ECC Decision (19)02

Land mobile systems in the frequency ranges 68-87.5 MHz, 146-174 MHz, 406.1-410 MHz, 410-430 MHz, 440-450 MHz and 450-470 MHz

Approved 8 March 2019

EXPLANATORY MEMORANDUM

1 INTRODUCTION

This ECC Decision addresses the use of the bands 68-87.5 MHz, 146-174 MHz, 406.1-430 MHz and 440-470 MHz by land mobile systems.

The band planning and guidance for cross-border coordination for these frequency bands is set out in Recommendation T/R 25-08 [4]. In line with Recommendation T/R 25-08, this ECC Decision covers both duplex operation and single frequency operation.

Land mobile systems in these frequency bands are mainly, but not exclusively, used for PMR/PAMR (Private (Professional) Mobile Radio / Public Access Mobile Radio) applications. For the frequency ranges 410-430 MHz and 450-470 MHz, this ECC Decision also includes harmonised technical conditions to be applied for land mobile systems with channel bandwidth of 1.4 MHz, 3 MHz or 5 MHz.

2 BACKGROUND

ECC Report 283 [1] provides results of compatibility and sharing studies related to the introduction of broadband land mobile systems as well as systems based on NB-IoT and LPWAN technologies in the bands 410-430 MHz and 450-470 MHz. No conclusion on the intermodulation effect from broadband interferers into narrow band victims could be reached in ECC Report 283 and additional investigations will be conducted within ECC.

WG FM conducted a questionnaire to CEPT administrations and industry on 400 MHz PMR/PAMR frequencies [30], and the result of the survey is that digital technologies become dominant. Although analogue equipment will still be in use, the vast majority of the new delivered equipment will be digital across all market segments. This ECC Decision has been developed in order to provide confidence to industry and potential users that the necessary frequency spectrum to meet the requirements will be provided in CEPT countries in accordance with the market developments. The ECC Report 292 [34] contains information about the current use, future opportunities and guidance to administrations for the 400 MHz PMR/PAMR frequency ranges.

This new ECC Decision is considered to be technology neutral, and it contains also the applicable technical conditions to foster new M2M/IoT applications.

In line with the development of land mobile PMR/PAMR the need for high-speed data and other additional services increases. Already now, there is an expressed requirement for services that cannot be delivered over traditional narrowband technology. In response, industry has already developed a number of systems, including for example TETRA TEDS using 25 kHz, 50 kHz, 100 kHz and 150 kHz bandwidth, systems using 200 kHz channel bandwidth based on GSM technology, M2M/IoT based on NB-IoT and LPWAN (Low Power Wide Area Networks) technologies, CDMA-PAMR using 1.25 MHz channel bandwidth or LTE (Long-Term Evolution) based technologies using 200 kHz, 1.4 MHz, 3 MHz and 5 MHz channel bandwidth.

This ECC Decision covers the designation and the availability of frequency bands, which may not be available in all CEPT countries due to different national circumstances.

The current software controlled radio equipment technology offers the flexibility with regard to different frequency availability situations within the CEPT member countries, which facilitates European frequency planning. The free carriage and use of land mobile systems' equipment throughout Europe is also addressed under this ECC Decision, as well as regulated for EU Member states under the RE Directive [31].

The band 450-470 MHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT) (see Resolution 224 (Rev.WRC-15) [5]). This identification does not preclude the use of this band by any application of the services to which it is allocated and does not establish priority in the Radio Regulations.

3 REQUIREMENT FOR AN ECC DECISION

The allocation or designation of frequency bands for use by a land mobile service or system under specified conditions in CEPT may either be enforced by law, regulation or administration action. Whilst it is considered necessary to designate and implement frequency bands for land mobile systems for PMR/PAMR, only the availability of an appropriate amount of radio spectrum within the national frequency usage tables encourages manufacturers and operators to make the necessary investments in these radiocommunication technologies.

ECC DECISION OF 8 MARCH 2019 ON LAND MOBILE SYSTEMS IN THE FREQUENCY RANGES 68-87.5 MHZ, 146-174 MHZ, 406.1-410 MHZ, 410-430 MHZ, 440-450 MHZ AND 450-470 MHZ (ECC/DEC/(19)02)

"The European Conference of Postal and Telecommunications Administrations,

considering

a) that in the European Table of Frequency Allocations and Applications in the Frequency Range 8.3 kHz to 3000 GHz (ERC Report 25) [7] the band 150.05-153.00 MHz is allocated on a primary basis to both the mobile service (except aeronautical mobile service) and the radio astronomy service and the band 406.1-410 MHz is allocated on a primary basis to both the land mobile service and the radio astronomy service whereas footnote 5.149 of the Radio Regulations urges administrations to take all practicable steps to protect the radio astronomy service from harmful interference. Footnote 5.149 also applies to the band 73.0-74.6 MHz;

b) that the radio astronomy service in the frequency range 406.1-410 MHz, and radiolocation systems in the frequency range 420-430 MHz which are deployed and protected at a national level, may require protection zones in some countries, if the frequency range 410-430 MHz is used by broadband land mobile systems;

c) that footnote 5.286AA of the Radio Regulations, identifies the band 450-470 MHz for use by administrations wishing to implement International Mobile Telecommunications, with reference to Resolution 224 (Rev.WRC-15) [5];

d) that Recommendation ITU-R M.1036 [8] includes frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations;

e) that footnote 5.265 in the Radio Regulations and Resolution 205 (Rev. WRC-15) [9] requests administrations not to make new frequency assignments within the frequency band 406.1-406.2 MHz under the mobile and fixed services;

f) that other relevant footnotes of the Radio Regulations should also be taken into account when identifying spectrum for Land Mobile PMR/PAMR;

g) that parts of the bands identified in this Decision are allocated to radio services other than the land mobile service and the usage of these bands may be subject to agreements between neighbouring countries in accordance with the ITU Radio Regulations;

h) that ERC Recommendation T/R 25-08 (revised version of 2018) [4] provides recommended channelling arrangements including the duplex spacing;

i) that multilateral/bilateral agreements on frequency coordination in border areas can have an influence on the availability of radio spectrum;

