



Consultation on 870-876 MHz and 915-921 MHz

Update and Way Forward

Consultation

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Closing Date for Responses:	28 March 2013

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Section 1

Summary

- 1.1 Ofcom last published an update on the release of the bands 872-876 MHz and 917-921 MHz in February 2010¹ following earlier consultations in 2009 and 2006. In this consultation we provide a further update and set out a proposed decision to release this spectrum for Short Range Devices (SRDs) and Radio Frequency Identification (RFIDs) on a licence exempt basis. Since our update in 2010, work by the Conference of European Posts and Telecommunications Administrations (CEPT) and European Telecommunications Standards Institute (ETSI) on the future use of these bands has progressed significantly. As a result it has become clear that it will be feasible for a number of key applications, including SRDs, RFIDs and GSM-R (mobile communications for railway operators), to effectively share these bands. The international work is planned to result in a change to the CEPT Recommendation for SRDs and RFIDs on use of these bands by these applications in 2013. In addition, the Ministry of Defence (MOD) has announced that it plans to release 870-872 MHz and 915-917 MHz to Ofcom or, following consultation within Government, transfer management to another Government department.
- 1.2 In light of these and other developments, we propose to release this spectrum on a licence exempt basis with technical conditions that enable SRD and RFID use. This could retain the potential for co-existence with GSM-R, including the extension spectrum referred to throughout this document as ER-GSM, if part of these bands were licensed for that use in the future (noting that we are not bringing forward proposals on licensing ER-GSM at present). This approach is consistent with the direction of the CEPT and ETSI work and with Government's existing requirements. If Government confirms the release of bands 870-872 MHz and 915-917 MHz to Ofcom, then we would expect to release that spectrum on the same basis alongside the bands 872-876 MHz and 917-921 MHz.
- 1.3 The benefits of such an approach include:
- Enabling more effective and reliable RFID tagging which could bring significant efficiency benefits in retail, logistics and distribution industries.
 - Enabling new low power wireless applications that can take advantage of the additional range possible at low frequencies and greater opportunities for innovation than is possible in the existing 863-870 MHz SRD band. This includes a range of machine-to-machine (M2M) applications such as alarms, home automation and smart metering.
 - Protecting users in neighbouring bands, including the provision of current and future cellular mobile services.
- 1.4 Our assessment is that this is likely to generate greater value for UK citizens and consumers than alternative approaches such as awarding a UK wide licence for individual use of the bands.
- 1.5 Following consideration of comments from stakeholders and confirmation from Government on the future of the bands 870-872 MHz and 915-917 MHz, we plan to make a decision on our approach to releasing the bands in spring this year. If we

¹ http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/update/

confirm the licence exempt approach outlined in this document, then we will undertake a further consultation on the technical details of its implementation in autumn this year with implementation completed in spring 2014; following approval of the final CEPT recommendation. This will avoid the specification of UK licence exempt devices inadvertently needing to differ from those in Europe.

Table 1.1. Our provisional timetable

	Date
Publication of consultation on approach to release	23 January 2013
Consultation period	10 weeks
Consultation closes	28 March 2013
Publish statement	Q2 2013
Consultation on technical details of exemption (if we decide on licence exempt release)	Autumn 2013
Publish Statement and Notice with draft regulations	Winter 2013/4
Implementation of regulations	Spring 2014

Section 2

Introduction and update

Introduction

- 2.1 Ofcom last published an update on the release of the bands 872-876 MHz and 917-921 MHz in February 2010² following earlier consultations in 2009 and 2006. In this consultation we provide a further update and set out our proposed approach to the release of this spectrum.
- 2.2 We consulted in 2009 on the appropriate approach to the release of bands 872-876 MHz and 917-921 MHz³ (the “2009 consultation”). We then provided an update on this work in 2010⁴ (the “2010 update”). This document should be read in conjunction with those earlier documents.
- 2.3 In the 2010 update we said that we were unlikely to recommence work on the release of the bands 872-876 MHz and 917-921 MHz until the direction of the European work was clearer and we highlighted five areas of further work:
- the assessment of the potential value that could be created through different uses of these bands;
 - the benefits of harmonisation for those applications where this is potentially relevant;
 - potential interference/coexistence problems;
 - the technical assumptions in relation to power levels, propagation methodology, separation distances and mitigation techniques that could be employed; and
 - the extent to which filtering will be required to protect existing and future mobile services in adjacent spectrum and how this should be implemented.
- 2.4 This document includes an update on these five areas as appropriate, noting that significant progress has been made on the technical areas of work in the international committees⁵.
- 2.5 Our 2010 update also re-iterated our invitation to stakeholders to provide additional information and analysis either on technical criteria, or that could help to inform an assessment of the potential value that could be created through particular uses of the bands⁶. We noted that responses to the 2009 consultation had elicited very little information or analysis of this type.
- 2.6 Since our (2010) update there have been a number of developments relevant to the release of this spectrum including:

² http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/update/

³ http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/?a=0

⁴ http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/update/

⁵ CEPT SRD Maintenance Group and CEPT Project Team 24

⁶ See Section 3, paragraph 3.3. of our Interim Statement:

(http://stakeholders.ofcom.org.uk/binaries/consultations/872_876_mhz/award_update.pdf)

- an announcement that the MOD intends to release the bands 870-872 MHz and 915-917 MHz⁷;
- other Government and public sector spectrum requirements have emerged;
- additional CEPT studies and progress with ETSI standards; and
- the Department of Energy and Climate Change (DECC) gas and electricity smart metering initiative⁸.

2.7 The rest of this section provides an overview of these developments, their implications for the options for releasing the spectrum, the regulatory and spectrum management context for our proposals and an outline of the rest of the document.

Government and Public Sector Developments

- 2.8 Since the publication of the Government's target of releasing 500 MHz of public sector spectrum by 2020⁹ in March 2011 the Government has been preparing bands for release and sharing. Two of the bands that the MOD has considered in this context are 870–872 MHz and 915–917 MHz. This follows the withdrawal of the MOD's Ptarmigan system in response to the harmonisation of the GSM-R bands and the subsequent grant of a Wireless Telegraphy Act 2006 ("WTA") licence to Network Rail.
- 2.9 Initially considered by the MOD for sharing, the MOD has said that it has made significant progress by clearing all military users from these bands. It also said¹⁰ in (August 2012) that it intended to consult with other Government departments in autumn 2012 on the future use of these bands with the intention of transferring management responsibility to another government department or releasing the spectrum to Ofcom.
- 2.10 That consultation has presented a limited opportunity for other Government departments and public bodies to make new requests to access these bands. In addition, some other Government departments have informed the MOD that their existing uses as well as potential emerging requirements need consideration before any exploitation plans can be finalised. These existing and potential emerging requirements are discussed below.

Existing uses

- 2.11 There is an existing use of the 870-872 MHz band by the Home Office as reported to the CEPT¹¹ in August 2012. The Home Office system features a number of fixed base stations and mobile units transmitting at a low duty cycle in the 870-872 MHz band. We published further information on the Home Office system in our Information Memorandum on the award of 800 MHz and 2.6 GHz spectrum¹².

⁷ <http://www.mod.uk/DefenceInternet/AboutDefence/WhatWeDo/ScienceandTechnology/Spectrum/>

⁸ http://www.decc.gov.uk/en/content/cms/tackling/smart_meters/smart_meters.aspx

⁹ http://www.culture.gov.uk/images/publications/Spectrum_Release.pdf

¹⁰ <http://www.mod.uk/DefenceInternet/AboutDefence/WhatWeDo/ScienceandTechnology/Spectrum/>

¹¹ SE24 Meeting M66, Montegrotto, 27-28 August 2012 (M66 07R0 SE24 WI41 UK Government Services)

¹² <http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/IM.pdf>

- 2.12 There are also wind profiler radars (WPRs) in the band 915-917 MHz. Two WPRs are currently operated by the Met Office at Camborne, Cornwall and the Isle of Man. We understand that the Met Office wishes to retain spectrum access for the operation of wind profilers (previously negotiated with the MOD). The protection and co-existence requirements for WPRs are being considered by the CEPT.

Emerging uses

Smart metering - Home Area Networks

- 2.13 The Department of Energy and Climate Change (DECC) has said that, as part of broader work to determine the optimal smart meter roll out strategy, they are preparing an outline business case identifying potential public benefits that might be derived from reserving a part of the 870-876 MHz band for the purpose of Home Area Networks (HANs) for smart metering communications. DECC proposed as part of their Smart Metering Equipment Technical Specifications version 2 consultation in autumn 2012 that smart meter deployments be allowed at both the 2.4GHz and 868 MHz (863 – 870 MHz) spectrum. They also asked for stakeholder views on the compatibility and benefits of reserving spectrum at 870-872MHz. DECC are expected to set out their full HAN strategy in part 2 of their response to this consultation in spring this year.

Fire and rescue Services

- 2.14 As part of the UK Fire and Rescue Service's (FRS) migration strategy for Breathing Apparatus Telemetry, the FRSs are considering a requirement for a 25 kHz channel in the band 870–876 MHz. The FRSs are expected to make their spectrum decision in spring this year. We published further information on FRS Breathing Apparatus Telemetry in our Information Memorandum on the award of 800 MHz and 2.6 GHz spectrum¹³.

International Developments

- 2.15 In Europe the CEPT has developed a roadmap towards a spectrum allocation for SRDs and RFIDs for the bands 870-876 MHz and 915-921 MHz that is expected to be compatible with the existing Government and public sector uses identified above. Ofcom and UK stakeholders (including the Government and public sector) have and continue to actively participate in the development of the Short Range Device/Maintenance Group (SRD/MG) work stream activities. The CEPT's roadmap is expected to lead to a non-mandatory recommendation for SRD and RFID use in the bands 870-876 MHz and 915-921 MHz by the autumn of 2014.
- 2.16 The progress of this roadmap and associated studies is summarised in section 3 and further detail is provided in Annex 5.

