CEPT ECC
Electronic Communications Committee

Addendum to CEPT Report 50

Addendum to the Report A from CEPT to the European Commission in response to the Mandate "On technical conditions regarding spectrum harmonisation options for wireless radio microphones and cordless video-cameras (PMSE equipment)"

Usability of the bands
821-832 MHz and 1785-1805 MHz for
wireless radio microphones

Report approved on 8 November 2013 by the ECC

0 EXECUTIVE SUMMARY

CEPT Report 50 [1] has been released as the first part of the response to the Mandate issued by the European Commission on technical conditions regarding spectrum harmonisation options for wireless radio microphones and cordless video-cameras (PMSE equipment). It deals specifically with the technical conditions for the use of the bands 821-832 MHz and 1785-1805 MHz for wireless radio microphones, including the technical conditions which can contribute to facilitate the use of PMSE equipment for EU-wide operations. These technical conditions have been derived from studies on the potential interference from PMSE into MFCN in the adjacent bands. In addition, CEPT Report 50 identified the need for further consideration on the usability of the bands for PMSE audio applications.

This supplemental report to CEPT Report 50 aims at addressing the usability of the bands for PMSE audio applications taking into account the results from CEPT Report 50 with additional assessment of the potential interference from MFCN into PMSE in the considered bands. The assumptions regarding audio PMSE in this Report are identical to those described in CEPT Report 50.

Usability of the band 1785-1805 MHz

Specific studies have been recently performed, as contained in the ECC Report 191 [2], on the interference from MFCN into PMSE audio applications operating in the 1785-1805 MHz duplex gap.

These studies show that a setup procedure is required to ensure the needed QoS for PMSE (see ANNEX 2:). The technical conditions under which PMSE could be operated with sufficient QoS will depend upon the interference scenarios, the worst case being when the PMSE receiver is located close to a transmitting MFCN pico BS. Concerning the impact from MFCN UE into PMSE, the studies have shown that considering UE with out-of-band emission performance better than in the published ETSI standards (e.g. through the implementation of duplex filtering) will significantly reduce the probability of interference into PMSE receivers.

These studies contain only analogue PMSE devices but the conclusions might be applied also for digital PMSE devices with low audio latency requirements.

Usability of the band 821-832 MHz

From CEPT Report 50, it is recommended to consider the band 821-823 MHz as a guard band because of adjacent band compatibility issues.

For the band 823-832 MHz, various studies have shown that separation distances are required between PMSE and MFCN applications. The most critical case occurs when MFCN UE and PMSE operate in close vicinity (e.g. same room scenario).

It is also expected that, as for the 1800 MHz band, a setup procedure is required to ensure the needed QoS for PMSE.

Additional considerations

Studies show that LTE will interfere with PMSE under certain circumstances. Measures can be taken to mitigate interference by following the procedures outlined in ANNEX 2:, i.e. monitor the spectrum and choose a channel free from interference. However, it should be noted that the spectrum environment is subject to change especially at a venue where the audience may be in close proximity to the PMSE receiver and have UE devices that are switched on and being used, therefore the PMSE channel may not remain free of interference throughout the event. The high QoS required by PMSE has to be maintained for the duration of the performance and it is unclear how this would be achieved especially considering the mobility of LTE UE.

The alignment of the ETSI standards for out-of-band emissions from MFCN UE with the equipment used in the studies would increase the usability of the band for PMSE.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
BS	Base Station
CEPT	European Conference of Postal and Telecommunications Administrations
ECC	Electronic Communications Committee
FDD	Frequency Division Duplex
LTE	Long Term Evolution
MFCN	Mobile and Fixed Communication Networks
OOB	Out-of-Band
PMSE	Programme making and special events
QoS	Quality of Service
SEAMCAT	Spectrum Engineering Advanced Monte-Carlo Analysis Tool
SRDs	Short Range Devices
TDD	Time Division Duplex
TS	Terminal Station
UE	User Equipment

1 INTRODUCTION

CEPT Report 50 [1] has been released as the first part of the response to the Mandate issued by the European Commission on technical conditions regarding spectrum harmonisation options for wireless radio microphones and cordless video-cameras (PMSE equipment). It deals specifically with the technical conditions for the use of the bands 821-832 MHz and 1785-1805 MHz for wireless radio microphones, including the technical conditions which can contribute to facilitate the use of PMSE equipment for EU-wide operations. These technical conditions have been derived from studies on the potential interference from PMSE into MFCN in the adjacent bands. In addition, CEPT Report 50 [1] identified the need for further consideration on the usability of the bands for PMSE audio applications.

