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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Introduction

ETSI ERM at its 21st meeting in October 2003 had approved a new work item proposal by ERM TG28 for an ETSI Technical Report on the conditions under which new technologies applications could be introduced to SRDs, i.e.the introduction of new techniques and protocols such as dynamic frequency agility, "Listen-Before-Talk" (LBT), dynamic duty cycle, etc., into the new extended 863 MHz to 870 MHz band and to run the new techniques in parallel with existing duty-cycle limited simplex systems.

The ETSI work is made in parallel with an EEC study on compatibility between existing and new proposed systems as the present ERC Recommendation 70-03 [2] does for example not allow spread spectrum technologies in the existing 868 MHz to 870 MHz band.

The result of the ECC study is given in ECC Report 37 [4], which showed that most of the ETSI proposed new systems and technologies can be allowed under the condition of a mandatory use of a LBT access protocol. Without the LBT protocol spread spectrum and other technologies can only be allowed if the transmitter duty cycle restriction is 0,1 % or less.

The present document shows the result of the ETSI study on implementation of LBT technologies with a view to incorporating them into future revisions of EN 300 220 [3] and potentially other standards for Short Range Devices (SRD).

1 Scope

The present document aims at providing an overview of the applicability of the Adaptive Frequency Agile (AFA) and Listen Before Transmit (LBT) techniques for use in Short Range Devices (SRD). LBT can be used separately or the two techniques may be used together.

The use of LBT and AFA are primarily intended as an enhancement for devices employed in the 863 to 870 MHz band and to improve the efficient use of the allocated radio spectrum.
Equipment with LBT is not restricted to a duty cycle limitation. If LBT is not used a duty cycle shall be applied as specified in ERC Recommendation 70-03 [2] Annex 1 according to ECC Report 37 [4].

The principle may be considered for use in other bands designated for Short Range Devices (SRD).

The present document supports the recommendations given in ECC Report 37 [4].

2 References

For the purposes of this Technical Report (TR), the following references apply:

[1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications equipment and the mutual recognition of their conformity.

[2] ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

[3] ETSI EN 300 220 (all parts):"Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW".

[4] ECC Report 37: "Compatibility of planned SRD applications with currently existing radiocommunication applications in the frequency band 863-870 MHz".

[5] ERC/DEC(01)04 of 12 March 2001 on harmonised frequencies, technical characteristics and exemption from individual licensing of Non-specific Short Range Devices operating in the frequency bands 868.0 - 868.6 MHz, 868.7 - 869.2 MHz, 869.4 - 869.65 MHz, 869.7 - 870.0 MHz.

[6] ERC/DEC(01)09 of 12 March 2001 on harmonised frequencies, technical characteristics and exemption from individual licensing of Short Range Devices used for Alarms operating in the frequency bands 868.60 - 868.7 MHz, 869.25 - 869.3 MHz, 869.65 - 869.7 MHz.

[7] ERC/DEC(01)18 of 12 March 2001 on harmonised frequencies, technical characteristics and exemption from individual licensing of Short Range Devices used for Wireless Audio Applications operating in the frequency band 863 - 865 MHz.

[8] ERC/DEC(97)06 of 30 June 1997 on the harmonised frequency band to be designated for Social Alarm Systems.

[9] ETSI EN 300 440: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 1 GHz to 40 GHz frequency range".

[10] ETSI EN 300 328: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive".

[11] ECC Report 11: "Strategic plans for the future use of the frequency bands 862-870 MHz and 2400-2483.5 MHz for Short Range Devices".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

duty cycle: ratio, expressed as a percentage, of the maximum total transmitter "on" time, relative to a one hour period

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AFA	Adaptive Frequency Agile
DSSS	Direct sequence spread spectrum
e.r.p	effective radiated power
ECC	Electronic Communications Committee
ERC	European Radiocommunications Committee
FHSS	Frequency hopping spread spectrum
LBT	Listen-Before-Transmit
OFDM	Orthogonal Frequency Division Multiplexing
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RSSI	Receiver Signal Strength Indicator
SRD	Short Range Device(s)
TX	Transmitter

4 Technical proposal

4.1 Frequency agile techniques

In this clause a generic scheme for Listen-Before-Transmit (LBT) is described in order to permit a dynamic channel allocation in the frequency band from 863 MHz to 870 MHz.

