under the umbrella of national civil administrations/frequency management authorities, in their capacity as ITU members.
- e. Further to this, the availability of pre-co-ordinated multinational frequency pools contributes to spectrum economy and also supports the readiness of forces.

16.3 Broadcast Shore-Ship-Shore Networks and Ship-Ship Communications

- a. Despite the introduction of military maritime satellite communications in the 1960's HF naval broadcasts, ship/shore and HF Maritime Rear Links (MRLs) have remained crucial for the provision of dedicated wide area secure links effecting the transfer of operational support information, now at increasingly higher data rates. A NATO-wide upgrade of this infrastructure and configuration is now well underway. Ship-to-ship HF voice and data links offer Low Probability of Intercept (LPI), BLOS3 circuits, which can be adapted for PC to PC operation. Paradoxically, in the civil maritime community, commercial pressures have encouraged the expansion and greater dependence upon satellite communications offering high data rates, whilst the slow (Morse and teletype) manpower intensive, HF systems have become increasingly redundant. HF, however, remains the key to coverage outside satellite cover above 70 degrees north and below 70 degrees south. HF remains predominant to Baltic and southern region maritime nations as well as to coverage of vast areas outside Europe and North America where satellite resources are much less concentrated. HF will continue to feature, not least, as a radio fit in most ships, depending upon area, as part of the Safety of Life at Sea Convention requirements.
- b. Naval Broadcast frequency requirements for Shore-Ship-Shore HF Communication Networks and Ship-Ship HF Communication Links, both in support of Command and Control, will clearly remain unchanged. In some geographical areas infrastructure and configuration of these networks are being improved or renewed.
- c. The presently existing amount of co-ordinated frequencies comprises about 150 channels of 3 kHz bandwidth between 1.5 and 12 MHz.

³ BLOS = Beyond Line-of-Sight

- d. Exercises with Partner Nations may require a further co-ordination effort to obtain an additional set of frequencies. This could lead to a duplication of the above requirement (i.e. at least 300 channels).

16.4 Aeronautical Off-Route Applications

- a. The use of the Aeronautical Off-Route (OR) channels given in Appendix S26 to the Radio Regulations constitute another essential spectrum resource for strategic and tactical military employment of air forces and maritime air components.
- b. In view of an increase of both mobility and tri-service tasking of military forces, any reduction of existing aeronautical HF OR allocations would have detrimental consequences for the execution of military missions. Therefore, the exemption of Appendix S26 from WRC-03 deliberations is appreciated and supported.

16.5 National Fixed HF Networks

- a. A number of nations are currently maintaining the operation of military fixed HF networks as a back-up to other military communication networks.
- b. Frequency requirements are to be stipulated by nations in addition to the HF requirements discussed above.
It is to be assumed that there are minimum requirements for up to 500 channels on an average basis.

16.6 National Mobile HF Networks

- a. The great majority of nations will maintain the operation of military mobile HF networks for training and exercises and for the support of all types of military missions.
- b. Frequency requirements for these national mobile contingencies could be compared to those of a typical CJTF.
Therefore, requirements for a possible “national CJTF” would be again approximately 540 channels (3KHz).
- c. It is to be assumed that these national frequency needs are to be considered as individual, stand-alone requirements, i.e. nation-by-nation.

EU/WEU Networks. The firm decision of the European Union with regard to the planned establishment of a European Force could probably be compared with the CJTF Concept of NATO. If so, the frequency requirements would have to be expected in a similar order – for the case of HF spectrum needs in the order of another 540 HF channels (3kHz) below 12 MHz.

National Networks of Non-NATO Nations. Military HF requirements exist worldwide. Due to propagation conditions, the use of the HF band and the specific properties of the range below roughly 12 MHz must be seen in a worldwide user context. It is obvious that the congestion of the HF band and the need for frequency sharing will continue.

Future Utilisation

The HF range between 1.5 -12 MHz is of critical importance to several classic radio communication services and their respective users. Even if in the recent past the military appeared to be shifting away from the HF frequency band as a primary means of communications due to the increasing availability of satellite communications and a demand for larger data transmission rates, the technological improvements in HF transmitters and receivers, especially the use of digital technology and of frequency adaptive systems again have made HF a viable primary means of communications for military purposes.

So, HF continues to be a pillar of tactical communications particularly when working with large coalitions and/or large task forces, where diversity enable better tactical information flow. Other new technologies, such as software programmable radios, tactical PC to PC data transfer and multi-path communication links incorporating HF provide the military large opportunities to continue to optimise the HF band as a viable resource.

New purchases for the Allied Command Europe (ACE) Communication and Information System (CIS) Contingency Assets and for Maritime CIS Contingency Assets require reliable spectrum access in accordance with the current regulations.

There are specific concerns regarding Power Line Technology⁴, which exploits the availability of power lines within the current national civilian infrastructure to provide high data rate information transfer. This technology, however, due to the use of unshielded power cables, significantly increases overall background noise, particularly in the HF band. This is due to the high amount of “unintended radiation.” The HF band is affected due to the good propagation it provides over long distances. The impact on this system serves to degrade existing communication capability for HF Air-Ground-Air communications, Naval communications and radio relay. In areas of high-density applications it appears that PLT could serve to completely disrupt HF communications unless its noise level is reduced to the point of being below the current background noise levels. Given the current level of technology, military services operating in the HF band can not coexist with PLT while significant degradation to the “disadvantaged user”⁵ could particularly be actualised due to an overall increase in background noise levels.

Therefore, any future regulatory provision for the HF bands below 12 MHz should be made with a wider scope for compensation and should support the main and classic users such as Fixed and Mobile, Broadcasting and Radio Amateur Services. An alignment of HF allocations particularly throughout ITU Regions would be advantageous.

16.7 Contribution from Sweden on military services

In a contribution from Sweden it is underlined that there are strong military interests in the LF, MF and HF bands, in particular in the frequency range 1600-12000 kHz. The main applications are for fixed and mobile services, the latter including land mobile, aeronautical mobile and maritime mobile services. Apart from national use, international communications are included, e.g. during the increasing number of international exercises and operations.

The traffic load differs considerable between difference applications. Some international networks operate on a continuous 24-hour basis while other networks operate intensely for shorter periods only during exercises.

Navel forces in Sweden rely heavily on LF, MF and HF for communications even for short range communications due to propagation problems caused by archipelago Naval coast-stations are primarily working in the frequency range 1.6-12 MHz on a continuous 24 hour basis. The higher frequency ranges (12-18 MHz) are used for traffic to and from Naval training ships during wintertime (3-4 months) world-wide, this frequency range is also used for traffic to an from Sweden armed forces on UN missions (currently in Kosovo).

Naval ships, however, use the entire MF and HF bands (1.6 – 28 MHz) for their tactical traffic on a daily basis and primarily during daytime, except during exercises when traffic load will increase considerably on a 24 hour a day basis.

16.8 Contribution from Germany on military services

In a military contribution from Germany it is mentioned

- That It is typical for military communication that there are no dedicated bands like there are designated and publicly known bands for the broadcast service or the amateur radio service in the HF radio spectrum. Instead of being grouped in bands, military frequencies rather are distributed almost evenly in the entire spectrum. Besides land mobile and maritime mobile usage such as ship-ship, ship-shore and broadcast, the military also make extensive use of aeronautical mobile applications in the HF bands.
- Industry (e.g. Rohde & Schwarz) has recently proposed new technologies, which are likely to be considered for procurement in mid future. These are for example data communication systems with TCP/IP capability and more modern modulation schemes. Prototypes are already operational.
- HF will gain an increase of importance for military usage.
- This is also in line with discussions inside NATO, where HF systems are not considered as backup media, but as complementary communication systems.
- Due to the nature of military radio services, a certain amount of secrecy with regard to new technologies is to be maintained.

⁴ Power Line Technology (PLT or PLC). For the purposes of this document will be referred to as PLT.

⁵ Disadvantaged Users. Constraints exist on certain HF users that impinge on their ability to get the maximum from the HF spectrum characteristics in tactical operations. These users are known as “disadvantaged” users and include some and individuals with manpack radios which all have small and inefficient antennas, low power transmitters and often need to operate from a position which is much less than optimum.