j) that software controlled radio equipment offers flexibility with regard to different frequency availability situations within CEPT administrations;

k) that there is a growing demand for Machine-to-Machine (M2M) type and Internet of things (IoT) communications;

l) that according to footnote ECA34 of ERC Report 25 [7] parts of the bands 450-457.5/460-467.5 MHz may also be used for existing and evolving public cellular networks on a national basis;

m) that ETSI has published the Harmonised European Standards EN 300 086 [16], EN 300 113 [17], EN 300 219 [18], EN 300 296 [19], EN 300 341 [20], EN 300 390 [21], EN 301 166 [22], EN 302 561 [23] and EN 303 039 [24] for equipment used in the land mobile service;

n) that ETSI has published the Harmonised European Standard EN 301 908 [25] for IMT based networks above 450 MHz;

o) that frequency ranges 451-456 MHz / 461-466 MHz and 452.5-457.5 MHz / 462.5-467.5 MHz are listed as E-UTRA operating bands 72 and 31 in ETSI TS 136 104 [2] and ETSI TS 136 101 [3];

p) that ETSI has published TS 102 361 [26] on Digital Mobile Radio (DMR) Systems using TDMA, TS 102 658 [27] and TS 102 490 [28] on Digital Private Mobile Radio using FDMA, and TS 103 236 [29] for Continuous Tone Controlled Signalling System (CTCSS) and Digitally Coded Squelch Signalling (DCSS) systems;

q) that administrations may consider identification of a minimum required spectral efficiency to support the migration to digital, more spectrum efficient technology which will allow the creation of additional channel capacity within the same radio spectrum, and support more users. This also provides an opportunity to migrate radio systems and improve interoperability;

r) that based on available digital PMR/PAMR technologies and the national needs, the administration may impose a minimum required spectral efficiency;

s) that other relevant ECC Decisions should also be taken into account when identifying spectrum for Land Mobile PMR/PAMR;

t) that ECC Report 283 [1] contains compatibility and sharing studies related to the introduction of broadband and narrowband systems in the bands 410-430 MHz and 450-470 MHz;

u) that results of ECC Report 283 are based on deployment assumptions specific to PMR and PPDR networks;

v) that ECC Report 283 analyses the impact of the introduction of broadband systems of land mobile services in the band 410-430 MHz with a view to give protection to radiolocation and radio astronomy services;

w) that in Article 5 of the Radio Regulations (RR), the allocation in ITU Region 1 to the radiolocation service is secondary in the band 420-430 MHz and primary in the band 430-440 MHz. Therefore, the base station transmitting in the band 420-430 MHz operates under a co-channel basis with radars within this band whereas it operates under adjacent band basis when the radar operates above 430 MHz. Given the allocation in the RR, the protection of radiolocation systems is mandatory only for the band 430-440 MHz, although minimisation of interference within the band 420-430 MHz is also desirable;

x) that LTE channel arrangements could be entirely placed in the tuning range of 410-417.5/420-427.5 MHz applying a 100 kHz channel spacing. In addition, a 40 dB of out-of-band-emission (OOBE) reduction from the band 31 standard (e.g. by means of LTE BS duplexer filtering) may be needed to avoid desensitisation of radiolocation systems operated in 430-440 MHz;

y) that ECC Report 283 also includes some considerations which can be applied for the cross-border-coordination of stations of broadband land mobile services with stations of the radio astronomy service between two countries;

z) that Digital Land Mobile PMR/PAMR systems include digital paging systems such as Narrowband Point-to-Multipoint (NP2M) systems;

aa) that ECC Report 39 [10] describes the technical impact of introducing CDMA-PAMR on 12.5 /25 kHz PMR/PAMR technologies in the 410-430 MHz and 450-470 MHz bands and investigates adjacent band compatibility between CDMA-PAMR and narrowband PMR/PAMR in the 400 MHz bands;

bb) that CDMA-PAMR systems with channel bandwidth of 1.25 MHz have been introduced within the 410-430 MHz and 450-470 MHz bands and technical conditions in the Annexes 2 and 3 of this ECC Decision can still be applied;

cc) that ECC Report 99 [11] describes the impact of TETRA Enhanced Data Services (TEDS) on existing PMR/PAMR and Air Ground Air (AGA) systems in the 400 MHz band, and provides information on the impact of TEDS on existing PMR/PAMR systems in the frequency range 380-470 MHz and on military radio applications below 400 MHz;

dd) that the Recommendation T/R 25-08 does not contain anymore the bands 870-876MHz/ 915-921 MHz for PMR/PAMR band planning. CEPT administrations may still utilise the bands 873-876 MHz and 918-921 MHz (or parts of it) for GSM-R on a national basis;

ee) that in addition, as specified in Article 3 of [14], EU Member States shall refrain from introducing new uses in the 874.4-876 MHz and 919.4-921 MHz sub-bands until such time as harmonised conditions for their use are adopted under Decision 676/2002/EC [15];

ff) that the Recommendation T/R 25-08 provides guidance for cross-border coordination of land mobile systems for the 29.7-470 MHz band;

gg) that the ECC Report 292 [34] contains information about the current use, future opportunities and guidance to administrations for the 400 MHz PMR/PAMR frequency ranges;

hh) that PAMR operators aim to provide radio services to a large variety of closed user groups as opposed to land mobile networks that are available to all subscribers;

ii) that administrations have the right to exercise spectrum/frequency management which may affect the number of service suppliers, in conformity with their international trade obligations and to European Community legislation as far as EU Member States are concerned;

jj) that ECC Decision (16)02 [12] describes harmonised technical conditions and frequency bands for the implementation of Broadband Public Protection and Disaster Relief (BB-PPDR) systems, inter-alia in parts of the 400 MHz band;

kk) that ECC Decision (08)05 [6] describes the harmonisation of frequency bands for the implementation of digital Public Protection and Disaster Relief (PPDR) narrow band and wide band radio applications in bands within the 380-470 MHz range;

ll) that national licensing regimes should minimise the burden upon the administrations and users of equipment;

mm) that one of the policy goals of the CEPT Electronic Communications Committee is to provide for the free circulation and use of radio equipment within the CEPT member countries;

nn) that administrations should work towards the exemption of relevant radio equipment from individual licensing based on harmonised criteria detailed in ERC Recommendation 01-07 [13];

oo) that operating under the control of a network means that the terminal does not transmit before it has received a signal from a valid network with which it can communicate (the receive-before-transmit principle);

pp) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the RE Directive. Conformity with the essential requirements of the RE Directive [31] may be demonstrated by compliance with the applicable Harmonised European Standard(s) or by using the other conformity assessment procedures set out in the RE Directive.