This supplemental report to CEPT Report 50 aims at addressing the usability of the bands for PMSE audio applications taking into account the results from CEPT Report 50 with additional assessment of the potential interference from MFCN into PMSE in the considered bands.

2 USABILITY OF THE BAND 1785-1805 MHz FOR PMSE AUDIO APPLICATIONS

2.1 STUDIES ON THE IMPACT FROM MFCN INTO PMSE IN THE 1785-1805 MHz BAND

The ECC Report 191 [2] has studied the impact from MFCN into PMSE in the 1785-1805 MHz band considering the scenarios described in the following table:

Table 1: Overview of scenarios and used distances

Outdoor/ Indoor	Interferer	Victim	Distances (Note 1)
Outdoor	LTE UE	PMSE	15..100 m
	LTE macro BS	PMSE	100..350 m
Mixed	LTE macro BS (outdoor)	PMSE (indoor)	100..350 m
Indoor	LTE UE	PMSE	5..50 m
	LTE pico BS	PMSE	

1. The distances contained in the table show the range of distances between LTE interferer and the PMSE receiver used in the Monte-Carlo simulations.

The studies consider LTE as the relevant technology for MFCN with technical characteristics in accordance with ETSI TS 136.101 [3] for LTE UE and ETSI TS 136.104 [4] for LTE BS. The main parameters for PMSE receivers considered in the studies were derived from ETSI TR 102 546 [5].

The details of the studies, performed with Monte-Carlo simulations are provided in the Annex 1 of ECC Report 191 [2], where probabilities of interference are determined for the scenarios outlined in Table 1:. These studies contain only analogue PMSE devices but the conclusions might be applied also for digital PMSE devices.

The studies regarding the impact on PMSE show the conditions under which PMSE is able to find an operational channel with a sufficient QoS.

If the frequency separation between LTE UE and the PMSE receiver is more than 10 MHz[1] the probability of interference from the LTE UE is negligible. The probability of interference from the LTE macro BS increases if the frequency separation to the LTE macro BS decreases.

The most critical case is if the PMSE receiver is located close to a transmitting MFCN pico BS, which uses frequency bands close to those frequency ranges in use by the PMSE receiver.

For the case that the MFCN LTE macro BS and PMSE are located both outdoor a separation distance of 100m is sufficient to ensure that PMSE has the possibility to find an operational channel.

[1] It is shown in ECC Report 191 that for frequency offsets greater than 10 MHz the received OOB emissions are dropping down due to the LTE spectrum mask and duplex filter applied.

The operation of a MCFN LTE pico station in the same room/hall where PMSE is used should be avoided unless additional mitigation techniques are applied. For frequency offsets larger than 1 MHz and 100 m separation, the impact of the MFCN LTE base station can be neglected. The probability of interference is considerably reduced if PMSE is operated indoor and the MFCN LTE base station is located outdoor due to the wall attenuation. In that case PMSE could find an operational channel with a sufficient QoS.

Concerning the impact from MFCN UE into PMSE, for the estimation of the probability of interference, a spatial separation is assumed: 5 m for indoor and 15 m for outdoor. If this separation distance is increased, the probability of interference decreases accordingly. Real UE will have better out-of-band emission performance than in the published ETSI standards (e.g. through the implementation of duplex filtering) and this will significantly reduce the probability of interference into PMSE receivers.