A listen-mode is understood to be the action taken by a device to detect an unoccupied sub-band or channel prior to transmitting. Listen-Before-Transmit then becomes the combination of listen modes followed by the transmit modes.

Frequency agility can be defined as the ability to select an unoccupied channel for operation in order to avoid other users within the same band and hence minimize interference.

A scheme relying on a central controller is not feasible for SRDs covering different systems in a given area. The scheme described is not the only way in which a dynamic channel allocation might be achieved.

The proposed scheme here is intended to be suitable for all applications and caters for a wide range of user requirements, which include:

- Receiver wake up , establish communication, send a short message and stand down. For battery-operated equipment the time spent establishing the link is important.
- To set up a link in order to transfer large amounts of data. This might take the form of long packets with short return acknowledgements.
- To rapidly switch between transmit and receive, sending short bursts in each direction in order to simulate a full duplex data link.
- To organize multiple nodes with a network.

The guiding design principles for such a scheme are:

1) Each device must check for channel occupancy before using a channel. The device must listen on the channel that it intends to transmit on.

2) If the channel is occupied then the device must either wait until the channel is free or look for another channel. Having chosen a free channel the device should not change channels unless contention is detected.

3) Having chosen a free channel the device may use it as long as it is consistent with the regulations.

4) Periodic checks for contention must also be made while using the channel.

5) LBT rules, as described below, must also be made while using the channel.

A secondary aim is to manage the situation when the band is heavily congested. In this case it is desirable that users experience gradual degradation in the quality of service rather than sudden death, and that the spectrum resources are shared in an equitable manner.

The means by which transmitters and receivers synchronize themselves is left to manufacturers.

4.1.1 Proposed channelization

For the band 863 MHz to 870 MHz, three channel bandwidths are proposed, 25 kHz, 50 kHz and 100 kHz. Each has advantages and disadvantages, however, it is recommended that the narrowest channel bandwidth is used in order to maximize the number of users within the available frequency band.

With narrow channel bandwidths, low data rates are obtainable which may result in longer overall transmission times, however, more channels are available.

The proposed channel schemes for 863 MHz to 870 MHz are given below. For other SRD bands different channel schemes may be used.

a) For an equipment with 25 kHz channel spacing the channel raster is the following:
f_0 = 863 MHz + (0,025 × (2N + 1)/2) where N is the channel number between 0 and 279.

b) For an equipment with 50 kHz channel spacing the channel raster is the following:
f_0 = 863 MHz + (0,05 × (2N + 1)/2) where N is the channel number between 0 and 139.

c) For an equipment with 100 kHz channel spacing the channel raster is the following:
f_0 = 863 MHz + (0,1 × (2N + 1)/2) where N is the channel number between 0 and 69.

The preferred channel bandwidth for high data rate systems as proposed by the industry is 100 kHz. Therefore, there are up to 70 channels of this bandwidth in the frequency range from 863 MHz to 870 MHz. Of these channels, 2 times 25 kHz channels in the sub-band from 869,200 MHz to 869,250 MHz are designated for social alarms applications per ERC/DEC(97)06 [8].

Devices fitted with LBT may make use of all the available channels. Devices without LBT may only use channels within the band 868 MHz to 870 MHz, subject to appropriate regulation ERC Recommendation 70-03 [2].

The algorithms used to seek a clear channel and the means by which transmitters and receivers co-ordinate themselves are left to manufacturers.

4.1.1.1 Congested channels

The intention is to avoid congested channels to the maximum extend. In this case it is considered preferable and more equitable that each device receives a lower quality of service than that some devices are locked out. A lower quality of service may mean a lower data rate or a longer wait to get access to a channel.

The scheme described here provides ways in which such gradual degradation can be achieved: This includes narrowing of channels, turnover of users, and time multiplexing in a channel.

4.1.1.2 Narrowing of channels

Some devices will be able to operate in channels of less than the proposed maximum of 100 kHz. If a device must listen for contention in the same channel bandwidth that it uses to transmit, then there are benefits to the device in choosing a narrower one. These benefits will be an improved link budget and greater probability of finding a free channel. This is further enhanced by setting the listening threshold field strength almost constant regardless of channel bandwidth.