DECIDES

1. that the **purpose of this ECC Decision** is to make available a sufficient amount of spectrum in response to market demand for land mobile systems within one or more of the following frequency ranges:

   – 68-87.5 MHz, 146-174 MHz; 406.1-410 MHz (see also considering e), 410-430 MHz, 440-450 MHz and 450-470 MHz;

2. that this Decision covers land mobile systems using different channel bandwidths and CEPT administrations **have the right to decide** which of the land mobile systems contained in the Annexes 1 to 4 to this Decision can be introduced in their national frequency allocation and utilisation plan(s);

3. that this ECC Decision is to provide CEPT administrations with the associated relevant Least Restrictive Technical Conditions (LRTC) for land mobile systems intended to ensure coexistence with other services;

4. that the technical requirements for land mobile systems with channel bandwidth of 6.25 kHz, 12.5 kHz and 25 kHz, 50 kHz, 100 kHz, 150 kHz and 200 kHz are those described in Annex 1. Note that these requirements can also be used for channel bandwidths between 6.25 kHz and 200 kHz;

5. that CEPT administrations wishing to introduce spectrum for land mobile systems with channel bandwidth of 1.25 MHz, 1.4 MHz, 3 MHz and 5 MHz in parts of the 400 MHz range shall apply technical conditions within the following paired frequency arrangements:

   a) 410-415 MHz (uplink) / 420-425 MHz (downlink) those specified in Annex 2;
   b) 411-416 MHz (uplink) / 421-426 MHz (downlink) those specified in Annex 2;
   c) 412-417 MHz (uplink) / 422-427 MHz (downlink) those specified in Annex 2;
   d) 451-456 MHz (uplink) / 461-466 MHz (downlink) those specified in Annex 3;
   e) 452.5-457.5 MHz (uplink) / 462.5-467.5 MHz (downlink) those specified in Annex 3;

6. that CEPT administrations wishing to introduce land mobile systems in the 410-430 MHz or 450-470 MHz frequency ranges based on NB-IoT and LPWAN technologies shall apply the technical requirements specified in Annex 4;

7. that CEPT **administrations shall**:

   – designate frequency bands (or individual frequencies) within the frequency ranges set out in *Decides 1* for the use of land mobile systems;

   – ensure co-existence between stations of the land mobile service, through cross-border coordination of base stations, taking into account the guidelines in Recommendation T/R 25-08 as well as Annex 5;

   – exempt from individual licensing and allow the free circulation and use of terminals of land mobile systems operating under the control of a network within the bands identified in *Decides* 1;

8. that this Decision replaces ECC Decision (04)06 [32] and ECC Decision (06)06 [33] which are withdrawn;

9. that this Decision **enters into force** on 8 March 2019;

10. that the preferred **date for implementation** of this Decision shall be 8 September 2019;

11. that CEPT administrations shall communicate the **national measures** implementing this Decision to the ECC Chairman and the Office when this ECC Decision is nationally implemented."

Note:

Please check the Office documentation database https://www.ecodocdb.dk for the up to date position on the implementation of this and other ECC Decisions.

ANNEX 1: TECHNICAL REQUIREMENTS FOR LAND MOBILE SYSTEMS WITH CHANNEL BANDWIDTH OF 6.25 KHZ, 12.5 KHZ AND 25 KHZ, 50 KHZ, 100 KHZ, 150 KHZ AND 200 KHZ

Note that these technical requirements can also be used by land mobile systems operating with channel bandwidth **between** 6.25 kHz and 200 kHz in the frequency bands 68-87.5 MHz, 146-174 MHz, 406.1-430 MHz and 440-470 MHz.

A1.1 ADJACENT AND ALTERNATE CHANNEL POWER

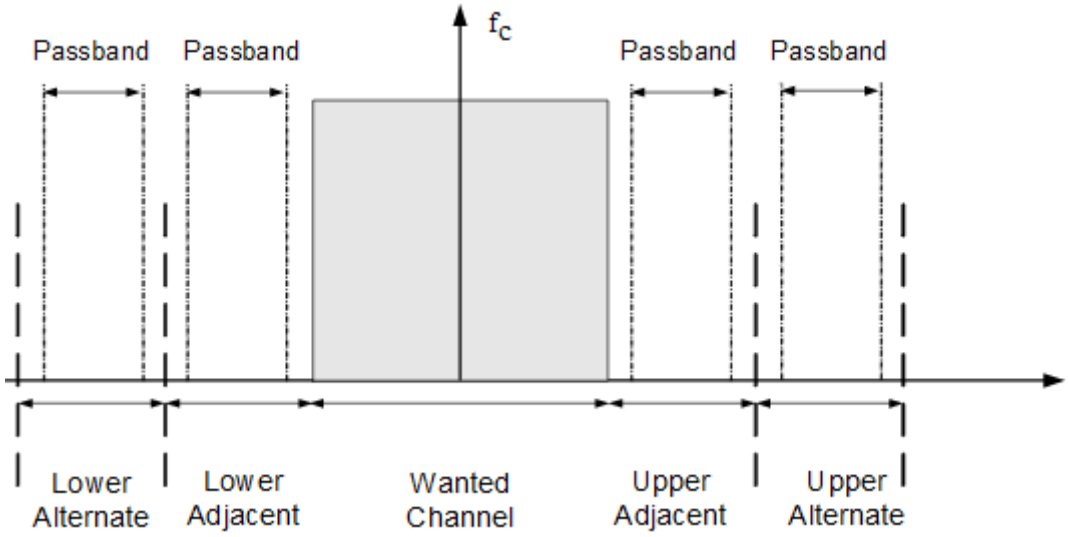

Figure 1: Wanted channel, adjacent and alternate adjacent channels

Within the wanted channel, the effective radiated power used shall comply with the authorisation conditions. Normal effective radiated power emissions within the wanted channel do normally not exceed 40 dBm for user equipment and 53 dBm for base station equipment.