2.2 ADDITIONAL CONSIDERATIONS ON THE POTENTIAL USE OF THE BAND 1785-1805 MHZ BY PMSE

Studies show that LTE will interfere with PMSE under certain circumstances. Measures can be taken to mitigate interference by following the procedures outlined in ANNEX 2:, i.e. monitor the spectrum and choose a channel free from interference. However, it should be noted that the spectrum environment is subject to change especially at a venue where the audience may be in close proximity to the PMSE receiver and have UE devices that are switched on and being used, therefore the PMSE channel may not remain free of interference throughout the event. The high QoS required by PMSE has to be maintained for the duration of the performance and it is unclear how this would be achieved especially considering the mobility of LTE UE.

2.3 CONCLUSION ON THE USABILITY OF THE BAND 1785-1805 MHZ FOR AUDIO PMSE APPLICATIONS

The studies regarding the impact on PMSE show that a setup procedure is required to ensure the needed QoS for PMSE. The technical conditions under which PMSE could be operated with sufficient QoS will depend upon the interference scenarios, the worst case being when the PMSE receiver is located close to a transmitting MFCN pico BS.

The alignment of the ETSI standards for out-of-band emissions for MFCN UE with the equipment used in the studies would increase the usability of the band for PMSE.

3 USABILITY OF THE BAND 821-832 MHz FOR PMSE AUDIO APPLICATIONS

3.1 STUDIES ON THE IMPACT FROM MFCN INTO PMSE IN THE BAND 821-832 MHZ

The impact from MFCN into PMSE in the band 821-832 MHz had been studied in CEPT Report 30 [6] and detailed results are provided in the Annex 5, section A5.1 of [6].

The results of the studies on the protection distances between MFCN and PMSE equipment required for the operation of PMSE equipment in the FDD duplex gap have shown that, the operation of radio microphones in the FDD duplex gap would generally not be constrained as a result of interference from MFCN equipment with the exception of the upper 1 MHz (i.e. 831-832 MHz) and the lower 200 kHz (i.e. 821-821.2 MHz) of the FDD duplex gap where the required protection distances may be considered prohibitive.

It should be noted that, as reported in CEPT Report 50 [1], the band 821-823 MHz should be considered as a guard band in order to protect MFCN from interference from PMSE operating in the duplex gap.

3.2 ADDITIONAL CONSIDERATIONS ON THE POTENTIAL USE OF THE BAND BY PMSE

In order to complement the analysis reported in section 3.1, this section contains information on studies currently under development within CEPT, which are relevant to assessing the usability of the duplex gap 821-832 MHz.

In particular, ECC Report 207 [7] investigates the impact from LTE below 862 MHz into SRDs in the band 863-870 MHz, including wireless microphones in the band 863-865 MHz. This includes both theoretical studies, including SEAMCAT simulations, and practical measurements. The preliminary results of those studies are:

- (1) There is little risk of harmful interference if the LTE UE and the SRDs are not used on the same premises (separation distance >10m).
- (2) There is a risk of interference whenever an LTE UE is used on the same premises (distances ≤ 10 m) as an SRD but this risk of interference varies due to several factors such as SRD receiver category and LTE UE emission mask: the risk can be high if an LTE UE is used towards its full capability, with high resource block allocations, in block C.
- (3) Category 3 SRD receivers (e.g. from EN 300 220 [8]) cannot coexist with LTE UE due to SRD receiver blocking effect. The removal of SRD Category 3 receivers in the band 863-870 MHz from the market place can reduce statistically blocking effects on total population of SRD receivers.
- (4) The SRD Category1 receiver may coexist with real measured LTE UE masks (15-20 dB lower OOB emissions), but may not with the LTE UE masks from the ETSI standard. However, manufacturing associations note that the use of a Category 1 receiver is not viable for SRD applications except for very specific high performance alarm base stations (e.g. EN 300 220).
- (5) SRD receivers with min Category 2 blocking performance may coexist with LTE under the following assumptions:
  - If the LTE UE is transmitting with OOB emissions complying with the 1.4 MHz mask from the standard; but all LTE UEs are expected to change their bandwidth and thus applicable OOB masks dynamically with different occurrence probabilities in time (e.g. high probability of small resource block allocations vs low probability of high resource block allocations).
  - If the real LTE UE OOB emissions for 3, 5 and 10 MHz bandwidth are below the mask specification in standards (e.g. by 15-20 dB for the 10 MHz mask). Available measurements' results of real LTE UE emissions confirmed that this may be realistic assumption as measured OOB emissions were well below the specification (in static transmission states of equipment under test).
  - At the expense of a reduction in SRD operating distance (e.g. down to 50% for the 10 MHz LTE UE mask).
- (6) SRDs experience the high LTE UE OOB emissions, that are caused by high (25-50) resource block allocations in the LTE UE but the activity factor of the LTE UE has not been considered in this report.