Equipment of different channel bandwidths can co-exist and can self organize themselves across the band. Manufacturers are encouraged to use the smallest channel bandwidths possible when considering an application.

4.1.1.3 Turnover of users

The aims of the present document is to improve sharing of the available spectrum. However, high duty cycle equipment ideally want a clear channel to themselves. Therefore, in a congested band with users coming and going it is simply a matter of waiting for a free channel. If, however, all channels are occupied and there is not a natural turnover of users, then the parameters above provide a way for a new device to cut in after a given maximum transmit time. If the previous device cannot find a new channel then the proposed arrangement would permit the channel to alternate between the two or more users at a relatively low switching rate.

4.1.1.4 Time multiplexing

Low duty cycle users are best served by rapid time switching in a small number of channels. Listen-Before-Transmit requirement and a maximum transmission length limit are already part of the present document. If overall duty cycle limits are imposed, then devices will be unlikely to use the maximum transmission time. In that case a more rapid time multiplexing of a single channel becomes possible on a point to point basis.

4.2 LBT principle

The basic principle for LBT is that equipment can transmit at any time if the channel is free. If the channel is busy the equipment is prevented from transmitting until the channel is free or the frequency is changed to a free channel.

An equipment with LBT functionality will be allowed to operate over the entire 863 MHz to 870 MHz band excluding the frequency range for social alarms. According to ECC Report 37 [4] it is assumed that equipment shall be compatible with the existing SRDs without LBT operating in 863 MHz to 865 MHz and 868 MHz to 870 MHz bands as regulated by Annex 1, Annex 7 (alarms, in general), Annex 10 and Annex 13 (audio applications) of ERC Recommendation 70-03 [2].

However, there must be some rules on how LBT shall work and there is a need for control of the equipment timing for various events. A proper LBT function is also fully dependent on certain receiver performance parameters.

A Listen-Before-Transmit (LBT) protocol is characterized by the following parameters:

- minimum transmitter off-time;
- minimum receiver listen -time;
- maximum transmitter on-time for a single transmit;
- maximum transmitter on-time for acknowledge transmissions;
- frequency agility with random frequency selection.

A receiver with high blocking performance is necessary to ensure that the receiver can listen effectively to a channel during high power transmissions at adjacent bands.

For spread spectrum LBT may also be applied. It shall be noted that:

- FHSS applications using LBT restrict the minimum dwell time.
- According to ECC Report 37 [4], FHSS applications in the band 863 MHz to 870 MHz shall consider a certain minimum number of hop channels to be compatible with existing applications.
- DSSS and Fast Hopping FHSS with LBT are very difficult to implement. In this case a low duty cycle applies (i.e. 0,1 % or 1 %) according to ECC Report 37 [4].

The transmitter on/off slew rate needs to be restricted due to the expected fast transmit/receive switching time by means of a spectrum mask.

4.2.1 Minimum transmitter off-time

The minimum TX off-time allows other users without LBT facility to get access to a channel.

4.2.1.1 Definition

TX-off is the minimum time the transmitter shall remain off following a transmission, a communication dialogue between units or a polling sequence of other units.

4.2.1.2 Proposed limit

The limit for TX-off is > 100 ms.

4.2.2 Minimum listening time

4.2.2.1 Definition

The minimum listening time is defined as the minimum time that the device listens in receiving mode after it has decided to transmit in order to determine whether the channel is available for use. The device must listen to the intended channel, for at least the specified minimum period, immediately prior to transmission. The listening time shall consist of the "minimum fixed listening time" and an additional pseudo random part. If during the listening mode another user is detected then the device must not transmit before the channel is determined to be free again. Alternatively, the equipment can select another channel and start the listen time before transmission.

4.2.2.2 Limit before first initial transmission

The total listen time, t_L, consists of a fixed part, t_F, and a pseudo random part, t_{PS}, as the following:

$$t_L = t_F + t_{PS}$$

a) The fixed part of the minimum listening time, t_F , shall not be less than 5 ms.

b) The pseudo random listening time shall be randomly varied between 0 ms and 5 ms as the following:

- If the channel is free at the start of the listen time, $t_{L,}$ then the pseudo random part, $t_{PS,}$ is automatically set to zero by the equipment itself.
- If the channel is busy at the start of the listen time, t_L, then pseudo random part, t_{PS} , should be randomly varied in 0,5 ms steps between 0 ms and 5 ms.