- Germany does not have an own military satellite system. Even in case of available satellite communications, HF communication has a major advantage over satellite communication. HF systems do not have such a single prominent point as the satellite in orbit, and thus are not prone to be interrupted completely by „switching off“ just a single node of the network. From a military point of view, this vulnerability consideration is important

17 CONCLUSIONS

The current study based on contributions from administrations, industry and users has shown that the LF, MF and HF frequency bands are still in use in Europe. For some of the services such as the Fixed and Mobile Services the civil commercial use is very limited. These bands are, however, intensively used by military applications including European wide military usage in the context of common European forces.

The Aeronautical and Maritime services as well as the Radionavigation Services have also safety of life implications. The frequency planning and use of frequency spectrum for those services are therefore subject to detailed worldwide frequency plans providing the necessary protection against interference.

The analogue technology is still dominating the traditional LF, MF and HF services and there are no plans in the short to medium term to introduce digital technology within commercial or safety services in those bands.

The Broadcasting Services uses the frequency bands available intensively and requirements for further spectrum have been raised in particular below 9 MHz. New digital technology has been developed and is expected to be introduced within the LF, MF and HF bands. It is envisaged that the digital technology used for the Broadcasting Service may create similar opportunities for the other services in the LF, MF and HF bands.

The existing and future services in the LF, MF and HF bands must be protected against interference from other services such as cable communication systems xDSL etc. The results of the study indicate a general intensive use of the LF, MF and HF spectrum, which does not provide possibilities for parts of the bands to be reserved for non-radio transmitted communication systems.

ANNEX 1

Frequency Allocations (primary services) in the LF MF and HF bands

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
AERONAUTICAL MOBILE (OR)					
Total bandwidth = 1125 kHz					
3025	- 3155	130 kHz		Appendix S26 Allotment	Current and future use
3800	- 3900	100 kHz		Appendix S26 Allotment	Current and future use
3900	- 3950	50 kHz	S5.213	Appendix S26 Allotment	Current and future use
4700	- 4750	50 kHz		Appendix S26 Allotment	Current and future use
4750	- 4850	100 kHz		Appendix S26 Allotment	Current and future use
5450	- 5480	30 kHz		Appendix S26 Allotment	Current and future use
5680	- 5730	50 kHz	S5.111 S5.115	Appendix S26 Allotment	Current and future use
6685	- 6765	80 kHz		Appendix S26 Allotment	Current and future use
8965	- 9040	75 kHz		Appendix S26 Allotment	Current and future use
11175	- 11275	100 kHz		Appendix S26 Allotment	Current and future use
13200	- 13260	60 kHz		Appendix S26 Allotment	Current and future use
15010	- 15100	90 kHz		Appendix S26 Allotment	Current and future use
17970	- 18030	60 kHz		Appendix S26 Allotment	Current and future use
23200	- 23350	150 kHz		Appendix S26 Allotment	Current and future use

AERONAUTICAL MOBILE (R)					
Total bandwidth = 1301 kHz					
2850	- 3025	175 kHz	S5.111 S5.115	Appendix S27 Allotment ICAO Annex 10	Current and future use
3400	- 3500	100 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
4650	- 4700	50 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
5480	- 5680	200 kHz	S5.111 S5.115	Appendix S27 Allotment ICAO Annex 10	Current and future use
6525	- 6685	160 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
8815	- 8965	150 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
10005	- 10100	95 kHz	S5.111	Appendix S27 Allotment ICAO Annex 10	Current and future use
11275	- 11400	125 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
13260	- 13360	100 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
17900	- 17970	70 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
21924	- 22000	76 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use

AERONAUTICAL RADIONAVIGATION					
Total bandwidth = 191 kHz					
255	- 283.5	29 kHz	S5.72 S5.74	GE 85 ICAO Annex 10	Still used
283.5	- 315	31 kHz	S5.72 S5.74	GE 85 ICAO Annex 10	Still used
315	- 325	10 kHz	S5.72 S5.75	GE 85 ICAO Annex 10	Still used
325	- 405	80 kHz	S5.72	GE 85 ICAO Annex 10	Still used
415	- 435	20 kHz	S5.72	GE 85 ICAO Annex 10	Limited use
505	- 526.5	21 kHz	S5.72 S5.81 S5.84	GE 85 ICAO Annex 10	Limited Use

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AMATEUR

Total bandwidth = 3290 kHz

1810	-	2000	190 kHz	S5.98 S5.99 S5.10 S5.101		In use
3500	-	3800	300 kHz	S5.120		In use
7000	-	7100	100 kHz	S5.120		In use
14000	-	14250	250 kHz	S5.120		In use
14250	-	14350	100 kHz	S5.120		In use
18068	-	18168	100 kHz	S5.120		In use
21000	-	21450	450 kHz	S5.120		In use
24890	-	24990	100 kHz	S5.120		In use
28000	-	29700	1700 kHz			In use

AMATEUR-SATELLITE

Total bandwidth = 2700 kHz

7000	-	7100	100 kHz	S5.140 S5.141		In use
14000	-	14250	250 kHz			In use
18068	-	18168	100 kHz	S5.154		In use
21000	-	21450	450 kHz			In use
24890	-	24990	100 kHz			In use
28000	-	29700	1700 kHz			In use

BROADCASTING

Total bandwidth = 5884 kHz

148.5	-	255	107 kHz	S5.68 S5.69 S5.70	GE75	In use
255	-	283.5	29 kHz	S5.70 S5.71	GE75	In use
526.5	-	1606.5	1080 kHz	S5.87	GE75	In use
2300	-	2498	198 kHz	S5.113		Tropical band
3200	-	3400	200 kHz	S5.113		Tropical band
3950	-	4000	50 kHz			Shared with Fixed
4750	-	4850	100 kHz	S5.113		Tropical band
4850	-	4995	145 kHz	S5.113		Tropical band
5005	-	5060	55 kHz	S5.113		Tropical band
5900	-	5950	50 kHz	S5.134 S5.136		WARC92 (2007)
5950	-	6200	250 kHz		ART S12 procedure	In use
7100	-	7300	200 kHz		ART S12 procedure	In use
7300	-	7350	50 kHz	S5.134 S5.143		WARC92 (2007)
9400	-	9500	100 kHz	S5.134 S5.146		WARC92 (2007)
9500	-	9900	400 kHz	S5.147 S5.148	ART S12 procedure	In use
11600	-	11650	50 kHz	S5.134 S5.146		WARC92 (2007)
11650	-	12050	400 kHz	S5.147 S5.148	ART S12 procedure	In use
12050	-	12100	50 kHz	S5.134 S5.146		WARC92 (2007)
13570	-	13600	30 kHz	S5.134 S5.151		WARC92 (2007)
13600	-	13800	200 kHz	S5.148	ART S12 procedure	In use
13800	-	13870	70 kHz	S5.134 S5.151		WARC92 (2007)
15100	-	15600	500 kHz	S5.148	ART S12 procedure	In use
15600	-	15800	200 kHz	S5.134 S5.146		WARC92 (2007)

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
17480 -	17550	70 kHz	S5.134 S5.146		WARC92 (2007)
17550 -	17900	350 kHz	S5.148	ART S12 procedure	In use
18900 -	19020	120 kHz	S5.134 S5.146		WARC92 (2007)
21450 -	21850	400 kHz	S5.148	ART S12 procedure	In use
25670 -	26100	430 kHz		ART S12 procedure	In use