However, it should be expected that the most critical LTE UE mask (one user is using all resource blocks available in the cell) will happen in real life only for short time periods (noting that the LTE base-station reallocates resources between LTE UEs with a time interval of 1 ms).

- (7) The most likely impacted SRD type may be an audio receiver (including baby alarms) in the band 863-865 MHz, as they may already be affected by very short LTE UE bursts with high resource block allocations and as they are working close in frequency to the LTE band.
- (8) SRDs using digital modulations may be better able to resist interference from LTE UE (e.g. thanks to using forward error correction, acknowledgement with re-transmission), but the high OOB emissions may generally lead to desensitisation and false signal level triggering in those receivers.

It is felt that the interference from LTE UE operating below 862 MHz into wireless microphones in the band 863-865 MHz may be comparable to the one generated by LTE UE operating above 832 MHz into the 821-832 MHz duplex gap.

In this band the same situation applies as for the 1800 MHz duplex gap with respect to mitigating interference by following the procedures outlined in ANNEX 2:, namely that the interference environment cannot be considered as constant even though the PMSE channel was clear during the initial assessment and setup.

Applicability of the studies performed for the 1785-1805 MHz duplex gap

Taking into account the similarities of both the MFCN and the PMSE characteristics in the two duplex gaps, it is expected that the results reported in section 2 would also be valid for the 800 MHz duplex gap, in a mirror situation due to the reverse directions between the 800 and 1800 MHz FDD plans.

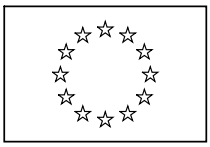
3.3 CONCLUSION ON THE USABILITY OF THE BAND 821-832 MHZ FOR AUDIO PMSE APPLICATIONS

From CEPT Report 50 [1], it is recommended to consider the band 821-823 MHz as a guard band because of adjacent band compatibility issues.

For the band 823-832 MHz, separation distances are required between PMSE and MFCN applications. The most critical case occurs when MFCN UE and PMSE operate in close vicinity (e.g. same room scenario).

It is also expected that, as for the 1800 MHz band, a setup procedure (e.g. as described in ANNEX 2:) would be required to ensure the needed QoS for PMSE, in the presence of MFCN interference.

ANNEX 1: MANDATE TO CEPT ON TECHNICAL CONDITIONS REGARDING SPECTRUM HARMONISATION OPTIONS FOR WIRELESS RADIO MICROPHONES AND CORDLESS VIDEO-CAMERAS (PMSE EQUIPMENT)



EUROPEAN COMMISSION
Information Society and Media Directorate-General

Electronic Communications Policy
Radio Spectrum Policy

Brussels, 15 December 2011
DG INFSO/B4

FINAL

MANDATE TO CEPT
ON TECHNICAL CONDITIONS REGARDING SPECTRUM HARMONISATION OPTIONS FOR WIRELESS RADIO MICROPHONES AND CORDLESS VIDEO-CAMERAS (PMSE EQUIPMENT)

1. PURPOSE

This mandate is a follow-up to the commitment made by the Commission in the Communication on the digital dividend[2] and in the proposal for a Radio Spectrum Policy Programme.[3] The main objective of this mandate is to identify technical conditions and options to make EU harmonised spectrum available for wireless radio microphones and cordless video-cameras. The aim is not to satisfy all the spectrum requirements[4] of the relevant users, but rather to create a baseline for economies of scale and the functioning of the internal market.