A1.2 ADJACENT AND ALTERNATE ADJACENT CHANNEL POWER

The power in the lower and upper adjacent channels, as well as in the lower and upper alternate adjacent channels, shall not exceed a value of 60 dBc below the transmitter output power without the need to be below -36 dBm e.r.p.

These limits are valid for all base stations, user equipment and repeaters.

A1.3 UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

The unwanted emissions within the spurious domain during operation shall not exceed -36 dBm for frequencies up to 1 GHz and shall not exceed -30 dBm for frequencies above 1 GHz. In standby mode, the unwanted emissions shall not exceed -57 dBm for frequencies up to 1 GHz and shall not exceed -47 dBm for frequencies above 1 GHz.

A1.4 INTERMODULATION ATTENUATION

This requirement applies only to transmitters to be used in base stations or repeaters.

Intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the transmitter power and an interfering signal entering the transmitter via its antenna.

In general, the intermodulation attenuation ratio shall be at least 40 dB for any intermodulation component.

Note that national administrations may require a more stringent intermodulation attenuation requirement for base station equipment to be used in special service conditions, e.g. at sites where more than one transmitter will be in service, this is recommended to be at least 70 dB for any intermodulation component.

A1.5 ADJACENT CHANNEL TRANSIENT POWER

Transient power is the power falling into adjacent spectrum due to switching the transmitter on and off. The transient power in the adjacent channels (e.g. caused by push-to-talk functionality) shall not exceed -60 dBc in the adjacent channels, or -50 dBc for equipment, without the need to be below -36 dBm.

A1.6 RECEIVER REQUIREMENTS

A1.6.1 Adjacent channel selectivity

The adjacent channel selectivity is the measure of the capability of the receiver of the land mobile system to receive a wanted modulated signal at the nominal operating frequency without exceeding a given degradation due to the presence of another land mobile system in assumed 25 kHz channels adjacent to the channel bandwidth for which the equipment is intended. E.g. the centre of an adjacent channel relative to the centre of the nominal channel is at +/- 62.5 kHz for a land mobile system operating with a 100 kHz channel bandwidth.

Table 1: Adjacent channel selectivity

Channel bandwidth	Unwanted signal levels
Up to 200 kHz	-37 dBm

A1.6.2 Receiver blocking

Blocking is the measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted input signal at any frequencies outside of the wanted channel and the lower and upper adjacent and alternate adjacent channels (see A1.6.1 above).

The blocking level shall not be less than -27 dBm.

ANNEX 2: TECHNICAL REQUIREMENTS FOR LAND MOBILE SYSTEMS WITH CHANNEL BANDWIDTH OF 1.25 MHZ, 1.4 MHZ, 3 MHZ AND 5 MHZ (FOR 410-430 MHZ)

A2.1 INTRODUCTION

1.4 MHz, 3 MHz and 5 MHz LTE FDD channelling arrangements could be implemented in the paired frequency arrangements in 410.0-415.0 MHz / 420.0-425.0 MHz, 411.0-416.0 MHz / 421.0-426.0 MHz and 412.0-417.0 MHz / 422.0-427.0 MHz.

1.25 MHz CDMA channelling arrangements could be implemented within the paired frequency arrangements in 410.0-420.0 MHz / 420.0-430.0 MHz.

The technical requirements set out in this Annex are derived from ECC Report 283 [1].

A2.2 TRANSMITTER MASKS

A) Base station (BS) transmitter mask

Table 2: BS in-block e.i.r.p. (dBm/cell, 1.4 MHz, 3 MHz and 5 MHz channel width)

Parameter	Value (dBm/cell)
Maximum in-block e.i.r.p.	56 (optionally: no limit for macro cells)

Table 3: BS frequency range of out-of-block emissions (OOBE) (1.4 MHz, 3 MHz and 5 MHz channel width)

Channel width	Delta F_c (MHz) from centre frequency	Out-of-band emissions (transmitter output power)	Measurement bandwidth
1.4 MHz	0.7 to 2.1	-1 dBm -10/1.4 * (Delta F_c – 0.7) dB	100 kHz
	2.1 to 3.5	-11 dBm	100 kHz
	3.5 to 9.95	-16 dBm	100 kHz
3 MHz	1.5 to 4.5	-5 dBm -10/3* (Delta F_c – 1.5) dB	100 kHz
	4.5 to 7.5	-15 dBm	100 kHz
	7.5 to 9.995	-16 dBm	100 kHz
5 MHz	2.5 to 7.5	-7 dBm -7/5* (Delta F_c – 2.5) dB	100 kHz
	7.5 to 9.95	-14 dBm	100 kHz

Note 1: for the maximum mean out-of-block e.i.r.p. the antenna gain and cable losses of the land mobile system have to be considered.
Note 2: additional out-of-band emission reduction may be necessary for the protection of other land mobile systems in the adjacent bands (see ECC Report 283). For the protection of the uplink frequencies of land mobile systems within 410-420 MHz, a maximum mean out-of-block e.i.r.p. of -43 dBm/100 kHz may be needed.
Note 3: additional 40 dB of out-of-block emission reduction may be needed for the protection of radiolocation services)

Table 4: BS frequency range of out-of-block emissions (1.25 MHz channel width)

Frequency offset from centre frequency (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-17 dBm	30 kHz
±1.98-4	-22 dBm	30 kHz

B) User Equipment (UE)

Table 5: UE transmitter characteristics

Parameter	Value
Channel bandwidth	1.25, 1.4, 3 or 5 MHz
Maximum mean in-block power	23 dBm (Note)
Note: administrations may use higher UE maximum mean in-block power up to 31 dBm for special deployment scenarios provided that protection of other services, networks and applications is not compromised. Vice-versa, the maximum mean in-block power of UEs for the protection of other services may be limited on a cell-by-cell basis.	