FIXED

Total bandwidth = 14296 kHz

14 -	20	6 kHz	S5.55 S5.56		Limited civil use
20 -	70	50 kHz	S5.56 S5.58		Limited civil use
72 -	84	12 kHz	S5.56		Limited civil use
86 -	90	4 kHz	S5.56		Limited civil use
110 -	112	2 kHz	S5.64		
118 -	126	8 kHz	S5.64		Limited civil use
129 -	130	1 kHz	S5.64		Limited civil use
130 -	148	18 kHz	S5.64 S5.67		Limited civil use
1606.5 -	1625	19 kHz	S5.92		Limited civil use
1635 -	1800	165 kHz	S5.92 S5.96		
1850 -	2000	150 kHz	S5.92 S5.96 S5.103		Limited civil use
2000 -	2025	25 kHz	S5.92 S5.103		Limited civil use
2025 -	2045	20 kHz	S5.92 S5.103		Limited civil use
2045 -	2160	115 kHz	S5.92		Limited civil use
2194 -	2300	106 kHz	S5.92 S5.103 S5.112		Limited civil use
2300 -	2498	198 kHz	S5.103		Limited civil use
2502 -	2625	123 kHz	S5.92 S5.103 S5.114		Limited civil use
2650 -	2850	200 kHz	S5.92 S5.103		Limited civil use
3155 -	3200	45 kHz	S5.116 S5.117		Limited civil use
3200 -	3230	30 kHz	S5.116		Limited civil use
3230 -	3400	170 kHz	S5.116 S5.118		Limited civil use
3500 -	3800	300 kHz	S5.92		Limited civil use
3800 -	3900	100 kHz			Limited civil use
3950 -	4000	50 kHz			Limited civil use
4000 -	4063	63 kHz	S5.126		Limited civil use
4438 -	4650	212 kHz			Limited civil use
4750 -	4850	100 kHz			Limited civil use
4850 -	4995	145 kHz			
5005 -	5060	55 kHz			Limited civil use
5060 -	5250	190 kHz			Limited civil use
5250 -	5450	200 kHz			Limited civil use
5450 -	5480	30 kHz			Limited civil use
5730 -	5900	170 kHz			Limited civil use

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
6765	- 7000	235 kHz			
7350	- 8100	750 kHz	S5.144		Limited civil use
8100	- 8195	95 kHz			Limited civil use
9040	- 9400	360 kHz			Limited civil use
9900	- 9995	95 kHz			Limited civil use
10100	- 10150	50 kHz			Limited civil use
10150	- 11175	1025 kHz			Limited civil use
11400	- 11600	200 kHz			Limited civil use
12100	- 12230	130 kHz			Limited civil use
13360	- 13410	50 kHz	S5.149		Limited civil use
13410	- 13570	160 kHz	S5.150		Limited civil use
13870	- 14000	130 kHz			Limited civil use
14350	- 14900	550 kHz			Limited civil use
15800	- 16360	560 kHz			Limited civil use
18030	- 18052	22 kHz			Limited civil use
18052	- 18068	16 kHz			Limited civil use
18168	- 18780	612 kHz			Limited civil use
19020	- 19680	660 kHz			Limited civil use
19800	- 19990	190 kHz			Limited civil use
20010	- 21000	990 kHz			Limited civil use
21850	- 21870	20 kHz	S5.155A		Limited civil use
21870	- 21924	54 kHz	S5.155B		Limited civil use
22855	- 23000	145 kHz	S5.156		Limited civil use
23000	- 23200	200 kHz			Limited civil use
23200	- 23350	150 kHz	S5.156A		Limited civil use
23350	- 24000	650 kHz			Limited civil use
24000	- 24890	890 kHz			Limited civil use
25010	- 25070	60 kHz			Limited civil use
25210	- 25550	340 kHz			Limited civil use
26175	- 27500	1325 kHz			Limited civil use
27500	- 28000	500 kHz			Limited civil use

Industrial, Scientific and Medical (ISM)

Total bandwidth = 370 kHz

6765	- 6795	30 kHz	S5.138		Short Range Devices
13553	- 13567	14 kHz	S5.150		Short Range Devices
26957	- 27283	326 kHz	S5.150		Short Range Devices

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

LAND MOBILE

Total bandwidth = 2784 kHz

1606.5 - 1625	19 kHz	S5.92		No civil use
1635 - 1800	165 kHz	S5.92 S5.96		No civil use
2045 - 2160	115 kHz	S5.92		No civil use
3800 - 3900	100 kHz			No civil use
4750 - 4850	100 kHz			No civil use
4850 - 4995	145 kHz			No civil use
5450 - 5480	30 kHz			No civil use
5730 - 5950	220 kHz			No civil use
23000 - 24890	1890 kHz			No civil use

MARITIME MOBILE

Total bandwidth = 5342 kHz

14 - 20	6 kHz	S5.57		No civil use
20 - 70	50 kHz	S5.57		No civil use
72 - 84	12 kHz	S5.57		No civil use
86 - 90	4 kHz	S5.57		No civil use
110 - 112	2 kHz	S5.64		No civil use
118 - 126	8 kHz	S5.60		No civil use
129 - 130	1 kHz	S5.64		No civil use
130 - 148.5	18 kHz	S5.64 S5.67		No civil use
415 - 435	20 kHz	S5.72	GE85	
435 - 495	60 kHz	S5.79	GE85	
505 - 526.5	21 kHz	S5.79	GE85	
1606.5 - 1625	19 kHz	S5.90	GE85	Limited civil use
1635 - 1800	165 kHz	S5.92 S5.96	GE85	Limited civil use
2045 - 2160	115 kHz	S5.92	GE85	Limited civil use
2170 - 2174	4 kHz		GE85	GMDSS
2190 - 2194	4 kHz		GE85	Limited civil use
2625 - 2650	25 kHz	S5.92		
4000 - 4063	63 kHz	S5.127	ART S52 Appendix S17	Limited civil use
4063 - 4438	375 kHz	S5.109 S5.110 S5.130 S5.131 S5.132 S5.128 S5.129	ART S52 Appendix S17	Limited civil use GMDSS
6200 - 6525	325 kHz	S5.109 S5.110 S5.130 S5.132 S5.137	ART S52 Appendix S17	Limited civil use GMDSS
8100 - 8195	95 kHz		ART S52 Appendix S17	Limited civil use
8195 - 8815	620 kHz	S5.109 S5.110 S5.132 S5.145 S5.111	ART S52 Appendix S17	Limited civil use GMDSS
12230 - 13200	970 kHz	S5.109 S5.110 S5.132 S5.145	ART S52 Appendix S17	Limited civil use GMDSS

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
16360 - 17410	1050 kHz	S5.109 S5.110 S5.132 S5145	ART S52 Appendix S17	Limited civil use	
18780 - 18900	120 kHz		ART S52 Appendix S17	Limited civil use	
19680 - 19800	120 kHz	S5.132	ART S52 Appendix S17	Limited civil use	
22000 - 22855	855 kHz	S5.132 S5.156	ART S52 Appendix S17	Limited civil use	
25070 - 25210	140 kHz		ART S52 Appendix S17	Limited civil use	
26100 - 26175	75 kHz	S5.132	ART S52 Appendix S17	Limited civil use	

MARITIME RADIONAVIGATION

Total bandwidth = 31 kHz

283.5 - 315	31 kHz	S5.73	GE85-IALA Plan	DGPS
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METEOROLOGICAL AIDS

Total bandwidth = 500 kHz

27500 - 28000	500 kHz			
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MOBILE

Total bandwidth = 526 kHz

495 - 505	10 kHz	S5.83	GMDSS	
2174 - 2190	16 kHz		GMDSS	
27500 - 28000	500 kHz			

MOBILE except aeronautical mobile

Total bandwidth = 895 kHz

1850 - 2000	150 kHz	S5.92 S5.96 S5.103		Maritime
3155 - 3200	45 kHz			Maritime
3200 - 3230	30 kHz			Maritime
3230 - 3400	170 kHz			Maritime
3500 - 3800	300 kHz			Limited civil use
5250 - 5450	200 kHz			Limited civil use

MOBILE except aeronautical mobile (R)

Total bandwidth = 3259 kHz

2000 - 2025	25 kHz	S5.92 S5.103		Limited civil use
2025 - 2045	20 kHz	S5.92 S5.103		Limited civil use
2194 - 2300	106 kHz	S5.92 S5.103 S5.112		Limited civil use
2300 - 2498	198 kHz	S5.103		Limited civil use
2502 - 2625	123 kHz	S5.92 S5.103 S5.114		Limited civil use
2650 - 2850	200 kHz	S5.92 S5.103		Limited civil use
4438 - 4650	212 kHz			No civil use
23350 - 24000	650 kHz	S5.157		No civil use
25010 - 25070	60 kHz			No civil use
25210 - 25550	340 kHz			No civil use
26175 - 27500	1325 kHz	S5.150		29960-27410 kHz PR27