Programme Making and Special Events (PMSE) applications fulfil an important role supporting social and cultural activities, ranging from local to EU-wide events and broadcasts, which also make a significant economic contribution. Various types of equipment are involved, such as wireless microphone applications, in-ear systems, cordless video-cameras and remote control systems, used in both professional and non professional environments.

[2] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – Transforming the digital dividend into social benefits and economic growth /*COM/2009/0586 final*/

[3] Proposal for a Decision of the European Parliament and of the Council establishing the first radio spectrum policy programme /*COM/2010/0471 final – COD 2010/0252*/

[4] Large events may have much higher spectrum requirements. However, these are very local and may vary over time. Consequently, they are best addressed through national case by case solutions on the base of appropriate equipment standards that specify tuning ranges for equipment.

2. JUSTIFICATION

Pursuant to Article 4 of the Radio Spectrum Decision[5] the Commission may issue mandates to the CEPT for the development of technical implementing measures with a view to ensuring harmonised conditions for the availability and efficient use of radio spectrum; such mandates shall set the task to be performed and the timetable therefore.

Without prejudice to the final text to be adopted by the European Parliament and the Council, the draft Radio Spectrum Policy Programme states that Member States shall examine ways and, where appropriate, take technical and regulatory measures, to ensure that the freeing of the 800 MHz band does not adversely affect PMSE users. In addition it states that Member States shall, in cooperation with the Commission, seek to ensure the necessary frequency bands for PMSE, according to the Union's objectives to improve the integration of the internal market and access to culture.

CEPT Report 32[6] concludes that:

1. The historic use of PMSE of the 470-862 MHz band will need to be adapted.

2. PMSE demand for spectrum is expected to continue to rise in the medium term.

3. Interleaved channels/white spaces in the UHF band are the principal spectrum for wide band audio applications. Therefore, the 470 MHz to 790 MHz range should be maintained for PMSE allowing them to operate on a temporary basis in areas where broadcasting is not yet used.

4. New frequency bands could be made available to PMSE in addition to 470-790 MHz.

In order to address in particular non-professional applications and a substantial amount of professional applications, and while recognising that it is not the aim to address all spectrum requirements, there is considerable justification for harmonising the band 821-832 MHz for wireless microphones.

Furthermore, the identification of detailed technical conditions for the use of band 1785-1805 MHz by wireless radio microphones is required before considering a possible harmonisation measure which includes EU-wide operations (this could include for example indoor and outdoor use and the variety of professional and non-professional situations).

In addition to the audio applications (wireless microphones) there is another important category of PMSE equipment, cordless video-cameras, which may face spectrum access issues. Currently, cordless video-cameras are often operating in the 2.3 GHz band and additional in the 2.6 GHz band. The fact that the 2.6 GHz band has been harmonised for terrestrial systems providing electronic communications services under new conditions of use and that some Member States are contemplating the use of the 2.3 GHz in the same way, makes it necessary to consider an alternative and sustainable solution for spectrum access for cordless video-cameras. Therefore, options or alternatives for spectrum use by cordless video-cameras need to be developed. It would be desirable to investigate new bands for cordless video-cameras use and sharing opportunities.

[5] Decision 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, OJL 108 of 24.4.2002.
[6] 30 October 2009.

Considering the above and taking into account the fact that EU-wide operations (such as touring shows) as well as ordinary citizens using wireless microphone equipment for non-professional purposes, could both benefit from harmonisation, the Commission believes that an additional mandate is justified. The mandate should concentrate on the analysis of the 821-832 MHz and 1785-1805 MHz bands for wireless microphones and on clarifying technical options to address future needs for cordless video-cameras.

3. MAIN EU POLICY OBJECTIVES

With this mandate, the Commission issues guidance to the CEPT to continue developing technical conditions and studies serving policy objectives which contributes to an improvement of efficient use of spectrum resulting in positive economic, social and cultural benefits in the EU. These main policy objectives include:

1. To ensure the availability of core spectrum for some categories of PMSE equipment, respectively wireless radio microphones and cordless video-cameras, with a view to supporting the development of media and entertainment industry (PMSE);

2. To strengthen the Internal Market dimension for potential single market services and PMSE equipment, that can improve frequency management, in relation to PMSE use as well as to improve the spectrum efficiency of PMSE equipment.