The limit for total listen time for the receiver consists of the sum of a) and b) together.

4.2.2.3 Acknowledge transmission

There is no requirement for a listen time according to clause 4.2.2.2 before an acknowledge can be performed. However, it shall be noted that if the start of an acknowledge is not received before the end of normal fixed part of the listen time (5 ms) then the channel might be taken by an other transmitter.

4.2.3 Maximum transmitter on-time

A transmitter shall only be allowed to transmit continuously for a maximum specified period. This will prevent a transmitter from occupying a channel for an extended period.
The maximum on-time shall always be as short as possible for the application. However, SRD applications are often battery operated. To ensure long battery life the equipment will frequently operate at a very low power supply duty cycle and therefore each receiver activation will be limited. Therefore, the maximum transmitter on-time must be longer than the receiver battery supply off-time.

4.2.3.1 Definition

The maximum transmitter on-time is defined as the maximum time the transmitter can be on during:

a) A single transmission.

b) Multiple transmissions and acknowledgements for a communication dialogue or polling sequence of other units under the condition that the channel is free.

An equipment intended for very long messages must be capable of switching to a "free" channel before the maximum transmitter on-time is reached for each channel of operation.

4.2.3.2 Proposed Limit

The limit for a single transmission TX on-time is < 1 s.

The limit for a transmission dialogue or a polling sequence is < 4 s.

4.3 Frequency agility

4.3.1 Definition

Frequency agility is the ability to determine an unoccupied sub-band or channel of operation in order to minimize interference with other users of the same band.

The intention of the random frequency selection is to provide an aggregate uniform loading across the spectrum. This requires that the device shall select an operating channel out of a minimum of 2 channels from those listed in clause 4.1.1, so that the probability of selecting a given channel shall be the same for all channels.

The probability of selecting each channel for "n" channels is 1/n. The probability of selecting a given channel shall be the same for all channels.

For FHSS: The probability of selecting a given channel shall be the same for all channels.

All frequencies designated within 863 MHz to 870 MHz as described in the ECC Report 11 [11] can be used with the exception of those for social alarms as specified in ERC Recommendation 70-03 [2].

4.3.2 Proposed limit

It shall be noted that any change of frequency including FHSS frequency hopping shall not be made in the transmit mode.

4.4 Receiver parameters

4.4.1 Receiver threshold

4.4.1.1 Definition

The receiver threshold in the listening mode, is defined as the minimum level of an un-modulated carrier that can be detected.

The receiver threshold is indirectly an essential requirement to fulfil the R&TTE Directive [1] as the transmit function is directly dependent on the ability of the equipment to detect if a channel is free.

It is assumed that the receiver threshold will use an Receiver Signal Strength Indicator (RSSI).

4.4.1.2 Proposed limit

There is no need to define a minimum receiver sensitivity, only a receiver LBT threshold level to make a decision whether a channel is occupied or not. The threshold is a function of:

- receiver bandwidth;
- environmental noise in band (industrial areas 5 dB to 10 dB).

The present document suggests setting the LBT threshold to +6 dB above the typical sensitivity level to avoid equipment detecting noise in the band as a channel busy signal. The proposed thresholds are given in table 1.

Table 1: Receiver threshold

Receiver bandwidth	Receiver threshold dBm e.r.p.
25 kHz	-102
50 kHz	-99
100 kHz	-96

4.4.2 Receiver blocking

4.4.2.1 Definition

Blocking or desensitisation in the listen mode, is a measure of the capability of the receiver to detect satisfactorily, a transmission from another user on the wanted sub-band, while rejecting an unwanted signal at frequencies other than those of the spurious responses, or the adjacent sub-bands or bands.

The parameter is an essential requirement to fulfil the R&TTE Directive [1] as the transmit function is directly dependent on the ability of the equipment to detect if a channel is free. Blocking is defined by EN 300 220-1 [3] at a frequency offset equal to or greater than 1 MHz. The present document suggests that blocking level is measured at a wanted signal sensitivity +10 dB.

4.4.2.2 Proposed Limit

It is proposed that an absolute level of -35 dBm e.r.p for the blocking limit is sufficient.