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

RADIO ASTRONOMY

Total bandwidth = 170 kHz

13360	-	13410	50 kHz	S5.149		In use
25550	-	25670	120 kHz	S5.149		In use

RADIOLOCATION

Total bandwidth = 30 kHz

1625	-	1635	10 kHz	S5.93	Brussels 67 agreement	HI-FIX
1800	-	1810	10 kHz	S5.93	Brussels 67 agreement	HI-FIX
2160	-	2170	10 kHz	S5.93 S5.107	Brussels 67 agreement	HI-FIX

RADIONAVIGATION

Total bandwidth = 75 kHz

9	-	14	5 kHz			
70	-	72	2 kHz	S5.60	Decca	
72	-	84	12 kHz	S5.60	Decca	
84	-	86	2 kHz	S5.60	Decca	
86	-	90	4 kHz		Decca	
90	-	110	20 kHz	S5.62	LORAN C	
110	-	112	2 kHz	S5.64	Decca	
112	-	115	3 kHz	S5.60	Decca	
115	-	118	3 kHz	S5.60	Decca	
118	-	126	8 kHz	S5.60	Decca	
126	-	129	3 kHz	S5.60	Decca	
129	-	130	1 kHz	S5.60	Decca	
405	-	415	10 kHz	S5.76		

STANDARD FREQUENCY AND TIME

Total bandwidth = 69 kHz

20	-	20	0 kHz			Still in use Also 77.5 kHz
2498	-	2501	3 kHz			Still in use
2501	-	2502	1 kHz			Still in use
4995	-	5003	8 kHz			Still in use
5003	-	5005	2 kHz			Still in use
9995	-	10003	8 kHz	S5.111		Still in use
10003	-	10005	2 kHz	S5.111		Still in use
14990	-	15005	15 kHz	S5.111		Still in use
15005	-	15010	5 kHz			Still in use
19990	-	19995	5 kHz	S5.111		Still in use
24990	-	25005	15 kHz			Still in use
25005	-	25010	5 kHz			Still in use

ANNEX 1A

Frequency Allocations in the LF MF and HF bands Below 3 MHz

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AERONAUTICAL RADIONAVIGATION

Total bandwidth = 191 kHz

255	-	283.5	29 kHz	S5.72 S5.74	GE 85 ICAO Annex 10	Still used
284	-	315	31 kHz	S5.72 S5.74	GE 85 ICAO Annex 10	Still used
315	-	325	10 kHz	S5.72 S5.75	GE 85 ICAO Annex 10	Still used
325	-	405	80 kHz	S5.72	GE 85 ICAO Annex 10	Still used
415	-	435	20 kHz	S5.72	GE 85 ICAO Annex 10	Limited use
505	-	526.5	21 kHz	S5.72 S5.81 S5.84	GE 85 ICAO Annex 10	Limited Use

AMATEUR

Total bandwidth = 190 kHz

1810	-	2000	190 kHz	S5.98 S5.99 S5.10 S5.101		In use
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BROADCASTING

Total bandwidth = 1414 kHz

148.5	-	255	107 kHz	S5.68 S5.69 S5.70	GE75	In use
255	-	283.5	29 kHz	S5.70 S5.71	GE75	In use
526.5	-	1606.5	1080 kHz	S5.87	GE75	In use
2300	-	2498	198 kHz	S5.113		Tropical band

FIXED

Total bandwidth = 1222 kHz

14	-	20	6 kHz	S5.55 S5.56		Limited civil use
20	-	70	50 kHz	S5.56 S5.58		Limited civil use
72	-	84	12 kHz	S5.56		Limited civil use
86	-	90	4 kHz	S5.56		Limited civil use
110	-	112	2 kHz	S5.64		
118	-	126	8 kHz	S5.64		Limited civil use
129	-	130	1 kHz	S5.64		Limited civil use
130	-	148.5	18 kHz	S5.64 S5.67		Limited civil use
1606.5	-	1625	19 kHz	S5.92		Limited civil use
1635	-	1800	165 kHz	S5.92 S5.96		
1850	-	2000	150 kHz	S5.92 S5.96 S5.103		Limited civil use
2000	-	2025	25 kHz	S5.92 S5.103		Limited civil use
2025	-	2045	20 kHz	S5.92 S5.103		Limited civil use
2045	-	2160	115 kHz	S5.92		Limited civil use
2194	-	2300	106 kHz	S5.92 S5.103 S5.112		Limited civil use
2300	-	2498	198 kHz	S5.103		Limited civil use
2502	-	2625	123 kHz	S5.92 S5.103 S5.114		Limited civil use
2650	-	2850	200 kHz	S5.92 S5.103		Limited civil use

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
LAND MOBILE					
Total bandwidth = 299 kHz					
1606.5 -	1625	19 kHz	S5.92		No civil use
1635 -	1800	165 kHz	S5.92 S5.96		No civil use
2045 -	2160	115 kHz	S5.92		No civil use
MARITIME MOBILE					
Total bandwidth = 534 kHz					
14 -	20	6 kHz	S5.57		No civil use
20 -	70	50 kHz	S5.57		No civil use
72 -	84	12 kHz	S5.57		No civil use
86 -	90	4 kHz	S5.57		No civil use
110 -	112	2 kHz	S5.64		No civil use
118 -	126	8 kHz	S5.60		No civil use
129 -	130	1 kHz	S5.64		No civil use
130 -	148.5	18 kHz	S5.64 S5.67		No civil use
415 -	435	20 kHz	S5.72	GE85	
435 -	495	60 kHz	S5.79	GE85	
505 -	526.5	21 kHz	S5.79	GE85	
1606.5 -	1625	19 kHz	S5.90	GE85	Limited civil use
1635 -	1800	165 kHz	S5.92 S5.96	GE85	Limited civil use
2045 -	2160	115 kHz	S5.92	GE85	Limited civil use
2170 -	2174	4 kHz		GE85	GMDSS
2190 -	2194	4 kHz		GE85	Limited civil use
2625 -	2650	25 kHz	S5.92		
MARITIME RADIONAVIGATION					
Total bandwidth = 31 kHz					
283.5 -	315	31 kHz	S5.73	GE85-IALA Plan	DGPS
MOBILE					
Total bandwidth = 26 kHz					
495 -	505	10 kHz	S5.83	GMDSS	
2174 -	2190	16 kHz		GMDSS	
MOBILE except aeronautical mobile					
Total bandwidth = 150 kHz					
1850 -	2000	150 kHz	S5.92 S5.96 S5.103		Maritime
MOBILE except aeronautical mobile (R)					
Total bandwidth = 672 kHz					
2000 -	2025	25 kHz	S5.92 S5.103		Limited civil use
2025 -	2045	20 kHz	S5.92 S5.103		Limited civil use
2194 -	2300	106 kHz	S5.92 S5.103 S5.112		Limited civil use
2300 -	2498	198 kHz	S5.103		Limited civil use
2502 -	2625	123 kHz	S5.92 S5.103 S5.114		Limited civil use
2650 -	2850	200 kHz	S5.92 S5.103		Limited civil use

Allocation Frequency band Bandwidth Footnotes Frequency Plan Remarks Trends

RADIOLOCATION

Total bandwidth = 30 kHz

1625	-	1635	10 kHz	S5.93	Brussels 67 agreement	HI-FIX
1800	-	1810	10 kHz	S5.93	Brussels 67 agreement	HI-FIX
2160	-	2170	10 kHz	S5.93 S5.107	Brussels 67 agreement	HI-FIX