Options for releasing the spectrum

- 2.17 The developments identified above have two important implications for Ofcom's options for releasing the spectrum in the UK.
- 2.18 First, the possibility of the MOD releasing the bands 870-872 MHz and 915-917 MHz to Ofcom creates the potential for us to release two blocks of 6 MHz, rather than two

¹³ <http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/IM.pdf>

blocks of 4 MHz. As well as offering greater capacity, a release of 2x6 MHz could have additional benefits because this would enable UK use to align with the future use by other European countries.

- 2.19 Second, a significant implication of the work that has been undertaken to date by the CEPT is that the options for releasing the spectrum in the UK have been clarified. What these options look like is shown in Annex 5 in figures A5.1 and A5.2. The CEPT's vision for the proposed bands 870-876 MHz and 915-921 MHz helps to visualise where each of the proposed SRD and RFID uses may be implemented if the CEPT's current proposals are adopted; including the technical conditions for co-existence. We consider that this work has now reached a sufficiently advanced stage to enable Ofcom to consult and decide upon the approach to the release of the spectrum. The final CEPT recommendation may affect the contents of a future consultation on, for example, the technical conditions associated with a licence exempt approach.
- 2.20 In particular the progress being made by the CEPT means that there is now a potential option of releasing the spectrum on licence exempt basis, so enabling a wide range of applications to be used, whilst *also* retaining the ability to accommodate ER-GSM if that is authorised in the future. Assuming this is the form of the final CEPT recommendation and that other CEPT countries adopt this, there could be additional benefits from the UK aligning with that (especially if 2x6 MHz were available). At the time of our previous (2009) consultation there was insufficient evidence from studies of the compatibility issues and mitigation techniques for a licence exempt option. In addition, the further technical work has clarified that a light licensing option (discussed in our previous consultation) is unlikely to be necessary.
- 2.21 These developments mean that our assessment of options can now be simplified compared to our earlier consultation. Previously we needed to consider the relative merits of full licensing (including ER-GSM) versus light regulatory approaches (including licence exempt and light licensing). As explained in more detail in section 4, mutually exclusive options for full licensing of ER-GSM and light licensing (eg for RFIDs) are now expected to be unnecessary as these uses can be accommodated with a licence exempt approach. Consequently our assessment can now focus on the likely benefits from a licence exempt approach in line with the direction of CEPT (on the basis that this would retain the ability for a licensed ER-GSM deployment) and considering whether there are any credible alternative approaches to releasing the spectrum which would be likely to create greater value.

Question 1. What other developments, in addition to the international and public sector developments we have identified, are relevant to our identification and assessment of options for release?

The Regulatory and Spectrum Management Context

- 2.22 We set out in Section 2 and Annex 7 of the 2009 consultation¹⁴ the regulatory and spectrum management framework within which our decision on the approach to

¹⁴ http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/?a=0

release of the spectrum will be made. Those sections explained the duties¹⁵ applicable to Ofcom's decision making process, and Ofcom's regulatory principles¹⁶.

2.23 In particular, we referred to Ofcom's powers under the WTA to grant licences for wireless telegraphy and also to make regulations exempting the establishment, installation or use of wireless telegraphy stations or apparatus from the need for a licence. In relation to the making of exemption regulations the WTA provides¹⁷:

- OFCOM may by regulations exempt such activities either absolutely or subject to such terms, provisions and limitations as may be so specified;
- OFCOM may not make regulations specifying terms, provisions or limitations in relation to the establishment, installation or use of wireless telegraphy stations or wireless telegraphy apparatus for the provision of an electronic communications network or electronic communications service unless the terms, provisions or limitations are of a kind falling within Part A of the Annex to Directive 2002/20/EC of the European Parliament and of the Council;
- Terms, provisions and limitations specified in regulations under subsection (3) must be (a) objectively justifiable in relation to the wireless telegraphy stations or wireless telegraphy apparatus to which they relate; (b) not such as to discriminate unduly against particular persons or against a particular description of persons; (c) proportionate to what they are intended to achieve, and (d) in relation to what they are intended to achieve, transparent; and
- In making exemption regulations Ofcom must be satisfied that the use of stations or apparatus described is not likely to: (a) involve undue interference with wireless telegraphy; (b) have an adverse effect on technical quality of service; (c) lead to inefficient use of the part of the electromagnetic spectrum available for wireless telegraphy; (d) endanger safety of life; (e) prejudice the promotion of social, regional or territorial cohesion; or (f) prejudice the promotion of cultural and linguistic diversity and media pluralism.

The rest of this document

2.24 Section 3 (supplemented by Annex 5) provides an overview and update on the available technical information about the bands, including how issues previously identified through our earlier consultations have been progressed and informs our view about the potential use of the band, including the ability of licence exempt SRD and RFID use to share with ER-GSM.

2.25 Section 4 then assesses whether pursuing that approach is likely to maximise the benefits to citizens and consumers from use of the band, or whether any alternatives could create greater value. It also considers the relative impact of releasing 2x4 MHz versus 2x6 MHz.

2.26 Section 5 sets out our proposed next steps and timetable for implementation, if our proposed licence exempt approach is confirmed. In particular, it aims to identify a

¹⁵ It should be noted in particular that since the 2009 consultation the Communications Act 2003 has been amended to add a specific duty at Section 4A for Ofcom to take account of European Commission recommendations for harmonisation.

¹⁶ <http://www.ofcom.org.uk/about/what-is-ofcom/statutory-duties-and-regulatory-principles/>

¹⁷ Following amendments made by the Electronic Communications and Wireless Telegraphy Regulations 2011/1210.

timetable that ensures that the UK does not inadvertently diverge from CEPT's recommendation whilst also making the spectrum available as earlier as possible in the UK for new uses.

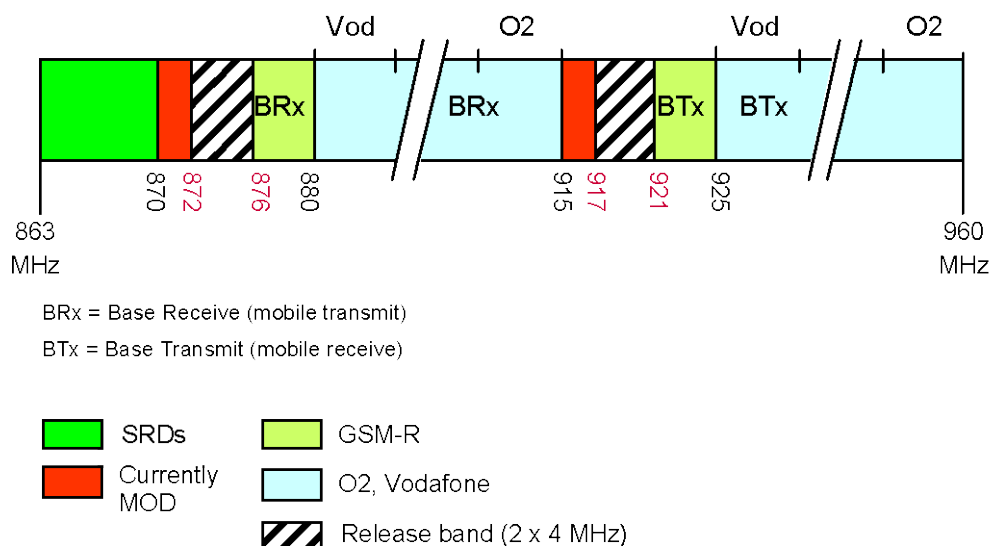
Section 3

Technical information about use of the spectrum

Introduction

- 3.1 This section provides a brief overview of updated technical information about the bands for release and the compatibility of their use with adjacent users (with more detail contained in Annex 5). This updated information informs our consideration of the options for release in section 4. However, further consideration of the technical details necessary for implementing release will be the subject of a further consultation, which amongst other things will take account of updated information from CEPT.
- 3.2 The following subsections cover:
- A recap of technical comments made in response to the 2009 consultation;
 - Compatibility of SRDs and/or RFIDs with:
 - Adjacent and near adjacent cellular services in the 880-915 MHz and 925-960 MHz bands and the band 790-862 MHz;
 - ER-GSM services;
 - Unmanned aerial vehicles (UAVs); and
 - Wind Profiling Radars (WPRs).

Figure 1: Spectrum use in the neighbourhood of the 870/915 MHz bands.



Technical comments raised in response to the 2009 consultation

- 3.3 In response to our 2009 consultation, users of adjacent spectrum said that their existing (and future) services needed protection from any new uses of the 872 MHz and 917 MHz bands.
- 3.4 Concerns were raised about the technical conditions and mitigation techniques associated with the option of licensing the 872-876 MHz and 917-921 MHz bands and protection to wideband mobile services such as UMTS in the band 880-915 MHz paired with 925-960 MHz previously reserved for GSM services. A number of responses argued that further analysis was required to assess the potential interference, coexistence and coordination problems and how these translated into real-life scenarios; the technical assumptions in relation to power limits and separation distances, the varying mitigation techniques that could be employed to reduce (interferer-to-victim) separation distances further and, as we said in our 2009 consultation (see paragraph 5.45), demonstrate that it is possible for the licence exempt services to co-exist together and with services in adjacent bands if licence exemption is to be considered.
- 3.5 Some respondents to our 2009 consultation suggested that we consider the European work in the CEPT and ETSI and the potential for a hybrid authorisation approach to co-channel sharing between GSM-R and SRD/RFID technologies.
- 3.6 We also note responses from NATS Ltd regarding filtering, the Met Office concern to protect WPRs operating in the band 915-917 MHz and from Intellect regarding the development of UAVs.

