Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

MANAGING THE TRANSITION TO DIGITAL SOUND BROADCASTING IN THE FREQUENCY BANDS BELOW 80 MHz

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0 SUMMARY

This report looks at the use of the lower frequency broadcast bands – below 80MHz – for digital broadcasting to national, local and community audiences. Included are the LF, MF, 26 MHz (HF) bands and VHF Band I. The report does not attempt to analyse the potential transition strategies for those HF bands which are primarily used for long distance, international broadcasting.

In ITU Regions 1 and 3, the GE75 LF/MF Final Acts provide a plan for the assignment of frequencies to broadcasting stations, a modification procedure (Article 4) and the technical details to be used for the preparation of the plan. This Agreement is based on analogue Amplitude Modulated Double-SideBand (AM DSB) transmissions.

Digital Radio Mondiale (DRM) as a technology is anticipated to be used alongside AM initially and then supersede it over time. It is a COFDM (Coded Orthogonal Frequency Division Multiplex) digital sound broadcasting modulation format which offers a better utilisation of spectrum and provides a considerably improved quality of service for both broadcaster and audience, while still fitting within the same channel bandwidths of existing AM transmissions. Based on work carried out in the ITU it is suggested that for the same interference potential, the total power in a DRM transmission should be 7 dB lower than the carrier power of the original AM assignment. Considerable detail can be found in ITU-R Recommendations BS 1514 and BS 1615 (references (1) and (2)), and on the DRM website www.drm.org.

All the necessary regulatory provisions, in particular the Rules of Procedure associated with the GE75 Agreement, are already in place to allow the deployment of DRM within the existing GE75 Plan and to allow a progressive analogue to digital transition for sound broadcasting in the LF and MF bands. Thanks to these Rules of Procedure, a significant number of DRM transmissions are currently ‘on air’ as advertised or experimental services Therefore, no action is currently required in this area.

Further work will be needed, however to review the necessary technical parameters, such as minimum usable field strength and protection ratio, for which the current values are partly based on the results of theoretical studies.

Given the improvement in quality available with DRM, there will be pressure to introduce stereo and other potential enhancements, some of which will require a greater transmission bandwidth. The GE 75 Plan has some assignments with bandwidths wider than the standard 9 kHz channel and the DRM standard encompasses similarly wider bandwidth modes. There will be a need for suitable DRM planning parameters for the wider bandwidth modes.

In the longer term, as more and more transmissions migrate to ‘digital’, the matter of protecting analogue transmission will become less important and the planning environment may need to be reconsidered, based on the experience gained from practical implementation. It may then be possible to enhance the existing regulatory provisions in order to take advantage of wider bandwidth modes and improved planning parameters as they become available. The improved planning parameters can be incorporated into the GE75 Agreement by a Regional Conference but such a Conference is not needed for the foreseeable future.

The inspiration behind the DRM system was a quality improvement for HF (Short Wave) broadcastings. The highest frequency HF band – the 26 MHz band – is very little used for conventional, long distance HF broadcasting. This band is relatively wide and could be used for local services, thereby augmenting the capacity already available in the LF and MF bands. Use of this band is currently regulated through Article 12 of the Radio Regulations. If it is to be used for local services the current regulatory arrangements would have to be suitably adapted.

At a ‘proof of concept’ level, the DRM has also been shown to work in VHF Band I, a band which is currently allocated to the broadcasting service but very little used for broadcast applications. Band I is not at present available for digital audio services although individual administrations could give the relevant authorisation. With this in mind there are a number of regulatory instruments that would have to be put in place before widespread deployment.

All concerned broadcasters and administrations within CEPT are encouraged to consider the transition from analogue to DRM digital transmissions in order to benefit from the improved quality of service which is already available.

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Managing the Transition to Digital Sound Broadcasting in the Frequency Bands Below 80 MHz

1 INTRODUCTION

AM double sideband broadcasting in the LF, MF bands has been in operation for some 85 years. Broadcasters rely heavily upon the use of these bands because of the ease of providing wide-area coverage with very stable and predictable propagation conditions. The technology is simple to implement for transmitters and receivers and, for at least half of that period of operation, has delivered good quality to listeners. However, growing demand for additional coverage and rising expectations for audio quality means that the services offered in the LF/MF bands have become increasingly unsatisfactory.

The first attempts, from the early 1950s, to counter interference and spectrum congestion involved the transfer or duplication of many service requirements into VHF Band II using FM. Another major factor at the time was to overcome impulsive interference from car spark ignition systems and other man-made noise sources. Although better suppression techniques eventually overcame those problems, broadcasting at LF/MF now faces new challenges from radiated noise caused by PLT (Power Line Technology) systems, together with switched mode power supplies in lighting and electronic equipment, and the large numbers of electronic devices like PCs. Nonetheless, AM broadcasting in the LF/MF bands has retained many advantages in terms of predictable coverage and simple receiver design.

1.1 Alternative modulation techniques in the LF/MF bands

Several schemes have been investigated to make better use of the available spectrum or to improve the listening experience in the LF/MF bands. Single SideBand (SSB) techniques, using both reduced and suppressed carriers were at one time considered to offer the possibility of easing congestion in the LF/MF bands. However, receiver complexity and expense with the available manufacturing technology at that time proved to be major negative factors; also the listening experience was judged to be poor. Perhaps the outcome would have been different if solid state processing and surface wave filters had been available to allow the production of low cost receivers without inductive components. But crucially, SSB did not offer a useful improvement in spectrum availability once the protected bandwidth requirements needed to support the rapid roll-off in the spectrum mask had been factored in.

The next scheme to be considered was AM stereo. A number of systems advanced to the trial stage, some of which, using quadrature frequency and phase shift modulation techniques, did prove that the available bandwidth of LF/MF broadcasting channels could support the transmission of more information. However, the project failed in terms of commercial viability. One interesting conclusion was that basic AM audio quality could be much improved by requiring better linearity in the design and coupling of transmitters and aerials. Also the standard of early solid state receivers left much to be desired. The inherent linearity of a valve super-heterodyne receiver was far superior to that of junction transistor designs.

The earlier false starts in improving LF/MF sound broadcasting were nevertheless instrumental in guiding further studies once the advent of digital sound compression techniques and narrow band modulation techniques had reached the stage where re-engineering a delivery system in the LF/MF bands to support digital sound broadcasting could be contemplated.

1.2 Possible use of the 26 MHz HF Band and VHF Band I

The 26 MHz band includes all frequencies between 25 670 kHz and 26 100 kHz. For the present discussion, VHF Band I is taken to include frequencies between 47 MHz and 68 MHz. From a technical point of view, there is no reason why this should not be extended to include the OIRT Bands (see Article 5 of the RR) used in certain countries for FM analogue broadcasting. While this band may not be available in all locations it is a valuable broadcasting resource where it is available and the technical arguments are the same as for the frequency bands immediately below it.

There is a high demand for radio services to small, local and even community areas. Such service areas are typically a few kilometres in radius covering just a small part of a town or city. As both the MF and VHF bands are already congested in many countries, it seems that this demand could be satisfied by

using the 26 MHz band and VHF Band I which are both already allocated to the broadcasting service but very little used. Use of digital modulation techniques would certainly provide the quality of coverage while requiring low transmitter power and hence low cost.

The most appropriate digital modulation scheme currently available for these bands appears to be the DRM30 / DRM+[1] family. DRM was originally conceived as a digital medium for use in the LF, MF and HF bands below 30 MHz. Propagation conditions in the HF band can be hostile; much development effort was expended in making DRM work in these hostile conditions and so it is ideally suited to the 26 MHz HF band. DRM+ has been more recently developed, and standardised[2] to offer the benefits of DRM in the broadcast bands between 30 MHz and 174 MHz. It uses a wider band multiplex. While DRM30 has been shown to work[3] in VHF Band I a bigger multiplex offers a greater correlation bandwidth and hence better defence against flat fading. Furthermore, higher bitrates are possible to give better audio quality and / or more services in the multiplex.

1.3 Advent of digital sound broadcasting below 30 MHz

The service requirements for a narrow bandwidth digital modulation system to replace analogue modulation in the LF, MF and HF bands were set by Recommendation ITU-R BS.1348 (1998, revised 2001), namely to:

- be capable of providing high-quality monophonic or stereophonic sound to vehicular, portable and fixed receivers;
- provide better spectrum and power efficiency than conventional analogue systems;
- provide significantly improved performance in a multipath environment;
- allow for a trade-off between extent of coverage and service quality for a given emission power;
- be capable of allowing, with a common receiver, the use of all means of programme delivery (e.g. mono, stereo, dual mono);
- be capable of providing facilities for programme-related data;
- be capable of providing additional data services;
- allow the manufacturing of low-cost receivers through mass production.

Subsequently two systems for digital sound broadcasting in the bands below 30 MHz were selected for evaluation in Recommendation ITU-R BS.1514, namely the Digital Radio Mondiale system (DRM) and the IBOC system (In Band, On Channel system. NB: in commercial deployment, IBOC is now referred to as HD Radio). Only the DRM system met all the objectives set throughout the LF, MF and HF bands. Following extensive tests over 5 years, European administrations are now concentrating on taking forward the deployment of DRM.

The DRM system was developed specifically to replace AM broadcasting in the LF, MF and HF bands. The audio signals are compressed into a data stream using Advanced Audio Coding (AAC) techniques, a further development by the Fraunhofer Institute of the MPEG[4] compression algorithms used in the production and distribution of audiovisual works. The system specification includes a choice of three audio codecs, and supports both Single Frequency and Multi-Frequency Network operation (SFN/MFN).

As with other systems for digital broadcasting (e.g. Eureka 147 DAB and Digital Video Broadcasting DVB-T), DRM uses coded orthogonal frequency division multiplexing (COFDM) to transmit the encoded audio data. In the DRM system, 200 sub-carriers are distributed across the 9 or 10 kHz channels used for broadcasting below 30 MHz. Each of the various subcarriers is modulated using Quadrature Amplitude Modulation (QAM) in order to carry the information content.

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[1] DRM30 is the DRM system initially designed for use in the frequency bands below 30 MHz. DRM+ is the extension of this system for use in the frequency bands between 30 and 174 MHz.

[2] The DRM system specification was revised to incorporate an additional mode designed for the lower VHF band (i.e. broadcast frequencies between 30 and 174 MHz) allowing operation in bands I and II (the FM band). This standard enhancement is called DRM+. The DRM system specification (ETSI ES 201 980 V3.1.1) is available for download from the ETSI website, http://portal.etsi.org.

[3] The technical feasibility of using Band I for DRM, and consequently for DRM+, has been proven by trials carried out by TDF in Rennes.

[4] Motion Picture Expert's Group

The system is actually a family of compression modes. In a standard mode, the DRM system can deliver a far superior audio quality within the same bandwidth of a standard AM broadcast, thereby achieving the important goal of improving the utilisation of the radio frequency spectrum. Various enhanced modes are also available which could be used to replace a standard monophonic AM broadcast by stereo or dual language programming. The DRM system has the capability to tailor its transmission characteristics to match the service requirements and variations in radio propagation conditions.

More recently the DRM system has been developed to incorporate modes which can operate in the frequency bands above 30 MHz. Called DRM+ these modes are intended to overcome the flat fading effects that could seriously affect very narrow band transmissions at these frequencies. VHF Band I is interesting in that is could be used for transmissions using narrow band DRM or using wider band DRM+. The other benefits of DRM+ would suggest that this is the better candidate system for deployment in VHF Band I. In addition to DRM a new system for "RealTime Audio Visual Information Transmission" (RAVIS) is being developed in Russia. Details can be found in Annex 9.

2 TRANSITION TO DRM

2.1 The LF / MF Bands

The substitution or addition of DRM emissions into bands formally used exclusively by AM double-sideband transmissions poses a number of regulatory and administrative problems. While the protection ratios between DRM emissions are more advantageous in terms of spectrum occupancy than those for AM, and DRM broadcasts can operate at lower power levels than AM, the worst case protection scenario is from DRM to AM emissions. In the HF bands, this was the main problem that had to be resolved in moving over to digital modulation, since previous WRC decisions, notably Resolution 517 (Rev.WRC-03), specifically allow digital modulation in the HF bands allocated to the broadcasting service, under the provisions of the six month seasonal scheduling Procedure of Article 12. The disparity in protection levels in a mixed environment of analogue and digital broadcasts was overcome by adopting a 7 dB power reduction for a digital broadcast compared to that for a comparable analogue broadcast. The 7 dB factor thus represents a compromise between retaining coverage requirements for digital broadcasts and the protection of analogue services, and also assumes the use of high compression audio processing for a comparable AM transmission. The worst case situation is mixed analogue and digital emissions in the same band – a situation that will persist for some time as the transition to digital modulation progresses. Planning for the optimum band utilization will be much easier in an all-digital environment.

The key to achieving an all-digital environment for sound broadcasting below 30 MHz is a rapid transition to digital broadcasting in the LF and MF bands. This is of crucial interest and importance to the major commercial and public service broadcasting networks in all countries. The objective of a rapid deployment of digital broadcasting in the LF and MF bands does, however, have to be consistent with the long established Plans for LF and MF sound broadcasting around the world.

2.1.1 Current regulatory situation in the LF/MF frequency bands

The ITU frequency allocations to the broadcasting service in the LF and MF bands are summarised in the table 1. The relevant extracts from the Radio Regulations, Article 5 (Frequency Allocations), are given in Annex 4.

ITU Regions And associated Agreements	LF Band	MF Band
Region 1 GE75	148.5-255.0 kHz 255.0-283.5 kHz (shared with aeronautical services)	526.5-1606.5 kHz
Region 2 RJ81 RJ88	- - -	525.0-535 kHz (shared with aeronautical services) 535.0-1 605.0 kHz 1 605.0-1 625.0 kHz 1 625.0-1 705.0 kHz (shared with fixed and mobile services)
Region 3 GE75	- - -	526.5-535 kHz (with mobile services on a secondary basis) 535.0-1 606.5 kHz

Table 1: ITU frequency allocations - LF and MF bands

For Europe the relevant Plan is that established at the ITU Conference of 1975 in Geneva for countries in ITU Regions 1 & 3 (the GE75 Plan). The GE75 LF/MF Final Acts provide a Plan for the assignment of frequencies to broadcasting stations, a modification procedure (Article 4) and the technical details to be used for the preparation of the Plan.

For ITU Region 2, the operative MF broadcasting plan is that of Rio de Janeiro, 1981 (the RJ81 Plan); there being no LF broadcasting band in Region 2.

GE75 is the latest in a series of Plans that have supported LF/MF broadcasting:

- Geneva 1925 – standardised on 10 kHz channel spacings at MF;
- Brussels 1928 – moved to 9 kHz channel spacings on MF below 1000 kHz;
- Prague 1929 – 9 kHz channel spacings on MF extended to 1400 kHz;
- Madrid/Lucerne 1932 – mostly 9 kHz channel spacings, but not harmonic multiples;
- Montreux 1939 – never implemented due to World War II;
- Copenhagen 1948 – all 9 kHz spacings, but offset from harmonic multiples by 1 kHz at MF and 2 kHz at LF.

The GE75 Plan is based on analogue double-sideband transmissions. All channel spacings are 9 kHz and, in order to reduce heterodyning, all assignments now operate on exact multiples of 9 kHz. Note, however, that channel bandwidths are not all fixed at 9 kHz; many assignments operate with 10, 15, 16, 18 or 20 kHz bandwidths. This is irrespective of domestic receiver bandwidths.

A regime of detailed international planning has proved essential for providing and coordinating terrestrial broadcasting in and between countries. Except for the HF bands, the coverage of terrestrial broadcasts is, for the most part, planned on the basis of national coverage. However, with the higher powers used, compared to many other radiocommunication services, the potential for interference can extend well beyond national boundaries. Moreover, many LF/MF stations, particularly from the early years of broadcasting, have been established with the purpose of extending the cultural reach of programming beyond national boundaries.