Table 6: UE maximum unwanted emission levels (1.4 MHz, 3 MHz and 5 MHz channel width)

Frequency offset from channel edge (MHz)	Channel width			Measurement bandwidth
	1.4 MHz	3 MHz	5 MHz	
± 0-1	-10 dBm	-13 dBm	-15 dBm	30 kHz
± 1-2.5	-10 dBm	-10 dBm	-10 dBm	1 MHz
± 2.5-2.8	-25 dBm	-10 dBm	-10 dBm	1 MHz
± 2.8-5		-10 dBm	-10 dBm	1 MHz
± 5-6		-25 dBm	-13 dBm	1 MHz
± 6-10			-25 dBm	1 MHz

Table 7: UE maximum unwanted emission levels (1.25 MHz channel bandwidth)

Frequency offset from centre frequency (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-24 dBm	30 kHz
±1.98-4	-44 dBm	30 kHz

A2.3 UNWANTED EMISSIONS

A2.3.1 Unwanted emissions in the spurious Domain

The unwanted emissions within the spurious domain during operation shall not exceed -36 dBm for frequencies up to 1 GHz and shall not exceed -30 dBm for frequencies above 1 GHz. In standby mode, the unwanted emissions shall not exceed -57 dBm for frequencies up to 1 GHz and shall not exceed -47 dBm for frequencies above 1 GHz.

A2.3.2 Intermodulation Attenuation

This requirement applies only to transmitters to be used in base stations or repeaters.

Intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the transmitter power and an interfering signal entering the transmitter via its antenna.

In general the intermodulation attenuation ratio shall be at least 40 dB for any intermodulation component.

Note that national administrations may require a more stringent intermodulation attenuation requirement for base station equipment to be used in special service conditions, e.g. at sites where more than one transmitter will be in service, this is recommended to be at least 70 dB for any intermodulation component.

A2.3.3 Adjacent channel transient power

Transient power is the power falling into adjacent spectrum due to switching the transmitter on and off. The transient power in the adjacent channels (e.g. caused by push-to-talk functionality) shall not exceed -60 dBc in the adjacent channels, or -50 dBc for equipment, without the need to be below -36 dBm.

A2.4 RECEIVER REQUIREMENTS

The baseline performance for receiver blocking for 1.25 MHz systems is:

a) BS: -43dBm at 900 kHz offset from the centre frequency;

b) UE: -44.5dBm at 900 kHz offset from the centre frequency.

The baseline performance for receiver selectivity and blocking performance for 1.4 MHz, 3 MHz and 5 MHz systems applicable for the 410-430 MHz is identical to those specification set out in ETSI TS 136 104 [2] for the BS and ETSI TS 136 101 [3] for UE for the band 31 and 72.

ANNEX 3: TECHNICAL REQUIREMENTS FOR LAND MOBILE SYSTEMS WITH CHANNEL BANDWIDTH OF 1.25 MHZ, 1.4 MHZ, 3 MHZ AND 5 MHZ (450-470 MHZ RANGE)

1.4 MHz, 3 MHz and 5 MHz LTE FDD channelling arrangements could be implemented in the paired frequency arrangements in 451.0-456.0 MHz / 461.0-466.0 MHz and 452.5-457.5 MHz / 462.5.0-467.5 MHz.

1.25 MHz CDMA channelling arrangements could be implemented within the paired frequency arrangements in 450.0-460.0 MHz / 460.0-470.0 MHz.

The technical requirements set out in this Annex are derived from ECC Report 283 [1].

The risk of interference between land mobile systems with channel bandwidth of 1.25 MHz, 1.4 MHz, 3 MHz or 5 MHz operating within the band 450-470 MHz and DTT (Digital Terrestrial Television) above 470 MHz can be reduced by a set of technical measures including a guard band between DTT and land mobile system BSs and an appropriate limit of the corresponding land mobile system BS out-of-band emissions.

A3.1 TRANSMITTER MASKS

A) Base station (BS) transmitter mask

Table 8: BS in-block e.i.r.p. (dBm/cell, 1.4 MHz, 3 MHz and 5 MHz channel width)

Parameter	Value (dBm/cell)
Maximum in-block e.i.r.p.	56 (optionally: no limit for macro cells)

Table 9: BS frequency range of out-of-block emissions (OOBE) (1.4 MHz, 3 MHz and 5 MHz channel width)

Channel width	Delta F_c (MHz) from centre frequency	Out-of-band emissions (transmitter output power)	Measurement bandwidth
1.4 MHz	0.7 to 2.1	-1 dBm -10/1.4 * (Delta F_c – 0.7) dB	100 kHz
	2.1 to 3.5	-11 dBm	100 kHz
	3.5 to 9.95	-16 dBm	100 kHz
3 MHz	1.5 to 4.5	-5 dBm -10/3* (Delta F_c – 1.5) dB	100 kHz
	4.5 to 7.5	-15 dBm	100 kHz
	7.5 to 9.995	-16 dBm	100 kHz
5 MHz	2.5 to 7.5	-7 dBm -7/5* (Delta F_c – 2.5) dB	100 kHz
	7.5 to 9.95	-14 dBm	100 kHz

Note 1: for the maximum mean out-of-block e.i.r.p. the antenna gain and cable losses of the land mobile system have to be considered.

Note 2: additional out-of-band emission reduction may be necessary for the protection of other land mobile systems in the adjacent bands (see ECC Report 283). For the protection of the uplink frequencies of land mobile systems within 450-460 MHz, a maximum mean out-of-block e.i.r.p. of -43 dBm/100 kHz may be needed.

Note 3: The emissions limits for the protection of DTT above 470 MHz are defined in section A3.2

Table 10: BS frequency range of OOBE (1.25 MHz channel width)

Frequency offset from centre frequency (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-17 dBm	30 kHz
±1.98-4	-22 dBm	30 kHz

In addition to the BS mask in Tables 9 and 10, BS equipment operating in the 460-470 MHz band shall meet the unwanted emission levels specified in Table 15 for the protection of DTT.

B) User Equipment (UE)

Table 11: UE transmitter characteristics

Parameter	Value
Channel bandwidth	1.25, 1.4, 3 or 5 MHz
Maximum mean in-block power	23 dBm (Note)
Note: administrations may use higher UE maximum mean in-block power up to 31 dBm for special deployment scenarios provided that protection of other services, networks and applications is not compromised. Vice-versa, the maximum mean in-block power of UEs for the protection of other services may be limited on a cell-by-cell basis.	