Compatibility with adjacent cellular services in the 880-915 MHz, 925-960 MHz and 790-862 MHz bands

- 3.7 Throughout Europe spectrum in the 900 MHz (880-915 MHz paired with 925-960 MHz) band is utilised by cellular 2G systems (GSM). Uplink transmissions from mobile user equipments are in 880-915 MHz and base station transmissions are in 925-960 MHz. This has already begun to be re-farmed in the UK for UMTS following liberalisation of that spectrum in 2010¹⁸.
- 3.8 Ofcom has also noted its intention to consult on varying licences in this band to permit the deployment of LTE and WiMAX technologies and intends to publish a consultation on this shortly¹⁹. Ofcom's competition assessment in relation to the forthcoming auction of spectrum in the 800 MHz and 2.6 GHz bands also assumes that the 900 MHz band would be available for the provision of services using LTE and/or WiMAX technologies use in the future. In addition, spectrum currently being awarded in the 800 MHz band will result in LTE transmissions from user equipment in 790-862 MHz.

Interference to SRDs from LTE

- 3.9 The CEPT has set out the parameters in preparation for an analysis of the interference potential from broadband LTE transmissions in adjacent bands into SRDs and RFIDs. Similar previous studies for interference between LTE and SRDs

¹⁸ <http://stakeholders.ofcom.org.uk/consultations/spectrumlib/advice-to-government/>

¹⁹ <http://stakeholders.ofcom.org.uk/binaries/consultations/variation-900-1800mhz-lte-wimax/statement/statement.pdf>

in other bands have identified the most critical co-existence scenario where LTE and SRD devices are closely co-located (referred to in CEPT studies as the “same room” scenario).

- 3.10 Ofcom has previously published a number of documents in relation to the use of SRDs alongside mobile broadband services operating in the 800MHz band. On 30 November 2011 we set out in an Information Update (the November Information Update)²⁰. We published the results of this coexistence study on 11 September 2012. In July 2012 we published our Information Memorandum on the award of 800 MHz and 2.6 GHz spectrum²¹. Paragraphs 3.37 to 3.46 of the Information Memorandum, consider the likely interference risk in relation to SRDs in the band 863-870 MHz. Much of the information we have published has been used to inform the work of CEPT and ETSI, including the work relating to the 870-876 MHz and 915-921 MHz bands and addressing the concerns raised by stakeholders to our 2009 consultation.
- 3.11 Our conclusion in the context of the 800 MHz band was that it is not appropriate to apply technical licence conditions to the 800MHz LTE licences to protect SRDs in the 863-870 MHz. This conclusion also applies to licence exempt SRD use of the 870-876 MHz band.

Protection of public cellular services in the 880-915 MHz, 925-960 MHz and 790-862 MHz bands

- 3.12 The ECC studies undertaken within CEPT, including draft ECC Report 189 and draft Report [WI41]²², use the technical characteristics and parameters provided by ETSI standards for public cellular services in the 790-862 MHz, 880-915 MHz and 925-960 MHz bands. As a result, the parameters and modelling methods used in the development of SRDs and RFID proposals are consistent with the protection of those public cellular services.

Compatibility with ER-GSM services

- 3.13 GSM-R is considered as a subset of PMR/PAMR under ECC/DEC (04)06²³. Wide Band Digital Land Mobile PMR/PAMR and the Railways GSM system is required to operate in the following frequency bands:
- 876 MHz to 915 MHz: mobile transmit, base receive; and
 - 921 MHz to 960 MHz: base transmit, mobile receive.
- 3.14 Network Rail is licensed in the UK to operate GSM-R services in 876-880 MHz and 921-925 MHz.
- 3.15 The technical parameters specified in the UK Radio Interface Requirement (IR2064)²⁴ are applied to achieve the desired level of compatibility between GSM-R and with other radiocommunications services, whilst promoting enterprise, innovation and competition. This UK Radio Interface requirement provides the necessary

²⁰ Use of Short Range Devices alongside mobile broadband services operating in the 800 MHz band <http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Update.pdf>

²¹ <http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/IM.pdf>

²² This report is still in development and CEPT has not yet assigned it a formal reference.

²³ <http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDEC0406.pdf>

²⁴ <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/research-guidelines-tech-info/interface-requirements/ir2064.pdf>

technical information and facilitates access to the GSM-R spectrum by making clear the assumptions that are made in planning the use of the GSM-R spectrum in the UK.

- 3.16 The Extended Railways GSM 900 system, which is known in the CEPT as ER-GSM, is required to operate within the following frequency bands:
- 873 MHz to 915 MHz: mobile transmit, base receive; and
 - 918 MHz to 960 MHz: base transmit, mobile receive.
- 3.17 ER-GSM is not used in the UK currently. However in our 2010 update we said that we should take account of work under way in Europe on the possibility of co-channel sharing between ER-GSM, SRDs and RFIDs before considering further the choice of authorisation approach for releasing the band, including the option for a hybrid approach, which was not considered in our earlier consultation.
- 3.18 These aspects of co-channel/co-frequency sharing and intra-SRD and RFID compatibility have been considered by CEPT and ETSI. Further detail of this work is given in Annex 5. In summary, the findings indicate that sharing between SRDs, RFIDs and ER-GSM will be technically feasible if mitigation methods are adopted, although we note that work is on going to specify the precise mechanisms to achieve this. It is our expectation that when the RFID standards are developed, the precise mechanism to allow sharing with ER-GSM will be incorporated within and will be based on the outcome of the CEPT studies. An important implication is that a licence exempt release could accommodate future licensing of ER-GSM.

Unmanned Aerial Vehicles (UAVs)

- 3.19 Deployment of Unmanned Aerial Vehicles (UAVs) was one potential use of the spectrum identified in our 2009 consultation and 2010 update. The CEPT Report [WI41]²⁵ concludes that the high altitudes of UAV operation means that line-of-sight conditions cannot be disregarded even at a larger distances, and that unless some mitigation mechanism is implemented in RFIDs they may create a very large interference potential to UAVs.
- 3.20 However, with the exception of non-operational trials for test and development purposes the bands are not used for UAVs in the UK and the Government has said that it has no plans to use the bands 870-876 MHz and 915-921 MHz for UAVs.

Wind Profiling Radars (WPRs)

- 3.21 The protection and co-existence requirements for WPRs are being considered by the CEPT and progress is included in Report [WI41]. In the UK, WPRs are operated by the Met Office. We understand that the Met Office wishes to retain spectrum access (previously negotiated with the MOD) for two existing (915 MHz) WPR sites near Camborne, Cornwall and on the Isle of Man.
- 3.22 The CEPT results reported so far show that without any mitigation techniques RFID emissions would constitute significant potential for disrupting the WPR receiver noise

²⁵ France has reported to the CEPT that it uses the frequency band 870-876 MHz for remote control of some types of UAVs flying at an altitude of 200m or lower for military and police purposes. See M65_44R0_SE24 Comments to Doc M65_36 on UAV_SRD sharing [[WI-41]_060(12)].

floor. We interpret this to mean that WPR receivers would be desensitized by the increase in the aggregate noise produced by RFIDs.

- 3.23 However, in practice WPRs are housed within enclosures that provide some isolation from interference. The CEPT studies have included mitigation in the form of penetration loss from the WPR antenna enclosures, as measured by our Baldock Technical Measurements Centre. The measured penetration loss is typically 10 dB. This figure has been used to refine the CEPT's modelling.

Section 4

Assessment of approach to releasing the spectrum

Introduction

- 4.1 This section sets out our assessment of the options for releasing the spectrum under consideration. Our aim is to identify the broad approach to release that is most likely to maximise the value to citizen and consumers from use of the band. At this stage we are not looking to assess the technical details of how this approach will be implemented as this will be the subject of a future consultation.
- 4.2 As noted in section 2, it is now increasingly clear that it will be feasible for a number of applications, including SRDs, RFIDs and ER-GSM, to share the 870-876 MHz and 915-921 MHz bands effectively. The specific proposals for spectrum access approved by ETSI, and currently being evaluated by CEPT, are: generic SRD, RFID and automotive SRD; smart meters; M3N and Smart Metering applications; alarms and social alarms; and assistive listening devices.
- 4.3 In the following discussion we therefore assess a licence exempt release which would allow SRD and RFID use. This approach would retain the option of licensing ER-GSM use in the future and of this use co-existing with licence exempt SRD and RFID use. We understand this option to be consistent with the direction of CEPT work.
- 4.4 We also consider alternative options of licensed release and light licensing. However, for the reasons set out below, we consider that a licence-exempt approach is likely to deliver the greatest benefits for UK citizens and consumers.
- 4.5 Our assessment assumes that the full 2x6 MHz (870-876 MHz and 915-921 MHz) is available to be released in the UK (subject to the retention of existing public sector uses in that band as noted in paragraphs 2.11 and 2.12), but we also consider whether our findings would be different if only 2x4 MHz (872-876 MHz and 917-921 MHz) were released.

Analysis of options

Licence exempt release

- 4.6 Under this approach we would proceed with the expectation of aligning UK technical conditions with those to be recommended by CEPT during 2013. Aligning with a licence exempt approach recommended by CEPT would help to ensure that economies of scale²⁶ in equipment manufacturing could be achieved. It would also enable compatibility between systems e.g. in the tracking of goods transported between the UK and other European countries.
- 4.7 Nonetheless, when considering the technical details of implementing the CEPT recommendations in the UK (as part of a further consultation) Ofcom would need to

²⁶ We note that these may not be achieved across all CEPT countries, as according to a recent ECO presentation, government services currently occupy all or parts of the 870-876/915-921 bands in 11 of 48 CEPT member countries.

consider whether the recommendations should be adopted fully in the UK, or whether any divergence would be appropriate to maximise the net benefit that could be achieved for citizens and consumers from use of these bands in the UK.

- 4.8 We expect that a licence exempt approach will have the following characteristics (also see Annex 5, figure A5.2):
- i) Technical conditions which enable the widest range of SRD applications, including smart metering;
 - ii) RFID use in the upper band;
 - iii) Sufficient restrictions on power and duty cycles to avoid imposing costs to adjacent cellular services; and
 - iv) The ability to co-exist with ER-GSM (in 873-876 MHz and 918-921 MHz bands) if that is licensed in the future.
- 4.9 Since low powered uses can share the spectrum, the value of a CEPT-aligned approach is, broadly, the sum of all the values for these individual uses. This is one of the main advantages of a licence exempt approach. It could also enable some additional benefit from ER-GSM use if that were to be licensed in the future. The main types of potential uses that would be consistent with a licence exempt release (SRDs, RFIDs, and ER-GSM) are considered in more detail below.
- 4.10 One note of caution with introducing licence exempt use for any spectrum is that such decisions are unlikely to be easily reversible. This is because it may not be easy to identify who, and what equipment, is using the spectrum or where, since devices are likely to be mobile and transitory. Therefore if, for example, international, technological or market developments mean that a highly valued use which cannot be accommodated in a licence exempt approach emerges in the future, it may be difficult to remove existing licence exempt users of the band and change the use. However, this seems relatively unlikely given that a high value alternative has not clearly emerged during the several years during which this spectrum has been available and consulted on.

Applications

Short Range Devices (SRDs)

- 4.11 SRDs can be used for a wide range of machine-to-machine applications (M2M) such as alarms, home automation and smart metering.
- 4.12 M2M is an area of increasing importance in terms of connections and revenues. Since our last consultation there has been considerable growth in the M2M communications sector, with revenues growing by nearly a quarter in 2011, and analysts are forecasting continued strong growth.²⁷ Although some of this growth will be in traffic carried by the cellular mobile network operators (MNOs), some will be

²⁷ Machina Research predicts that M2M connections will grow from 1 billion in 2010 to 12 billion in 2020 (M2M Global Forecast and Analysis 2010-20); see also Analysys Mason: Impact of radio spectrum on the UK economy and factors influencing future spectrum demand, page 74.

carried by other networks. For example one analyst has said that MNOs realised a small proportion of M2M revenues, of just 4% in 2011.²⁸

- 4.13 If the 870-876 MHz and 915-921 MHz bands are made available for licence exempt use, we expect that SRDs will be able to operate at a relative mix of higher power and longer duty cycles than is currently the case in the 863-870 MHz band, as a result of improved technology for managing in band and out of band interference. ECC Report 181²⁹ sets out a range of techniques for mitigating interference and improving spectrum efficiency.
- 4.14 In addition, there will be greater application neutrality in 870-876 MHz and 915-921 MHz, based on the principles set out in ECC Report 181: different applications will not be tied to specific channels, with the result that individual devices will have access to a wider bandwidth than at present. This greater flexibility could allow greater opportunities for innovation in the use of SRDs than is currently possible.
- 4.15 One particular area of M2M communications that has been highlighted as important is the energy / utilities sector. A recent report by Analysys Mason for BIS and DCMS notes that M2M connections in this sector are forecast to grow at a 50% over the next decade. According to Analysys Mason, this growth is driven by regulatory changes and the benefits of for firms accessing more granular demand and supply side data in near real time to reduce costs and increase service offerings.³⁰ One potential application for the spectrum being released is for smart metering communication.
- 4.16 In this context a specific initiative of relevance is the Government's Smart Metering Implementation Programme. This has the aim of rolling out 53 million smart electricity and gas meters to all domestic properties and smart or advanced meters to small and medium non-domestic sites in Great Britain by 2019³¹. As part of that programme DECC is also currently procuring the wide area³² communication systems for smart metering, with the appointment due to be made by July 2013. The technologies providing the basis for the Wide Area Network (WAN) roll out will be determined by this procurement process.
- 4.17 DECC currently estimates that the total value from smart meter roll-out to residential users is significant, with £4.8 billion benefits to 2030 on a NPV basis, on costs of £10.8 billion³³. If this spectrum were used for smart metering and led to even a small reduction in these costs then the benefits from this use could be significant.
- 4.18 In conclusion, we consider there is scope for substantial benefits from enabling SRD use in the 870 MHz and 915 MHz band for a range of applications.

²⁸ Machina Research: M2M Global Forecast and Analysis, cited in figure 5.42 of Ofcom's 2012 Communications Market Report.

²⁹ <http://www.eroocdb.dk/Docs/doc98/official/pdf/ECCREP181.PDF>

³⁰ Analysys Mason: Impact of radio spectrum on the UK economy and factors influencing future spectrum demand, page 85.

³¹ <http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/6505-smart-meters-government-response-to-the-consultati.pdf>

³² Distinct from the Home Area Network (HAN) for smart meters discussed in section 2.

³³ See <http://www.decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4906-smart-meter-rollout-domestic-ia-response.pdf>

Radio Frequency Identification (RFID) systems

- 4.19 The growth of RFID systems appears to have been more rapid than previously expected: in 2006, EPCglobal³⁴ predicted tag sales would grow from 200 million to almost 1.2 billion in 2012, but a different source³⁵ suggests figures were around 1.2 billion by 2010.
- 4.20 EPCglobal France more recently completed a study showing demand for additional spectrum allocations for RFID at 915-921 MHz. The study, based on inputs from 16 French users, predicted a substantial increase in the number of applications within the next two years. It said that in addition to logistics and warehouse management, RFID would be deployed in new applications such as customer services and transport.
- 4.21 UK research firm IDTechEx estimates that the value of the global RFID market will be USD7.5 billion (£5.1 billion) in 2012, up 17% from USD6.4 billion (£4.1 billion) in 2011³⁶. As an illustration, if the UK accounted for around 3.5% of this value (consistent with its share of world output), the value in the UK would be around £170 million. In response to our August 2009 consultation, GS1UK said that UHF RFID use was growing steadily in the UK, and cited examples of adoption by Marks and Spencer, C&A and others. Nedap also said there was a growing interest in use of RFID for inventory control in the clothing sector.
- 4.22 In this context, an improvement in RFID quality which increases the value generated by these devices and/or led to faster adoption of RFID systems has the potential to generate significant benefits. In particular, the use of RFIDs in the 915-921 MHz range has the potential to deliver benefits compared to their current use at 865-868 MHz in the UK due to performance improvements and economies of scale.
- 4.23 Performance improvements arise because tags that are used globally are manufactured with their centre frequencies tuned to around 915 MHz. Operation near the ideal frequency means tag signals should be stronger, increasing the reading performance. A 2008 ETSI Technical Report estimated that, by comparison with the limit of 2 W e.r.p. in the current frequency range of 865 MHz to 868 MHz, an increase in the limit to 4 W e.r.p. in the new proposed frequency range of 915 MHz to 921 MHz would lead to the remote identification reading range increasing by approximately 40% and the reading performance increasing by 70 to 100%³⁷. Draft ECC Report 189 suggests the move will potentially permit data rates that are four times faster than those currently possible.
- 4.24 In practice this means that reliability could be improved for applications such as tracking airport baggage and pallets of goods in warehouses. RFID tags can be missed if they are far from the reader (for example in large bundles). Our understanding is that the improved performance could therefore lead to existing logistics operations becoming more efficient. A further benefit would arise if improved performance resulted in RFID tracking being introduced in situations where it was previously not considered sufficiently reliable.

³⁴ A joint venture between GS1 and GS1 US, which aims at worldwide adoption and standardization of Electronic Product Code (EPC) technology.

³⁵ IDTechEx; both quoted in a draft ECC report 189.

³⁶ Cited by Analysys Mason, Impact of radio spectrum on the UK economy and factors influencing future spectrum demand, 5 November 2012, page 47.

³⁷ See Appendix B, page 44

http://www.etsi.org/deliver/etsi_tr/102600_102699/10264902/01.01.01_60/tr_10264902v010101p.pdf

- 4.25 Many of applications identified by EPCglobal France involve item level tagging at source, which will require better reading performance than is presently possible at 865–868 MHz. For example, their study concluded that RFID use is moving towards warehouse applications where all products will be tagged, and typically a pallet may comprise 1000 different products. Their view was that using the present band 865–868 MHz, RFID will be incapable of reading all tags on a pallet within an acceptable length of time, and that higher data rates (which will be achievable in 915-921 MHz) will increase the number of tags that can be read.
- 4.26 Alignment with the spectrum adopted in North America for this use (902-928 MHz) would also be expected to reduce costs through economies of scale. This could result in an increase take up of RFIDs by retailers. In addition, there are expected to be benefits from RFID equipment being interoperable across Europe and globally. In response to our 2009 consultation, GS1UK suggested that this is especially the case “because of the cross-border nature of fast moving consumer goods (FMCG) supply chains both within the EU and globally.”