4.4.3 Receiver selectivity

Receiver selectivity was investigated to determine whether or not it was an essential requirement according to the R&TTE Directive [1]. However, by measurements it is found that receiver selectivity is not a real requirement. If the selectivity is low, then the receiver RSSI will detect the signal from an adjacent channel and thereby determine that the channel is busy. This fact will then prevent the equipment from transmitting.

4.5 FHSS with LBT

The limits for FHSS given by ECC Report 37 [4] are shown in table 2.

Table 2: FHSS with LBT

Parameter/sub-band	865 MHz to 868 MHz	865 MHz to 870 MHz	863 MHz to 870 MHz
Max. radiated power	25 mW e.r.p.	25 mW e.r.p.	25 mW e.r.p.
Max. channel bandwidth	50 kHz	100 kHz	100 kHz
Min. number of hop channels	59	49	69

FHSS is only permitted as shown in the table 2.

The frequencies designated for social alarms are excluded from use.

4.5.1 Definition

FHSS will work with LBT as the information contained in the frequency hop sequence is transferred several times over a number of different hop channels. If a FHSS equipment hops to a busy channel it will not be able to transmit, neither will it be able to receive channel information. After a period equal to the specified dwell time the equipment will hop to the next channel in the sequence, which may be free, if not the transmitter has to wait or hop to the next channel.

4.5.2 Proposed limits

a) A minimum number of hop channels within the frequency band shall be according to table 2.

b) A maximum dwell time shall be 400 ms.

c) LBT can only be implemented for FHSS if the minimum dwell time is substantially longer than 5 ms.

d) The minimum listen time of 5 ms applies at each hop channel before transmission.

e) An acknowledge shall be received within 5 ms. If the acknowledge is received after 5 ms then a TX-off of 100 ms applies.

The maximum dwell time is 400 ms as specified by e.g., EN 300 440 [9] and EN 300 328 [10].

Consequently, the maximum transmitter on-time of 1 s for a single transmission does not apply but the maximum communication time for a communication dialog of 4 s over several hops does apply.

4.6 FHSS without LBT (faster hopping than clause 4.5)

FHSS with dwell times below 5 ms using LBT is not possible and according to ECC Report 37 [4]. A duty cycle of 0,1 % or 1 % for the entire transmission shall apply, see table 3:

Table 3: FHSS without LBT

Parameter/sub-band	865 MHz to 868 MHz	865 MHz to 870 MHz	863 MHz to 870 MHz
Max. radiated power	25 mW e.r.p.	25 mW e.r.p.	25 mW e.r.p.
Max. channel bandwidth	50 kHz	100 kHz	100 kHz
Min. number of hop channels	59	49	69
Max duty cycle (entire transmission)	1 %	0,1 %	0,1 %

If the SRD market later requires an extensive use of fast hopping FHSS then the following special requirements shall be investigated intensively:

a) Number of hop channels shall be increased to the maximum possible.

b) The time between reuse of any specific channel shall not be less than 100 ms according to the proposed rule for transmit off-time.

c) Any channel change shall not be made in the transmit mode if possible.
If this is not possible then the channel switching speed shall be high enough not to cause any substantial aggregate interference for longer periods than a small fraction of the time duration for a single data bit received by the interfered victim receiver. Consequently, it may be necessary to specify the rate of the actual frequency switching time, df/dt. It shall be noted that this requirement may be in direct conflict with the specified limit for the transmitter spectrum mask.

4.7 Transmitter on-/off-slew rate

4.7.1 Definition

Some SRD equipment is used for the transmission of data with sequentially fast switching between transmit and receive state. Therefore, it is suggested that transmitter RF power on-/off-slew rates shall be specified in form of a spectrum mask. A measurement of the spectrum mask during continuous switching between receive and transmit could determine if the requirement is met.

4.7.2 Proposed limit

The radiated transmitter spectrum mask shall meet the requirements of EN 300 220-1 [3].

4.8 Other technical considerations

4.8.1 DSSS duty cycle restriction

The mixed environment of many SRDs with and without LBT will not work for Direct Sequence Spread Spectrum (DSSS) modulated equipment having a high duty cycle. ECC Report 37 [4] recommends only to allow DSSS equipment with a duty cycle (i.e. 0,1 % or 1 %) and excludes intended DSSS spectrum within the social alarm band, see table 4.