3. To exploit the socio-economic and cultural benefit for EU citizens and PMSE users to the fullest extent by facilitating economies of scale, lower prices and foster cross-border portability and interoperability.

4. TASK ORDER AND SCHEDULE

Through this mandate, the CEPT is requested:

(1) To identify the technical conditions for the use of the band 821-832 MHz for wireless radio microphones (which optionally include in-ear systems and control systems) in the EU. This should take into account the technical conditions specified in EC Decision 2010/267/EU on the EU harmonisation of the 800 MHz band as well as any relevant outcomes of WRC-12.

(2) To identify the technical conditions resulting in a harmonisation of technical parameters in the band 1785-1805 MHz for the use of wireless radio microphones (which optionally include in-ear systems and control systems).

(3) To identify the technical conditions and the necessary frequency bands for ensuring the sustainable operation of cordless video-cameras in the EU, including spectrum sharing opportunities possible through technological developments.

(4) To identify technical conditions which can contribute to facilitate the use of wireless radio microphone and cordless video-camera-equipment for EU-wide operations, including specific aspects to improve the frequency management and the overall spectrum efficiency of equipment,

The Commission may provide CEPT with further guidance on this mandate.

The deliverable for this mandate will be two reports A and B:

- Report A on the technical conditions for the use of the bands 821-832 MHz and 1785-1805 MHz for wireless radio microphones in the EU, including the technical conditions which can contribute to facilitate the PMSE equipment for EU-wide operations;

- Report B on the technical conditions for ensuring the sustainable operation of cordless video-cameras in the EU.

The following delivery dates are scheduled:

Delivery date	**Deliverable**
3/07/12	For RSC#40 Progress report A
4/12/12	For RSC#42 Progress report B
4/12/12	For RSC#42 Draft final report A, subject to public consultation
11/03/13	Final report A delivery
July 2013	For RSC#44 Draft final report B, subject to public consultation
November 2013	Final report B delivery

In implementing this mandate, the CEPT shall, where relevant, take the utmost account of Community law applicable and support the principles of technological neutrality, non-discrimination and proportionality insofar as technically possible.

The Commission, with the assistance of the Radio Spectrum Committee pursuant to the Radio Spectrum decision, may consider applying the results of this mandate in the EU, pursuant to Article 4 of the Radio Spectrum Decision.

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ANNEX 2: SETUP PROCEDURE FOR AN INTERFERENCE FREE OPERATION OF WIRELESS MICROPHONE AND IN-EAR MONITOR LINKS

In this annex the setup procedure for an interference free operation is described. This procedure is performed before the PMSE user can go online and during the use of the equipment. The procedure is used for analogue systems and in principle also for digital systems.

A2.1 SECURE INTERFERENCE FREE OPERATION OF WIRELESS MICROPHONE AND IN-EAR MONITOR LINKS

Microphone user sets up his equipment.

First thing to do: switch on the receiver and listen to its output. This is either done through the connected power amplifier system via the mixing console or through a headphone directly connected to the receiver headphone socket.

If there is no signal audible the receiver’s frequency can be used for operation.

There may or may not be an audible signal at the receiver output. If there is an audible signal, the frequency is already occupied and cannot be used. However, it is possible that the frequency is occupied but there is no audio signal coming from the receiver. Most analogue PMSE systems use a "tone key" system which helps prevent unwanted signals and noise from being output by the receiver. Unless the unwanted PMSE transmission is using the same tone key frequency, the user will not be able to hear it. However, the unwanted signal may still cause interference if it is strong enough. Likewise, digital PMSE systems use various modulation and coding schemes which are typically incompatible. It is quite possible that a channel could be occupied by a different type of digital system and no audio would be heard from the receiver. The same thing would happen if an analogue PMSE system picked up a digital PMSE transmission, and vice versa.