ER-GSM

- 4.27 GSM-R is an international GSM-based standard, used for wireless communication between train and railway regulation control centres, which in Europe currently operates in the 2x4 MHz band above the 870 MHz and 915 MHz bands (i.e. 876-880 MHz and 921-925 MHz). An extension is currently being contemplated, known as ER-GSM, which could enhance the capacity and capability of the current service.
- 4.28 In the UK, Network Rail has previously suggested that the GSM-R band is congested in some geographical areas and expressed interest in an extension into the top 2x3 MHz of the 870 MHz and 915 MHz bands (i.e. 873-875 MHz and 918-921 MHz). At the time of our 2009 consultation it was not clear whether ER-GSM would be able to effectively share with licence exempt SRD and RFID use within these bands. However, as discussed in Section 3 (and detailed in Annex 5), work undertaken within CEPT since 2009 now indicates that this sharing will be technically feasible if mitigation methods are adopted.
- 4.29 At this stage we are not planning to award licences for ER-GSM use of this band and we note that the relevant standards are still in development. Nonetheless we consider that there are potential benefits from enabling ER-GSM to share 873-876 MHz and 918-921 MHz in the future. This co-existence may require technical restrictions on some other uses sharing the spectrum, for example smart meters located near railway tracks in urban areas or the implementation of mitigation techniques. BNetzA, the German regulator, has facilitated trials assessing the extent of restrictions required in such circumstances. These studies have been forwarded to the CEPT for inclusion within the technical study SE24 [WI-41]. Therefore any future decision to authorise ER-GSM would need to take into account any resulting loss in value from reduced service capabilities or increased equipment costs for SRDs and RFIDs.

Alternative approaches

Fully licensed

- 4.30 This approach would award an individual licence, probably national in scope, to use the spectrum at a higher power level than permitted by licence exemption. To protect neighbouring bands however, relatively stringent power restrictions would still apply.

We would expect to award this via an auction, in accordance with our general policy of making use of market mechanisms³⁸.

Applications

- 4.31 Previously we considered a main candidate to be ER-GSM under this approach on based on the assumption that its co-existence with licence exempt use was unlikely³⁹. Our current view, however, is that co-existence is feasible. We also noted that a TETRA based network might be built, but given the absence of expressed interest we now see this as unlikely.
- 4.32 Consequently, the most likely use that requires a licensed approach would be a national mobile broadband network. Ofcom's recent UHF Strategy statement⁴⁰ set out our view that we expect strong demand for increased mobile broadband capacity in the coming years. However, the value of the 870 MHz and 915 MHz bands for this purpose is likely to be greatly limited because:
- i) these bands are not harmonised internationally for mobile broadband use, and
 - ii) technical constraints on the spectrum which would severely limit the power at which it could be operated.
- 4.33 We therefore consider that licensed use of the band for mobile broadband is unlikely to be practical and therefore enabling this use is unlikely to deliver significant benefits to consumers. In addition we note that, since we anticipate a Europe-wide adoption of licence exemption for this spectrum, based on a CEPT recommendation, a licensed approach would also need to face issues of interference from equipment roaming from elsewhere in the EU.

Light licensing

- 4.34 The 2009 consultation considered the possibility of a 'light licensing' regime. Under such a regime users of a band are awarded non-exclusive licences which are typically available to all and are either free or only have a nominal fee attached to them. This was based on assumptions of the type of apparatus that may be used in the band above 915 MHz. However, the types of systems now envisaged by the CEPT studies include a number of mitigation or politeness techniques. These techniques can diminish the coordination distance or the time interval of any interference. In view of the increased scope to address the risk of interference, our current view is that there is no longer a case for light licensing, as opposed to licence exempt use.

Conclusion

- 4.35 A licence exempt approach will allow a range of potential uses as outlined above. Indeed it appears likely that it would be consistent with most or all of the major potential uses of the band (including retaining ability to licence ER-GSM in the future).

³⁸ See Ofcom's Spectrum Framework Review

http://stakeholders.ofcom.org.uk/binaries/consultations/sfr/statement/sfr_statement

³⁹ See the 2009 Consultation

http://stakeholders.ofcom.org.uk/binaries/consultations/872_876_mhz/summary/872_condoc.pdf

⁴⁰ <http://stakeholders.ofcom.org.uk/consultations/uhf-strategy/>

- 4.36 We recognise that there is some uncertainty about whether some of these potential uses, such as ER-GSM or smart metering, will materialise and about the scale and value of use by other applications such as SRD and RFID. However, overall we consider that a licence exempt approach offers substantial scope for this spectrum to be put to valuable use. As regards the alternative uses we have considered, full licensing appears unlikely to be practical and we consider that there is no longer a case for a light licensing approach.
- 4.37 Consequently, our assessment is that releasing the spectrum on a licence exempt basis is likely to generate greater value for the UK citizens and consumers than alternative approaches.
- 4.38 We also consider that our assessment of the approach to release 2x6 MHz is likely to apply equally to a release of 2x4 MHz; that is 872-876 MHz and 917-921 MHz. Although the value that could be realised for the SRD and RFID uses identified above is likely to be reduced if there were less spectrum available, the relative assessment of different approaches to release would not change. Consequently, if Government does not release part or all of the bands 870-872 MHz and 915-917 MHz to Ofcom then we would propose to proceed with a licence exempt release of the bands 872-876 MHz and 917-921 MHz.

Equality Impact Assessment

- 4.39 Ofcom is required by statute to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. Equality Impact Assessments (EIAs) also assist us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers regardless of their background or identity. It is not apparent to us that the outcome of our proposed approach for the release of 870 MHz and 915 MHz spectrum is likely to have any particular impact on race, disability or gender equality. Specifically, we do not envisage the impact of any outcome to be to the detriment of any group of society.

Question 2. Do you have any additional information or analyses that could help to inform our assessment of the value that could be created through different uses of the spectrum?

Question 3. Do you agree with our proposal to release 870-876 MHz / 915 -921 MHz for licence exempt SRD and RFID applications if Government releases 870-872 MHz / 915-917 MHz?

Question 4. Do you agree with our proposal to release 872-876 MHz / 917-921 MHz for licence exempt SRD and RFID applications if Government does not release 870-872 MHz / 915-917 MHz?

Section 5

Next Steps

- 5.1 Following consideration of comments from stakeholders and confirmation from Government on the future of 870-872 MHz and 915-917 MHz we plan publish our decision on our approach to releasing the bands, that is whether we intend to implement a licence exempt release of the spectrum as outlined in this consultation or adopt an alternative approach, in the second quarter of this year.
- 5.2 If our decision is to implement a licence exempt release of this spectrum, then there are a number of factors which are relevant to the timing of our following steps:
- First, there are potential benefits from providing information about the release of this spectrum to inform the Smart Meter Implementation Programme, with mass roll out of smart meters expected from late 2014.
 - Second, early decisions will allow for the necessary regulations to be brought forward on a timely basis – helping support any related technology deployments.
 - Third, the details of the CEPT recommended position will not be finalised until Q1 2014 although there will be progressively more certain proposals in the run up to that point. In particular, we anticipate that the CEPT will finalise any changes to Recommendation 70-03 in the autumn of 2013 and seek to approve these in January 2014. Given that there could be material benefits from aligning a UK licence exemption with that adopted in other CEPT countries, we would not implement the UK regulation until the CEPT position was clear. This will avoid the specification of UK licence exempt devices inadvertently differing from those in other CEPT countries.
 - Fourth, in implementing the UK release we will need to be clear whether the 2x2 MHz of spectrum at 870-872, 915-917 MHz currently managed by Government is also to be released. This is the subject of discussion within Government at present and we currently anticipate the position to become clear within Q1 2013.
- 5.3 Taking these factors into account, we anticipate that our subsequent steps would then comprise:
- a further consultation on the technical details of implementing licence exemption in the UK in Autumn this year. This would be timed to take into account both CEPT reports, ECC Report 189 and the SE24 Report, following their completion;
 - a statement on the technical details of UK implementation together with a Notice and draft regulations that implement the licence exemption in Winter 2013/4; and
 - implement the exemption regulations in Spring 2014.
- 5.4 In the time up to the implementation of release in 2014, the spectrum will continue to be available for non-operational uses. Non-operational licences aim to promote the development and trialling of innovative uses of the radio spectrum in the UK, including the testing, development, trials and demonstration of radio equipment. They do not allow commercial use. This licensing may be particularly relevant in this case given that the spectrum is largely unused at present and because there are new

applications (as discussed in this consultation) that might benefit from development and trialling ahead of the spectrum being released.

5.5 Our provisional timetable is summarised below.

Table 1.1. Our provisional timetable

	Date
Publication of consultation on approach to release	23 January 2013
Consultation closes	28 March 2013
Publish statement on approach to release	Q2 2013
Consultation on technical details of exemption (if we decide on licence exempt release)	Autumn 2013
Publish Statement and Notice with draft regulations	Winter 2013/4
Implementation of regulations	Spring 2014

Question 5. Do you have a view on the sequencing and timing of Ofcom's next steps if the spectrum is released for licence exempt SRD and RFID applications?

Annex 1

Responding to this consultation

How to respond

- A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 28 March 2013**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <http://stakeholders.ofcom.org.uk/consultations/870-915/howtorespond/form>, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email stephen.jones@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 Responses may alternatively be posted or faxed to the address below, marked with the title of the consultation.
- Steve Jones
3rd Floor
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- Fax: 020 7981 3333
- A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

- A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact stephen.jones@ofcom.org.uk.

Confidentiality

- A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether

all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

- A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at <http://www.ofcom.org.uk/about/account/disclaimer/>

Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in Q2 2013.
- A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/static/subscribe/select_list.htm

Ofcom's consultation processes

- A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.
- A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.
- A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing

☐

Name/contact details/job title

☐

Whole response

☐

Organisation

☐

Part of the response

☐

If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

☐

Name

Signed (if hard copy)

Annex 4

Consultation questions

Question 1. What other developments, in addition to the international and public sector developments we have identified, are relevant to our identification and assessment of options for release?

Question 2. Do you have any additional information or analyses that could help to inform our assessment of the value that could be created through different uses of the spectrum?

Question 3. Do you agree with our proposal to release 870-876 MHz / 915 -921 MHz for licence exempt SRD and RFID applications if Government releases 870-872 MHz / 915-917 MHz?

Question 4. Do you agree with our proposal to release 872-876 MHz / 917-921 MHz for licence exempt SRD and RFID applications if Government does not release 870-872 MHz / 915-917 MHz?

Question 5. Do you have a view on the sequencing and timing of Ofcom's next steps if the spectrum is released for licence exempt SRD and RFID applications?

Annex 5

Technical compatibility studies

Introduction

- A5.1 In this annex we provide an overview of the progress of various technical compatibility studies that are being conducted by the ECC and the CEPT.
- A5.2 The information presented in this annex is taken from the most recent studies available including draft ECC Report 189 and the CEPT's draft Report [WI41] on the "Impact of SRD and RFID applications on radio services and their co-existence in the frequency bands 870-876 MHz and 915-921 MHz"; from work within the European Telecommunications Standards Institute (ETSI) and from studies and information published by Ofcom.
- A5.3 The CEPT's report provides significant detail of the methods used for the compatibility and co-existence studies. Another issue treated by the CEPT studies is the anticipated deployment densities of the various types of SRD. Neither the study methods nor the use of or derivation for the anticipated density of deployment information for SRDs is reproduced here.

Technologies and uses being evaluated

- A5.4 The CEPT Project Team (SE PT 24) is currently evaluating the five proposals for spectrum access in 870-876 MHz and 915-921 MHz that have been drawn up, collated and approved within the ETSI.
- ETSI Systems Reference Document TR 102 649-2 – Generic SRD, RFID and automotive SRD.
 - ETSI Systems Reference Document TR 102 886 – Smart meters.
 - ETSI Systems Reference Document TR 103 055 - Metropolitan Mesh Machine Networks (M3N) and Smart Metering (SM) applications.
 - ETSI Systems Reference Document TR 103 056 – Alarms and Social Alarms.
 - ETSI Systems Reference Document TR 102 791 - Assistive Listening Devices (awaiting amendment for digital systems).

Scope of CEPT compatibility and co-existence studies

870-876 MHz:

- A5.5 In-band inter-system co-existence studies between SRD and ER-GSM use. This will establish the possibility and scope for sharing and any impact on the overall range of SRD use within the limits of 870-876 MHz as well as the proposed splitting into two sub-bands for SRD use.
- A5.6 Adjacent-band inter-system co-existence studies at 876 MHz between SRD and R-GSM. The Project Team has not yet decided whether this aspect requires investigation.

- A5.7 Intra-SRD sharing (i.e. between different SRD applications, including Smart Metering and M3N) studies within 870-876 MHz. This focuses on different SRD applications in order to establish the minimum [mitigation] mechanisms necessary (LBT/AFA, LDC, FHSS, etc.) for their co-existence.
- A5.8 In-band, intra-system studies with any other residual uses of the band such as defence systems, Tactical Radio Relay links, UAVs and nationally implemented CDMA and similar Broadband Wireless Access (BWA) networks.

915-921 MHz:

- A5.9 In-band, inter-system co-existence studies between SRD/RFID and ER-GSM. This will establish the potential for sharing and the types of SRD/RFID use within the band 915-921 MHz.
- A5.10 Adjacent-band, inter-system co-existence studies below 915 MHz between SRD/RFID and GSM/LTE and above 921 MHz between SRD/RFID and R-GSM.
- A5.11 Intra-SRD sharing (i.e. between RFID and SRD applications) studies within 915-921 MHz in order to establish suitable mitigation techniques (AFA, LDC, etc.) for their internal co-existence.
- A5.12 In-band intra-system studies with any other residual users of the band, such as defence systems and nationally implemented BWA networks – subject to national requests and provision of suitable information.

A5.13 The table below identifies those areas of compatibility study that have been or are currently being evaluated by the CEPT.

Preliminary summary of SRD studies completed in CEPT

	870-873 MHz	873-876 MHz	915-918 MHz	918-921 MHz
Radio services to be considered	(French) UAV, (German) TRR	GSM-R Uplink	(French) UAV, (German) TRR, Other, Adjacent channel issues	GSM-R downlink
RFID	N/A	N/A	<ul style="list-style-type: none"> • Compatibility not possible without mitigation techniques. Protection zones without mitigation would be 35km. • There are ongoing studies to assess the effect of DAA and APC as suitable mitigation. • The impact from the mobile uplink below 915 MHz should also be assessed 	<ul style="list-style-type: none"> • Studies finalised, solution based on a sensing procedure
SRDs	<ul style="list-style-type: none"> • Compatibility not possible without mitigation techniques; Protection zones without mitigation would be 35km. • There are ongoing studies to assess the effect of DAA and APC as suitable mitigation. 	<ul style="list-style-type: none"> • Compatibility will be possible provided mitigation techniques are deployed in the SRD apparatus. • Further, compatibility will be achieved for low deployment figures of SRD apparatus utilising a specific very low Duty Cycle, based on the results of Berlin measurements • There are ongoing studies to assess the effect of DAA and APC as suitable mitigation. These studies are 	<ul style="list-style-type: none"> • Compatibility not possible without mitigation techniques; • Protection zones without mitigation would be 35km. • There are ongoing studies to assess the effect of DAA and APC. • The impact from the mobile uplink below 915 MHz should also be assessed 	<ul style="list-style-type: none"> • Studies are expected to be completed by March 2013

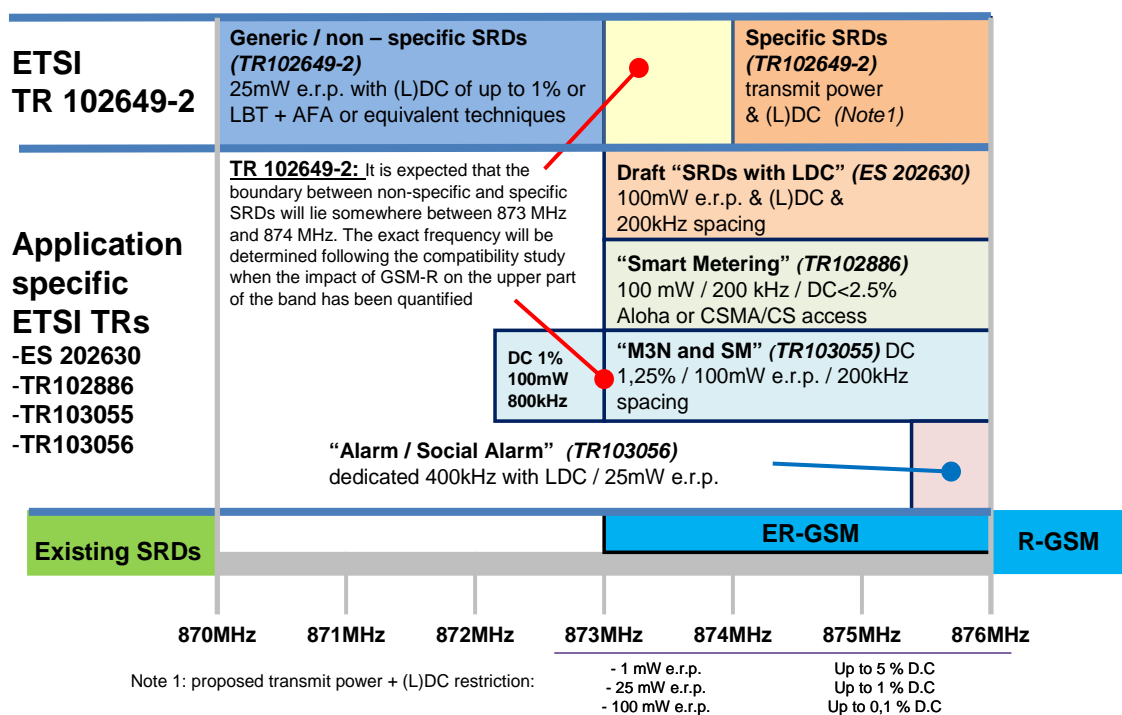
		expected to be completed by March 2013.		
Intra SRD discussion	<ul style="list-style-type: none"> How the band is arranged for SRD needs to be concluded 		<ul style="list-style-type: none"> The need or otherwise for coexistence studies between RFID and SRDs has yet to be agreed How the band is arranged for SRD needs to be concluded. 	

APC means Automatic Power Control
DAA means Detect and Avoid

Band plans

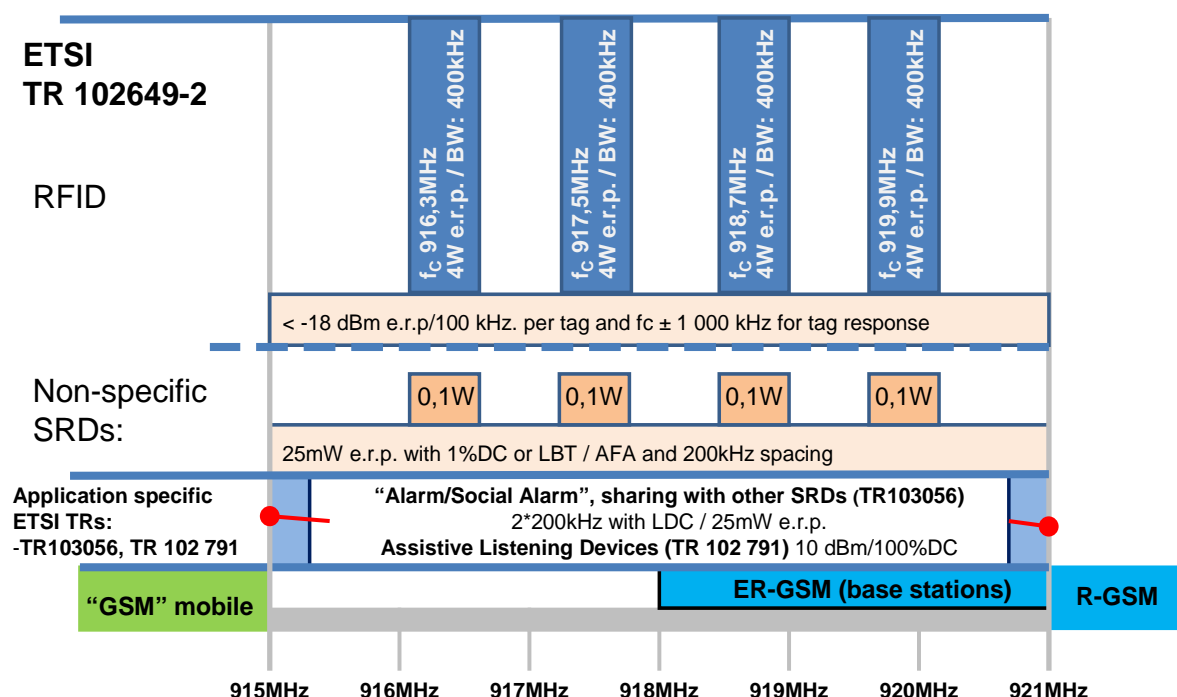
A5.14 The original vision for the frequency bands 870-976 MHz and 915-921 MHz is defined in TR 102 649-2. From the latest SRD/RFID requirements, CEPT has re-drawn the proposed bands 870-876 MHz and 915-921 MHz (Figures. A5.1 and A5.2 below). This re-drawing of the bands helps to visualise where each of the proposed uses may be implemented if the CEPTs current proposals are adopted including the technical conditions for co-existence.

Figure A5.1 CEPT proposed arrangement for the band 870-876 MHz



A5.15 Source: ECC Report [WI41]. Summary of TRs outlining SRD requirements in the band 870-876 MHz. Note: where the figure refers to DC this means duty cycle, which is the ratio of the pulse duration and the pulse repetition time period over any one single hour, expressed as a percentage in this case.

Figure A5.2 CEPT's proposed arrangement for the band 915-921 MHz



A5.16 Source: ECC Report [WI41]. Summary of TRs outlining SRD/RFID requirements in the band 915-921 MHz. Note: where the figure refers to DC this means duty cycle, which is the ratio of the pulse duration and the pulse repetition time period over any one single hour, expressed as a percentage in this case.

GSM-R and ER-GSM

SRDs and GSM-R bearers

A5.17 Whilst we note that the CEPT's work is still not concluded its investigations into the feasibility of sharing between SRDs and GSM-R bearers have shown that:

For transparent data bearers

- Aggregate interference activity that can be withstood (both setting up calls and established bearers) into a victim operating towards the limit of its performance envelope lies between 15 and 25%. This appears to be true irrespective of the interfering power. The impact of the duration of individual transmissions is inconclusive, but keeping transmissions below 20ms would appear to be sensible.
- Operation (up to 100% duty cycle) in adjacent and next adjacent channels is feasible, but the protection ratio (C/I) for the former should be at most -25 dB (eg -65 dBm adjacent channel interferer into a victim receiving -90 dBm) in order for calls to be able to be set up reliably. The protection ratio for next adjacent channel is -65 dB.

For voice bearers

- Aggregate interference activity that can be withstood (both setting up calls and established bearers) into a victim operating towards the limit of its performance envelope lies around 10%. This appears to be true irrespective of the interfering power. Again, the impact of the duration of individual transmissions is inconclusive, but transmissions of up to 40 ms appear feasible.
- Operation (up to 100% duty cycle) in adjacent and next adjacent channels is feasible with a protection ratio of at least -65 dB.
- Comparing the results of practical stress tests the CEPT concludes that co-existence between a mix of application-specific SRDs and GSM-R might be feasible, because the simulated probability of interference lies within the tolerable limits observed during practical tests. However, the practically established limits on length of individual SRD transmissions (as verified during both Kolberg and Berlin tests) need to be observed during design and operation of respective SRD applications allowed to operate in co-channel mode in the band 873-876 MHz.

Adjacent band interference from SRD around 876 MHz

- A5.18 In its studies, the CEPT modelling shows that the probability of SRD interference to ER-GSM reception in the adjacent band is negligible at around 0.4% and does not much depend on the size of SRD operational sub-bands in the 870-876 MHz range. These results relate well with the results of practical testing, which showed that a GSM-R receiver can tolerate the presence of adjacent interfering signals exceeding the wanted signal by up to 25 dB in the first adjacent channel and up to 65 dB in the following.
- A5.19 The results of a co-existence test between ER-GSM and RFIDs are described in ETSI TR 101 537 V1.1.1 (2011-02). These tests were undertaken at the BNetzA Test Laboratory at Kolberg to determine the parameters necessary to permit RFID to share the band 918 MHz to 921 MHz with ER-GSM.

RFID vs. ER-GSM: co-existence without mitigation techniques

- A5.20 Summarising the material presented by the CEPT report [WI41], for a protection criterion signal-to-interference ratio (SIR) of 0 dB, 100kHz offset between RFID and the ER-GSM channels and a minimum signal level of -86 dBm at the ER-GSM mobile, the following conclusions may be reached:
- Co-channel operation of the RFID interrogators and the ER-GSM downlink in the band 918-921 MHz should be avoided due to the large protection distances required.
 - For the protection of ER-GSM mobiles from RFID interrogators a frequency offset of $\geq 700\text{kHz}$ is required assuming a separation distance of more than 20m.
 - The avoidance procedure for RFID interrogators should be specified:
 - Manually (e.g. just the bands below 918 MHz to be used);
 - Or a dynamically (using DAA) where the threshold levels and the timing should be specified.

- For the protection of ER-GSM mobiles from RFID tags the following protection distances are necessary:
 - for outdoor Tags between 40 m (NLOS conditions, propagation exponent 3.5) and 260 m (LOS conditions);
 - for indoor Tags between 20 m (NLOS conditions, propagation exponent 3.5) and 80 m (LOS conditions);
 - In a multiple tag scenario, the average power transmitted by an RFID tag over its interrogation cycle is one third of its maximum value, which corresponds to a reduction of 4.8 dB. Since the maximum possible power from a tag while transmitting is -15 dBm/200 kHz, its average power over an interrogation cycle will be -19.8 dBm/200 kHz. This equates to a reduction in the worst case protection distances of approximately 60% of the values shown above.
 - This may be seen as acceptable as the use of this application is predominantly indoor.
- There is no impact from the proposed two RFID channels in the band 915-918 MHz (916.3 MHz and 917.5 MHz) on ER-GSM mobiles. Furthermore the 3 upper ER-GSM channels in the 918–921 MHz band are also free from interference from RFID. However, the impact on other services in this band should be analysed (e.g. tactical radio relay⁴¹, UAV) before this band can be seen as “interference free”;
- No harmful interference is expected to the GSM band below 915 MHz due to the frequency separation.

The impact of RFID on ER-GSM with mitigation techniques

A5.21 From the previous section it follows that RFID needs to avoid any co-channel interference in the ER-GSM band 918-921 MHz. Proposals for the avoidance procedure are provided in an updated version of ETSI TS 102 902 V1.2.2, which was adopted by ETSI TC ERM for publication in November 2012. Additionally the results of a demonstration of principal of the mitigation technique are described in ETSI TS 102 903 V1.1.1 (2011-08). The latter document also describes the various compliance tests necessary to verify proper operation of the proposed mitigation technique for inclusion in an ETSI standard.

Summary and conclusions on RFID vs. ER-GSM coexistence

Coexistence without mitigation techniques

- A5.22 Assuming a protection criterion SIR of 0 dB and 100kHz offset between RFID and the ER-GSM channels, the following can be summarised:
- Co-channel operation of the RFID interrogators and the ER-GSM downlink in the band 918-921 MHz needs to be avoided due to the large protection distances required;

⁴¹ Note. The UK does not use tactical radio relay services. The UK uses of the band for UAVs under test and development , non-operational licensing arrangements.

- For the protection of ER-GSM mobiles from RFID interrogators a frequency offset of $\geq 700\text{kHz}$ is required assuming a separation distance of more than 20m;
- For the protection of ER-GSM mobiles from RFID tags protection distances of up to some 60 m are necessary (see clause 5.1.2.3). This may be seen as acceptable as the use of RFID applications is predominantly indoors;
- No impact is expected from the two proposed high power RFID channels in the band 915-918 MHz (916.3 and 917.5 MHz) on ER-GSM mobiles (NB: the centre frequency of the lowest ER-GSM channel is 918.2 MHz);
- Also no harmful interference is expected to the GSM band below 915 MHz due to the frequency separation.

A5.23 The results of some practical tests at an operational site between ER-GSM and RFID are reported in draft TR 101 602. These tests were carried out with modified interrogators that were fitted with DAA operating in accordance with the proposed mitigation technique. The results showed that RFID can share the band with ER-GSM without causing unacceptable interference.

Downlink detection

A5.24 The CEPT results show that, with a threshold value of -98 dBm, the ER-GSM mobile is protected in most cases.