A crucial element in the broadcasting Plans developed for LF, MF, VHF and UHF terrestrial broadcasting is to define a means of calculating the usable field strength for the Plan entries. The usable field strengths then serve as a reference that can be used to assess the impact on coverage with modifications or additions to the entries in the Plan. A common methodology used to assess the impact of modifications or additions to a broadcasting Plan is to assess whether the effect of the changed interference environment will degrade the usable field strength at the test points, determined in accordance with the GE75 Agreement, by more than 0.5 dB. The “half dB rule” is fundamental to the maintenance of the GE75 Plan for LF/MF Broadcasting in ITU Regions 1 & 3.

2.1.2 Adapting the GE75 Plan for the DRM system

In order to facilitate the rapid deployment of digital broadcasting in the LF and MF bands, but without introducing the additional uncertainties of reviewing the GE75 Plan in all its aspects, a mechanism was developed, with the assistance of the Radio Regulatory Board (RRB), whereby an existing GE75 assignment may be converted to DRM with a power reduction of 7 dB. New DRM assignments may also be considered, under the standard procedures for modifying the Plan, but again with a power reduction of 7 dB relative to that of comparable new broadcasting assignments using analogue double sideband emissions. This power reduction was considered to be effective in maintaining the existing interference environment of the GE75 Plan and was based on the existing practice in the HF bands.

To a first approximation the power needed for a DRM transmission is the same as the sideband power in an AM transmission. There is therefore a considerable power saving through elimination of the carrier component. An exact comparison is, however, difficult because of the widespread use of asymmetric modulation and high compression audio processing in modern AM transmitters. Since the 1980s, most designs now function using pulsed modulation, switched at around a 60 kHz rate, and can deliver 125% modulation in the sideband energy for audio peaks. The fact that the modulation process is, in effect, digitally switched also means that conversion to fully digital modulation is relatively straightforward and DRM transmitters use similar techniques but at the higher switching frequency of 192kHz.

The mechanism for introducing DRM into the GE75 Plan is through Rules of Procedure modifying how the Radiocommunication Bureau handles notifications and examinations made under the regulatory procedures of the GE75 Plan. This was possible because the GE75 Plan had already envisaged the use of other modulation methods at a later date and, unlike the RJ81 Plan, imposes no technological restrictions on modulation methods. In the RJ81 Plan, sound broadcasting transmissions must be receivable using envelope detection.

2.1.3 The Rules of Procedure including the decision of the RRB in December 2002

Two Rules of Procedure have been prepared by the Radiocommunication Bureau of the ITU to complement the GE75 Final Acts in order to permit the use of DRM transmissions in the GE75 LF/MF Plan. In December 2002, the Radio Regulatory Board (RRB) amended these Rules of Procedure, as follows:

- The first Rule of Procedure is related to "Resolution N°8 (Relating to the Use of Bandwidth Saving Modulation Systems) " of the GE75 Final Acts. In order to permit the conversion of existing analogue assignments to digital. this Rule of Procedure records that *"any frequency assignment for AM broadcasting in the Plan may provisionally be used with digital modulation (transmission types DRM A2 or B2), provided the radiation is reduced by at least 7 dB in all directions, compared to the radiation of the AM modulated frequency assignment in the Plan"*. The DRM A2 and B2 modes are optimised for higher data throughput, as opposed to error correction overheads, and therefore provide for better audio quality, but depend on the stable propagation conditions in the LF/MF bands in order to maintain reliability.

  This first Rule of Procedure, as amended by the RRB in December 2002, is shown in Annex 1.

- The second Rule of Procedure is related to "Chapter 4 (Broadcasting Standards) of Annex 2" of the GE75 Final Acts. It is intended to clarify the technical requirements and procedures to permit notification of DRM Mode A2 or B2 assignments into the GE75 Plan. The Rule of Procedure states: *"In the examination of the probability of interference from notices related to assignments using digital modulation, the Bureau shall use a co-channel protection ratio increased by 7 dB, and an adjacent channel protection ratio increased by 1 dB compared to the one applicable to the interfered transmitter"*.

  This second Rule of Procedure, as amended by the RRB in December 2002, is shown in Annex 2.

An additional amendment introduced by the RRB decision to each Rule of Procedure is that *"This Rule of Procedure is of a provisional nature until such time that it is confirmed by a competent conference empowered to deal with the subject matter."* For completeness the full text of the RRB decision adopted in December 2002 is shown in Annex 3.

The RRB noted the comments and support from a number of administrations for the desirability of facilitating the introduction of digital modulation, while preserving the integrity of the Plan.

The RRB also considered comments from other administrations that suggested that issues dealt with in the Rules should be subject to consideration by a Conference. However, the RRB concluded that, given the current schedule of conferences, such a consideration is not envisaged in the foreseeable future. Indeed, until the transition to digital modulation has progressed to the extent that the remaining analogue stations need no longer constrain the power or coverage requirements of replacement or new digital assignments, there would be no purpose in re-considering the Plan.

2.1.4 Planning Criteria

Rec. ITU-R BS 1615 "Planning parameters for digital sound broadcasting at frequencies below 30 MHz" forms the basis of all the planning parameters required to plan a DRM service. It contains all the necessary planning parameters (i.e. protections ratios and minimum usable field strengths) and describes their derivation which is partly based on a theoretical approach and will need verification within the broadcast environment of the GE 75 Plan.

Therefore with the expected increase in the number of DRM transmissions, there will be a need for field measurements to confirm the compatibility checks as outlined in the table below.

This should include minimum usable field strength and protection ratio values for the DRM system for the cases shown in Table 2:

Wanted Emission	Unwanted Emission
Analogue	DRM
DRM	Analogue
DRM	DRM

Table 2: Considered cases

2.1.5 Further development of the GE75 Plan to facilitate the transition to DRM

An essential component of a broadcasting Plan is the ability to define a reference situation in terms of usable fields strengths, and hence coverage potential, that will support further development of the Plan. Thus, eventually, the GE75 Plan will need to be revised in terms of all digital entries, with remaining analogue assignments having to accept operation within the envelope of a digital assignment, which would be the reverse of the present situation. At the least, this will require moving away from the provisional limitation of DRM operation in the LF/MF bands to the 9 kHz bandwidth modes for GE75. The DRM planning parameters will need to be expanded and confirmed to incorporate the wide bandwidth modes (10, 15, 16, 18, and 20 kHz), allowed for in the Plan, assuming that future receivers are capable of receiving in these wider bandwidths.

At present, the wider bandwidth assignments in the GE75 Plan allow broadcasters a greater freedom to provide a higher quality AM services without using the high degree of audio compression and processing assumed in establishing the 7 dB compatibility figure for 9 kHz channel bandwidths. However nearly all analogue receivers filter out the majority of any extra bandwidth for on channel analogue signals, but would suffer adjacent channel interference from a DRM signal wider than the standard 9 kHz GE75 channels.

For the future, once analogue is switched off, the wider bandwidth assignments in the GE75 Plan may be able to exploit the full capabilities of the DRM system to provide additional functionality, such as stereo, additional languages or digital data. Moreover, the MF prediction method is being revised in ITU-R SG3 to include "city absorption" etc. It is therefore premature to consider revision to the Plan as a whole or even just the technical part of the associated Agreement until a stable known planning environment is established, and the limitations imposed by co-existence in a predominantly analogue environment have been removed.

2.1.6 Need for a revision of GE75 Agreement and PLAN

To take account of co- and adjacent channel DRM transmissions in their own right, the existing or modified planning parameters need to be incorporated into the GE75 Final Acts. This would involve changes to Annex 2, Chapter 4 of the Agreement, particularly the following sections:

- Class of Emission
- Protection Ratios
- Co-Channel Protection Ratios
- Adjacent Channel Protection Ratios
- Minimum Value of Field Strength
- Usable Field Strength.

Furthermore, various issues related to coverage for DRM will need to be addressed, such as:

- How is the DRM coverage defined?
- How is it protected?
- How a protected AM coverage area might change as an assignment changes to DRM?[5]
- How a protected coverage is defined in a plan that encompasses both DRM and AM assignments?
- How a protected coverage might have to change to reflect legitimate changes to the plan and how any subsequent increases or losses in coverage should be treated?

Such revisions to the GE75 Final Acts can only be introduced by a competent Regional Radiocommunications Conference[6]. Although the changes required are substantial, they do not necessarily affect the frequency assignment Plan. It is therefore likely that the changes to the modification procedure could in principle be agreed at a short conference aimed only at the revision of technical parameters and associated procedures.

Administrations already have a possibility to modify and add assignments to the GE75 Plan in order to meet the requirements for digital transmission (DRM). It is expected that over time most, if not all, existing AM services would migrate to DRM. This in itself may yield increased spectrum efficiency (SFN usage) and allow introduction of new services. Furthermore, a substantial experience in the roll-out of DRM transmissions is required to verify and/or improve the planning parameters contained in the current ITU Recommendations and to evaluate the performance of consumer receivers.

Therefore, it is considered that a planning conference to revise the GE75 Agreement and the associated Plan is not needed in the foreseeable future and this question should be revisited at an appropriate time in the future. Convening such a conference while the transition is still in progress would absorb considerable financial and engineering resources and preparations are likely to be time consuming. The overall benefit of having a revised Agreement would be significantly reduced by the increased complexity of the procedures and contentious timescales, most of which will become redundant after the transition is complete.

2.2 The 26 MHz HF band

Apart from a few experimental transmissions, the 26 MHz band, like all the HF bands, is currently the preserve of analogue AM. Compared with analogue FM and DAB, analogue AM is very frugal in its use of spectrum but suffers from low subjective audio quality. The DRM system has been specifically developed to work in (among others) the HF bands. Considerable R&D effort was expended in developing the DRM system to get the best audio quality available from a given HF channel. Existing transmissions in the lower HF bands show that, while not to the standard of analogue FM, remarkably high audio quality can be obtained. Further to this the DRM specification incorporates various operational modes which trade audio quality against robustness in difficult propagation conditions and

[5] Some coverage implications of the transition to DRM are elaborated in Annex 5 to this Report.

[6] Article 14, No.2, of GE75 states that "The Agreement shall remain in force until it is revised by a competent conference of the Members of the Union in Regions 1 and 3 of the GE75 Agreement"

allow the use of channel bandwidths wider than the 9 kHz or 10 kHz usually associated with AM broadcasting.

The greatest demand for new services is often focused on small, local and even community coverage. Such services could be accommodated in the 26 MHz HF band. This band – the uppermost HF band – is little used because it is only of value to international broadcasters when sunspot numbers are high. When sunspot numbers are low it is not used at all. When sunspot numbers are high use is limited; many international broadcasters being unwilling to invest in antennas that are only of use for a limited time during the sunspot cycle.

The use of DRM30 for local services in the 26 MHz band offers significant market opportunity. Local broadcasting will usually attract greater audiences and greater commercial interest than international broadcasting which has until now been the major preserve of DRM30. Large numbers of transmitters and receivers will be required opening markets for the manufacturers of silicon chips, receivers, transmitters and antennas. The 'rollout' of the system will further require the services of system integrators, site owners and expert services.

A number of tests of DRM30 at 26 MHz have shown the feasibility of using this band for local services[7].

2.2.1 The existing use of the 26 MHz band

The band 25 670 kHz-26 100 kHz is allocated to the broadcasting service in Article 5 of the ITU Radio Regulations, as shown in Table 3.

Allocation to services			
Region 1		**Region 2**	**Region 3**
25 550-25 670	RADIO ASTRONOMY 5.149		
25 670-26 100	BROADCASTING		
26 100-26 175	MARITIME MOBILE 5.132		

Table 3: Allocation of the 26 MHz band in the ITU Radio Regulations

Appendix 11 of the Radio Regulations, *System specifications for double-sideband (DSB), single-sideband (SSB) and digitally modulated emissions in the HF broadcasting service*, provides the details of the analogue and digital modulation systems that can be used.

Because at the moment the 26 MHz band is used for very long distance international services its use has to be coordinated internationally. Planning of broadcasting services in the 26 MHz band is described in the ITU Radio Regulations in Article 12, *Seasonal planning of the HF bands allocated to the broadcasting service between 5 900 kHz and 26 100 kHz*. This gives the procedures to be used in the planning of the HF broadcasting service and supports the concept of informal coordination to resolve incompatibilities which is currently achieved in three international coordination groups:

- The High Frequency Coordination Conference (HFCC);
- Arab States Broadcasting Union (ASBU);
- The Asia Pacific Broadcasting Union High Frequency Conference (ABU-HFC).

These groups meet twice a year to resolve incompatibility problems in the relevant broadcasting season. Details can be found at http://www.itu.int/ITU-R/terrestrial/broadcast/hf/coord/index.html.

In a few CEPT countries, this band is currently used for other local applications including SRD, inductive applications and defence systems (see also Annex 10).

[7] See *Draft new Report ITU-R BS.[DRM]- Planning parameters and coverage for digital DRM broadcasting at frequencies below 30 MHz* approved as Doc 6/142 by Study Group 6 in May 2009

2.2.2 The regulatory conditions for the 26 MHz band

DRM is a European Standard ETSI ES 201 980. The system specification (ETSI ES 201 980 V3.1.1) is available for download from the ETSI website, http://portal.etsi.org. It covers DRM30 for use in the frequency bands below 30 MHz and DRM+ for use between 30 and 174 MHz.

DRM30 is one of the systems recommended for use in the bands below 30 MHz in Recommendation ITU-R BS.1514 - *System for digital sound broadcasting in the broadcasting bands below 30 MHz*. The planning parameters can be found in Recommendation ITU-R BS.1615 - *"Planning parameters" for digital sound broadcasting at frequencies below 30 MHz*. ITU-R Resolution 543 (WRC-03) - *Provisional RF protection ratio values for analogue and digitally modulated emissions in the HF broadcasting* service - gives the RF protection ratios, extracted from Recommendation ITU-R BS.1615, to be used on a provisional basis.

The 26 MHz band continues to be used by international broadcasters wishing to exploit the long distance propagation characteristics which are evident when sunspot activity is high. If the band is to be used for local services, due account must be taken of this. A means must be found to allow these services to co-exist which, ideally, do not require local broadcasters to participate in the international coordination process.

One solution would be to sub-divide the 26 MHz band. International services could continue in one part and be co-ordinated under Article 12 as at present. In the other part, local services could be planned by administrations taking the necessary care to avoid internal and cross border conflicts. This approach has already been implemented in the coordination groups on an informal basis. Currently the lower part of the band - 25 670-25 850 kHz - is recommended for long-distance international services while the upper part - 25 850-26 100 kHz - is recommended for local services. The actual frequency boundary could be adjusted in light of the needs for each type of service. If this approach is used – and acknowledging that the band's effectiveness for long distance coverage is governed by sunspot activity - it would be prudent to look at the historic use of the 26 MHz band for international broadcasting over previous 11-year sunspot cycles, to determine a more appropriate sub-division. For example, if only a couple of frequencies have been used for international broadcasting over the last few sunspot maximums *and* the usage is unlikely to change in the future then the majority of the band could be allocated to local broadcasting. However, some caution with this approach would be needed as, once local broadcasting is licensed, it would be practically impossible to review the sub-division in favour of international broadcasting should this increase above anticipated demand.

High power international and low power local services could share the same spectrum relying on the informal coordination procedures of Article 12 to resolve any interference problems. This would require either the individual local broadcasters or a representative from the national licensing authority to attend the coordination meetings. This could well be cumbersome and difficult to achieve in practice.

Consequently, the band partitioning is likely to be the best option but this would need global recognition. If global recognition were accepted, it would not require any change to Article 5 of the Radio Regulations as the band 25 670-26 100 kHz is already allocated to the broadcasting service.

Irrespective of the possible international coordination, there needs to be a national regulatory or licensing framework. This could specify the technical parameters for each station in order to reduce the potential of interference to other stations using the same frequency in another area.

2.2.3 Technical considerations related to the 26 MHz band

Transmissions at 26 MHz can propagate in three different ways:

1. *Ground wave* – This is sometimes referred to as a surface wave as the energy propagates near the surface of the earth. At 26 MHz, the distance travelled is measured in a few kilometres but depends on the conductivity of the earth's surface (see ITU-R Recommendation P.368);
2. *Space wave* – sometimes referred to as line-of-site as the energy travels in a straight line from the transmitter location to the receiver. The range depends on the height above ground of the transmitting antenna and can be measured in tens of kilometres;
3. *Sky wave* – this is when the wave if refracted by the ionosphere and returns to the earth's surface where it can be reflected back to the ionosphere for further refraction. The distance travelled can be measured in many hundreds of kilometres.