The user also monitors the RF and Audio Level indicators to prove the audible output of the link. If there is no indication at these two level meters the frequency is not in use and can be used for interference free operation: the transmitter can be switched on at the receiver’s frequency.

The most basic method for determining whether a given frequency is in use is by monitoring the receiver's RF indicator. However, the lack of an indication does not necessarily mean that interference-free operation is assured because these RF indicators are not precision devices and there could still be a residual signal present on the frequency.

If there is a signal audible or the two level meter show signals a different frequency will be adjusted at the receiver and the same test has to be done again.

Some receivers do this check already alone in “sound-check-mode” or similar. In this mode the spectrum is scanned and frequencies for operation are indicated. The user can choose out of the offered frequencies one for his operation.

Many recent PMSE models incorporate some type of built-in scanning capability that will help the user determine which channels are usable. The operation of this function may range from basic to highly sophisticated, rivalling the performance of a dedicated spectrum analyser. In general, these scanners are useful for finding "open" frequencies.

Certain manufacturers offer for their receiver systems an Ethernet link so that the receiver can be connected to a notebook. These manufacturers also offer on their homepage free of charge software that makes the receiver to operate as a spectrum scanner – similar to the above mentioned “sound-check-mode”. This time all the results can be seen on the notebooks screen and a frequency gap for the operation can be chosen.

Several manufacturers have enabled their PMSE systems to be connected to a computer to provide enhanced scanning and frequency management capabilities. A variety of interfaces are used, including

Ethernet and USB. For multichannel operation of wireless links the manufacturers offer sets of frequencies which are calculated to be free of interference. These frequencies have to be chosen for the operation for maximum security of the wireless link. In the vast majority these frequencies are stored as presents in both: receiver and transmitter.

A2.2 THE PRESELECTED COMPATIBLE CHANNEL GROUPS PROVIDED BY PMSE

Manufacturers are selected to be free from Inter-modulation Distortion interference. This does not mean that they are free from all sources of interference; only interference caused by interaction between multiple systems. The use of these frequencies should help ensure that a multi-channel PMSE system can be operated reliably. They do not affect whether the link is "secure" in the sense that the transmissions are protected from outside interference or interception.

PMSE user coordination on site:

PMSE users coordinate themselves on site for interference free operation. The current analogue systems allow listening to the links of other users and making it easy to get into personal contact with these operators. In this personal contact the operation time or the coordinating of the frequency use will be coordinated personally.

For the reasons given above, either analogue or digital systems necessarily allow users to monitor the links of other users. Therefore, this technique is not commonly used or relied upon as a means of frequency coordination at multi-user events.

It has to be noticed that the coordination has to be modified with digital systems as the finding of the “interfering” operator will be more complicated. Solutions for this, like monitoring of signal strength indicator, have to be discussed.

For large events, there will typically be an assigned frequency coordinator who also monitors frequency use. PMSE system operators are normally required to register their systems with the coordinator to prevent interference. Coordinators typically use spectrum analysers to monitor and control spectrum usage.

ANNEX 3: LIST OF REFERENCES

[1] CEPT Report 50: Report A from CEPT to the European Commission in response to the Mandate on PMSE - Technical conditions for the use of the bands 821-832 MHz and 1785-1805 MHz for wireless radio microphones in the EU
[2] ECC Report 191: Adjacent band compatibility between MFCN and PMSE audio applications in the 1800 MHz range
[3] ETSI TS 136 101: “LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception”
[4] ETSI TS 136 104: “LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception”
[5] ETSI TR 102 546: “Electromagnetic compatibility and Radio spectrum Matters (ERM); Technical characteristics for Professional Wireless Microphone Systems (PWMS); System Reference Document”
[6] CEPT Report 30 on the identification of common and minimal (least restrictive) technical conditions for 790 - 862 MHz for the digital dividend in the European Union
[7] ECC Report 207: Adjacent band co-existence of SRDs in the band 863-870 MHz in light of the LTE usage below 862 MHz
[8] ETSI EN 300 220: Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW.