



# Mobile Phone Repeaters

Indoor and in-vehicle

	<b>Consultation</b>
Publication date:	05 April 2017
Closing Date for Responses:	06 June 2017

# About this document

This document sets out proposals to allow consumers to operate two categories of Mobile Phone repeaters on a licence-exempt basis i.e. with no need for a licence:

- static mobile phone repeaters intended for indoor use; and
- low gain mobile phone repeaters intended for in-vehicle (in-car) use.

Repeaters boost and retransmit mobile signals. Their use by consumers is currently unlawful, as the type of wideband repeater that we come across today can cause interference or other adverse effects to mobile services for other nearby customers. The only exception is if the repeaters are supplied and operated under the control of a mobile network operator.

The effect of our proposals would be that repeaters which meet our requirements would be available for consumers to buy and install lawfully themselves. This relates specifically to static repeaters, intended for in-home use; and 'low gain' repeaters, intended for use in cars. The use of wideband repeaters installed by consumers themselves would continue to be unlawful.

The closing date for responses is 06 June 2017.

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## Section 1

# Executive Summary

- 1.1 Accessing the mobile network within their own home can be troublesome for some consumers, particularly where they live towards the edge of mobile network coverage. The same can be said of accessing the network from within a vehicle. In both cases, the penetration loss involved can mean that, where the mobile phone signal is weak outdoors, it falls below a usable level once inside. One potential solution to this problem is to use a device called a mobile phone repeater (sometimes also referred to as signal boosters or signal enhancers).
- 1.2 At present, the use of a mobile phone repeater is only authorised if it is supplied and operated under the control of a mobile network operator (under its Wireless Telegraphy licence). The use of consumer (self) installed repeaters is unlawful. However, such repeaters are sometimes used (often without a real appreciation by the consumer that the use of the device they buy is unlawful). Typically, these are crude wideband amplifiers that can cause harm to the mobile operators' networks and therefore to other consumers. The interference or other adverse effects on the technical quality of service caused by the unlawful use of such wideband repeaters has become one of the categories of complaint most reported to us. Ofcom has a duty to secure efficient use of the spectrum and we have, and use, powers to enforce against unlawful use.
- 1.3 In our March 2016 document, "Improving mobile coverage, Enabling the benefits of consumer installed mobile repeaters"<sup>1</sup> we set out our intention to examine approaches to developing a set of equipment parameters for mobile phone repeaters that we could licence-exempt for use in the UK. The proposals Ofcom is now setting out in this document are intended to facilitate the development of such licence-exempt devices to improve coverage within a consumer's home or vehicle without causing harm to the mobile operators' networks. In effect, they are intended to facilitate the same level of access within the home or vehicle that the consumer would experience outdoors at the same location<sup>2</sup>.
- 1.4 In this consultation, we set out proposals that static mobile phone repeaters, intended for indoor use and meeting the conditions set out later in the document, should be allowed to be used on a licence exempt basis. The conditions would include requirements that the repeaters operate only over the frequency bands of any single licensed network operator at a given time, adjusts its power to the minimum necessary to make a reliable connection, and incorporates anti-oscillation<sup>3</sup> measures. Devices that meet these requirements would then be available for consumers themselves to buy and install. This proposal does not encompass the use of static wideband repeaters, the use of which would remain unlawful.

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<sup>1</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0031/68737/statement.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0031/68737/statement.pdf)

<sup>2</sup> The UK is not alone in recognising that consumers require a lawful way to improve coverage within their home and cars. In March 2014, the USA regulator, the FCC, introduced a new rule for "wireless signal boosters". In February 2016 the FCC provided an update and sought comment on the performance of the then 76 consumer signal boosters it had authorised

<sup>3</sup> See section 3.22

- 1.5 Ofcom also proposes that low gain mobile phone repeaters, intended for in-vehicle use and meeting the corresponding conditions set out later in this consultation document, should be allowed to be used on a licence exempt basis.
- 1.6 The frequency bands covered for both of our proposals can be found using the Ofcom Interactive Spectrum Map. See Annex 5.
- 1.7 Ofcom is not prescribing the mobile phone technologies that can be used. E.g. 2G, 3G, 4G. Individual manufacturers would be free to provide cost efficient solutions that are optimised to work for particular technologies or frequency bands.
- 1.8 The deadline specified for making representations on this proposal, as set out in this document is 6 June 2017. Details of how to respond to this consultation are set out in Annex 1.