Transmissions for local services would use either ground wave or space wave or even a combination of the two depending on the type of antenna used. International transmissions use sky wave propagation.

Local services in the 26 MHz band using 'space wave' propagation which is not subject to the vagaries of the sunspot cycle or ionospheric variability would be able to use the less robust / highest quality modes. As the 26 MHz is relatively large and little used it would be quite feasible to mount wideband (20 kHz channel) transmissions again improving quality and allowing stereo services.

A receiver that is located close to the transmitter used for space wave local transmissions will better defend itself against sky wave interference from other stations at times of high sunspot activity. Larger areas might be covered using single frequency networks of low power transmitters exploiting the constructive nature of interference from synchronised digital stations using OFDM modulation.

International transmissions usually employ far higher transmitter powers and high gain transmitting antennas than those used for local services. For receivers located further from a local transmitter, it is therefore possible that these long-distance transmissions will arrive with a similar field strength. This supports the need to sub-divide the band to avoid interference between these two services.

Even though local services can be planned to use low power, it is possible for some energy to be refracted by the ionosphere thus causing interference to another service at some distance away. This can happen at some times in the day even at periods of low sunspot activity but will lengthen in duration with increased activity. For this reason, the technical parameters for local services at 26 MHz need to be determined to minimise the possibility of such interference.

ITU-R Study Group 6 has approved Question 127/6 "*Mitigation techniques required for the use of digital modulation in the "26 MHz" broadcasting band for local coverage"* with a view to recommending the appropriate technical and regulatory parameters for local broadcasting at 26 MHz. The situation in the 26 MHz band is summarised in the following extract from Question 127/6 on the subject:

considering

a) that the broadcasting service band from 25 670–26 100 kHz (herein called the "26 MHz band"), which is exclusively allocated to the BS, is rarely used for traditional long range cross-border reception broadcasts;
b) that this lack of use is due to the fact that more favourable and reliable propagation is available at lower HF nearly all the time, and is covered by the various coordinating committees in harmony with the application of Article 12;
c) that recent experimental broadcasting for local digitally modulated transmissions (using the DRM30 system, known as Digital System A in Recommendation ITU-R BS.1514) have been very effective for providing local services much like VHF FM;
d) that the signals only require RF bandwidths of 10 kHz for audio quality similar to, but somewhat lower than FM stereo, and only 20 kHz for full stereo;
e) that transmit antennas have been designed and used that maximize ground wave and line-of-sight propagation and minimize sky wave propagation.

If the 26 MHz band is partitioned as currently recommended on an informal basis in the HF Coordination Groups, the total spectrum available for local transmissions would be 250 kHz. This provides 25 DRM channels using DRM30 in the 10 kHz mode and 12 if using the 20 kHz mode (if the whole 26 MHz broadcasting band is made available for local broadcasting then the numbers increase to 43 and 21). This does not include any guard band and assumes adjacent channel conflict can be resolved in the planning process.

The geographical separation needed between channels (carrying different programmes) on the same frequency will depend on transmitter power, antenna gain and directivity characteristics. Clearly, the total number of separate channels that could be found in, for example, a country will be established through normal frequency planning techniques given knowledge of the relevant planning parameters. If the 26 MHz band is to be used for relatively small area coverage it is likely that any one frequency might be used several times.

2.3 The VHF Band I

Successful tests have been carried out in Band I[8] which demonstrate that this band is suitable for local broadcasting using both the DRM30 and DRM + systems.

While equally able to offer line of sight services to small communities, VHF Band I might better be used to provide services to somewhat wider areas. This is perfectly feasible as evidenced by its traditional use for television. Band I is now little used for television and so large parts of it are free in many parts of the world. It is worth noting that where parts of Band I have been used by administrations for other purposes there is little co-ordination. Different parts are used in different countries for different applications (see Annex 10). However, the band is wide and space is usually available in parts of the band albeit different parts of the band in different parts of the world.

As with the 26 MHz band line of sight transmission and a relatively large amount of available spectrum offer the opportunity to use higher quality, wide channel modes with the DRM30 system. In VHF Band I the DRM + system is perhaps the better option as it can offer up to 4 high quality audio services in a 100 kHz multiplex. The trade off between the number of streams and the audio quality – fewer streams higher quality – should be noted.

2.3.1 The existing use of Band I

VHF Band I is the frequency band from 47 to 68 MHz. In Region 1, this Band is allocated to the broadcasting service on a primary basis in the ITU Radio Regulations. In the European Broadcasting Area (EBA), the broadcast use is analogue television and FM sound broadcasting; SAB/SAP applications are also included on a secondary basis. In some European countries, the broadcasting usage of the band has stopped. Further information is available in Annex 10.

The Stockholm ST61 Agreement for television and sound broadcasting in the European broadcasting area is the oldest broadcasting Plan. It is still in force after 48 years and shows 1119 assignments currently[9] registered in Band I in Region 1 (see Annex 6).

Band I is not exclusively allocated to broadcasting and there is sharing with land mobile and some other services (for example, the amateur service) in a number of countries. Parts of Band I are also allocated to the fixed service on a secondary basis in certain countries.

Within Band I there are several channel/frequency assignment arrangements. In Eastern Europe, in France and in Ireland channels are 8 MHz wide and in other countries the channel width is 7 MHz. There is little consistency in the allocation of vision frequencies for a given channel within countries using either 7 or 8 MHz channels. There is, of course, no alignment of channel edges between countries using 7 MHz channels and those using 8 MHz channels.

Despite being allocated to the Broadcasting service in the ITU, a number of other diverse applications also have allocations in Band I through footnotes in the Radio Regulations (see Annex 7). The trend in several European countries within CEPT has been to withdraw broadcasting activity from this Band. For the long term, the CEPT plans do not consider this Band for broadcasting any more, as shown in Table 4 which is an extract from the European Common Allocation Table (see the ERC Report 25 for more details - available at www.ero.dk).

[8] The technical feasibility of using Band I for DRM, and consequently for DRM+, has been proven by trials carried out by TDF in Rennes.

[9] The situation as of the end of 2009.

	- Europe (ECA) -
46.400 - 47.000 MHz	Defence systems / PMR / Wind profilers / Radio microphones and Assistive Listening Devices
47.000 - 48.000 MHz	Defence systems / PMR / Wind profilers
47.000 - 47.250 MHz	On-site paging
48.000 - 48.500 MHz	Defence systems / PMR / Wind profilers
48.500 - 50.000 MHz	Defence systems / PMR / Wind profilers / Space research
50.000 - 51.000 MHz	Defence systems / PMR / Wind profilers / Amateur
51.000 - 52.000 MHz	Defence systems / PMR / Wind profilers / Amateur
52.000 - 54.000 MHz	Defence systems / PMR / Wind profilers
54.000 - 61.000 MHz	Defence systems / PMR / Wind profilers
61.000 - 68.000 MHz	PMR / Wind profilers
68.000 - 70.450 MHz	Defence systems / PMR/PAMR

Table 4: Major utilisation of Band I in the European Common Allocation Table

2.3.2 The regulatory conditions for Band I

DRM30 is the DRM system initially designed for use in the frequency bands below 30 MHz. DRM+ is the extension of this system for use in the frequency bands between 30 and 174 MHz, allowing operation in bands I and II (the FM band). The DRM system specification (ETSI ES 201 980 V3.1.1) is available for download from the ETSI website, http://portal.etsi.org.

This specification has been presented to the ITU an awaits inclusion in ITU-R Rec. BS 1114 "Digital Sound Broadcasting between 30 MHz and 3000 MHz".

The relevant 'Plan' at present in force for Band I, as an annex to Regional Agreements, is: *"The Plans for television and sound broadcasting in the European Broadcasting Area, Stockholm, 1961 (ST61)"*;

From an ITU perspective, this band is still allocated to the Broadcasting service in Region 1 and partly in Regions 2 and 3. It is also allocated on a secondary basis to other services (mobile, radiolocation, etc.). It should be noted that the part of ST61 Agreement related to Band I is still applicable.

Any use of this Band in the future for broadcasting in Europe would require a modification of the CEPT long term plans. Other Radiocommunication services, such as military communications and scientific applications (wind profiler radars for example) still have interest in using it. It will remain in use in some countries for analogue TV until the analogue switch off, which is expected between 2012 and 2015 in Europe. For the long term, the CEPT plans do not consider this band for broadcasting (see ERC Report 25).

There is a proposal that the CEPT considers revising the ERC Report 25 in the part 47-68 MHz to permit the introduction of digital sound broadcasting in this part of the spectrum (Band I).

The procedure for modification of the ST61 Plan is mainly based on coordination between the administrations concerned, and is as simple as possible, with low involvement of the ITU Radiocommunication Bureau. In the bands 47-68 MHz, the administration proposing a modification to the Plan directly seeks the agreement of any other administration if the distance to the border of its territory is less than the coordination distance. This coordination distance is determined from Annex 1 to the Agreement and depends on transmitter effective radiated power, effective antenna height and propagation zones. If the affected administration fails to reply within ten weeks, a reminder is sent. If no reply has been received two weeks after the reminder, the affected administration is considered to have given its agreement. Once all the agreements have been obtained, the initiating administration informs the ITU BR. The modification is published in Part B of Special Section ST61 and entered into the Plan. However, in some cases, for example for very high effective antenna heights, Annex 1 does not give values for the coordination distance.

This procedure is described in Articles 4 and 5 of the '*The Final Acts of the European Broadcasting Conference in the VHF and UHF Bands, Stockholm 1961*'. A corresponding extract is included in Annex 8 to show the similarity with, for example, the GE84 Plan for Band II and other plans with which the reader may be more familiar.

2.3.3 Technical considerations related to Band I

There are a number of factors which need to be taken into consideration when assessing the suitability of DRM30 / DRM+ in Band I. Some are positive, some less so and some are neutral. The following is a list of these considerations and their relevance.

- **Antenna dimensions** - One reason often cited for the unpopularity of Band I spectrum relates to the physical size of even simple aerial systems. A quarter wavelength whip antenna at 60 MHz is some 1.2 metres high, making it somewhat unattractive for handheld applications. While the use of H-field antennas for receiving applications may be particularly promising. It may be possible to use orthogonal elements, under software control, to create an adaptive antenna, capable of rejecting some sources of man-made noise, or other interferers.
- **Man-made noise** - From the earliest days of broadcast television, the high levels of man-made noise present in this band have caused problems for users.
- **Ionospheric Interference** - A regular cause of complaint by TV viewers in the summer months was the interference caused by propagation, via sporadic ionisation of the E-layer, of signals from very distant (~1000 km) TV transmitters.
- **Diffraction losses** - The most appealing characteristic of this part of the spectrum is that the diffraction losses over typical terrain are small compared to higher frequencies in the spectrum.
- **Spectrum Availability** - Band I is largely under-utilised and could be usefully used for transition scenarios from analogue to digital or just for new broadcast technologies and services.
- **Coverage potential** - Band I offers favourable propagation conditions to cover medium to large areas with a low number of transmitters.
- **Broadcast Technologies** - The technical feasibility of using Band I for DRM30 and for DRM+ has been proven by trials carried out in France. Also at present for sound broadcasting in Band I many existing assignments are registered for FM use.
- **Standardisation -** DRM+ has been recently (2009) granted standardisation through ETSI (ETSI ES 201 980 V3.1.1) and is designed to be used between 30 and 174 MHz encompassing Band I.
- **Channel Raster -** A suitable channel raster would need to be defined in Band I in order to use it with the signal bandwidths corresponding to DRM+. The DRM+ channel bandwidth is compatible with the existing channel raster in Band II.
- **Time and frequency diversity -** Some of the issues outlined above, like man-made noise, could be the limiting factors in the coverage obtained by radio systems at these frequencies. Problems with anomalous propagation are also likely. Therefore it is suggested that with suitable software techniques time and frequency diversity may be a useful addition to modern receiver design for successful reception.

The whole of Band I between 47 and 68 MHz (21 MHz) could accommodate 210 DRM+ channels. As with the 26 MHz band this does not include any guard band and assumes adjacent channel conflict can be resolved in the planning process. Again, the geographical separation needed between channels (carrying different programmes) on the same frequency will depend on transmitter power, antenna gain and directivity characteristics. Clearly, the total number of separate channels that could be found in, for example, a country will be established through normal frequency planning techniques given knowledge of the relevant planning parameters. If Band I is to be used for relatively small area coverage it is likely that any one frequency might be used several times.

In practice, given the existing use of Band I for other purposes in many countries, the number of available channels in the band will be smaller. In much the same way as with the 26 MHz band it is likely that Band I will have to be sub-divided to allow DRM+ broadcasts to co-exist with other services. Also, as different countries use this band in different ways it is unlikely that a universally applied sub-division could be found. This is however a matter for local administrations and it is not necessary to be prescriptive.http:///

3 CONCLUSIONS

3.1 The LF / MF Bands

The switch from AM sound broadcasting to digital transmission (DRM) in the LF/MF bands will bring many benefits to listeners in terms of improved audio quality and the availability of added value options. The subjective experience on an average quality receiver will be much the same as FM and the wider area coverage will provide benefits to broadcasters and society as a whole in reducing the consumption of electrical power.

The current regulatory provisions, in particular the GE75 Agreement and the associated Rules of Procedure, are adequate to allow the deployment of DRM within the existing GE75 Plan and to allow a progressive analogue to digital transition. Therefore, no action is currently required in this area.

However, there are some shortcomings in the current regulatory situation. The current Rules of Procedure are limited to DRM transmissions with spectrum occupancy 2 (9 kHz). There is no provision for increasing spectrum occupancy. Furthermore, these Rules of Procedure are provisional and as a consequence the DRM transmissions introduced using these Rules of Procedure are also provisional.

In the longer term, as more and more transmissions migrate to 'digital', the matter of protecting analogue transmission will become less important and the planning environment may need to be reconsidered, based on the experience gained from practical implementation. It may be possible to enhance the existing regulatory provisions in order to take advantage of wider bandwidth modes and improved planning parameters as they become available. Further work will be needed to review the necessary technical parameters, such as minimum usable field strength and protection ratios, for which the current values are partly based on the results of theoretical studies.

An ITU conference may need to be convened at an appropriate point in the future to revise the GE75 Agreement and the associated Plan. Such a conference should take advantage of wider bandwidth DRM modes and improved planning parameters as they become available and should aim at optimising network coverage so as to make best use of the advantages offered by DRM.

3.2 The 26 MHz HF band

It is possible to use the 26 MHz broadcasting band for local coverage using DRM30. It is suggested that the approach should include the following elements:

1. A limit on the maximum ERP to be used by any station in this band;
2. A limit on the number of stations within an area;
3. Frequency assignments to be made on a national basis;
4. Bilateral/multilateral agreements for neighbouring countries where local broadcasting at 26 MHz is implemented.

3.3 The VHF Band I

Equally, VHF Band I could be used for local transmissions using DRM30 or DRM+ with similar constraints to those listed for the 26 MHz band. The greater quality and versatility of the DRM+ system would suggest that this was the preferred option for Band I. Band I is not at present, formally available for DRM+ (or DRM30) transmissions although individual administrations could give the relevant authorisation. With this in mind there are a number of regulatory instruments that would have to be put in place before widespread deployment.

It is proposed that the CEPT considers revising the ERC Report 25 (the ECA Table) in the part 47-68 MHz to permit the introduction of digital sound broadcasting in this part of the spectrum (Band I).

The different propagation characteristics would point to the use of Band I for coverage of larger areas than the 26 MHz band. Given that there is a demand for services to cover different geographical areas it may be concluded that DRM30 in the 26 MHz band and DRM+ in VHF Band I could work in tandem and provide services that were complementary.

4 REFERENCES

(1) **Recommendation ITU-R - BS.1514**: System for digital sound broadcasting in the broadcasting bands below 30 MHz.

(2) **Recommendation ITU-R - BS.1615**: Planning parameters for digital sound broadcasting at frequencies below 30 MHz.

(3) **Recommendation ITU-R - BS.1348**: Service requirements for digital sound broadcasting at frequencies below 30MHz.

(4) **Final Acts** of the Regional Administrative Conference, LF/MF broadcasting Conference (Regions 1 and 3) Geneva, 1975:

(5) **ITU Circular letter CCRR/20:** Special study, under No. 13.15 of the Radio Regulations, in relation to the regional agreements GE75, RJ81 and RJ88

ANNEX 1: RULE OF PROCEDURE RELATED TO RESOLUTION N°8 OF THE GE75 AGREEMENT, AS AMENDED BY DECISION OF THE RRB IN DECEMBER 2002

Resolution No. 8 of the Regional Conference, Geneva, 1975, states:

"1. *that broadcasting stations may provisionally use bandwidth saving modulation methods on condition that interference in the same or adjacent channels concerned does not exceed the interference resulting from the application of double sideband modulation with full carrier (A3E)*;

2. *that any administration which envisages using these methods of emission shall seek the agreement of all affected administrations by following the procedure specified in Article 4 of the Agreement*."

After consideration of the relevant ITU-R studies, the Board decided that any frequency assignment for AM broadcasting in the Plan may provisionally be used with digital modulation (transmission types DRM A2 or B2), provided the radiation is reduced by at least 7 dB in all directions, compared to the radiation of the AM modulated frequency assignment in the Plan.

Therefore, when examining the conformity to the GE75 Plan of a notice received under Article 11 of the Radio Regulations, the Bureau shall accept such a notice as being in conformity to the Plan. A note should indicate that the favourable finding is provisional.

This Rule of Procedure is of a provisional nature until such time that it is confirmed by a competent conference empowered to deal with the subject matter.

ANNEX 2: RULE OF PROCEDURE RELATED TO ANNEX 2 TO THE GE75 AGREEMENT, AS AMENDED BY DECISION OF THE RRB IN DECEMBER 2002

Chapter 4 of Annex 2 gives the broadcasting standards applicable to the Agreement. In particular:

4.1 *Class of Emission*: The Plan is established for a system with double sideband amplitude modulation with full carrier (A3E).

4.2 *Power*: The power of a transmitter is the carrier power in the absence of modulation.

4.3 *Radiated Power*: The radiated power is assumed to be the product of the nominal power of the transmitter and the gain of the antenna (relative to a short vertical antenna) without taking into account any losses*. It is expressed either by the cymomotive force (c.m.f. in V or in dB relative to 300 V) or by the effective monopole radiated power (e.m.r.p. in kW or in dB relative to 1 kW).

4.4 *Protection Ratios*: In applying the Agreement, the values of the co-channel and adjacent channel protection ratios given below should be used unless otherwise agreed between the administrations concerned. In the case of fluctuating wanted or unwanted signals, the values of the protection ratio apply for at least 50% of the nights of the year at midnight.

However, Resolution No. 8 of the Regional Conference, Geneva, 1975, states:

"*1. that broadcasting stations may provisionally use bandwidth saving modulation methods on condition that interference in the same or adjacent channels concerned does not exceed the interference resulting from the application of double sideband modulation with full carrier (A3E)*;

2. that any administration which envisages using these methods of emission shall seek the agreement of all affected administrations by following the procedure specified in Article 4 of the Agreement."

After consideration of the relevant ITU-R studies, the Board decided that any frequency assignment for AM broadcasting in the Plan may provisionally be used with digital modulation (transmission types DRM A2 or B2), provided the radiation is reduced by at least 7 dB in all directions, compared to the radiation of the AM modulated frequency assignment in the Plan.

The power of the transmitter to be notified in case of digital modulation shall be the total power within the necessary bandwidth.

In the examination of the probability of interference from notices related to assignments using digital modulation, the Bureau shall use a co-channel protection ratio increased by 7 dB, and an adjacent channel protection ratio increased by 1 dB compared to the one applicable to the interfered transmitter.

When the proposed assignment using digital modulation is recorded into the Plan following the application of Article 4, it shall bear a symbol indicating that the recording is provisional. The reference situation shall be determined as if it were an AM transmission using an audio-frequency modulating signal of 4.5 kHz and a high degree of compression.

This Rule of Procedure is of a provisional nature until such time that it is confirmed by a competent conference empowered to deal with the subject matter.

ANNEX 3: DECISION OF THE RRB - DECEMBER 2002

The RRB (Radio Regulatory Board) approved the Rules of Procedure as proposed with the following amendments:

1) Amend the fourth paragraph of the Rule relating to Resolution 8 (Annex 1 to CCRR/20) and the ninth paragraph of the Rule relating to Annex 2 (Annex 2 to CCRR/20) as follows: "After consideration of the relevant ITU-R studies, the Board decided that any frequency assignment for AM broadcasting in the Plan may provisionally be used with digital modulation (transmission types DRM A2 or B2), provided the radiation is reduced by at least 7 dB in all directions, compared to the radiation of the AM modulated frequency assignment in the Plan".

2) Add a new sentence at the end of each rule as follows: "This Rule of Procedure is of a provisional nature until such time that it is confirmed by a competent conference empowered to deal with the subject matter."

   The Board noted the comments and support from a number of administrations for the desirability of facilitating the introduction of digital modulation, while preserving the integrity of the Plan. The Board also considered comments from other administrations that suggested that issues dealt with in the Rules should be subject to consideration by a Conference.

   The Board concluded that, given the current schedule of conferences, such a consideration is not envisaged in the foreseeable future.

ANNEX 4: EXTRACT FROM THE RADIO REGULATIONS, ARTICLE 5 (FREQUENCY ALLOCATIONS):

LF and MF Frequency Bands allocated to Broadcasting

110-255 kHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>110-112
FIXED
MARITIME MOBILE
RADIONAVIGATION

5.64</td><td rowspan="6">110-130
FIXED
MARITIME MOBILE
MARITIME RADIO-
NAVIGATION 5.60

Radiolocation</td><td>110-112
FIXED
MARITIME MOBILE
RADIONAVIGATION 5.60

5.64</td></tr>
<tr><td>112-115
RADIONAVIGATION 5.60</td><td>112-117.6
RADIONAVIGATION 5.60</td></tr>
<tr><td>115-117.6
RADIONAVIGATION 5.60
Fixed
Maritime mobile

5.64 5.66</td><td>Fixed
Maritime mobile

5.64 5.65</td></tr>
<tr><td>117.6-126
FIXED
MARITIME MOBILE
RADIONAVIGATION 5.60
5.64</td><td>117.6-126
FIXED
MARITIME MOBILE
RADIONAVIGATION 5.60
5.64</td></tr>
<tr><td>126-129
RADIONAVIGATION 5.60</td><td>126-129
RADIONAVIGATION 5.60
Fixed
Maritime mobile
5.64 5.65</td></tr>
<tr><td>129-130
FIXED
MARITIME MOBILE
RADIONAVIGATION 5.60

5.64</td><td>129-130
FIXED
MARITIME MOBILE
RADIONAVIGATION 5.60

5.64</td></tr>
<tr><td>130-148.5
FIXED
MARITIME MOBILE
5.64 5.67

148.5-255
BROADCASTING

5.68 5.69 5.70</td><td>130-160
FIXED
MARITIME MOBILE
5.64

160-190
FIXED

190-200
AERONAUTICAL
RADIONAVIGATION</td><td>130-160
FIXED
MARITIME MOBILE
RADIONAVIGATION
5.64

160-190
FIXED
Aeronautical radionavigation</td></tr>
</table>

5.65 *Different category of service:* in Bangladesh, the allocation of the bands 112-117.6 kHz and 126-129 kHz to the fixed and maritime mobile services is on a primary basis (see No. **5.33**). (WRC-2000)

5.66 *Different category of service:* in Germany, the allocation of the band 115-117.6 kHz to the fixed and maritime mobile services is on a primary basis (see No. **5.33**) and to the radionavigation service on a secondary basis (see No. **5.32**).

5.67 *Additional allocation:* in Azerbaijan, Bulgaria, Mongolia, Kyrgyzstan, Romania and Turkmenistan, the band 130-148.5 kHz is also allocated to the radionavigation service on a secondary basis. Within and between these countries this service shall have an equal right to operate. (WRC-2000)

5.68 *Alternative allocation:* in Angola, Burundi, Congo (Rep. of the), Malawi, the Dem. Rep. of the Congo, Rwanda and South Africa, the band 160-200 kHz is allocated to the fixed service on a primary basis. (WRC-03)

5.69 *Additional allocation:* in Somalia, the band 200-255 kHz is also allocated to the aeronautical radionavigation service on a primary basis.

5.70 *Alternative allocation:* in Angola, Botswana, Burundi, Cameroon, the Central African Rep., Congo (Rep. of the), Ethiopia, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Nigeria, Oman, the Dem. Rep. of the Congo, Rwanda, South Africa, Swaziland, Tanzania, Chad, Zambia and Zimbabwe, the band 200-283.5 kHz is allocated to the aeronautical radionavigation service on a primary basis. (WRC-03)

200-495 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
255-283.5 BROADCASTING AERONAUTICAL RADIONAVIGATION 5.70 5.71	**200-275** AERONAUTICAL RADIONAVIGATION Aeronautical mobile	**200-285** AERONAUTICAL RADIONAVIGATION Aeronautical mobile
283.5-315 AERONAUTICAL RADIONAVIGATION MARITIME RADIONAVIGATION (radiobeacons) 5.73 5.72 5.74	**275-285** AERONAUTICAL RADIONAVIGATION Aeronautical mobile Maritime radionavigation (radiobeacons) **285-315** AERONAUTICAL RADIONAVIGATION MARITIME RADIONAVIGATION (radiobeacons) 5.73	
315-325 AERONAUTICAL RADIONAVIGATION Maritime radionavigation (radiobeacons) 5.73 5.72 5.75	**315-325** MARITIME RADIONAVIGATION (radiobeacons) 5.73 Aeronautical radionavigation	**315-325** AERONAUTICAL RADIONAVIGATION MARITIME RADIONAVIGATION (radiobeacons) 5.73
325-405 AERONAUTICAL RADIONAVIGATION 5.72	**325-335** AERONAUTICAL RADIONAVIGATION Aeronautical mobile Maritime radionavigation (radiobeacons) **335-405** AERONAUTICAL RADIONAVIGATION Aeronautical mobile	**325-405** AERONAUTICAL RADIONAVIGATION Aeronautical mobile
405-415 RADIONAVIGATION 5.76 5.72	**405-415** RADIONAVIGATION 5.76 Aeronautical mobile	
415-435 MARITIME MOBILE 5.79 AERONAUTICAL RADIONAVIGATION 5.72	**415-495** MARITIME MOBILE 5.79 5.79A Aeronautical radionavigation 5.80	
435-495 MARITIME MOBILE 5.79 5.79A Aeronautical radionavigation		
5.72 5.82	5.77 5.78 5.82	

5.71 *Alternative allocation:* in Tunisia, the band 255-283.5 kHz is allocated to the broadcasting service on a primary basis.

5.72 Norwegian stations of the fixed service situated in northern areas (north of 60° N) subject to auroral disturbances are allowed to continue operation on four frequencies in the bands 283.5-490 kHz and 510-526.5 kHz.

5.73 The band 285-325 kHz (283.5-325 kHz in Region 1) in 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. (WRC-97)

5.74 *Additional Allocation:* in Region 1, the frequency band 285.3-285.7 kHz is also allocated to the maritime radionavigation service (other than radiobeacons) on a primary basis.

5.75 *Different category of service:* in Armenia, Azerbaijan, Belarus, the Russian Federation, Georgia, Moldova, Kyrgyzstan, Tajikistan, Turkmenistan, Ukraine and the Black Sea areas of Bulgaria and Romania, the allocation of the band 315-325 kHz to the maritime radionavigation service is on a primary basis under the condition that in the Baltic Sea area, the assignment of frequencies in this band to new stations in the maritime or aeronautical radionavigation services shall be subject to prior consultation between the administrations concerned. (WRC-2000)

5.76 The frequency 410 kHz is designated for radio direction-finding in the maritime radionavigation service. The other radionavigation services to which the band 405-415 kHz is allocated shall not cause harmful interference to radio direction-finding in the band 406.5-413.5 kHz.

5.77 *Different category of service:* in Australia, China, the French Overseas Territories of Region 3, India, Indonesia (until 1 January 2005), Iran (Islamic Republic of), Japan, Pakistan, Papua New Guinea and Sri Lanka, the allocation of the band 415-495 kHz to the aeronautical radionavigation service is on a primary basis. Administrations in these countries shall take all practical steps necessary to ensure that aeronautical radionavigation stations in the band 435-495 kHz do not cause interference to reception by coast stations of ship stations transmitting on frequencies designated for ship stations on a worldwide basis (see No. **52.39**). (WRC-2000)

5.78 *Different category of service:* in Cuba, the United States of America and Mexico, the allocation of the band 415-435 kHz to the aeronautical radionavigation service is on a primary basis.

5.79 The use of the bands 415-495 kHz and 505-526.5 kHz (505-510 kHz in Region 2) by the maritime mobile service is limited to radiotelegraphy.

5.79A When establishing coast stations in the NAVTEX service on the frequencies 490 kHz, 518 kHz and 4 209.5 kHz, administrations are strongly recommended to coordinate the operating characteristics in accordance with the procedures of the International Maritime Organization (IMO) (see Resolution **339 (Rev.WRC-97)**)*. (WRC-97)

5.80 In Region 2, the use of the band 435-495 kHz by the aeronautical radionavigation service is limited to non-directional beacons not employing voice transmission.

5.81 (SUP - WRC-2000)

5.82 In the maritime mobile service, the frequency 490 kHz is, from the date of full implementation of the GMDSS (see Resolution **331 (Rev.WRC-97)**)*, to be used exclusively for the transmission by coast stations of navigational and meteorological warnings and urgent information to ships, by means of narrow-band direct-printing telegraphy. The conditions for use of the frequency 490 kHz are prescribed in Articles **31** and **52**. In using the band 415-495 kHz for the aeronautical radionavigation service, administrations are requested to ensure that no harmful interference is caused to the frequency 490 kHz. (WRC-97)

495-1 800 kHz

Allocation to services		
Region 1	**Region 2**	**Region 3**
495-505 MOBILE (distress and calling) 5.83		
505-526.5 MARITIME MOBILE 5.79 5.79A 5.84 AERONAUTICAL RADIONAVIGATION	**505-510** MARITIME MOBILE 5.79	**505-526.5** MARITIME MOBILE 5.79 5.79A 5.84 AERONAUTICAL RADIONAVIGATION Aeronautical mobile
	510-525 MOBILE 5.79A 5.84 AERONAUTICAL RADIONAVIGATION	Land mobile
5.72	**525-535**	
526.5-1 606.5 BROADCASTING	BROADCASTING 5.86 AERONAUTICAL RADIONAVIGATION	**526.5-535** BROADCASTING Mobile 5.88
5.87 5.87A	**535-1 605** BROADCASTING **1 605-1 625**	**535-1 606.5** BROADCASTING
1 606.5-1 625 FIXED MARITIME MOBILE 5.90 LAND MOBILE 5.92	BROADCASTING 5.89 5.90	**1 606.5-1 800** FIXED MOBILE RADIOLOCATION RADIONAVIGATION
1 625-1 635 RADIOLOCATION 5.93	**1 625-1 705** FIXED MOBILE BROADCASTING 5.89 Radiolocation 5.90	
1 635-1 800 FIXED MARITIME MOBILE 5.90 LAND MOBILE 5.92 5.96	**1 705-1 800** FIXED MOBILE RADIOLOCATION AERONAUTICAL RADIONAVIGATION	5.91

5.83 The frequency 500 kHz is an international distress and calling frequency for Morse radiotelegraphy. The conditions for its use are prescribed in Articles **31** and **52,** and in Appendix **13**.

5.84 The conditions for the use of the frequency 518 kHz by the maritime mobile service are prescribed in Articles **31** and **52** and in Appendix **13**. (WRC-97)

5.85 Not used.

5.86 In Region 2, in the band 525-535 kHz the carrier power of broadcasting stations shall not exceed 1 kW during the day and 250 W at night.

5.87 *Additional allocation:* in Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland and Zimbabwe, the band 526.5-535 kHz is also allocated to the mobile service on a secondary basis. (WRC-03)

5.87A *Additional allocation:* in Uzbekistan, the band 526.5-1 606.5 kHz is also allocated to the radionavigation service on a primary basis. Such use is subject to agreement obtained under No. **9.21** with administrations concerned and limited to ground-based radiobeacons in operation on 27 October 1997 until the end of their lifetime. (WRC-97)

5.88 *Additional allocation:* in China, the band 526.5-535 kHz is also allocated to the aeronautical radionavigation service on a secondary basis.

5.89 In Region 2, the use of the band 1 605-1 705 kHz by stations of the broadcasting service is subject to the Plan established by the Regional Administrative Radio Conference (Rio de Janeiro, 1988).

The examination of frequency assignments to stations of the fixed and mobile services in the band 1 625-1 705 kHz shall take account of the allotments appearing in the Plan established by the Regional Administrative Radio Conference (Rio de Janeiro, 1988).

5.90 In the band 1 605-1 705 kHz, in cases where a broadcasting station of Region 2 is concerned, the service area of the maritime mobile stations in Region 1 shall be limited to that provided by ground-wave propagation.

5.91 *Additional allocation:* in the Philippines and Sri Lanka, the band 1 606.5-1 705 kHz is also allocated to the broadcasting service on a secondary basis. (WRC-97)

5.92 Some countries of Region 1 use radiodetermination systems in the bands 1 606.5-1 625 kHz, 1 635-1 800 kHz, 1 850-2 160 kHz, 2 194-2 300 kHz, 2 502-2 850 kHz and 3 500-3 800 kHz, subject to agreement obtained under No. **9.21**. The radiated mean power of these stations shall not exceed 50 W.

5.93 *Additional allocation:* in Angola, Armenia, Azerbaijan, Belarus, the Russian Federation, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Mongolia, Nigeria, Uzbekistan, Poland, Kyrgyzstan, Slovakia, the Czech Rep., Tajikistan, Chad, Turkmenistan and Ukraine, the bands 1 625-1 635 kHz, 1 800-1 810 kHz and 2 160-2 170 kHz and, in Bulgaria, the bands 1 625-1 635 kHz and 1 800-1 810 kHz, are also allocated to the fixed and land mobile services on a primary basis, subject to agreement obtained under No. **9.21**. (WRC-2000)

5.94 and **5.95** Not used.

5.96 In Germany, Armenia, Austria, Azerbaijan, Belarus, Denmark, Estonia, the Russian Federation, Finland, Georgia, Hungary, Ireland, Iceland, Israel, Kazakhstan, Latvia, Liechtenstein, Lithuania, Malta, Moldova, Norway, Uzbekistan, Poland, Kyrgyzstan, Slovakia, the Czech Rep., the United Kingdom, Sweden, Switzerland, Tajikistan, Turkmenistan and Ukraine, administrations may allocate up to 200 kHz to their amateur service in the bands 1 715-1 800 kHz and 1 850-2 000 kHz. However, when allocating the bands within this range to their amateur service, administrations shall, after prior consultation with administrations of neighbouring countries, take such steps as may be necessary to prevent harmful interference from their amateur service to the fixed and mobile services of other countries. The mean power of any amateur station shall not exceed 10 W. (WRC-03)

ANNEX 5: COVERAGE IMPLICATIONS OF THE TRANSITION TO DRM

The coverage range of transmissions in the LF/MF bands is determined by the electrical properties of the ground along the path from the transmitter to receiver, and the effects of the ionosphere. Propagation at these frequencies is predominately determined by the transmission of a ground wave (or more precisely a surface wave) along the surface of the earth. The range of the ground wave is related to the conductivity of the earth's surface along the path; the longest ranges being achieved over surfaces with good conductivity and consequently low attenuation (e.g., salt water, coastal areas, grass land) and the shortest over surfaces with poor conductivity and consequently high attenuation (e.g., deserts, built-up areas). Eventually the limit of coverage is reached when the signal strength is attenuated to a level that is no longer usable for communication purposes, but it may still be significant in degrading reception of transmissions in adjacent areas.

Propagation by sky wave - reflection from the ionosphere - also plays a part in determining the wanted coverage area and also the extent of interference to other transmissions beyond the reliable coverage area. Reflections from the ionosphere can extend the range of LF/MF transmissions to several times the ground wave limit. The effect is particularly evident during the night when the lowest ionised layer of the ionosphere, the D-layer, rapidly disappears after sunset. The D- layer predominantly acts as an absorber of LF/MF radio waves. Normally, the impact of the ionosphere on LF/MF broadcasting is that strong reflections from the next higher layer of the ionosphere, the E-layer, will take place at night once the effect of absorption in the D-layer disappears at sunset.

The effect is more pronounced at MF, greatly extending the potential range of the transmissions. This can be a negative effect, because of *mutual interference* between stations on the same frequency, and *interference fading* caused by a broadcasting transmitter's own signals arriving at the receiver by different paths from the transmitting station. Alternatively, ionospheric propagation effects can be exploited by planning for extended coverage at night by sky wave. Normally though, action is taken to minimise the interference from sky wave effects through aerial designs that limit high angle radiation, or through making power reductions at night. As the main purpose of the GE75 Plan is to maximise re-use of the LF/MF spectrum for broadcasting, the planned characteristics of the assignments typically include day and night time variations to the aerial configuration and transmitter power.

The treatment of day and night coverage variability will require further consideration before any revision of the Plan for an all digital environment can be contemplated. This is because of the more adverse impact on digital reception quality in areas where a broadcast is received via ground wave and sky wave simultaneously. With analogue modulation, the audible effect of interference fading in the zone where the ground wave and sky wave components overlap is a fairly annoying continuous variation between a low level noisy distorted sound and a louder slushy sound, but programme content remains intelligible. With DRM the effect is heard as a pronounced rhythmic fading pattern, where the signal goes from good to almost total mutual interference/cancellation, which may well be perceived as more objectionable than the AM case.

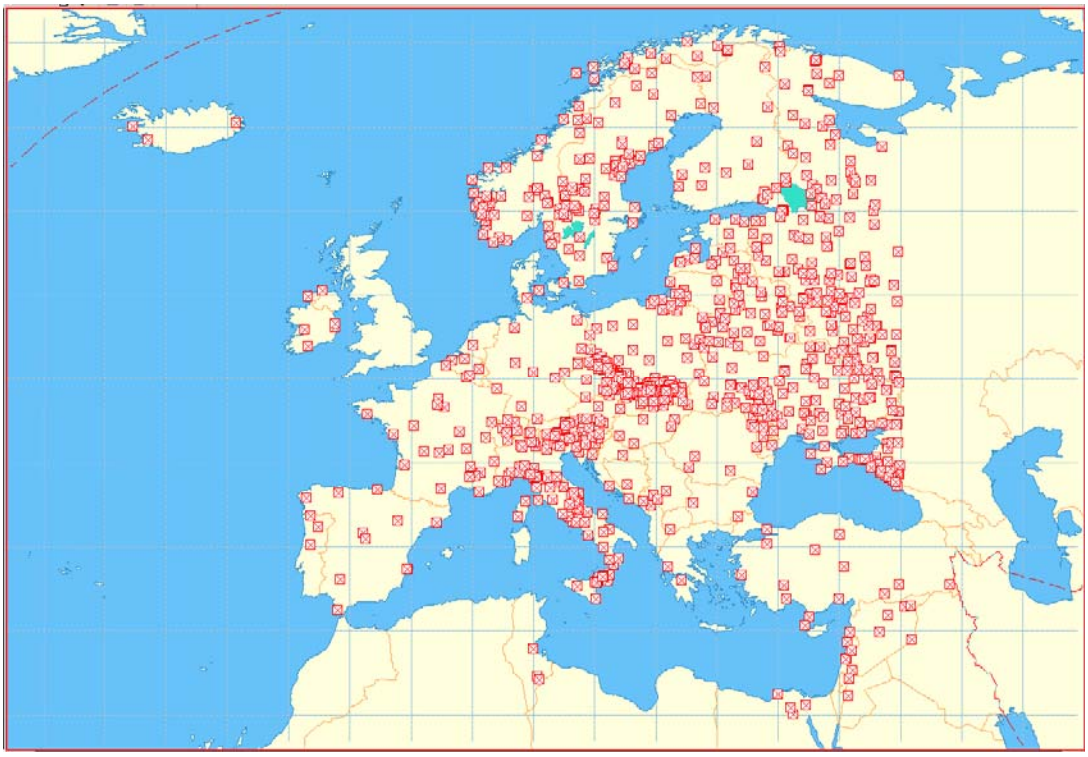
The night time skywave propagation also means that the co-ordination of high power stations has to be done over a very wide geographical area, as signals can easily reach across a continental scale. It is this very large co-ordination area which would make reconvening any conference to review GE75 a truly monumental task, possibly on a similar scale to the RRC06, but with co-ordination ranges, and the number of countries from which approval would be required per high power transmitter multiplied by a factor of 10 or more. This would be a very time consuming and costly exercise, especially when considering that we already have a set of Rules of Procedure to cover it.

Another planning consideration that will change substantially after the period of mixed analogue and digital broadcasting gives way to predominately digital use is the high level of protection that is required for coordinating stations in the analogue to analogue and digital to analogue cases, compared to digital to digital. This means that coverage from digital broadcasting stations will be subject to limitations during the transition period that can be relaxed after the transition is substantially complete.

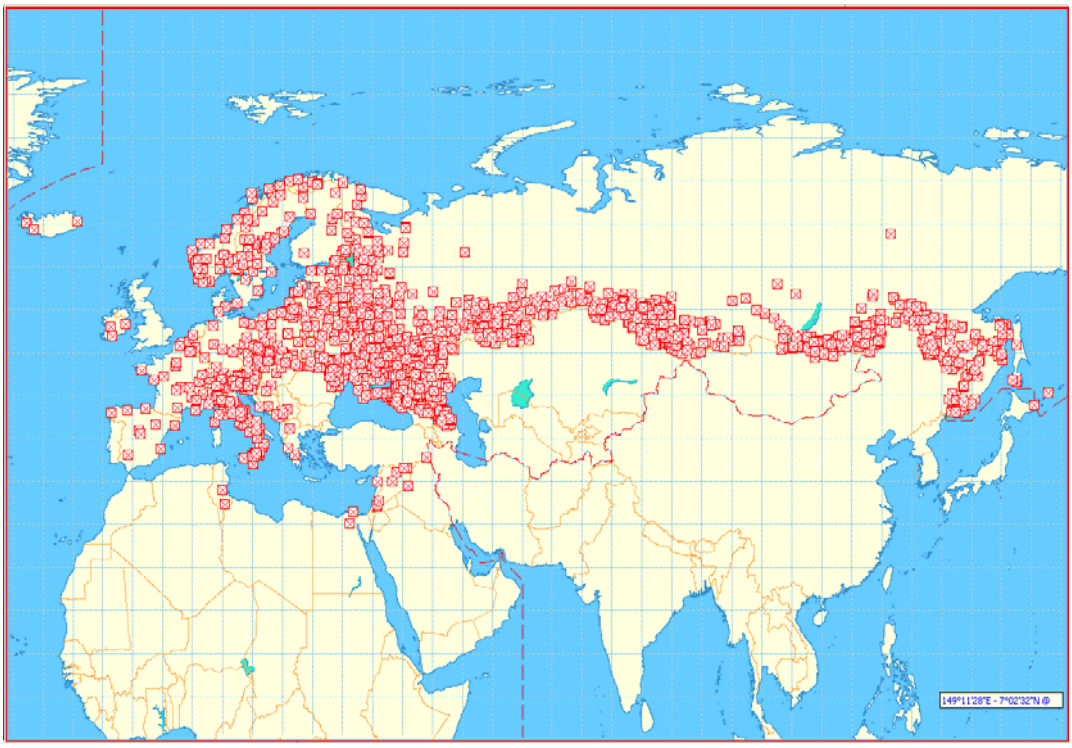
To attempt to improve on this situation by revising the GE75 Plan before this point would involve introducing complex coordination procedures to cover all the possible variants in coordinating band use between stations (legacy analogue to analogue, analogue to digital, digital to analogue and digital to digital), all but one of which would become obsolete in due course. In addition to the waste of time and resources involved, the prospect of an impending re-planning conference for the LF/MF bands will create uncertainty as to the outcome and may well dissuade broadcasters from taking the risk of re-engineering their LF/MF networks. The design and construction of LF/MF transmitting stations requires a far greater effort in terms of financial planning, civil engineering and health and safety considerations than VHF FM broadcasting stations.

ANNEX 6: EXTRACT FROM THE ST61 PLAN: ASSIGNMENTS IN BAND I AS OF THE END OF 2009

The following map is an extract from the ITU BRIFIC 2651 DVD data which shows the current disposition of some 1119 assignments currently registered in ST61 in Band I in Region 1. As can be clearly seen administrations have different views as to the usefulness of Band I judging by the number of assignments.



The following map is an extract from the ITU BRIFIC 2651 DVD data which shows the current disposition of some 1688 Article 11 registrations currently registered in Band I in Region 1 with the same country by country basis as in the map of ST61 assignments above.



ANNEX 7: EXTRACT FROM ARTICLE 5 OF THE ITU RADIO REGULATIONS FOR BAND I

47-75.2 MHz

<table>
<tr><th colspan="3">Allocation to services</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td rowspan="3">47-68
BROADCASTING

5.162A 5.163 5.164 5.165
5.169 5.171</td><td>47-50
FIXED
MOBILE</td><td>47-50
FIXED
MOBILE
BROADCASTING
5.162A</td></tr>
<tr><td colspan="2">50-54
AMATEUR
5.162A 5.166 5.167 5.168 5.170</td></tr>
<tr><td>54-68
BROADCASTING
Fixed
Mobile

5.172</td><td>54-68
FIXED
MOBILE
BROADCASTING

5.162A</td></tr>
</table>

5.162A *Additional allocation:* in Germany, Austria, Belgium, Bosnia and Herzegovina, China, Vatican, Denmark, Spain, Estonia, the Russian Federation, Finland, France, Ireland, Iceland, Italy, Latvia, The Former Yugoslav Republic of Macedonia, Liechtenstein, Lithuania, Luxembourg, Moldova, Monaco, Norway, the Netherlands, Poland, Portugal, Slovakia, the Czech Rep., the United Kingdom, Sweden and Switzerland the band 46-68 MHz is also allocated to the radiolocation service on a secondary basis. This use is limited to the operation of wind profiler radars in accordance with Resolution **217 (WRC-97)**. (WRC-2000)

5.163 *Additional allocation:* in Armenia, Azerbaijan, Belarus, the Russian Federation, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Mongolia, Uzbekistan, Kyrgyzstan, Slovakia, the Czech Rep., Tajikistan, Turkmenistan and Ukraine, the bands 47-48.5 MHz and 56.5-58 MHz are also allocated to the fixed and land mobile services on a secondary basis. (WRC-03)

5.164 *Additional allocation:* in Albania, Germany, Austria, Belgium, Bosnia and Herzegovina, Botswana, Bulgaria, Côte d'Ivoire, Denmark, Spain, Estonia, Finland, France, Gabon, Greece, Ireland, Israel, Italy, the Libyan Arab Jamahiriya, Jordan, Lebanon, Liechtenstein, Luxembourg, Madagascar, Mali, Malta, Morocco, Mauritania, Monaco, Nigeria, Norway, the Netherlands, Poland, Syrian Arab Republic, the United Kingdom, Serbia and Montenegro, Slovenia, Sweden, Switzerland, Swaziland, Chad, Togo, Tunisia and Turkey, the band 47-68 MHz, in Romania the band 47-58 MHz, in South Africa the band 47-50 MHz, and in the Czech Rep. the band 66-68 MHz, are also allocated to the land mobile service on a primary basis. However, stations of the land mobile service in the countries mentioned in connection with each band referred to in this footnote shall not cause harmful interference to, or claim protection from, existing or planned broadcasting stations of countries other than those mentioned in connection with the band. (WRC-03)

5.165 *Additional allocation:* in Angola, Cameroon, Congo (Rep. of the), Madagascar, Mozambique, Somalia, Sudan, Tanzania and Chad, the band 47-68 MHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

5.169 *Alternative allocation:* in Botswana, Burundi, Lesotho, Malawi, Namibia, the Dem. Rep. of the Congo, Rwanda, South Africa, Swaziland, Zambia and Zimbabwe, the band 50-54 MHz is allocated to the amateur service on a primary basis.