Uplink detection

A5.25 The CEPT studies concluded that it was possible to validate the threshold values proposed in ETSI TS 102 902 under the assumption that the max acceptable interference power received by the ER-GSM mobile is -86dBm. This means that a SIR of 0dB (which comes from the proposed channel offset of 100 kHz)) and minimum signal strength of -86 dBm might be acceptable. For the usual minimum signal strength of -96 dBm the threshold values should be 10 dB more stringent.

Wind Profiler radars

A5.26 The Met Office currently operates two WPRs in the 915-917 MHz band.

A5.27 In the CEPT study (Report [WI41], section 5) it has been assumed WPR installations may be surrounded by RFIDs. We understand that the Met Office wishes to retain spectrum access for the operation of wind profilers (previously negotiated with the MOD). The results reported in the CEPT Report [WI41] show that without mitigation techniques that are already in place, the RFID emissions would constitute significant potential for disrupting a WPR receiver's noise floor.

A5.28 The CEPT studies have assumed that WPR emission power escaping the antenna enclosure in horizontal plane are in the order of 17 dBm/2500 kHz or 9 dBm/400 kHz, hence the RFID Receiver Detect-And-Avoid sensing threshold of some -95 dBm/400 kHz should allow maximum detection path loss of some 105 dB or reliable detection distance at some 100-200 m (assuming Hata-rural propagation model). However, this protection level is reduced for two reasons:

- The antenna beam is attenuated by approximately 18 dB at angles up to about 11° from horizontal. Therefore, if RFIDs are assumed to be ground based or near

ground based, an additional 18 dB of attenuation can be assumed in path loss to the radar receiver.

- Further, the UK installed WPRs are fitted within a screened enclosure intended to provide a very high level of attenuation off-axis. The Ofcom Baldock Technical Measurements Centre have very recently completed measurements on the screening isolation (loss) from WPR enclosures and found the result to be typically 10 dB.

- A5.29 The protection and co-existence requirements for WPRs, including the measured screen attenuation, are being considered by the CEPT. The CEPT studies have assumed that WPRs might be operated in populated areas, e.g. suburban zones, where also typically various industrial and warehousing operations may take place. Hence it would be logical to assume that WPR installation may be surrounded by, e.g. warehouses using RFIDs, i.e. corresponding to a “same operational area” scenario.
- A5.30 The two WPRs are currently operated by the Met Office at Camborne, Cornwall and the Isle of Man are in rural rather than sub-urban areas. We understand that the Met Office wishes to retain spectrum access for the operation of wind profilers (previously negotiated with the MOD).
- A5.31 The CEPT results reported so far show that without any mitigation techniques RFID emissions would constitute significant potential for disrupting the WPR receiver noise floor. We interpret this to mean that WPR receivers would be desensitized by the increase in the aggregate noise produced by RFIDs.
- A5.32 The CEPT studies say that if RFIDs were to use a DAA mitigation mechanism, this should help avoiding the first of four RFID channels because the RFID receiver would detect the presence of WPRs.
- A5.33 The CEPT studies have also considered mitigation in the form of penetration loss from WPR antenna enclosures, but these studies assume that the emission power escaping the WPR antenna enclosure in horizontal plane to be in the order of 50 dBm – 33 dBi = 17 dBm/2500 kHz or 9 dBm/400 kHz, hence the RFID Rx DAA sensing threshold of some -95 dBm/400 kHz should allow maximum detection path loss of some 105 dB or reliable detection distance at some 100-200 m (assuming Hata-rural model). Therefore with appropriate DAA in the RFID Interrogator, RFID can be assumed to be compatible with WPR.
- A5.34 Tests continue to ensure an appropriate mitigation technique is applied for RFID. Ofcom is aware that the RFID industry and Met Office are planning further practical compatibility tests using RFID apparatus modified to simulate the proposed 915-921 MHz band apparatus. It is expected that the results of this testing will be incorporated into the report being developed in CEPT.

Breathing Apparatus Telemetry (BAT)

- A5.35 The most current information on interference from SRDs to BAT equipment is the Breathing Apparatus Telemetry System Interference Study, Aegis and ERA Technology (2012)⁴², which we have published. This study includes both

⁴²See http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/spectrum-clearance/Aegis_Report.pdf

measurements and modelling into BAT for the band 869.40-869.65 MHz, but not for the band 870-872 MHz. The CEPT has noted, but has not studied the case of BAT.

- A5.36 The Aegis study states that conducted measurements made on four representative SRDs operating at 869.5 MHz show that the impact on the BA telemetry system is broadly in line with expectation, with protection ratios of up to 5dB being required; and that statistical modelling using Monte Carlo techniques predicts a probability of losing around one message or poll in 1000 when the BA telemetry system is operated in the vicinity of a single SRD operating at the same frequency.
- A5.37 Aegis concludes that it is not straightforward to interpret this risk in system operation terms, as no availability targets have been specified for the BAT system, nor have any quantitative measurements of performance been made. Aegis says that it seems likely that the probability of interference from co-channel SRD devices to BA telemetry at 869.5 MHz is so low as to be insignificant in the operation of telemetry system. No assessment of interference risk has been made yet for the band 870-872 MHz.
- A5.38 Aegis concludes that the likelihood that these devices are actually within the area of influence for telemetry should also be considered.

Smart Metering

- A5.39 SRDs for Smart Metering (SM) are described by ETSI TR 102 886⁴³. Annex E1 of ETSI TR 102 886 (Expected Compatibility Issues) states that the proposed frequency band for deployment of the SRD devices in Smart Metering is the ER-GSM band of 873-876 MHz. (The upper duplex band of 918-921 MHz is not considered.). Given that government is considering proposals that identify the 870-872 MHz spectrum for Smart Metering we assume that deployment would be in line with TR 102649-2 (see Figure A5.1 above).
- A5.40 The CEPT is treating Smart Meters as SRDs and therefore treating the interference as intra-SRD. However, ECC Report [W141] has so far only assessed SRDs as the victim use, while smart meters are treated as in-band interferers. The technical compatibility report from the CEPT is scheduled to be available as a final draft at the March 2013 meeting of SE24.
- A5.41 Annex E2 of ETSI TR 102 886 (Potential co-existence issues) states that co-existence may be divided into co-channel and adjacent channel compatibility. Adjacent channel compatibility is discussed in annex C of TR 102 649-2. We do not yet have certainty on which technology the Smart Metering HAN will use, but if the proposed parameters for generic SRDs in 870-873 MHz specified by TR 102 649-2 are too restrictive then Smart Meters may have to deploy in 873-876 MHz and hence the option to use 870-872 MHz will disappear. On co-channel interference TR 102 886 states that the "...localisation of ER-GSM equipment identifies the first potential compatibility issue, which will be defined by the geographical location of Smart Meters where these are located adjacent to the railway track. Such co-location will be prevalent in urban areas where scarcity of land for development means both low and high density buildings about the railway thoroughfare/premises."

⁴³ See

http://www.etsi.org/deliver/etsi_tr/102800_102899/102886/01.01.01_60/tr_102886v010101p.pdf

- A5.42 Annex E3 states that “Given the possible compatibility issues of proximity and duty cycle, the SRD community was keen to establish the tolerance of GSM-R to interference from a collocated SRD device operating in the same frequency band to determine if coexistence was possible with ER-GSM (i.e. ER-GSM Mobile Station transmit band) without causing unacceptable levels of interference. As the GSM-R network is used to transfer safety critical information the determination of the effect of collocated SRD devices is crucial if this frequency band is to be used for Smart Metering and Smart Grid applications.” It identifies: “preliminary co-channel testing in the band 873-876 MHz undertaken by the BNetzA who kindly provided the use of their laboratory at Kolberg in order to conduct some feasibility tests.
- A5.43 The conclusion (see TR 102 886 Annex E5) of the testing was that “without considering any attenuation affects of building materials, a separation distance of 10 m offered adequate protection under the conditions of test. Furthermore the duty cycle established during test suggests that for the deployment conditions envisaged, co-existence with E-GSM-R might be achieved with relaxed duty cycle limits.” However, what the testing was unable to establish was the effect of multiple interferers.
- A5.44 Mitigation is considered in Annex E of TR 102 886. Annex E2.2 considers excluding SRD devices from premises within a fixed distance from railway tracks, sidings and mitigating factors including sectorised antenna used for the ER-GSM base stations and mitigation inherent in the indoor location of SRD devices; and the attenuation of the building structures.
- A5.45 Annex E2.3 considers the use of forward error correction in ER-GSM systems and Annex E2.4 considers the threshold of susceptibility of a base station in receive mode at the cell boundary where the equipment will be most sensitive to interference.
- A5.46 From an examination of two possible scenarios it is concluded (see TR 102 886 Annex E5) that system trade-offs need to be made. These trade-offs are the subject of ongoing discussion in CEPT SE PT24 [WI41].

Annex 6**Glossary**

CEPT	European Conference of Postal and Telecommunications Administrations
ECC	Electronic Communications Committee
ER-GSM	Extended frequency ranges for Global System for Mobile Communications – Railway
ERP	Effective Radiated Power
ETSI	European telecommunications Standards Institute
FM	Frequency Managment (CEPT WG FM is the frequency management working group of the CEPT)
GSM	Global System for Mobile Communications
GSM-R	Global System for Mobile Communications – Railway
LTE	Long Term Evolution
MHz	Megahertz
PT	Project Team
RFID	Radio frequency identification
SE	Spectrum Engineering (CEPT WG SE is the spectrum engineering working group of the CEPT)
SRD	Short range devices
TG	Task Group
UAV	Unmanned aerial vehicle
UMTS	Universal Mobile telecommunications System