RADIONAVIGATION

Total bandwidth = 75 kHz

9	-	14	5 kHz			
70	-	72	2 kHz	S5.60	Decca	
72	-	84	12 kHz	S5.60	Decca	
84	-	86	2 kHz	S5.60	Decca	
86	-	90	4 kHz		Decca	
90	-	110	20 kHz	S5.62	LORAN C	
110	-	112	2 kHz	S5.64	Decca	
112	-	115	3 kHz	S5.60	Decca	
115	-	118	3 kHz	S5.60	Decca	
118	-	126	8 kHz	S5.60	Decca	
126	-	129	3 kHz	S5.60	Decca	
129	-	130	1 kHz	S5.60	Decca	
405	-	415	10 kHz	S5.76		

STANDARD FREQUENCY AND TIME

Total bandwidth = 4 kHz

20	-	20	0 kHz			Still in use Also 77.5 kHz
2498	-	2501	3 kHz			Still in use
2501	-	2502	1 kHz			Still in use

Frequency Allocations in the LF MF and HF bands 4 MHz band

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AERONAUTICAL MOBILE (OR)

Total bandwidth = 430 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
3025 -	3155	130 kHz		Appendix S26 Allotment	Current and future use
3800 -	3900	100 kHz		Appendix S26 Allotment	Current and future use
3900 -	3950	50 kHz	S5.213	Appendix S26 Allotment	Current and future use
4700 -	4750	50 kHz		Appendix S26 Allotment	Current and future use
4750 -	4850	100 kHz		Appendix S26 Allotment	Current and future use

AERONAUTICAL MOBILE (R)

Total bandwidth = 325 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
2850 -	3025	175 kHz	S5.111 S5.115	Appendix S27 Allotment ICAO Annex 10	Current and future use
3400 -	3500	100 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
4650 -	4700	50 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use

AMATEUR

Total bandwidth = 300 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
3500 -	3800	300 kHz	S5.120		In use

BROADCASTING

Total bandwidth = 495 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
3200 -	3400	200 kHz	S5.113		Tropical band
3950 -	4000	50 kHz			Shared with Fixed
4750 -	4850	100 kHz	S5.113		Tropical band
4850 -	4995	145 kHz	S5.113		Tropical band

FIXED

Total bandwidth = 1215 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
3155 -	3200	45 kHz	S5.116 S5.117		Limited civil use
3200 -	3230	30 kHz	S5.116		Limited civil use
3230 -	3400	170 kHz	S5.116 S5.118		Limited civil use
3500 -	3800	300 kHz	S5.92		Limited civil use
3800 -	3900	100 kHz			Limited civil use
3950 -	4000	50 kHz			Limited civil use
4000 -	4063	63 kHz	S5.126		Limited civil use
4438 -	4650	212 kHz			Limited civil use
4750 -	4850	100 kHz			Limited civil use
4850 -	4995	145 kHz			Limited civil use

LAND MOBILE

Total bandwidth = 345 kHz

Allocation	Frequency band	Bandwidth	Footnotes	Frequency	Remarks Trends
3800 -	3900	100 kHz			No civil use
4750 -	4850	100 kHz			No civil use
4850 -	4995	145 kHz			No civil use

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks</i>	<i>Trends</i>
MARITIME MOBILE						
Total bandwidth = 438 kHz						
4000	- 4063	63 kHz	S5.127	ART S52 Appendix S17	Limited civil use	
4063	- 4438	375 kHz	S5.109 S5.110 S5.130 S5.131 S5.132 S5.128 S5.129	ART S52 Appendix S17	Limited civil use GMDSS	
MOBILE except aeronautical mobile						
Total bandwidth = 545 kHz						
3155	- 3200	45 kHz			Maritime	
3200	- 3230	30 kHz			Maritime	
3230	- 3400	170 kHz			Maritime	
3500	- 3800	300 kHz			Limited civil use	
MOBILE except aeronautical mobile (R)						
Total bandwidth = 212 kHz						
4438	- 4650	212 kHz			No civil use	

Frequency Allocations in the LF MF and HF bands *6 MHz band*

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AERONAUTICAL MOBILE (OR)

Total bandwidth = 160 kHz

5450	-	5480	30 kHz		Appendix S26 Allotment	Current and future use
5680	-	5730	50 kHz	S5.111 S5.115	Appendix S26 Allotment	Current and future use
6685	-	6765	80 kHz		Appendix S26 Allotment	Current and future use

AERONAUTICAL MOBILE (R)

Total bandwidth = 360 kHz

5480	-	5680	200 kHz	S5.111 S5.115	Appendix S27 Allotment ICAO Annex 10	Current and future use
6525	-	6685	160 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use

BROADCASTING

Total bandwidth = 355 kHz

5005	-	5060	55 kHz	S5.113		Tropical band
5900	-	5950	50 kHz	S5.134 S5.136		WARC92 (2007)
5950	-	6200	250 kHz		ART S12 procedure	In use

FIXED

Total bandwidth = 645 kHz

5005	-	5060	55 kHz			Limited civil use
5060	-	5250	190 kHz			Limited civil use
5250	-	5450	200 kHz			Limited civil use
5450	-	5480	30 kHz			Limited civil use
5730	-	5900	170 kHz			Limited civil use

Industrial, Scientific and Medical (ISM)

Total bandwidth = 30 kHz

6765	-	6795	30 kHz	S5.138		Short Range Devices
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LAND MOBILE

Total bandwidth = 250 kHz

5450	-	5480	30 kHz			No civil use
5730	-	5950	220 kHz			No civil use

MARITIME MOBILE

Total bandwidth = 325 kHz

6200	-	6525	325 kHz	S5.109 S5.110 S5.130 S5.132 S5.137	ART S52 Appendix S17	Limited civil use GMDSS
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MOBILE except aeronautical mobile

Total bandwidth = 200 kHz

5250	-	5450	200 kHz			Limited civil use
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STANDARD FREQUENCY AND TIME

Total bandwidth = 10 kHz

4995	-	5003	8 kHz			Still in use
5003	-	5005	2 kHz			Still in use

Frequency Allocations in the LF MF and HF bands 8 MHz band

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
AERONAUTICAL MOBILE (OR)					
	Total bandwidth = 75 kHz				
	8965 - 9040	75 kHz		Appendix S26 Allotment	Current and future use
AERONAUTICAL MOBILE (R)					
	Total bandwidth = 150 kHz				
	8815 - 8965	150 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
AMATEUR					
	Total bandwidth = 100 kHz				
	7000 - 7100	100 kHz	S5.120		In use
AMATEUR-SATELLITE					
	Total bandwidth = 100 kHz				
	7000 - 7100	100 kHz	S5.140 S5.141		In use
BROADCASTING					
	Total bandwidth = 750 kHz				
	7100 - 7300	200 kHz		ART S12 procedure	In use
	7300 - 7350	50 kHz	S5.134 S5.143		WARC92 (2007)
	9400 - 9500	100 kHz	S5.134 S5.146		WARC92 (2007)
	9500 - 9900	400 kHz	S5.147 S5.148	ART S12 procedure	In use
FIXED					
	Total bandwidth = 1535 kHz				
	6765 - 7000	235 kHz			
	7350 - 8100	750 kHz	S5.144		Limited civil use
	8100 - 8195	95 kHz			Limited civil use
	9040 - 9400	360 kHz			Limited civil use
	9900 - 9995	95 kHz			Limited civil use
MARITIME MOBILE					
	Total bandwidth = 715 kHz				
	8100 - 8195	95 kHz		ART S52 Appendix S17	Limited civil use
	8195 - 8815	620 kHz	S5.109 S5.110 S5.132 S5.145 S5.111	ART S52 Appendix S17	Limited civil use GMDSS
STANDARD FREQUENCY AND TIME					
	Total bandwidth = 8 kHz				
	9995 - 10003	8 kHz	S5.111		Still in use

Frequency Allocations in the LF MF and HF bands *12 MHz band*

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AERONAUTICAL MOBILE (OR)

Total bandwidth = 160 kHz

11175 - 11275	100 kHz		Appendix S26 Allotment	Current and future use
13200 - 13260	60 kHz		Appendix S26 Allotment	Current and future use

AERONAUTICAL MOBILE (R)

Total bandwidth = 320 kHz

10005 - 10100	95 kHz	S5.111	Appendix S27 Allotment ICAO Annex 10	Current and future use
11275 - 11400	125 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
13260 - 13360	100 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use

BROADCASTING

Total bandwidth = 800 kHz

11600 - 11650	50 kHz	S5.134 S5.146		WARC92 (2007)
11650 - 12050	400 kHz	S5.147 S5.148	ART S12 procedure	In use
12050 - 12100	50 kHz	S5.134 S5.146		WARC92 (2007)
13570 - 13600	30 kHz	S5.134 S5.151		WARC92 (2007)
13600 - 13800	200 kHz	S5.148	ART S12 procedure	In use
13800 - 13870	70 kHz	S5.134 S5.151		WARC92 (2007)

FIXED

Total bandwidth = 1745 kHz

10100 - 10150	50 kHz			Limited civil use
10150 - 11175	1025 kHz			Limited civil use
11400 - 11600	200 kHz			Limited civil use
12100 - 12230	130 kHz			Limited civil use
13360 - 13410	50 kHz	S5.149		Limited civil use
13410 - 13570	160 kHz	S5.150		Limited civil use
13870 - 14000	130 kHz			Limited civil use

Industrial, Scientific and Medical (ISM)

Total bandwidth = 14 kHz

13553 - 13567	14 kHz	S5.150		Short Range Devices
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MARITIME MOBILE

Total bandwidth = 970 kHz

12230 - 13200	970 kHz	S5.109 S5.110 S5.132 S5.145	ART S52 Appendix S17	Limited civil use GMDSS
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RADIO ASTRONOMY

Total bandwidth = 50 kHz

13360 - 13410	50 kHz	S5.149		In use
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Frequency Allocations in the LF MF and HF bands *16 MHz band*

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
<i>AERONAUTICAL MOBILE (OR)</i>					
Total bandwidth = 90 kHz					
15010 -	15100	90 kHz		Appendix S26 Allotment	Current and future use
<i>AMATEUR</i>					
Total bandwidth = 350 kHz					
14000 -	14250	250 kHz	S5.120		In use
14250 -	14350	100 kHz	S5.120		In use
<i>AMATEUR-SATELLITE</i>					
Total bandwidth = 250 kHz					
14000 -	14250	250 kHz			In use
<i>BROADCASTING</i>					
Total bandwidth = 700 kHz					
15100 -	15600	500 kHz	S5.148	ART S12 procedure	In use
15600 -	15800	200 kHz	S5.134 S5.146		WARC92 (2007)
<i>FIXED</i>					
Total bandwidth = 1110 kHz					
14350 -	14900	550 kHz			Limited civil use
15800 -	16360	560 kHz			Limited civil use
<i>STANDARD FREQUENCY AND TIME</i>					
Total bandwidth = 20 kHz					
14990 -	15005	15 kHz	S5.111		Still in use
15005 -	15010	5 kHz			Still in use

Frequency Allocations in the LF MF and HF bands *18 MHz band*

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
AERONAUTICAL MOBILE (OR)					
	Total bandwidth = 60 kHz				
	17970 - 18030	60 kHz		Appendix S26 Allotment	Current and future use
AERONAUTICAL MOBILE (R)					
	Total bandwidth = 70 kHz				
	17900 - 17970	70 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
AMATEUR					
	Total bandwidth = 100 kHz				
	18068 - 18168	100 kHz	S5.120		In use
AMATEUR-SATELLITE					
	Total bandwidth = 100 kHz				
	18068 - 18168	100 kHz	S5.154		In use
BROADCASTING					
	Total bandwidth = 540 kHz				
	17480 - 17550	70 kHz	S5.134 S5.146		WARC92 (2007)
	17550 - 17900	350 kHz	S5.148	ART S12 procedure	In use
	18900 - 19020	120 kHz	S5.134 S5.146		WARC92 (2007)
FIXED					
	Total bandwidth = 1500 kHz				
	18030 - 18052	22 kHz			Limited civil use
	18052 - 18068	16 kHz			Limited civil use
	18168 - 18780	612 kHz			Limited civil use
	19020 - 19680	660 kHz			Limited civil use
	19800 - 19990	190 kHz			Limited civil use
MARITIME MOBILE					
	Total bandwidth = 1290 kHz				
	16360 - 17410	1050 kHz	S5.109 S5.110 S5.132 S5.145	ART S52 Appendix S17	Limited civil use
	18780 - 18900	120 kHz		ART S52 Appendix S17	Limited civil use
	19680 - 19800	120 kHz	S5.132	ART S52 Appendix S17	Limited civil use
STANDARD FREQUENCY AND TIME					
	Total bandwidth = 5 kHz				
	19990 - 19995	5 kHz	S5.111		Still in use

Frequency Allocations in the LF MF and HF bands *22 MHz band*

<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
<i>AERONAUTICAL MOBILE (OR)</i>					
	Total bandwidth = 150 kHz				
	23200 - 23350	150 kHz		Appendix S26 Allotment	Current and future use
<i>AERONAUTICAL MOBILE (R)</i>					
	Total bandwidth = 76 kHz				
	21924 - 22000	76 kHz		Appendix S27 Allotment ICAO Annex 10	Current and future use
<i>AMATEUR</i>					
	Total bandwidth = 450 kHz				
	21000 - 21450	450 kHz	S5.120		In use
<i>AMATEUR-SATELLITE</i>					
	Total bandwidth = 450 kHz				
	21000 - 21450	450 kHz			In use
<i>BROADCASTING</i>					
	Total bandwidth = 400 kHz				
	21450 - 21850	400 kHz	S5.148	ART S12 procedure	In use
<i>FIXED</i>					
	Total bandwidth = 2209 kHz				
	20010 - 21000	990 kHz			Limited civil use
	21850 - 21870	20 kHz	S5.155A		Limited civil use
	21870 - 21924	54 kHz	S5.155B		Limited civil use
	22855 - 23000	145 kHz	S5.156		Limited civil use
	23000 - 23200	200 kHz			Limited civil use
	23200 - 23350	150 kHz	S5.156A		Limited civil use
	23350 - 24000	650 kHz			Limited civil use
<i>MARITIME MOBILE</i>					
	Total bandwidth = 855 kHz				
	22000 - 22855	855 kHz	S5.132 S5.156	ART S52 Appendix S17	Limited civil use
<i>MOBILE except aeronautical mobile (R)</i>					
	Total bandwidth = 650 kHz				
	23350 - 24000	650 kHz	S5.157		No civil use

Frequency Allocations in the LF MF and HF bands *26 MHz band*

Allocation Frequency band Bandwidth Footnotes Frequency Remarks Trends

AMATEUR

Total bandwidth = 1800 kHz

24890 - 24990 100 kHz S5.120 In use

28000 - 29700 1700 kHz In use

AMATEUR-SATELLITE

Total bandwidth = 1800 kHz

24890 - 24990 100 kHz In use

28000 - 29700 1700 kHz In use

BROADCASTING

Total bandwidth = 430 kHz

25670 - 26100 430 kHz ART S12 procedure In use

FIXED

Total bandwidth = 3115 kHz

24000 - 24890 890 kHz Limited civil use

25010 - 25070 60 kHz Limited civil use

25210 - 25550 340 kHz Limited civil use

26175 - 27500 1325 kHz Limited civil use

27500 - 28000 500 kHz Limited civil use

Industrial, Scientific and Medical (ISM)

Total bandwidth = 326 kHz

26957 - 27283 326 kHz S5.150 Short Range Devices

LAND MOBILE

Total bandwidth = 1890 kHz

23000 - 24890 1890 kHz No civil use

MARITIME MOBILE

Total bandwidth = 215 kHz

25070 - 25210 140 kHz ART S52 Appendix S17 Limited civil use

26100 - 26175 75 kHz S5.132 ART S52 Appendix S17 Limited civil use

METEOROLOGICAL AIDS

Total bandwidth = 500 kHz

27500 - 28000 500 kHz

MOBILE

Total bandwidth = 500 kHz

27500 - 28000 500 kHz

MOBILE except aeronautical mobile (R)