5.171 *Additional allocation:* in Botswana, Burundi, Lesotho, Malawi, Mali, Namibia, Dem. Rep. of the Congo, Rwanda, South Africa, Swaziland and Zimbabwe, the band 54-68 MHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

ANNEX 8: OPPORTUNITIES IN BAND I FOR THE INTRODUCTION OF NEW MODULATION TECHNIQUES WITHIN ST61

The band 47 MHz to 68 MHz (Band 1) is allocated to the broadcasting service in Article 5 of the ITU-R Radio Regulations in ITU Region 1. However, in many countries this band is also allocated to other services on either a primary or secondary basis by means of a footnote.

Broadcasting services in the European Broadcasting Area were planned under the Stockholm 61 Regional Agreement (ST61). Band 1 contains assignments for both TV and VHF FM sound broadcasting (mono).

This Annex considers how new modulation techniques might be introduced in Band I within the provisions of the ST61 Agreement.

Article 4 of the ST61 Agreement describes the actions to be taken should an administration wish to change the characteristics of an existing sound broadcasting station or introduce a new broadcasting station. The technical annex to ST61 describes the possible introduction of stereophonic sound broadcasts which need to be protected from "fixed or mobile" interferers. This suggests that Band 1 from its inception would contain other services. Therefore, one might assume that other modulation modes would be acceptable subject to the application of suitable protection criteria.

Extracts from the ST61 Agreement to be read in conjunction with the above discussion

ARTICLE 4

Changes in the Characteristics of Stations covered by the Agreement

1 *Procedure in the Frequency Bands 41-68 Mc/s, 87.5-100 Mc/s, 174-216 Mc/s, 470-582 Mc/s and 606- 790 Mc/s*

19 1.1 When a Contracting Administration proposes to change the characteristics of a broadcasting station shown in the Plans or brought into operation in accordance with the provisions of the present Agreement, or proposes to put into operation a broadcasting station not appearing in the Plans, the following action shall be taken:

20 1.1.1 If the distances from the station under consideration to the nearest points of the boundaries of other countries, the administrations of which are contracting administrations, are less than the limits corresponding to the proposed power of the station and other characteristics specified in Annex 1, the administrations of those countries shall be consulted by registered post

21 1.1.2 In effecting this consultation the Administration proposing the change shall furnish all the information specified in Appendix 1, Section A, of the Radio Regulations, together with the effective height of the antenna as defined in Annex 2 to the Agreement, its directional characteristics and the polarization of radiation. The administrations that are being consulted may request any other information they need to assess the probability of harmful interference to their own services.

22 1.1.3 If agreement is reached between the administrations concerned, the Administration proposing the change may proceed with its project. Administrations which have been consulted and have not replied within ten weeks following the date of registration of the consultation letter in the post of the country of origin shall be reminded by urgent telegram. Administrations which have not replied within two weeks following the despatch of the urgent telegram shall be considered to have agreed to the proposed change.

23 1.1.4 If no agreement is reached between the administrations concerned, the I.F.R.B. shall make any technical examination that may be requested by the Administration proposing the change, or by administrations whose services may be affected by the proposed change, and shall inform them of the results of such examination.

24 1.2 The Administration proposing the change may proceed with its project without consulting other administrations if:

25 *a)* the proposed modification relates to a reduction in power or to other changes of technical characteristics which would reduce the probability of harmful interference to services of other countries, or

26 *b)* the distances from the station under consideration to the nearest points of the boundaries of other countries, the administrations of which are contracting administrations, are equal to or greater than the limits corresponding to the proposed power of the station and other characteristics specified in Annex 1.

27 1.3 In the cases referred to in sub-paragraph 1.1.3 and paragraph 1.2 above, the Administration proposing the change shall inform the I.F.R.B. of the particulars specified in sub-paragraph 1.1.2 above and, where appropriate, of the names of the countries consulted.

28 1.4 The I.F.R.B. shall publish the information in a special section of its weekly circular, specifying either that the proposed change is the result of consultation carried out under the provisions of subparagraphs 1.1.1, 1.1.2 and 1.1.3 above, or that it is being effected under the provisions of paragraph 1.2 above.

2 *Procedures in the Frequency Bands 162-174 Mc/s, 216-230 Mc/s, 582-606 Mc/s and 790-960 Mc/s*
2.1 *Procedure for Broadcasting Stations*

29 2.1.1 Any Contracting Administration proposing to change the technical characteristics of any of its broadcasting stations appearing in the Plans or to operate broadcasting stations not appearing in the Plans, shall first inform the I.F.R.B., furnishing the technical information specified in sub-paragraph 1.1.2 above.

30 2.1.2 The I.F.R.B. shall publish this information in a special section of its weekly circular, indicating that comments on such information should be sent directly to the Administration originating the proposal.

31 2.1.3 Such comments must be received by the Administration originating the proposal within the twelve weeks following the date of the weekly circular in question. Administrations which have not furnished such comments within this period shall be considered to have agreed to the proposed change.

32 2.1.4 If no comments have been received at the expiry of the period of twelve weeks referred to in subparagraph 2.1.3 above, or if agreement has been reached with the administrations making these comments, the Administration proposing the change may proceed with its project, and shall inform the I.F.R.B. in the manner specified in paragraph 1.3 above.

2.2 *Procedure for Stations of Services other than Broadcasting*

33 For stations of services other than broadcasting, the provisions of the Radio Regulations shall apply, taking into account the categories of service and allocations specified in Article 5 thereof. Contracting administrations proposing to change the technical characteristics of such stations or to establish new stations of such services shall take into account the broadcasting stations appearing in the Plans or brought into use in accordance with this Agreement and shall do so after reaching mutual agreement with the administrations that may be concerned.

3 *Procedure common to all Frequency Bands*

34 3.1 The Secretary-General shall be informed by the I.F.R.B. of all changes made in the Plans in application of the provisions of Sections 1 and 2 above.

35 3.2 If a change, although made in accordance with the provisions of Sections 1 and 2 above, causes harmful interference to services of other contracting administrations, the Administration which has made the change shall take the requisite action to eliminate such interference.

36 3.3 If, after application of the procedure defined in, sub-paragraphs 1.1.1, 1.1.2 and 1.1.3 on the one hand, and paragraphs 2.1 and 2.2 on the other hand, no agreement has been reached between the administrations concerned, recourse may be had to the procedures defined in Article 15 of the Radio Regulations, or in Article 27 of the International Telecommunication Convention, Geneva, 1959, as the case may be.

ANNEX 1 to the Regional Agreement for the European Broadcasting Area (ST61)

Tables of Distances to be used in the Application of Article 4 of the Agreement

The following tables give, for each frequency band*), as a function of the effective radiated power, the effective transmitting antenna height (h) and the nature of the path under consideration, the limiting distances to be taken into account in the application of Article 4 of the Agreement. For powers different from the values given in the tables, the limiting distance shall be determined by linear interpolation. For antenna heights different from the values given in the tables, the limiting distance corresponding to the next higher height shall be used.

For mixed paths in the case of Bands I, II and III, no consultation is necessary if:

a) the total length of the path is equal to or greater than the limiting distance quoted in the table for a sea path; or

b) the total length of those parts of the path lying over land is equal to or greater than the limiting distance quoted in the table for a land path. For mixed paths in the case of Bands IV and V, where the percentage of sea path is different from the values quoted in the tables, the distance corresponding to the next higher percentage shall be used. For transmitting antenna effective heights greater than 1200 m, or in cases where no limiting distance appears in the tables, the procedure given in Section 2.1 of Article 4 shall be applied.

*) For simplicity, the frequency band is designated as follows: 41-68 Mc/s Band I

TABLE A – BAND I

Effective Radiated Power (E.R.P.)	Limiting distances in km for different effective antenna heights h								
	h = 75 m			h = 300 m			h = 1200 m		
	Land	Sea (generally)	Sea Mediterranean	Land	Sea (generally)	Sea Mediterranean	Land	Sea (generally)	Sea Mediterranean
300 kW	660	920	*)	680	970	*)	760	1 050	*)
100	600	830	1050	630	870	*)	700	950	*)
30	540	740	920	565	780	970	650	850	1050
10	480	630	830	520	670	870	590	750	950
3	430	530	740	465	570	780	540	650	850
1	370	450	630	420	490	670	480	560	750
300 W	320	370	530	360	410	570	420	480	650
100	270	300	450	310	330	490	370	410	560
30	220	230	370	260	270	410	330	340	480
10	170	170	300	205	205	330	290	290	410
3	130	130	230	160	160	270	240	240	340
1	100	100	170	135	135	205	200	200	290
300 mW	70	70	130	100	100	160	160	160	240
100	50	50	100	80	80	135	140	140	200
30	35	35	70	60	60	100	120	120	160
10	25	25	50	50	50	80	100	100	140
3	25	25	35	35	35	60	80	80	120
1	25	25	25	30	30	50	65	65	100

ARTICLE 5

Notification of Frequency Assignments

37 Whenever an assignment in conformity with the Plans or for which the procedure prescribed in Article 4 of the present Agreement has been applied, is put into service, the Administration concerned shall notify this assignment to the I.F.R.B. in accordance with the provisions of Article 9 of the Radio Regulations.

ANNEX 9: REALTIME AUDIO VISUAL INFORMATION SYSTEM– RAVIS

RAVIS (Realtime AudioVisual Information System) is a system for digital terrestrial sound and multimedia broadcasting using VHF narrowband radiofrequency channels. The system has been developed with the aim to increase efficiency of Bands I and II utilization which are used for stereophonic FM sound broadcasting.

Advanced channel coding and OFDM modulation provide high spectral efficiency of RAVIS. Bitrate from 150 to 700 kbps is available in 200 kHz bandwidth radio channel (200 – 900 kbps in 250 kHz radio channel). So, one narrowband radio channel can carry a set of sound programmes or a video programme with some sound accompaniment channels. The quality of sound in RAVIS is higher than that in traditional analogue FM broadcasting.

RAVIS provides stable both fixed and mobile reception (at velocities up to 250 - 300 km/h) in city environment, in regions with difficult topography, in mountainous and woody regions – in the environment characterized by multipath propagation, absence of line-of-site transmitter antenna, etc.

Flexible choice of channel coding and modulation parameters (FEC rate, modulation constellation type, guard interval length) allow to build up broadcasting networks (both MFN and SFN) in different conditions (large and small cities, countryside, etc.).

RAVIS can carry three logical data channels. In addition to main service channel it is possible to transmit low bitrate data with enhanced reliability (low bitrate channel, ~ 12 kbps) and robust data (robust data channel, ~ 5 kbps). These additional channels may be used for instance for emergency notification, etc.

Broadcaster can vary such parameters as presence/absence of additional logical data channels, FEC rate, main service channel modulation type to achieve optimal trade-off between coverage area on the one hand and the number and quality of delivered services (sound and video programmes, additional data) on the other hand.

It is possible to build different configurations of delivered services at available bitrate. Utilization of high efficient video and audio encoders (MPEG-4 AVC/H.264, MPEG-4 HE-AAC and MPEG Surround) makes it possible to transmit a video programme or a set of stereophonic or multichannel sound programmes through one radio channel. Additional services such as EPG, text messages, still images, etc. may be transmitted simultaneously with main services.

RAVIS utilizes narrow bandwidth radiofrequency channels. These channels fit into European FM broadcasting raster based on 200 kHz channels. So RAVIS may be used simultaneously with analogue FM broadcasting. It substantially simplifies soft analogue to digital broadcasting switch. RAVIS may be used also in combination with other narrowband digital terrestrial broadcasting systems.

The first field trials of RAVIS have been carried out in Russian Federation in 2006. The results of RAVIS development and trials were submitted to ITU-R in the Russian Federation contributions for Study Group 6. General description of the system have been included into ITU-R Report BT.2049-2 in 2008 (Appendix 5 – Digital narrowband multimedia broadcasting system AVIS).

RAVIS is an open standard. Second version of the standard has been developed at present. In this version error rate performance of the system was increased and possibilities of adaptation of system parameters to broadcaster’s demands were enhanced.

RAVIS test broadcasting will be carried out in Russian Federation in 2010.

ANNEX 10: INFORMATION FROM ADMINISTRATIONS ON THE CURRENT AND FUTURE USE OF FREQUENCY BANDS

LF band (148.5 – 255.0 kHz)[10]

Country	Current use	Future use	Remark
Austria	- allocated to broadcasting on a primary basis - currently no usage for broadcasting - no LW assignments in the GE75 Plan.	There are no plans for future usage at this point in time.	From the current point of view there are no plans for the immediate change of usage in any of these listed frequency bands in Austria.
Belgium	- not allocated to a radioservice - the band is in use by medical implants in health care and short range devices for inductive applications	Future use is under investigation.	
Croatia	- allocated to broadcasting on a primary basis - currently no usage for broadcasting	There are no plans for future usage at this point in time.	
Czech Republic		No official decision related to the future use of above mentioned frequency bands in CZE has been made so far, but there is no problem expected concerning utilization of these frequency bands and particular assignments in MF Band for digital audio broadcasting (DRM/DRM+).	CEPT harmonized approach is desired.
Estonia	- According to the Estonian Frequency Allocation Plan this frequency band is allocated for LW AM- radio. - No any actual usage.	There are no specific plans for future usage at this point in time.	
Finland	- Primary allocation for Broadcasting (LW AM-radio). - Usage according to GE75 plan. Finland has 4 assignments in this band. - Currently not used.	No plans for future use at this time.	Source: Radio Frequency Regulation No. 4, Frequency Allocation Table
France	- allocation for broadcasting - analogue radio, DRM trials	No change is foreseen in the near future	
Germany	- allocation for broadcasting - analogue radio, DRM trials	No change is foreseen in the near future	DRM transmissions are already allowed
Hungary	- Primary allocation broadcasting - Not used for broadcasting - Hungary has no LF assignments in the GE75 Plan	There are no specific plans for future use at this time	
Ireland	- Broadcasting is allocated on a primary basis in the LF band for AM sound. Currently there is one broadcast transmitter in operation in this band which broadcasts Public Service content on 252 kHz. - Short range devices are also allocated for use in this band for inductive applications and wireless applications in healthcare as per Tables 7 and 10 of ComReg Doc 02/71R4 respectively.	There are no specific plans for the future use of this band within Ireland at this time.	
Latvia	In the National Frequency Plan these frequency bands are allocated to LW AM broadcasting. No assignments are included In the GE 75 plan for Latvia.	No plans for future use.	

[10] Additional information, supplied by EBU, is provided in the Appendix to this Annex.