Table 12: UE maximum unwanted emission levels (1.4 MHz, 3 MHz and 5 MHz channel width)

Frequency offset from channel edge (MHz)	Channel width			Measurement bandwidth
	1.4 MHz	3 MHz	5 MHz	
± 0-1	-10 dBm	-13 dBm	-15 dBm	30 kHz
± 1-2.5	-10 dBm	-10 dBm	-10 dBm	1 MHz
± 2.5-2.8	-25 dBm	-10 dBm	-10 dBm	1 MHz
± 2.8-5		-10 dBm	-10 dBm	1 MHz
± 5-6		-25 dBm	-13 dBm	1 MHz
± 6-10			-25 dBm	1 MHz

Table 13: UE maximum unwanted emission levels (1.25 MHz channel bandwidth)

Frequency offset from centre frequency (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-24 dBm	30 kHz
±1.98-4	-44 dBm	30 kHz

In addition to the UE masks in Tables 12 and 13, UE equipment operating in the 450-460 MHz band shall meet the unwanted emission levels specified in Table 14 for the protection of DTT.

A3.2 LEVELS FOR PROTECTION OF DTT ABOVE 470 MHZ

UE of land mobile system with channel bandwidth of 1.25 MHz, 1.4 MHz, 3 MHz or 5 MHz shall meet the OOBE levels specified in Table 14 for the protection of DTT.

Table 14: Land mobile system UE OOBE level for protection of DTT above 470 MHz

Frequency range	User equipment maximum mean OOBE	Measurement bandwidth
For DTT frequencies above 470 MHz where broadcasting is protected	- 42 dBm	8 MHz

BS of land mobile systems with channel bandwidth of 1.25 MHz, 1.4 MHz, 3 MHz or 5 MHz shall meet the OOBE e.i.r.p. levels specified in Table 15 for the protection of DTT above 470 MHz.

Table 15: Land mobile system BS OOBE levels for protection of DTT above 470 MHz

Frequency range	Condition on Base station in-block e.i.r.p. P (dBm/cell)	Maximum mean OOBE e.i.r.p (dBm/cell)	Measurement bandwidth
For DTT frequencies above 470 MHz where broadcasting is protected	P ≥ 60	-7	8 MHz
	P < 60	(P – 67)	8 MHz
For DTT frequencies above 470 MHz where broadcasting is subject to an intermediate level of protection or when mitigation techniques are used; at a national level depending on the type of mobile network deployment	P ≥ 56	-4	8 MHz
	P < 56	(P – 60)	8 MHz

A3.3 UNWANTED EMISSIONS

A3.3.1 Unwanted emissions in the spurious Domain

The unwanted emissions within the spurious domain during operation shall not exceed -36 dBm for frequencies up to 1 GHz and shall not exceed -30 dBm for frequencies above 1 GHz. In standby mode, the unwanted emissions shall not exceed -57 dBm for frequencies up to 1 GHz and shall not exceed -47 dBm for frequencies above 1 GHz.

A3.3.2 Intermodulation Attenuation

This requirement applies only to transmitters to be used in base stations or repeaters.

Intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the transmitter power and an interfering signal entering the transmitter via its antenna.

In general, the intermodulation attenuation ratio shall be at least 40 dB for any intermodulation component.

Note that national administrations may require a more stringent intermodulation attenuation requirement for base station equipment to be used in special service conditions, e.g. at sites where more than one transmitter will be in service, this is recommended to be at least 70 dB for any intermodulation component.

A3.3.3 Adjacent channel transient power

Transient power is the power falling into adjacent spectrum due to switching the transmitter on and off. The transient power in the adjacent channels (e.g. caused by push-to-talk functionality) shall not exceed -60 dBc in the adjacent channels, or -50 dBc for equipment, without the need to be below -36 dBm.

A3.4 RECEIVER REQUIREMENTS

The baseline performance for receiver blocking for 1.25 MHz systems is:

a) BS: -43dBm at 900 kHz offset from the centre frequency

b) UE: -44.5dBm at 900 kHz offset from the centre frequency

The baseline performance for receiver selectivity and blocking performance for 1.4 MHz, 3 MHz and 5 MHz systems is set out in ETSI TS 136 104 [2] for the BS and ETSI TS 136 101 [3] for UE.

ANNEX 4: DESCRIPTION AND TECHNICAL CONDITIONS FOR LAND MOBILE SYSTEMS BASED ON NB-IOT AND LPWAN TECHNOLOGIES IN THE 410-430 MHZ AND 450-470 MHZ FREQUENCY RANGES

The following technical conditions shall be applied as an essential component necessary to ensure coexistence between neighbouring networks. Operators may agree, on a bilateral or multilateral basis, different technical parameters providing that they continue to comply with the technical conditions applicable for the protection of other services, applications or networks and with their cross-border obligations.

The technical requirements set out in this Annex are derived from ECC Report 283 [1].

A4.1 LTE NB-IOT (INBAND)

In an inband deployment, the NB-IoT technology will use some of the resources of an existing wideband carrier. This corresponds to a change of transmission mode on some subcarriers of a wideband carrier. This is very similar to what happens when a specific modulation is selected by the BS to serve a specific terminal.

Embedding an NB-IoT in an LTE carrier does not change the power or the spectrum emission mask, either on the BS (base station) or the UE (user equipment) side. In particular, it is not possible to go closer to block edge than a current LTE UE could go.

A4.2 LTE NB-IOT (GUARDBAND)

A guard band NB-IoT deployment corresponds to the case where a narrowband transmission is added on the side of an existing wideband carrier. This is made possible by the fact that wideband transmission technologies typically transmit a signal narrower than the channel bandwidth, i.e. they implement implicit guard bands within their transmission channel. The IoT can leverage these implicit guard bands as operating spectrum. The limits in Tables 16 to 18 in section A4.3 apply for operation of a NB-IoT carrier adjacent to the BS radio frequency bandwidth edge.

A4.3 LTE NB-IOT (STANDALONE)

In a standalone deployment, the IoT carrier is deployed independently, in its own narrow band spectrum. This is exactly the same deployment mode as GSM.

Table 16: Transmission parameters

NB-IoT	Standalone
Channel bandwidth (BW) Channel	200 kHz
UE maximum e.i.r.p.	23 dBm

Table 17: Frequency offset for NB-IoT standalone operation

Lowest or Highest Carrier	Foffset
Standalone NB-IoT	200 kHz

Table 18: Standalone NB-IoT BS out-of-band emissions (OOBE)

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement (Notes 1 and 2) NB-IoT BS unwanted emission (transmitter output power)	Measurement bandwidth
0 MHz ≤ Δf < 0.05 MHz	0.015 MHz ≤ f_offset < 0.065 MHz	$Max(5dBm - 60 \cdot \left(\frac{f_{offset}}{MHz} - 0.015 \right) dB + XdB, -14dBm)$	30 kHz
0.05 MHz ≤ Δf < 0.15 MHz	0.065 MHz ≤ f_offset < 0.165 MHz	$Max(2dBm - 160 \cdot \left(\frac{f_{offset}}{MHz} - 0.065 \right) dB + XdB, -14dBm)$	30 kHz
0.15 MHz ≤ Δf < 0.2 MHz	0.165 MHz ≤ f_offset < 0.215 MHz	-14 dBm	30 kHz
0.2 MHz ≤ Δf < 1 MHz	0.215 MHz ≤ f_offset < 1.015 MHz	$-14dBm - 15 \cdot \left(\frac{f\_offset}{MHz} - 0.215 \right) dB$	30 kHz

NOTE 1: In case the carrier adjacent to the radio frequency bandwidth edge is a NB-IoT carrier, the value of X = PNB-IoT carrier – 43, where PNB-IoT carrier is the power level of the NB-IoT carrier adjacent to the RF bandwidth edge. In other cases, X = 0.

Note 2: for the maximum mean out-of-block e.i.r.p. the antenna gain and cable losses of the land mobile system have to be considered. Additional out-of-band emission reduction may be necessary for the protection of other land mobile systems in the adjacent bands (see ECC Report 283).

Band 31 and Band 72 have been specified in ETSI TS 136 104 [2] and ETSI TS 136 101 [3] also for use with NB-IoT carriers. The same technical baseline as well as receiver parameters can be assumed for operations inside the 410-430 MHz band.

ECC Report 283 assumed for the in band BS emissions a maximum of 54 dBm/200 kHz e.i.r.p.

A4.4 LPWAN

Table 19: LPWAN system parameters

LPWAN parameters	Baseline value
Channel bandwidth	125 kHz to 250 kHz
BS maximum e.i.r.p.	33.6 dBm
UE maximum e.i.r.p.	23 dBm

Table 20: LPWAN BS unwanted emissions (e.i.r.p.)

LPWAN BS frequency offset from centre frequency	BS unwanted emissions (e.i.r.p.)
at LPWAN channel edge	-55.4 dBm/1 kHz
at channel edge +/- 125 kHz	-65.4 dBm/1 kHz
at channel edge +/- 250 kHz	-62.4 dBm/100 kHz

Table 21: LPWAN UE unwanted emissions (e.i.r.p.)

LPWAN UE frequency offset from centre frequency	UE unwanted emissions (e.i.r.p.)
at LPWAN channel edge	-31 dBm/1 kHz
at channel edge +/- 125 kHz	-41 dBm/1 kHz
at channel edge +/- 250 kHz	-36 dBm/100 kHz

Table 22: LPWAN Receiver considerations

LPWAN Receiver parameter	Baseline
Receiver selectivity	The adjacent channel rejection at 200 kHz offset from centre frequency is -75 dBm, at 400 kHz is -62 dBm. If LTE is used in the adjacent spectrum, the BS receiver adjacent channel rejection is to be improved by 30 dB.
Receiver blocking	-55 dBm at 1 MHz offset from centre frequency -45 dBm at 2 MHz offset from centre frequency

Note: the precise parameters may depend on the spreading factor used in an LPWAN system.

A4.5 UNWANTED EMISSIONS

A4.5.1 Unwanted emissions in the spurious Domain

The unwanted emissions within the spurious domain during operation shall not exceed -36 dBm for frequencies up to 1 GHz and shall not exceed -30 dBm for frequencies above 1 GHz. In standby mode, the unwanted emissions shall not exceed -57 dBm for frequencies up to 1 GHz and shall not exceed -47 dBm for frequencies above 1 GHz.

A4.5.2 Intermodulation Attenuation

This requirement applies only to transmitters to be used in base stations or repeaters.

Intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the transmitter power and an interfering signal entering the transmitter via its antenna.

In general, the intermodulation attenuation ratio shall be at least 40 dB for any intermodulation component.

Note that national administrations may require a more stringent intermodulation attenuation requirement for base station equipment to be used in special service conditions, e.g. at sites where more than one transmitter will be in service, this is recommended to be at least 70 dB for any intermodulation component.

A4.5.3 Adjacent channel transient power

Transient power is the power falling into adjacent spectrum due to switching the transmitter on and off. The transient power in the adjacent channels shall not exceed -60 dBc in the adjacent channels, or -50 dBc for equipment, without the need to be below -36 dBm.

ANNEX 5: GUIDELINES FOR CEPT ADMINISTRATIONS TO ENSURE CO-EXISTENCE

The technical requirements set out in Annexes 1 to 4 alone may not guarantee interference-free adjacent spectrum use in all cases.

The impact of LTE-based systems in the 400 MHz frequency ranges on narrowband PMR, DTT above 470 MHz, on radars , on the radio astronomy, on the fixed service, on PMR links in audio-visual production, on paging and SRD systems is described in ECC Report 283 [1]. In this Report, the interference probability calculations have been performed for downlink capacity/traffic limited systems; results may differ for uplink capacity/traffic limited systems, which may tolerate a noise rise in UE receivers up to a level of the DL/UL imbalance.

One interference effect to be taken into account is the potential impact of Intermodulation Distortion in PMR receivers caused by neighbouring broadband signals. This is dependent on frequency offset of the LTE carrier from the victim PMR receiver, the received power and the intermodulation performance of the victim PMR receiver at that frequency offset. No conclusion on the intermodulation effect from broadband interferers into narrow band victims could be reached in ECC Report 283 and additional investigations will be conducted within ECC.