Total bandwidth = 1725 kHz

25010 - 25070 60 kHz No civil use

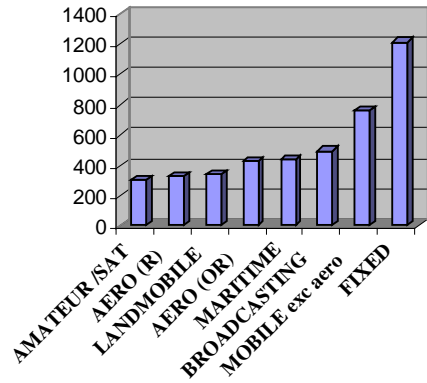
25210 - 25550 340 kHz No civil use

26175 - 27500 1325 kHz S5.150 29960-27410 kHz
PR27

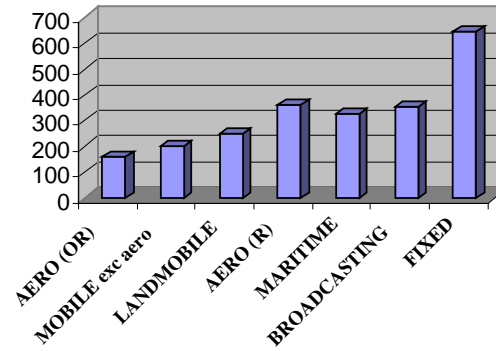
<i>Allocation</i>	<i>Frequency band</i>	<i>Bandwidth</i>	<i>Footnotes</i>	<i>Frequency</i>	<i>Remarks Trends</i>
<i>RADIO ASTRONOMY</i>					
	Total bandwidth = 120 kHz				
	25550 - 25670	120 kHz	S5.149		In use
<i>STANDARD FREQUENCY AND TIME</i>					
	Total bandwidth = 20 kHz				
	24990 - 25005	15 kHz			Still in use
	25005 - 25010	5 kHz			Still in use

Overview of Frequency Allocations

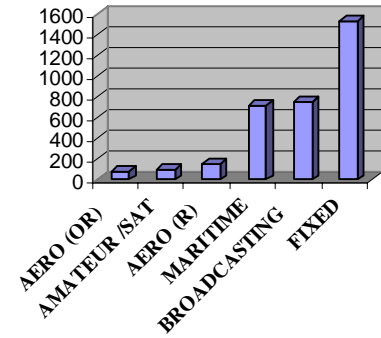
HF Allocations 4 MHz



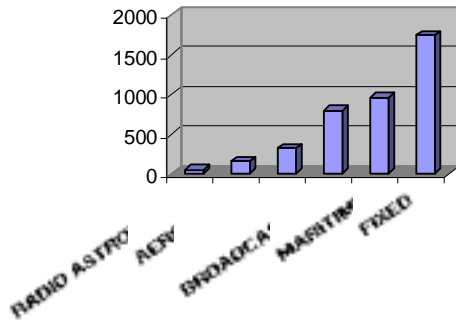
HF Allocations 6 MHz



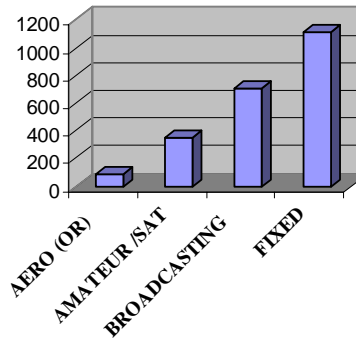
HF Allocations 8 MHz



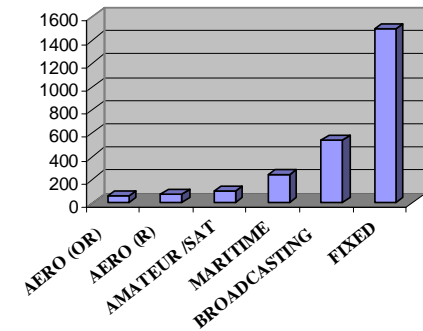
HF Allocations 12 MHz



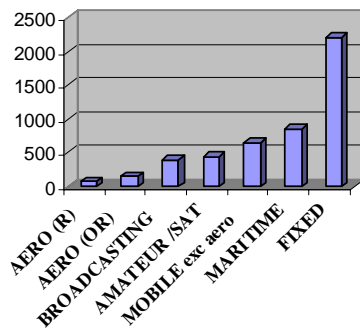
HF Allocations 16 MHz



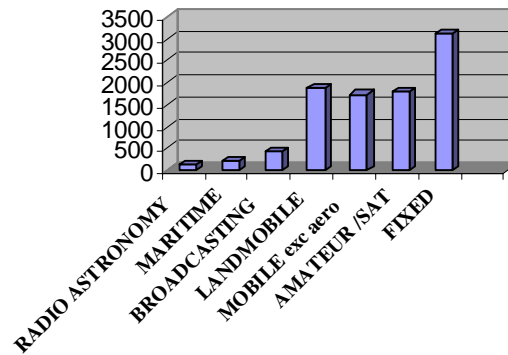
HF Allocations 18 MHz



HF Allocations 22 MHz

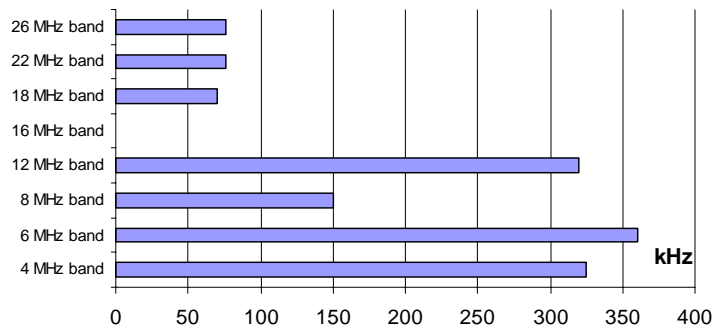


HF Allocations 26 MHz

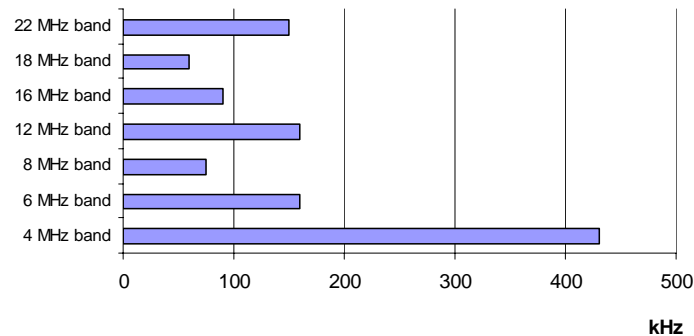


Overview of Frequency Allocations

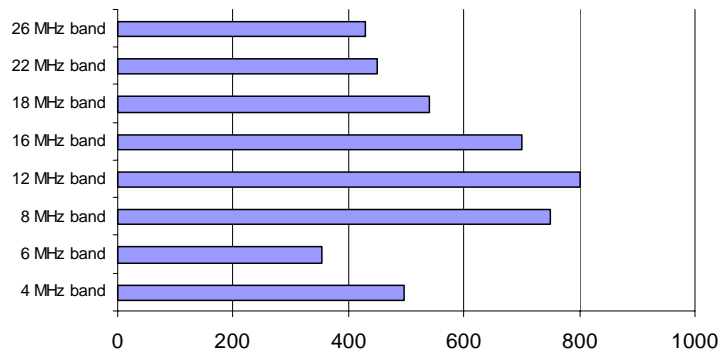
Frequency bands allocated to the Aeronautical Mobile (R) Service



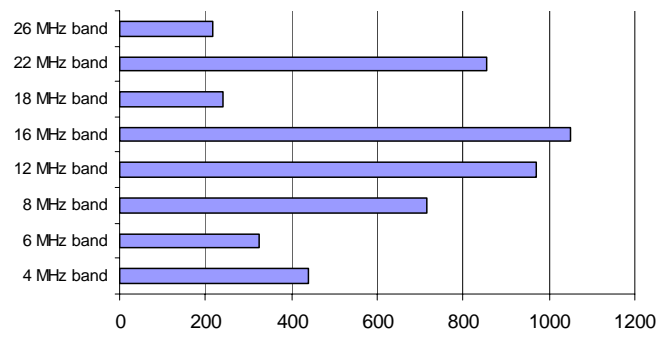
Frequency bands allocated to the Aeronautical Mobile (OR) Service