Country	Current use	Future use	Remark
Lithuania	- The frequency band is allocated on primarily basis to broadcasting. Currently there is no broadcast transmitter in operation. - There is a secondary allocation to Short range devices for inductive applications and Active Medical Implants and their associated peripherals in accordance to ERC/REC 70-03.	There are no specific plans for the future usage.	
The Netherlands	- Broadcasting. Under specific conditions SRD for inductive systems on NIB-basis - Mobile (secondary service), SRD, medical implants. Under specific conditions SRD for inductive systems on NIB-basis - Not in use by broadcast	No plans available at this time.	DRM transmissions are already allowed
Norway	- Broadcast - analogue AM sound broadcast transmitters (Ingoy, 153 kHz)	- Broadcast - To be determined	
Portugal	- Currently not used by Broadcasting Service (primary allocation); - SRD usage for inductive systems (148.5 kHz - 5 MHz) according to ERC/REC 70-03 (Annex 9); - SRD usage for wireless systems for medical applications (9-315 kHz) according to ERC/REC 70-03 (Annex 12) and Decision 2008/432/EC of 23 May.	No plans for changes at this time.	
Russian Federation	Analogue broadcasting	Digital broadcasting (DRM)	
Slovak Republic	- allocated for broadcasting services, inductive systems - currently not used for broadcasting service. - no assignments are included in the GE 75 Plan for Slovakia.	There are no plans for future usage at this time	
Spain	- Allocated for broadcasting services - 5 frequencies assigned (to RNE) for public service, but not implemented - Not in use		
Sweden	- Broadcasting - analogue radio (GE75) - no broadcasting service implemented - radio transmitters for inductive transmission (license exempt)	At the moment there are no indications that the current situation is going to change in the near future	Sources: - the Swedish frequency plan - the Swedish licence register
Switzerland	- Primary allocation for broadcasting - Main use: - broadcasting (primary) - high tension power line transmission (secondary)	No major changes foreseen in use of these frequencies.	Short Range Devices: 9-315 kHz: Wireless applications in healthcare: ULP-AMI: RIR1006-01, ERC/REC 70-03 148.5 kHz - 5 MHz: Wideband SRD, Annex1
Ukraine	This band is used for analogue sound broadcasting in accordance with the Geneva-75 Agreement. Ukraine has 2 frequency assignments in Geneva 75 Plan on frequencies 171 and 207 kHz	This band is planned for usage by digital terrestrial audio broadcasting of DRM standard	
United Kingdom	- Primary allocation Broadcasting. - Used for Broadcasting with a number of assignments in the GE75 Plan - Also used for radio teleswitching on a NI/NP basis to broadcasting	There are no plans for future usage at this time.	

LF band (255.0 - 283.5 kHz)

Country	Current use	Future use	Remark
Austria	- co-primary allocation to broadcasting and aeronautical radio navigation - currently no usage for broadcasting - no LW assignments in the GE75 Plan.	There are no plans for future usage at this point in time.	From the current point of view there are no plans for the immediate change of usage in any of these listed frequency bands in Austria.
Belgium	- not allocated to broadcasting - allocated on a primary basis to aeronautical radionavigation - the band is in use by medical implants in health care and short range devices for inductive applications	Future use is under investigation	
Croatia	- co-primary allocation to broadcasting and aeronautical radio navigation - currently no usage for broadcasting	There are no plans for future usage at this point in time.	
Czech Republic	1 assignment / 1 transmitter in operation TOPOLNA, 270 kHz, 650 kW, public service	No official decision related to the future use of above mentioned frequency bands in CZE has been made so far, but there is no problem expected concerning utilization of these frequency bands and particular assignments in MF Band for digital audio broadcasting (DRM/DRM+).	CEPT harmonized approach is desired.
Estonia	- According to the Estonian Frequency Allocation Plan this frequency band is allocated for LW AM- radio. - No actual usage.	There are no specific plans for future usage at this point in time.	
Finland	-Primary allocations for Aeronautical Radionavigation (Non-Directional Beacons) and Broadcasting. -Usage according to GE75 plan but no assignments in this band. -Currently not used.	No plans for future use at this time.	Source: Radio Frequency Regulation No. 4, Frequency Allocation Table
France	- allocation for broadcasting - aeronautical radio navigation, primary service - analogue radio	No change is foreseen in the near future	
Germany	- allocation for broadcasting - aeronautical radio navigation, primary service - analogue radio, DRM trials	No change is foreseen in the near future	DRM transmissions are already allowed
Hungary	- Co-primary allocation Broadcasting and Aeronautical Radio Navigation - Not used for broadcasting - Hungary has no LF assignments in the GE75 Plan	There are no specific plans for future use at this time	
Ireland	Broadcasting is allocated on a primary basis in the LF band for AM sound. Short range devices are also allocated for use in this band for inductive applications and wireless applications in healthcare as per Tables 7 and 10 of ComReg Doc 02/71R4 respectively.	There are no specific plans for the future use of this band within Ireland at this time.	
Latvia	In the National Frequency Plan these frequency bands are allocated to LW AM broadcasting. No assignments are included In the GE 75 plan for Latvia.	No plans for future use.	

Country	Current use	Future use	Remark
Lithuania	The frequency bands are allocated on primarily basis to: - Broadcasting. Currently there is no broadcast transmitter in operation. - Aeronautical Radionavigation: 255.0 - 283.5 kHz. There is no transmitter in operation. There is a secondary allocation to Short range devices for inductive applications and Active Medical Implants and their associated peripherals in accordance to ERC/REC 70-03.	There are no specific plans for the future usage.	
The Netherlands	- Broadcasting. Under specific conditions SRD for inductive systems on NIB-basis - Mobile (secondary service), SRD, medical implants. Under specific conditions SRD for inductive systems on NIB-basis - Not in use by broadcast	No plans available at this time.	DRM transmissions are already allowed
Norway	- Broadcast - analogue AM sound broadcast transmitters - Aeronautical radionavigation (Aeronautical radio beacons)	- Broadcast - To be determined	
Portugal	- Currently not used by Broadcasting Service (primary allocation); - SRD usage for inductive systems (148.5 kHz - 5 MHz) according to ERC/REC 70-03 (Annex 9); - SRD usage for wireless systems for medical applications (9-315 kHz) according to ERC/REC 70-03 (Annex 12) and Decision 2008/432/EC of 23 May.	No plans for changes at this time.	
Russian Federation	Analogue broadcasting	Digital broadcasting (DRM)	
Slovak Republic	- allocated for broadcasting services, inductive systems - currently not used for broadcasting service. - no assignments are included in the GE 75 Plan for Slovakia.	There are no plans for future usage at this time	
Spain	The frequency bands are allocated on primarily basis to: - Broadcasting (but there are no assignments) - Aeronautical Radionavigation There is a secondary allocation to Short range devices for inductive applications and Active Medical Implants and their associated peripherals in accordance to ERC/REC 70-03	There are no plans for future usage at this time.	
Sweden	- Broadcasting - analogue radio (GE75) - no broadcasting service implemented - radio transmitters for inductive transmission (license exempt)	At the moment there are no indications that the current situation is going to change in the near future.	Sources: - the Swedish frequency plan - the Swedish licence register
Switzerland	- Primary allocation for broadcasting - Main use: - broadcasting (primary) - high tension power line transmission - 255-266 kHz and 280-282 kHz (secondary) - 282-293.5 kHz (primary)	No major changes foreseen in use of these frequencies.	Short Range Devices: 9-315 kHz: Wireless applications in healthcare: ULP-AMI: RIR1006-01, ERC/REC 70-03 148.5 kHz - 5 MHz: Wideband SRD, Annex 1
Ukraine	This band is used for analogue sound broadcasting in accordance with the Geneva-75 Agreement.	This band is planned for usage by digital terrestrial audio broadcasting of DRM standard	

Country	Current use	Future use	Remark
United Kingdom	- Co-primary allocation Broadcasting and Aeronautical Radio Navigation - Some Broadcasting use with assignments in the GE75 Plan	There are no plans for future usage at this time	

MF band (526.5 - 1606.5 kHz)

Country	Current use	Future use	Remark
Austria	- allocated to broadcasting on a primary basis - currently no usage for broadcasting - The last Austrian MW station BISAMBERG has been decommissioned in March 2010.	There are no plans for future usage at this point in time.	From the current point of view there are no plans for the immediate change of usage in any of these listed frequency bands in Austria.
Belgium	- allocated to broadcasting on a primary basis (analogue AM-radio)	Future use is under investigation	
Croatia	- allocated to broadcasting on a primary basis - 3 assignments used for broadcasting (2 analogue, 1 digital – DRM test)	There are no plans for future usage at this point in time.	
Czech Republic	- cca 100 assignments; only 7 transmitters in operation: LIBLICE, 639 kHz, 1500 kW, public service OSTRAVA, 639 kHz, 30 kW, public service DOBROCHOV, 954 kHz, 200 kW, public service C.BUDEJOVICE, 954 kHz, 30 kW, public service KARLOVY VARY, 954 kHz, 20 kW, public service DOMAMIL, 1332 kHz, 50 kW, public service ZBRASLAV, 1062 kHz, 20 kW, commercial	No official decision related to the future use of above mentioned frequency bands in CZE has been made so far, but there is no problem expected concerning utilization of these frequency bands and particular assignments in MF Band for digital audio broadcasting (DRM/DRM+).	CEPT harmonized approach is desired.
Estonia	- According to the Estonian Frequency Allocation Plan this frequency band is allocated for MW AM- radio. - The actual usage is 1035 kHz MW AM radio station located in Tartu.	There are no specific plans for future usage at this point in time.	
Finland	- Primary allocation for Broadcasting (MW AM-radio). - Usage according to GE75 plan. Finland has 76 assignments in this band. - Currently there is one permanent transmitter 963 kHz in Pori and a few temporary broadcasts annually, mainly on 1602 kHz.	No plans for future use at this time.	Source: Radio Frequency Regulation No. 4, Frequency Allocation Table
France	- allocation for broadcasting - analogue radio, DRM	No change is foreseen in the near future	The same also applies to the bands: 3950 – 4000 kHz 5950 – 6200 kHz 7200 – 7300 kHz 17550 – 17900 kHz
Germany	- allocation for broadcasting - analogue radio, DRM trials	No change is foreseen in the near future	The same also applies to the bands: 3950 – 4000 kHz 5950 – 6200 kHz* 7200 – 7300 kHz* 17550 – 17900 kHz* * DRM regular operations

Country	Current use	Future use	Remark
Hungary	- Primary allocation: Broadcasting, - Secondary allocation: Aeronautical Radio Navigation - Used for AM sound transmissions - 3 national MF analogue networks (13 transmitters) and one local MF transmitter in operation		The use of the band for digital radio broadcasting service is possible according to the National Radio Allocation Table (if demand, based on ITU Rules of Procedure Part A3)
Ireland	Broadcasting is allocated on a primary basis in the MF band for AM sound, however, there are no longer any permanent broadcast transmissions operating in this band in Ireland. A number of short term temporary broadcasts occur annually. Frequencies which have been used in the recent years are, 549 kHz, 1278 kHz and 1584 kHz each for roughly 30 days per year. Short range devices are also allocated for use in this band for inductive applications[11] and wireless applications in healthcare (315 - 600kHz) as per Tables 7 and 10 of ComReg Doc 02/71R4 respectively.	Up to two permanent AM sound transmissions are planned to come on air later this year. There are no specific plans for the future digital use of this band within Ireland at this time.	
Latvia	In the National Frequency Plan this frequency band is allocated to MW AM broadcasting. GE 75 plan contains 32 assignments to Latvian broadcasting stations on 11 frequencies. MF broadcasting was suspended before approx. 10 years and currently only one assignment is in use.	No definite plans for future use at this time. Future use based on DRM system could be reviewed at a later stage, provided receivers for future digital sound broadcasting systems become widely available.	
Lithuania	The frequency band is allocated on primarily basis to Broadcasting. 3 AM sound transmission stations are used. There is a secondary allocation to Short range devices: for inductive applications and Active Medical Implants and their associated peripherals (526.5 – 600 kHz) in accordance to ERC/REC 70-03.	There are no specific plans for the future usage.	
The Netherlands	- Broadcasting. Under specific conditions SRD for inductive systems on NIB-basis - In use (AM transmissions): - 2 frequencies for public broadcaster - 13 frequencies for commercial broadcasters	No plans available at this time.	DRM transmissions are already allowed, but until now not used.
Norway	- Broadcast - analogue AM sound broadcast transmitters, ITU GE 75 Plan (Vigra, 630 kHz; Røst, 675 kHz) - DRM license - 1314 kHz	- Broadcast - DRM (planned)	
Portugal	- Currently used by Sound Broadcasting Service (primary allocation); there are several transmitters (MW AM-radio), operating in accordance with GE-75; - SRD usage for inductive systems (148.5 kHz - 5 MHz), among others RFID (400-600 kHz), according to ERC/REC 70-03 (Annex 9); - SRD usage for wireless systems for medical applications (315-600 kHz), according to ERC/REC 70-03 (Annex 12).	No plans for changes at this time.	

[11] This category covers, for example, devices for car immobilisation, animal identification, alarm systems, cable detection, waste management, personal identification, wireless voice links, access control, proximity sensors, anti-theft systems including RF anti-theft induction systems, data transfer to handheld devices, automatic article identification, wireless control systems and automatic road tolling.

Country	Current use	Future use	Remark
Russian Federation	Analogue broadcasting	Digital broadcasting (DRM)	
Slovak Republic	- allocated for broadcasting services, fixed and mobile systems. - currently used by sound broadcasting service; two transmitters (Nitra, Košice) operating in accordance with GE75	There are no plans for future usage at this time	
Spain	MW AM broadcasting	At the moment the broadcasters can transmit on DRM using their analogue frequencies. There is not a specific plan by now, but it is expected in future.	DRM transmissions are already allowed, but only the National Public Broadcaster (RNE) has one transmitter in Arganda del Rey (6 kW, 1359 kHz)
Sweden	- Broadcasting - analogue radio (GE75) - One 600 KW transmitter in Sölvesborg, 1179 KHz - Radio transmitters for inductive transmission (license exempt)	At the moment there are no indications that the current situation is going to change in the near future	Soources: - the Swedish frequency plan - the Swedish licence register
Switzerland	- Primary allocation for broadcasting 531 kHz Beromünster. 765 kHz Sottens. 1485 kHz Savièse. 1566 kHz Sarnen. AM sound analogue: RIR0201-11	No major changes foreseen in use of these frequencies.	Short Range Devices: 315- 600 kHz: Wireless applications in healthcare: ULP-AID: RIR1006-03, 400 - 600 kHz: Inductive applications: RFID only: RIR1005-14, ERC/REC 70-03 148.5 kHz - 5 MHz: Wideband SRD, Annex 1
Ukraine	This band is used for analogue sound broadcasting in accordance with the Geneva-75 Agreement. In this band Ukraine has 139 frequency assignments in Geneva 75 Plan.	This band is planned for usage by digital terrestrial audio broadcasting of DRM standard.	
United Kingdom	- Primary allocation Broadcasting - Used for Broadcasting with a number of assignments in the GE75 Plan	There are no plans for future usage at this time	BBC World Service has transmissions audible in Western Europe on 648 kHz (analogue) and 1296 kHz (DRM) and also transmits analogue services from Cyprus on 639 kHz, 720 kHz and 1323 kHz

26 MHz HF band (25 670 kHz - 26 100 kHz)

Country	Current use	Future use	Remark
Austria	- allocated to broadcasting on a primary basis - currently no usage for broadcasting	There are no plans for future usage at this point in time.	From the current point of view there are no plans for the immediate change of usage in any of these listed frequency bands in Austria.
Belgium	- allocated to broadcasting on a primary basis - the band is in use by short range devices for inductive applications	Future use is under investigation.	
Croatia	- allocated to broadcasting on a primary basis - currently no usage for broadcasting	There are no plans for future usage at this point in time.	
Czech Republic	There is no utilization of the 26 MHz band in CZE at present	No official decision related to the future use of above mentioned frequency bands in CZE has been made so far, but there is no problem expected concerning utilization of these frequency bands and particular assignments in MF Band for digital audio broadcasting (DRM/DRM+).	CEPT harmonized approach is desired.
Estonia	- According to the Estonian Frequency Allocation Plan this frequency band is allocated for SW (11m) AM- radio. - No actual usage.	There are no specific plans for future usage at this point in time.	
Finland	- Primary allocation for Broadcasting (SW AM-radio). - Currently not used.	No plans for future use at this time.	This band is under review. Source: Radio Frequency Regulation No. 4, Frequency Allocation Table
France	- allocation for broadcasting - analogue radio, local radio, DRM trials	No change is foreseen in the near future	
Germany	- allocation for broadcasting - analogue radio, DRM trials	No change is foreseen in the near future	
Hungary	- Primary allocation broadcasting - No broadcast transmissions operating at this time		The use of the band for digital radio broadcasting service is possible according to the National Radio Allocation Table (if demand, based on ITU Rules of Procedure Part A3)
Ireland	Broadcasting is allocated on a primary basis in the 26MHz Band, however, there are no broadcast transmissions operating in this band in Ireland.	There are no specific plans for the future use of this band within Ireland at this time.	
Latvia	According to the National Frequency Plan this frequency band is allocated to sound broadcasting. Currently not used.	No definite plans for future use at this time. Future use based on DRM system could be reviewed at a later stage, provided receivers for future digital sound broadcasting systems become widely available	
Lithuania	The frequency band is allocated only to Broadcasting on primary basis. There are no current broadcast transmissions operating in this band.	There are no specific plans for the future usage.	
The Netherlands	- Broadcasting. Under specific conditions SRD for inductive systems on NIB-basis - Not in use	No plans available at this time.	DRM transmissions are already allowed

Country	Current use	Future use	Remark
Norway	- Broadcast - analogue AM sound broadcast transmitters	- Broadcast - To be determined	
Portugal	- Currently used by Sound Broadcasting Service (primary allocation); there are 3 radio stations (SW AM-radio), operating in accordance with RR Art. 12; - SRD usage for inductive systems (5-30 MHz), according to ERC/REC 70-03 (Annex 9).	No plans for changes at this time.	
Russian Federation	Analogue broadcasting	Digital broadcasting (DRM)	
Slovak Republic	- primary allocated for broadcasting services. - currently not used for broadcasting service.	There are no plans for future usage at this time	
Spain	- Broadcasting - Not used	There are no plans by now	
Sweden	- Broadcasting - analogue radio - Three 500 kW transmitters in Hörby, 5800-26100 kHz - Radio transmitters for level measurements in closed vessels or spaces (license exempt)	At the moment there are no indications that the current situation is going to change in the near future	Soources: - the Swedish frequency plan - the Swedish licence register
Switzerland	- primary allocation for broadcasting		Monitoring of PLC developments in order to prevent EMC problems is still necessary and ongoing. 5-30 MHz: Wideband SRD, Annex 1
Ukraine	This band is used for analogue sound broadcasting in accordance with the appropriate Seasonal schedule published by ITU pursuant to Article 12 of the Radio Regulations.	This band is planned for usage by digital terrestrial audio broadcasting of DRM standard.	
United Kingdom	- Primary allocation Broadcasting - Currently no usage for Broadcasting. Some trials have taken place in the past.	There are no plans for future usage at this time.	