## Section 2

# Background

- 2.1 In our statement of 18 March 2016, we set out the important role consumer installed mobile phone repeaters could potentially play in improving coverage, particularly inside buildings, vehicles and trains; and in remote rural locations.
- 2.2 We also recognised that a legitimate retail market for consumer-installed mobile phone repeaters would help reduce the likelihood that consumers unwittingly purchase unauthorised illegal repeaters which may cause undue interference to other mobile networks.
- 2.3 While recognising this potential value, we also highlighted the challenges associated with ensuring that the use of these repeaters, which boost and retransmit the mobile signals, is not likely to involve adverse effects, such as causing undue interference to other spectrum users. We provided some high-level guidance on the types of interference management approaches likely to be required to help ensure that consumer installed mobile phone repeaters are not likely to have adverse effects on other users. These included;
- only amplifying the mobile channel being used and not the other mobile channels;
  - automatically switching off when not in use or if the repeater starts to self-oscillate or malfunction;
  - adapting the transmitted uplink power of the repeater to the minimum needed to make a reliable connection
- 2.4 We recognised that further detailed technical work was required by industry stakeholders to develop the appropriate technical specifications. In parallel to this, we recognised the benefit of a standardised approach that could be internationally harmonised.
- 2.5 This work has been developed as part of a wider programme of activity to support mobile coverage in the UK. Ofcom's proposed Annual Plan for 2017 identifies a priority of improving the coverage of fixed and mobile communications services to meet the needs of people and businesses across the UK. This builds on the work already undertaken to identify the increasing consumer demands for and the benefits of access to mobile services through our Mobile Data Strategy<sup>4</sup>. In our draft plan, we have set out our intention to assess and consider implementing new regulatory approaches, including through possible mobile licence conditions and coverage obligations in new licences for the 700 MHz spectrum band, and a review of our policy on mobile repeaters.

## Legal framework

- 2.6 Ofcom's responsibilities for spectrum management are set out primarily in two Acts of Parliament which confer on us our specific functions, powers and duties: The Communications Act 2003 (the '2003 Act') and the Wireless Telegraphy Act 2006

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<sup>4</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0027/58347/Mobile-Data-Strategy-statement.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0027/58347/Mobile-Data-Strategy-statement.pdf)  
[https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0033/79584/update-strategy-mobile-spectrum.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0033/79584/update-strategy-mobile-spectrum.pdf)

(the 'WT Act').<sup>5</sup> Amongst our functions and powers are the making available of frequencies for use for particular purposes and the granting of rights of use of spectrum through wireless telegraphy licences and licence exemptions.

### **The 2003 Act**

- 2.7 Our principal duties under the 2003 Act, when carrying out our functions and exercising our powers, are to further the interests of citizens and consumers, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum and the availability throughout the United Kingdom of a wide range of electronic communications services.
- 2.8 We must also have regard to (i) the desirability of promoting competition in relevant markets; (ii) the desirability of encouraging investment and innovation in relevant markets; (iii) the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it; and (iv) the different interests of persons in the different parts of the United Kingdom, of the different ethnic communities within the United Kingdom and of persons living in rural and in urban areas.
- 2.9 The 2003 Act also sets out certain regulatory principles. It says that in performing our duties we must have regard to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed.

### **The WT Act**

- 2.10 Additionally, in carrying out our spectrum functions, we have a duty under section 3 of the WT Act to have regard in particular to: (i) the extent to which the spectrum is available for use or further use for wireless telegraphy; (ii) the demand for use of that spectrum for wireless telegraphy; and (iii) the demand that is likely to arise in future for such use.
- 2.11 We also have a duty to have regard to the desirability of promoting: (i) the efficient management and use of the spectrum for wireless telegraphy; (ii) the economic and other benefits that may arise from the use of wireless telegraphy; (iii) the development of innovative services; and (iv) competition in the provision of electronic communications services.
- 2.12 Ofcom's powers in relation to spectrum licenses and exemptions include those in section 8 of the WT Act. Section 8(1) says it is unlawful for a person to use wireless telegraphy apparatus except under and in accordance with a licence granted by us. Section 8(3) gives us power to make regulations exempting the use of certain wireless telegraphy apparatus from the need for a licence, either absolutely or subject to such terms, provisions and limitations as we specify. Section 8(3A) and (3B) restrict the terms, provisions and limitations we can specify. The latter requires that they must be:

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<sup>5</sup> The European Common Regulatory Framework for electronic communications (in particular, the Framework Directive and the Authorisation Directive) sets out the broad legal framework for how spectrum should be authorised and managed in the UK and aims to harmonise the regulation of electronic communications networks and services throughout the European Union.

- objectively justifiable in relation to the wireless telegraphy apparatus to which they relate;
- not such as to discriminate unduly against particular persons or against a particular description of persons;
- proportionate to what they are intended to achieve; and
- in relation to what they are intended to achieve, transparent.

2.13 Section 8(4) says Ofcom has an obligation to make licence exemption regulations under sub-section (3) in respect of apparatus of particular descriptions where certain conditions are met. These conditions are set out in section 8(5), and include that the use of apparatus of the particular description is not likely to:

- involve undue interference with wireless telegraphy;
- have an adverse effect on technical quality of service;
- lead to inefficient use of the part of the electromagnetic spectrum available for wireless telegraphy; or
- endanger safety of life.

2.14 Accordingly, Ofcom must authorise the use of consumer installed repeaters of particular descriptions on a licence exempt basis if they satisfy the appropriate conditions. We may do so subject to specified terms, provisions and limitations.

### **Radio Equipment Directive**

2.15 Radio equipment, including mobile phone repeaters, also has to comply with requirements derived from the Radio Equipment Directive<sup>6</sup> (the “RED”), which came into force on 13 June 2016, replacing Directive 1999/5/EC. At the time of publication, the UK has not yet implemented the RED into UK law and the Radio Equipment and Telecommunications Terminal Equipment Regulations 2000 (the “R&TTE Regulations”) continue to apply.

2.16 One requirement of this regime is that radio equipment may only be placed on the market and put into service where it meets certain essential requirements. These include that it must be constructed such that it uses the relevant radio spectrum so as to avoid harmful interference.

2.17 One way in which these requirements may be satisfied is by meeting an applicable Harmonised Standard. Meeting such a standard gives rise to a presumption of conformity with the requirements. There are some Harmonised Standards that apply to certain types of repeaters.<sup>7</sup>

### **Application**

2.18 We cannot be satisfied, on the basis of the evidence currently available to us, that the use of consumer installed repeaters available in the UK at present is not likely to

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<sup>6</sup> The Radio Equipment Directive (RE-D) 2014/53/EU **came into force on the 13th June 2016, replacing Directive 1999/5/EC.**

<sup>7</sup> See EN 301 908-11, EN 301 908-15 and EN 303 609.



involve undue interference to, or otherwise affect the technical quality of service for, other spectrum users. We set out the basis for that view in the following section of this document.

- 2.19 However, we are proposing to licence exempt certain consumer installed mobile repeaters in future. That is, repeaters of particular descriptions which adhere to terms, provisions and limitations (including technical requirements) such that their use would meet the conditions in sections 8(4) and 8(5) of the WTA 2006 described above.
- 2.20 Our provisional view is that such repeaters could operate without causing harm to mobile networks and other spectrum users. On that basis, their use should be authorised via licence-exemption, so that they could be used without the need for a licence, like other low power devices use of which is normally authorised that way.
- 2.21 In particular, we are consulting in this document on the proposal to exempt use of low power mobile phone repeater equipment from requiring a licence when operating in the frequency bands presently licensed to Mobile Network Operators. The relevant licence exemption regulations would include the applicable technical conditions by referring to two interface requirements, to be titled:
- “UK Interface Requirements [number] Licence Exempt Static Mobile Phone Repeaters, Intended for Indoor Use”; and
  - “UK Interface Requirements [number] Licence Exempt Low Gain Mobile Phone Repeaters, Intended for In-Vehicle Use”.
- 2.22 We have formulated our proposals by reference to our statutory duties. For the reasons set out in this document, our provisional assessment is that that they are consistent with those duties and the terms, provisions and limitations would meet the requirements in section 8(4).
- 2.23 They would be:
- **objectively justified** in that they would address risks of undue interference and/or adverse effects on the technical quality of service that would otherwise arise from the use of consumer-installed repeaters;
  - **not unduly discriminatory** against particular persons or against a particular description of persons in that they would apply to all users of relevant repeaters (and, indirectly, to all manufacturers and sellers);
  - **proportionate** to what they are intended to achieve, in that they are necessary to ensure that use of the relevant repeaters would not be likely to have relevant adverse effects; and
  - **transparent** in relation to what they are intended to achieve, in that they are described and explained in this document and would be specified in the relevant interface requirements and exemption regulations.
- 2.24 They would also encourage the development of a retail market for lawful consumer-installed mobile phone repeaters. This would help provide coverage solutions for consumers who need them, without harming operators and other users. It would also help reduce the likelihood that consumers purchase unauthorised (and unlawful) repeaters which do cause such harm, and so reduce the market for such devices.

- 2.25 In these ways, the proposals would help secure optimal use of the spectrum. They would also help encourage investment and innovation, and promote competition, in relevant markets, as well as furthering the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it in the United Kingdom, including those in rural areas (where mobile coverage is often less).

### **Impact Assessment**

- 2.26 Section 7 of the 2003 Act requires that, where we are proposing to do anything for the purposes of, or in connection with, the carrying out of our functions, and it appears to us that the proposal is important, we are required to carry out and publish an assessment of the likely impact of implementing the proposal, or a statement setting out our reasons for thinking that it is unnecessary to carry out such an assessment. Specific aspects of our assessment are in Annex [4] to this document. The analysis presented in this document as a whole, however, constitutes our overall impact assessment.

### **Equality Impact Assessment**

- 2.27 Ofcom is also required by statute to assess the potential impact of all its functions, policies, projects and practices on the following equality groups: age, disability, gender, gender reassignment, pregnancy and maternity, race, religion or belief and sexual orientation. 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.
- 2.28 The proposals set out in this document would apply equally to all users of mobile phone repeaters. We have not identified any differential impact of our proposals in relation to the identified equality groups and, in our assessment, they would not disproportionately affect any group of consumers.

### **Engagement to date**

- 2.29 This consultation follows a programme of work over the past few years to investigate the issues surrounding the use of repeaters. This began with a Call for Inputs on the use of 'Mobile coverage enhancers and their use of unlicensed spectrum'.<sup>8</sup> Through this Call for Input, Ofcom sought to develop a better understanding of the role that consumer-installed mobile coverage enhancers could play in improving indoor mobile coverage, alongside others solutions such as femtocells and smart repeaters.
- 2.30 Ofcom subsequently commissioned PA Consulting to investigate the likely effect of different repeater implementations on other mobile users. The main conclusion in PA's report<sup>9</sup> was that it is possible to make and install mobile repeaters that would not cause any noticeable interference to other users, whilst recognising that technical features of repeaters sold in the retail market are not sufficient in most cases today to achieve this.
- 2.31 Ofcom published a document<sup>10</sup> in March 2016, following this CFI process, signalling our intention to further consider the technical approaches that would enable end-use

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<sup>8</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0028/58528/Mobile-Coverage-Enhancers.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0028/58528/Mobile-Coverage-Enhancers.pdf)

<sup>9</sup> <https://www.ofcom.org.uk/research-and-data/technology-research/2015-reports/effects-of-repeaters-on-mobile-networks>

<sup>10</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0031/68737/statement.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0031/68737/statement.pdf)

repeaters to be made available in the UK on a licence exempt basis. Since then we have undertaken a period of engagement with industry, together with further research and analysis, to inform the proposals set out in this Consultation.

## Document structure

2.32 The rest of this document is structured as follows:

- section 3 sets out our proposals for static mobile phone repeaters, intended for indoor use, to be user installed and authorised for use on a licence-exempt basis;
- section 4 sets out our proposals for low gain mobile phone repeaters, intended to for in-vehicle use, to be authorised for use on a licence-exempt basis; and
- draft example tables, intended for inclusion in the national Interface Requirements for indoor and in-vehicle repeaters are included at Annexes 6 and 7 respectively.

## Next Steps

2.33 Following publication of this consultation document, stakeholders are invited to provide their feedback on the proposals set out in sections 3 and 4.

2.34 Ofcom will carefully consider the responses and, should we decide to proceed with our proposals, we would then:

- publish a statement setting out our decision and describing the actions needed take to bring this initiative into our regulations;
- consult on draft regulations under which a user of equipment complying with the Interface Requirement would be exempt from the need to hold a licence (these regulations would cite compliance with the Interface Requirement as a necessary condition for exemption); and
- notify to the European Commission the Interface Requirements (setting out the operational and spectrum management conditions under which such equipment could be authorised for use in the UK).

## Section 3

# Proposals for static mobile phone repeaters, intended for indoor use

3.1 This section sets out proposals for authorising use of static mobile phone repeaters intended for indoor and that can be bought and installed by consumers themselves. We begin by explaining the rationale for developing these proposals. We then set out the proposed technical conditions with which the repeater would need to comply, together with an explanation of the reasons for the proposed conditions. Finally, we explain the way we propose to authorise the use of such repeaters.

## Rationale for proposals

3.2 Under the terms of their mobile spectrum licences, mobile phone operators can install mobile phone repeaters themselves. When doing so, they use equipment that is compliant with relevant EU Directives, the RED in particular, and the R&TTE Regulations. They install it in a way that is designed to avoid undue interference or adverse effects to the technical quality of service to their own and to other networks. There are relevant Harmonised Standards supporting the compliance of these repeaters with the RED and the Regulations.

3.3 The relevant European (ETSI) Harmonised Standards for these repeaters are:

- EN 303 609: Global System for Mobile communications (GSM); GSM Repeaters; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/E;
- EN 301 908-11; IMT cellular networks; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 311: CDMA Direct Spread (UTRA FDD) Base Stations (BS) Repeaters; and
- EN 301 908-15;- IMT cellular networks; Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 15: Evolved Universal Terrestrial Radio Access (E-UTRA FDD) Repeaters.

3.4 Repeaters that meet these standards are presumed to comply with the RED and the R&TTE Regulations. They are capable of using the relevant radio spectrum so as to avoid harmful interference, and without causing other adverse effects on technical quality of service, in certain circumstances. That is, where they are installed and operated by Mobile Network Operators as part of their licensed, planned and controlled networks.

3.5 However, we know there is also a demand from consumers to buy, install and use repeaters for themselves, to improve the coverage they receive, even though there is no lawful route for them to do so at present. The difficulty this produces is that in these cases repeaters, even those meeting one of the Harmonised Standards, are liable to cause undue interference and/or adverse effects on technical quality of service.

3.6 Consumers may install and use repeaters anywhere, in locations unplanned by the mobile network operators. Where they do so, they can cause the kinds of

interference or adverse effects referred to in the PA report (below). Ofcom has also observed these sorts of effects in practice. In 2016, we received 178 of complaints of interference or other adverse effects that were identified as being caused by self-installed repeaters.

- 3.7 It is this position that our proposals would seek to change. Our key objective is to facilitate the ability of consumers to improve their mobile coverage, furthering their interests, without these adverse effects on others.
- 3.8 Our provisional assessment is that, to achieve that objective, it is necessary to identify a set of technical requirements, additional to those in the relevant Harmonised Standards, within which consumers may use self-installed repeaters. This would reflect the fact that Licence Exempt repeaters may be installed anywhere, and would not form part of a planned network installation.

### **The PA report**

- 3.9 The PA Consulting report noted the main features of the additional technical constraints that were likely to be appropriate. These are set out below.
- 3.10 We have, since the publication of the PA report, carried out a more detailed technical review, leading to the proposals set out in the next sub-section. In the process, we have:
- reviewed the rules that FCC has introduced for cell enhancers in the US;
  - held discussions with manufacturers of mobile phone repeaters; and
  - had discussions with Mobile Network Operators.
- 3.11 The PA report explains why repeaters are useful in mobile networks. It notes that consumers' expectations have risen and that dissatisfaction with coverage not-spots has grown. The report indicates scenarios where a weaker signal can be experienced by the consumer. Examples include:
- where a building is shadowed by other buildings;
  - in remote areas, far from the nearest base station;
  - in buildings where penetration losses are high e.g. old stone buildings or newer buildings with metallised glass windows to meet the latest building requirements for insulation; and
  - in hilly areas where the path from base station to user is obstructed by the terrain.
- 3.12 The PA report then identifies the nature of the interference issues and/or the technical effects on quality of service caused by repeaters. Wideband repeaters, which operate across a range of frequencies, use of which is licensed to different operators, may amplify both the intended signal and those on other networks or alternate base stations. The report notes that there are several different mechanisms by which a repeater could interfere with or affect the operation and performance of mobile networks:
- raising the noise floor on the uplink signal;

- raising the noise floor on the downlink signal;
- blocking (overloading) the base station receiver;
- disrupting the uplink power control;
- oscillations<sup>11</sup> and spurious emissions; and
- distortion or delay of the signals.

## Proposed Technical requirements

- 3.13 From consumers' perspectives, it is essential that the benefits to one consumer from using a mobile phone repeater are not outweighed by any interference issues or adverse effects caused to others. Ofcom is active in removing from the market, mobile phone repeaters that interfere with the operation and performance of the mobile networks. This is something we will continue to do.
- 3.14 We are, however, also supportive of consumers' expectations in respect of improving coverage. We therefore propose, in light of all the above, that any licence exemption should be subject to the following technical requirements.
- 3.15 In particular, static mobile phone repeaters intended for indoor use will typically have an antenna situated in a location where a good connection to the base station can be made. This may for example be in the window of an upstairs room.
- 3.16 Such repeaters can vary in design. Some may be single integral units whilst others may come in two separate parts (where the separate parts are linked together, for example by cable or by a 5GHz Wi-Fi connection). Where it comes in two parts, the consumer can site one part so it has a good connection to the base station and the other to give the best coverage within the home.
- 3.17 We refer to these types of repeater as 'static.' By this, we mean they are intended to be placed indoors and remain in-situ when operating. They are not intended to be used whilst in motion (e.g. in a vehicle).
- 3.18 We propose that a repeater capable of licence exemption would work by amplifying the signal equally in both directions (uplink and downlink), to and from the consumer's handset to the base station. In order for the repeater to work in a safe way, it would need to be able to determine the reduction in signal power on the path from the base station (the coupling loss) and automatically to adjust its gain, so that it would only amplify the signal sufficiently to provide an acceptable service, while not unduly raising the noise within the mobile network or blocking (overloading) the base station's receiver. If it cannot do this, it could not transmit.
- 3.19 Our proposals are also based on the requirement that the mobile phone repeater should only communicate with one mobile phone network at a time. This is because the coupling loss to the nearest serving base station of one network will be different to that of any of the other networks and the repeater can only set its gain in relation to one network at a time.
- 3.20 In practice, a consumer who had bought the repeater would select which operator's network they would like it to work with when they initially set it up. Once set up, the

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<sup>11</sup> See section 3.22

consumer could simply leave the repeater to operate to the selected mobile network. However, if in future they wish to change the network, they would be able to select a different one as and when required by re-running the set-up process. Further, it is sometimes necessary for the mobile phone operators to change the frequency bands available to consumers, such as when they migrate from 3G to 4G. In those instances, consumers may also need to re-run the initial set up.

3.21 With these high-level points in mind, Table 1 below sets out the technical requirements we are proposing for static mobile phone repeater apparatus intended for indoor use. In subsequent paragraphs, we explain our reasoning further for the specific technical limits proposed.

**Table 1: Proposed technical requirements for licence exempt static mobile phone repeater apparatus, intended for indoor use**

<p><b>Frequency Band</b></p> <p>The amplified frequencies shall be limited to that of a single mobile network operator in their relevant bands of operation (e.g. 800 MHz band and 2100 MHz band etc.)</p> <p>The equipment may be re-configured to an alternative Mobile Network, but may only operate to one operator when configured.</p>			
<p><b>Transmit Power</b></p> <p>The transmit power shall be limited as follows:</p> <ul style="list-style-type: none"> <li>• In the uplink, the power is limited to the maximum permitted power for a user equipment (handset) for that particular frequency band in existing regulations (see Annex 5).</li> <li>• In the downlink, the power is limited to 10 dBm.</li> </ul>			
<p><b>Transmit Gain Control</b></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <p>The uplink and downlink gain in dB of a single operator repeater, referenced to its input and output ports, shall not exceed BSCL-30dB. Where BSCL cannot be determined, the repeater must not transmit</p> <p>The uplink and downlink gain in dB of a single operator repeater, referenced to its input and output ports shall not exceed 100dB</p> </td> <td style="width: 50%; border: none; vertical-align: top;"> <p>Where BSCL (base station coupling loss) is the path loss between the base station and the repeater, the apparatus shall determine this value by calculating the difference between the carrier power received at the repeater and the carrier power transmitted from the base station. E.g. The carrier power transmitted by the base station may be determined from the system information messages sent by the base station on its control channels.</p> </td> </tr> </table>		<p>The uplink and downlink gain in dB of a single operator repeater, referenced to its input and output ports, shall not exceed BSCL-30dB. Where BSCL cannot be determined, the repeater must not transmit</p> <p>The uplink and downlink gain in dB of a single operator repeater, referenced to its input and output ports shall not exceed 100dB</p>	<p>Where BSCL (base station coupling loss) is the path loss between the base station and the repeater, the apparatus shall determine this value by calculating the difference between the carrier power received at the repeater and the carrier power transmitted from the base station. E.g. The carrier power transmitted by the base station may be determined from the system information messages sent by the base station on its control channels.</p>
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### **Automatic Standby**