Table 4: DSSS restrictions

Parameter/sub-band	865 MHz to 868 MHz	865 MHz to 870 MHz	863 MHz to 870 MHz
Max. radiated power	25 mW e.r.p.	25 mW e.r.p.	25 mW e.r.p.
Occupied bandwidth	0,6 MHz	3 MHz	7 MHz
Max power density, e.r.p.	6,2 dBm/100 kHz	-0.8 dBm/100 kHz	-4.5 dBm/100 kHz
Max duty cycle, (entire transmitter)	1 % or LBT	0.1 % or LBT	0.1 % or LBT

4.8.2 Other types of spread spectrum modulation

Other types of spread spectrum modulated equipment (e.g. OFDM) could be peak and average power limited in order to allow co-existence to be achieved.

5 Standards

5.1 Regarding EN 300 220

For the new generic SRD equipment with LBT the traditional duty cycle restriction is not required. Frequency-agile equipment may use all frequencies as defined in clause 4.1.1. This can be done on the basis that the effect of LBT was simulated by excluding co-channel scenarios in the recent ECC compatibility study (ECC Report 37 [4]).

Both kinds of equipment - with or without LBT - should co-exist in a revised version of EN 300 220 [3]. For equipment without LBT, the duty cycle restriction is to be applied. i.e. either duty cycle or LBT is mandatory.

LBT with optional use of Adaptive Frequency Agility (AFA) will enhance the performance of the system.

This requires the implementation of new clauses for frequency-agile generic SRD-equipment using LBT-functionality.

For equipment using LBT, receiver parameters become essential radio parameters which need to be included in the harmonized standard.

The proposed channelization concept depicted in clause 4.1.1 needs to be incorporated in the revised version of EN 300 220-1 [3] and EN 300 220-3 [3].

5.2 Receiver classification

Receivers used in short range radio devices are divided into three classes, each having its own set of minimum performance criteria. This classification is based on the impact to other users where the equipment does not operate above the specified minimum performance level.

It is recommended that equipment with LBT shall be designed as close as possible to class 1 as defined in the current version of EN 300 220-1 [3] and EN 300 220-2 [3] as appropriate.

6 Existing applications within 863 MHz to 870 MHz

The band 863 MHz to 865 MHz is used for radio microphones and wireless audio applications in accordance with ERC Recommendation 70-03 [2] Annex 10 and Annex 13 respectively.

The band 868 MHz to 870 MHz is designated for different types of SRD applications with defined duty cycle and power levels in order to allow a particular type of application to develop within a particular sub-band. Thus Annex 1 to ERC Recommendation 70-03 [2] contains the regulations for NON-specific SRD applications within 868 MHz to 870 MHz and Annex 7 contains sub bands with technical parameters specifically designated for alarm systems including Social alarms within the band 869,20 MHz to 869,25 MHz (covered by ERC Decision (97)06 [8]).

In order to promote further harmonization and stronger commitment from European Administrations the European Communications Committee has adopted ERC Decisions ERC/DEC(01)04 [5], (01)09 [6] and (01)18 [7] covering SRD applications within the frequency bands 868 MHz to 870 MHz and 863 MHz to 865 MHz.

Other services and applications use the band 863 MHz to 870 MHz such as cordless telephony (CT 2), military tactical radio links.

The list of SRD applications for the band is:

- 863,000 MHz to 865,000 MHz radio microphones;
- 863,000 MHz to 865,000 MHz wireless audio applications;
- 864,800 MHz to 865,000 MHz wireless audio applications;
- 868,000 MHz to 868,600 MHz non specific short range devices;
- 868,600 MHz to 868,700 MHz alarms;
- 868,700 MHz to 869,200 MHz non specific short range devices;
- 869,200 MHz to 869,250 MHz alarms;
- 869,250 MHz to 869,300 MHz alarms;
- 869,300 MHz to 869,400 MHz non specific short range devices;
- 869,400 MHz to 869,650 MHz non specific short range devices;
- 869,650 MHz to 869,700 MHz alarms;
- 869,700 MHz to 870,000 MHz non specific short range devices.

History

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