VHF Band I (47 - 68 MHz)

Country	Current use	Future use	Remark
Austria	- co-primary allocation to broadcasting and land mobile service - currently no usage for broadcasting	There are ongoing discussions in Austria regarding the possible military usage or amateur radio usage of Band I, but there is no decision yet.	From the current point of view there are no plans for the immediate change of usage in any of these listed frequency bands in Austria.
Belgium	- allocated on a co-primary basis to broadcasting (analogue TV) and land mobile service - the band 50-52 MHz is also used by the amateur service on a secondary basis	Future use is under investigation	
Croatia	- 47-61 MHz primary allocation to land mobile service - 50-52 MHz secondary allocation for amateur service - 61-68 MHz co-primary basis to broadcasting and land mobile service; currently used for analogue television broadcasting	There are no plans for future usage at this point in time.	

Country	Current use	Future use	Remark
Czech Republic	- 41 transmitters in operation: PRAHA, 49.75 MHz (R1), 160 kW, commercial C.BUDEJOVICE, 59.25 MHz (R2), 100 kW, commerc. OSTRAVA, 49.75 MHz (R1), 100 kW, commercial plus 38 low power repeaters from 1 to 12 W ERP (commercial). - Band I is still used for analogue distribution of commercial program TV NOVA. The latest switch-off date is fixed to 30.06.2012.	No official decision related to the future use of above mentioned frequency bands in CZE has been made so far, but there is no problem expected concerning utilization of these frequency bands and particular assignments in MF Band for digital audio broadcasting (DRM/DRM+).	CEPT harmonized approach is desired.
Estonia	- According to the Estonian Frequency Allocation Plan this frequency band is allocated for TV-channels. - The actual usage is: R1 48.5-56.5 MHz, transmitter located in Kunda, R2 58–66 MHz, transmitter located in Tallinn/Kloostrimetsa and Narva. - Partly this band is used also by land mobile and radio amateur services.	Analogue television broadcasting transmission will be finished by 1st of July 2010 at the latest.	
Finland	- primary allocations for Broadcasting and Mobile services - secondary allocation for radio amateur service in the sub-band 50-52 MHz. - Television use has ended in Finland in this band. - Radio amateur usage according to Regulation Ficora 6. User certificate required. - The 67.500 MHz channel used for hobby and professional activities according to notification RHA68.		This band is under review. Source: Radio Frequency Regulation No. 4, Frequency Allocation Table
France	- defence systems - audio radio links - wind–profiling networks, secondary service (radars and radiometers to provide profiles of tropospheric variables continuously and automatically) - security devices for ground to train TV transmission (white spaces) - robotics (white spaces) - amateur radio (secondary service)	No change is foreseen in the near future.	
Germany	- assigned to Ministry of Defence - wind–profiling networks, secondary service (radars and radiometers to provide profiles of tropospheric variables continuously and automatically) - 50.08-51 MHz amateur radio, secondary service	No change is foreseen in the near future.	
Hungary	48.5-56.5 MHz and 58-66 MHz: - primary allocation for broadcasting - currently 3 operating analogue TV stations, expected to be switched off until 2012. 47-48.5 MHz: - primary allocation for military fix/mobile services (allocation for military fix services according to Article 11) 50-52 MHz: - secondary allocation for radio amateur service 60-66 MHz: - secondary allocation for military land mobile 66-68 MHz: - primary allocation for military land mobile	Band 48.5-68 MHz envisaged for military fix/mobile usage	

Country	Current use	Future use	Remark
Ireland	Broadcasting is allocated on a primary basis in Band I, however, there are no longer any broadcast transmissions operating in this band in Ireland. There are three secondary allocations on a national basis within this band, namely: • Short Range Devices (49.82-49.98MHz) are allocated on a secondary basis for "non specific" use as per ComReg Doc 02/71R4. • Radio Amateurs (50–52 MHz) are allocated on a secondary basis, details of the number of current users in this frequency block is not tracked at this time due to its secondary nature. • Radiolocation, specifically wind profiler radars as per ITU Resolution 217, is allocated for use in Ireland on a secondary basis in the frequency band 46–68 MHz, however currently there are no wind profiler radars operating in Ireland in this band.	There are no specific plans for the future use of this band within Ireland at this time.	
Latvia	- According to the National Frequency Plan this frequency band is allocated primarily to broadcasting: 48.5-66 MHz – BT; 66-68 – BS. The ST61 Plan contains 8 BT records and 8 BC records. - Currently 5 BT stations in operation. - Operation will be suspended. - Use of BC assignments is already suspended (transferred to Band II) - In accordance with the National Frequency Plan this band is used as well for secondary services: - Radio location (wind radars); - Radio amateur service; - Land mobile service. - The use for these services is not extensive.	Analogue television will be suspended by 1st of June 2010. No plans for future use taking into account suspending of BT and BC broadcasting have been developed up to now. Use by land mobile service mainly is expected. Future use for sound broadcasting based on DRM+ system could be reviewed at a later stage, provided receivers for future digital sound broadcasting systems become widely available	
Lithuania	The frequency band is allocated on primary basis to: - Broadcasting: 48.5-66 MHz to TV and 66-73 MHz to radio broadcasting. Currently 3 analogue TV stations and 5 radio stations are in operation. - Land mobile: 48.5-56.5 MHz. The band is used for defence systems. There are three secondary allocations: - Wind profiler radars (radiolocation) in 46 – 68 MHz. No information about the usage. - Radio Amateurs in 50–-52 MHz. - Fixed and land mobile in 47-48.5 MHz and 56.5-58 MHz. The band is used for defence systems.	There are no specific plans for the future usage.	
The Netherlands	47-50 MHz: Mobile communication. Video transfer at underground stations 50-52 MHz: - Mobile communication. Video transfer at underground stations - amateur (secondary service) 52 -61 MHz: - Mobile communication. Video transfer at underground stations 47-61 MHz: in use for Mobile communications (not for BC), assigned to Ministry of Defence 61-68 MHz: - Broadcasting (TV) - not in use	47- 61 MHz: No plans available at this time. 61-68 MHz: No plans available at this time, but Ministry of Defence is interested .	

Country	Current use	Future use	Remark
Norway	- Broadcast - Radiolocation - Amateur Radio (51-52 MHz)	- Military (suggested to be awarded to military use) - Broadcast (66-68 MHz suggested for DRM transmissions)	
Portugal	• Currently used by analogue television broadcasting service (primary allocation); there are 2 transmitters, operating in accordance with ST-61; • Currently not used by Radiolocation Service (secondary allocation, limited to wind profile radars); • Usage on a secondary basis for Amateur Radio Service in the 50-50.5 MHz sub-band, with a maximum permitted power of 25 e.m.r.p.; • Restricted sub-bands: 47.25-49.5 MHz; 50.5-51 MHz; 54-68 MHz.	This band is under review as a consequence of the analogue TV switch-off.	
Russian Federation	Analogue Broadcasting (TV, FM sound broadcasting)	Broadcasting (DTV, Digital sound broadcasting)	
Slovak Republic	- primary allocated for broadcasting services. - currently not used for broadcasting - the band 50-52 MHz is used by the amateur service n a secondary basis. - radiolocation. - fixed and land mobile (defence systems).	There are no plans for future usage at this time	
Spain	Broadcasting - Additional primary allocation for land mobile service - Additional secondary allocation for radiolocation service - 50-52 MHz amateur radio - 47-49 MHz Ministry of Defence	There are no plans by now.	
Sweden	- Broadcasting - TV - ST61, Wi95revCo07 - No services implemented - Amateur radio 50-52 MHz, 200 W (license exempt)	At the moment there are no indications that the current situation is going to change in the near future.	Sources: - the Swedish frequency plan - the Swedish licence register
Switzerland	47-50 MHz: - Land mobile primary 50-52 MHz: - Land mobile primary - Amateur secondary 52-68 MHz - Land mobile primary	The Stockholm 1961 Agreement remains in force and should be respected. Predominantly used by military (except 50-52 MHz). Wind profiler radars to have due regard to minimising interference to other services, dependent on the status of those services.	46-68 MHz Geographical sharing with wind profiler radars (RR 5.162A). UWB Applications, Annex 1
Ukraine	In Ukraine this band is divided into several sub-bands: - 48.5-65.9 MHz – this band is used by analogue video broadcasting in accordance with the Stockholm-61 Agreement. Ukraine has 159 frequency assignments in Stockholm-61 Plan. Assigning of frequencies to analogue broadcasting stations with radiated power more than or equal to 100 W is ceased from 1 January 2006 and with radiated power less than 100 W – from 1 January 2007 - 65.9-68.0 MHz – this band is used for analogue sound broadcasting in accordance with the Stockholm-61 Agreement. Ukraine has 32 frequency assignments in Stockholm-61 Plan.	Not decided yet	

Country	Current use	Future use	Remark
United Kingdom	- No allocation to Broadcasting 47 – 50 MHz: - Primary allocation to Land Mobile 50 – 51 MHz - Primary allocation to Amateur 51 – 68 MHz - Primary allocation to Land Mobile - Secondary allocation in the band 47 – 68 MHz to PMSE, wind profile radars and short term Ocean Surface Current Radars. Wind profilers are in use in this band in the UK	The band 55-68 MHz has been identified for award by Ofcom.	

APPENDIX TO ANNEX 10

ADDITIONAL INFORMATIONCONCERNING THE USE OF LF BANDS[12]

Part 1: European countries using the LW band for broadcasting

Country	Name of station	Frequency	Future use
Czech Republic	Topolna	270 kHz	No change is foreseen in the near future
France	Allouis	162 kHz	No change is foreseen in the near future (see Part 2 below)
France	Roumoules	216 kHz (Radio Monte Carlo)	No change is foreseen in the near future (see Part 2 below)
Germany	Sender Donebach	153 kHz	No change is foreseen in the near future
Germany	Zehlendorf	177 kHz	No change is foreseen in the near future
Germany	Saarlouis	183 kHz	No change is foreseen in the near future
Germany	Aholming	207 kHz	No change is foreseen in the near future
Ireland	Clarkstown	252 kHz	No change is foreseen in the near future
Luxembourg	Junglinster	234 kHz	No change is foreseen in the near future
Norway	Ingoy	153 kHz	No change is foreseen in the near future
Russian Federation	Several transmitters		Possibly for DRM
Ukraine	Brovary	171 and 207 kHz	Possibly for DRM
United Kingdom	Droitwich+Burghead+Westerglen (co-frequency network)	198 kHz	No change is foreseen in the near future (see Part 2 below)
Belarus	Sasvony	279 kHz	No information
Bulgaria	Sofia	261 kHz	No information
Iceland	Hellissandur	189 kHz	No information
Iceland	Eiðar	207 kHz	No information
Romania	Bod	153 kHz	No information
Poland	Warsaw, Solec Kujawski	198, 225 kHz	No information
Turkey	Agri, Ankara, Van, Erzurum	162, 180 kHz, 225, 243 kHz	No information

[12] This information has been supplied by the EBU.

Part2: Further information on the situation in the UK and in France (May 2010)

UK: Position of the BBC with regard to long wave

The BBC has made no decision to close down the Radio 4 long wave service at any point in the near future. Although the Digital Britain report sets out the case for a digital future for radio, we note that it doesn't explicitly require the closure of the BBC's long wave services. At the present time, we believe that there remains value to our audiences through the broadcast of Radio 4 on long wave and the cost of doing so remains acceptable to us. As part of any renewal of our transmission contracts, and following on from the market reviews anticipated by the Digital Britain report, we would expect to review this in the future to assess the continuing value for money.

In terms of the digital standards to which European countries may migrate the only firm decision at the moment is DAB, with the possibility of a future consideration of DRM.

Long Wave in France

TDF / France is operating one LW transmitter (162 kHz) located at Allouis (centre of France). The RF power is 2000 kW; the two solid-state transmitters have been renewed in 2000/2003. The antenna includes two vertical masts providing a directional diagram with a slight increase of radiated power in the southern direction. During daytime, the whole country is covered, as well as surrounding countries, such as parts of UK, Belgium, the Netherlands, parts of Germany, Switzerland. During night time, the coverage is significantly extended.

This LW station is used 24h/24 by Radio France, the national public broadcaster. Radio France applies the "France Inter" programme. This programme is the main national one, giving a large panel of news, sports, light and classical music, magazines...

There are several FM (analogue) networks operated by TDF for Radio France; one of them also offers "France Inter" programme. However, in the French territory, the coverage provided by the FM network is not as wide as the LW coverage.

According to the results of analysis, the remaining number of listeners in LW makes the LW operation useful and desirable. These listeners are currently living in parts of the countryside or mountains where FM coverage is not efficient with a portable receiver at ground level. It happens also that car drivers are interested in LW reception for France Inter because, once again, there are gaps of FM coverage along some roads or highways, despite the common usage of the "RDS system" by the FM network. That is why Radio France is still relying on the LW transmission.

Radio France is extending its offers on various vectors such as satellites, Internet, mobile telephone... but these offers reach a limited number of listeners. The possible usage of DRM in LW as well as in MW has been studied but no decision has been taken.

TDF, through its sister company "Monte Carlo Radio", is also operating one LW transmitter (216 kHz) located at Roumoules (South East of France). The RF power is 1400 kW; new solid-sate transmitters were installed in 1999. This station is used 20h/24 by Radio Monte Carlo (RMC), a commercial broadcaster.

There is one FM (analogue) network for Radio Monte Carlo, but the coverage provided by the FM network is not as wide as the LW coverage. That is why RMC, is still relying on the LW transmission.

It should be noted that Radio Luxembourg (RTL, 234 kHz) and Europe 1 (183 kHz) are also operating LW transmitters for their French speaking programmes beamed to France and neighbouring French speaking countries.

For information, it must be added that listeners in France who would like to receive an English-speaking programme have to tune in BBC on LW (198 kHz)
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To summarize, it appears that LW transmissions are made in parallel with FM and other means and there is no known plan to stop LW in the coming 5~8 years.