ECC Report 283 considers that compatibility between LTE systems in the 410-430 MHz band and the Radio astronomy service below 410 MHz is possible provided that minimum frequency separation and separation distances are implemented.

LPWAN:

ECC Report 283 considered a guard-band of 200 kHz between the TETRA base station (BS) and the LPWAN end device. This guard band is needed to minimise the interference from TETRA BS transmitter to LPWAN end device receiver.

ECC Report 283 considered the compatibility between a LPWAN system and airborne radars in the 410-430 MHz range is possible with a minimum guard band of 0.5 MHz from operating frequency edges.

ECC Report 283 considers the compatibility between LPWAN system in the band 410-430 MHz and the radio astronomy service below 410 MHz is possible under the condition of minimum frequency separation and separation distances are implemented.

LPWAN gateways (base stations) can operate with duty cycle limitations, if needed for compatibility reasons with adjacent services.

ECC Report 283 identified, based on measurements that compatibility with adjacent LTE is ensured with an improvement of the LPWAN receiver adjacent channel selectivity by 30 dB.

ANNEX 6: LIST OF REFERENCE

This annex contains the list of relevant reference documents.

[1] ECC Report 283: “Compatibility and sharing studies related to the introduction of broadband and narrowband systems in the bands 410-430 MHz and 450-470 MHz”
[2] ETSI TS 136 104: “LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception”
[3] ETSI TS 136 101: “LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception”
[4] Recommendation T/R 25-08: “Planning criteria and cross-border coordination of frequencies for land mobile systems in the range 29.7-470 MHz” (version from 2018)
[5] Resolution 224 (Rev.WRC-15): “Frequency bands for the terrestrial component of International Mobile Telecommunications below 1 GHz”
[6] ECC Decision (08)05: “The harmonisation of frequency bands for the implementation of digital Public Protection and Disaster Relief (PPDR) narrow band and wide band radio applications in bands within the 380-470 MHz range”
[7] ERC Report 25: “The European table of frequency allocations and applications in the frequency range 8.3 kHz to 3000 GHz”
[8] Recommendation ITU-R M.1036: “Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications (IMT) in the bands identified for IMT in the Radio Regulations”
[9] Resolution 205 (Rev. WRC-15): “Protection of the systems operating in the mobile-satellite service in the frequency band 406-406.1 MHz”
[10] ECC Report 39: “The technical impact of introducing CDMA-PAMR on 12.5 / 25 kHz PMR/PAMR technologies in the 410-430 and 450-470 MHz bands”
[11] ECC Report 99: “TETRA Enhanced Data Services (TEDS): Impact on existing PMR/PAMR and Air Ground Air (AGA) systems in the 400 MHz band”
[12] ECC Decision (16)02: “Harmonised technical conditions and frequency bands for the implementation of Broadband Public Protection and Disaster Relief (BB-PPDR) systems”
[13] ERC Recommendation 01-07: “Harmonised regime for exemption from individual licensing for the use of radio spectrum”
[14] Commission Implementing Decision on the harmonisation of radio spectrum for use by short range devices within the 874-876 and 915-921 MHz frequency bands
[15] Decision 676/2002/EC: Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision)
[16] ETSI EN 300 086: “Land Mobile Service; Radio equipment with an internal or external RF connector intended primarily for analogue speech”
[17] ETSI EN 300 113: “Land Mobile Service; Radio equipment intended for the transmission of data (and/or speech) using constant or non-constant envelope modulation and having an antenna connector”
[18] ETSI EN 300 219: “Land Mobile Service; Radio equipment transmitting signals to initiate a specific response in the receiver”
[19] ETSI EN 300 296: “Land Mobile Service; Radio equipment using integral antennas intended primarily for analogue speech”
[20] ETSI EN 300 341: “Land Mobile Service; Radio equipment using an integral antenna transmitting signals to initiate a specific response in the receiver”
[21] ETSI EN 300 390: “Land Mobile Service; Radio equipment intended for the transmission of data (and speech) and using an integral antenna”
[22] ETSI EN 301 166: “Land Mobile Service; Radio equipment for analogue and/or digital communication (speech and/or data) and operating on narrow band channels and having an antenna connector”
[23] ETSI EN 302 561: “Land Mobile Service; Radio equipment using constant or non-constant envelope modulation operating in a channel bandwidth of 25 kHz, 50 kHz, 100 kHz or 150 kHz”
[24] ETSI EN 303 039: “Land Mobile Service; Multichannel transmitter specification for the PMR Service”
[25] ETSI EN 301 908 series for IMT cellular networks
[26] ETSI TS 102 361 series for Digital Mobile Radio (DMR) Systems
[27] ETSI TS 102 658: “Digital Private Mobile Radio using FDMA with a channel spacing of 6.25kHz”
[28] ETSI TS 102 490: “Peer-to-Peer Digital Private Mobile Radio using FDMA with a channel spacing of 6.25 kHz with e.r.p. of up to 500 mW”

[29] ETSI TS 103 236: “Continuous Tone Controlled Signalling System (CTCSS) and Digitally Coded Squelch Signalling (DCSS) systems”
[30] FM54(14)18: “WGFM Questionnaire to CEPT administrations and industry on 400 MHz PMR/PAMR frequencies”
[31] The Radio Equipment Directive (RED) 2014/53/EU: OJ L153 22 May 2014 replaces the Radio & Telecommunication Terminal Equipment Directive (R&TTE Directive) 1999/5/EC, repealed with effect from 13 June 2016
[32] ECC Decision (04)06: “The availability of frequency bands for the introduction of Wide Band Digital Land Mobile PMR/PAMR in the 400 MHz” (withdrawn)
[33] ECC Decision (06)06: “The availability of frequency bands for the introduction of Narrow Band Digital Land Mobile PMR/PAMR in the 80 MHz, 160 MHz and 400 MHz bands” (withdrawn)
[34] ECC Report 292: “Current Use, Future Opportunities and Guidance to Administrations for the 400 MHz PMR/PAMR frequencies”