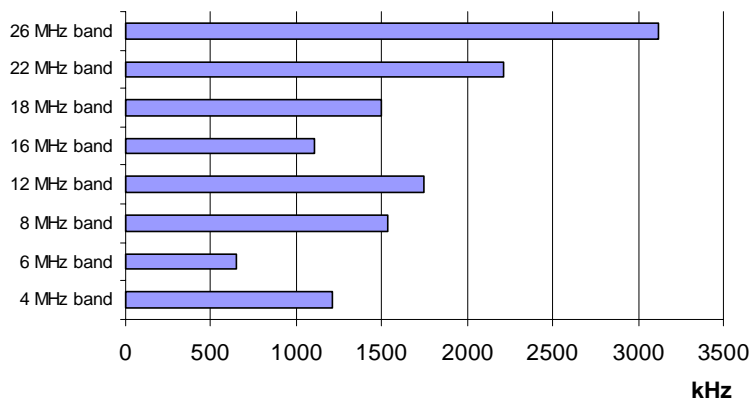
Frequency bands allocated to the Broadcasting Service



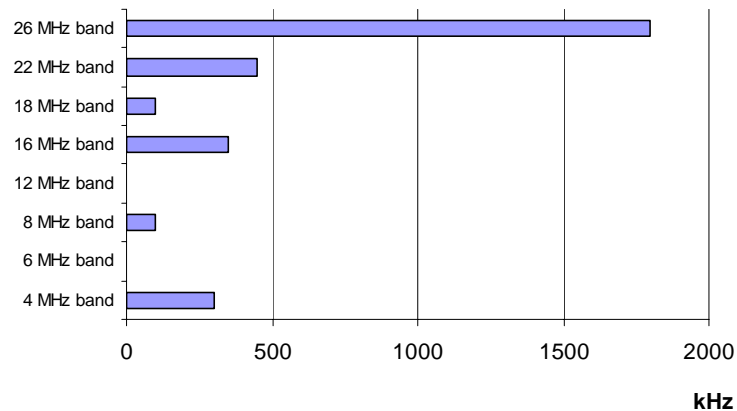
Frequency bands allocated to the Maritime Mobile Service



Frequency bands allocated to the Fixed Service

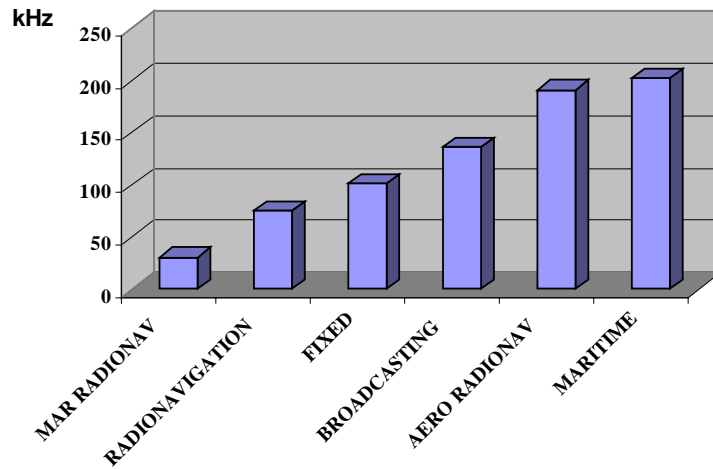


Frequency bands allocated to the Amateur and Amateur satellite service

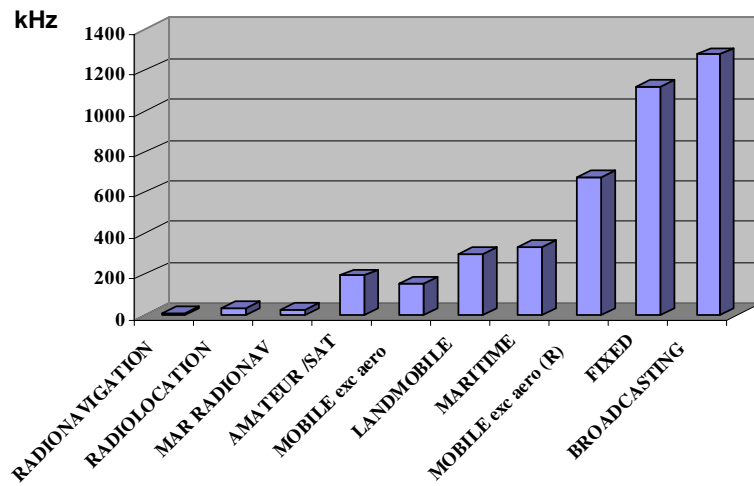


Overview of Frequency Allocations

MF Allocations 9 - 526.5 kHz



MF Allocations 1606.5 - 2850 kHz



ANNEX 3

Glossary

AM	Amplitude Modulation
ADF	Automatic Direction Finder
ATC	Air Traffic Control
ATS	Air Traffic Service
CJTF	Combined Joint Task Force
DRM	Digital Radio Mondiale
DSC	Digital Selective Calling
EBU	European Broadcasting Union
ECAC	European Civil Aviation Conference
ESDI	European Security and Defence Identity
EU	European Union
GE75	Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3), Geneva 75
GE85	Regional Administrative Conference for the Planning of the MF Maritime and Aeronautical Radionavigation Services (Region 1), Geneva 85
GMDSS	Global Maritime Distress and Safety system
HF	High Frequencies 3 – 30 MHz
IARU	International Radio Amateur Union
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
ITU	International Telecommunications Union
LF	Low Frequencies 30-300 kHz
MF	Medium Frequencies 300 kHz – 3000 kHz
NATO	North Atlantic Treaty Organization
NDB	Non Directional Radio Beacon
PLC	Power Line Communication
PLT	Power Line Technology
QSL	Confirmation of reception of transmission
WEU	Western Union
WRC	World Radio conference of ITU
XDSL	X Digital Subscriber Line

ANNEX 4

List of contributors*Company*

Austrian Amateur organisation
 Austrian Broadcasting
 Austrian Red Cross
 BBC
 BBC World Service
 Croatian Institute of
 Croation Institute of
 Czech Telecom Office
 Deutsche Telekom
 Deutscher Amateur Radio Club
 Digita Oy
 DRM
 EBU
 Estonian Administration
 Eurocontrol
 General State Supervisory
 Hungarian Administration
 IBPT
 ICAO
 Icelandic Broadcasting
 Irish Aviation Authority
 Luxembourg
 Min of Interior
 Ministero delle Comunicazioni
 Monte Carlo Radiodiffusion
 NARFA Germany
 National Radiocommunications
 National Telecom Agency
 NATO EAPC/PIP
 Norwegian Post and Telecom
 Oberste Post- und
 OFCOM
 Polish Telecom
 Post og Telestyrelsen
 Radio Vaticana
 Radiodifusao Portuguesa
 RegTP
 Slovak Telecom Office
 Spanish Administration
 SRG SSR
 Tele Danmark
 Telecom Administration Centre
 Telecom Agency
 Telecommunication State
 Telecommunication Regulatory
 Telenor
 Turkey Administration
 UK Radio Authority

Country

Austria
 Austria
 Austria
 United Kingdom
 United Kingdom
 Croatia
 Croatia
 Czech Republic
 Germany
 Germany
 Finland
 Switzerland
 Switzerland
 Estonia
 Switzerland
 Russia
 Hungary
 Belgium
 France
 Iceland
 Ireland
 Luxembourg
 Austria
 Italy
 Monaco
 Germany
 Poland
 Denmark
 Belgium
 Norway
 Austria
 Switzerland
 Poland
 Sweden
 Vatican City
 Portugal
 Germany
 Slovak Republic
 Spain
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 Denmark
 Finland
 Lithuania
 Latvia
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 Turkey
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