When the repeater is no longer serving an active device connection it must, after no more than 5 minutes, reduce any uplink noise power to no more than  $-70$  dBm/MHz.

### **Anti-Oscillation**

Repeaters must be able to detect and mitigate (i.e. by automatic gain reduction or shut down), any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within:

- 0.3 seconds in the uplink band; and
- 1 second in the downlink band.

In cases where oscillation is detected, the repeater must continue this mitigation for at least one minute before restarting. After five such restarts, the user-installed mobile phone repeater must not resume operation until manually reset.

3.22 The proposed technical requirements set out in Table 1 above reflect the following considerations:

- Power

It is already clearly established that the power limits applicable to handsets are not likely to cause undue interference or adverse technical effects. It would therefore be important, in avoiding these effects, that the mobile phone repeater, as seen by a base station, appears as if it were a handset.

On that basis, the maximum power in the uplink would be limited to that currently authorised for mobile phone handsets in the relevant band.

The maximum power in the downlink would be limited to 10 dBm. In our provisional assessment, this would be sufficient to allow coverage within a typical domestic home, while making undue interference or adverse technical effects to other mobile phone users in the vicinity unlikely.

In making this assessment, we have also needed to consider the impact to other mobile handset users outside the building where the repeater is located. In doing that, we have been mindful of the likely building attenuation and the coupling loss to other users.

- Gain

We propose that the maximum gain the repeater could introduce would be 30 dB less than the RF coupling loss between the base station and the repeater. It would also be limited to a maximum of 100 dB.

To determine the coupling loss to the base station, the repeater would need to be able to determine the relevant information from the base station, for instance by interrogating the control channels and making appropriate signal strength measurements. If the repeater was unable to determine the coupling loss to the base station, it would not be able to transmit. This would prevent repeaters close to the base station being brought into use, which could cause an unacceptable noise rise in



the base station and lead to users at the edge of coverage of that base station losing service.

We propose the 30 dB margin on the basis it would to limit the noise rise caused by repeaters to less than 0.5 dB under an extreme, but plausible, scenario (which we have taken as 50 users simultaneously communicating with a single base station at any instant in time via use of repeaters<sup>12</sup>). The value of 30 dB is derived as follows.

- To ensure that the additive increase in noise is less than 0.5 dB, the total noise power from all repeaters in the cell must at least 10 dB lower than the existing base station noise power, i.e.  $10 \text{ Log}_{10} 1.1 = 0.5 \text{ dB}$
- Assuming 50 active repeaters in the cell, the contribution to noise, of each repeater must be 17 dB below this i.e.  $10 \text{ dB} + 10 \text{ Log}_{10} 50 = 27 \text{ dB}$
- Finally, we have added a further 3 dB to the margin to reduce the noise amplified by the repeater from a mobile phone handset that may be located very close to it.

We propose the 100 dB maximum limit on the basis a gain of that level is unlikely in practice. It reflects that, to grant a licence exemption, we must be satisfied undue interference or adverse effects on the technical quality of service are unlikely to occur.

Our provisional judgment is that these requirements would be necessary to ensure that the repeater would be unlikely to have the relevant effects. Our assessment is that, with any greater gain, there would be a realistic risk of those effects occurring.

- Automatic Standby

We also propose that an automatic standby feature must be enabled. This would ensure that, when the repeater is not in active use, it is not likely to add noise to the network. We consider a level of  $-70 \text{ dBm/MHz}$  to be sufficient, but no more than necessary, in this respect. It is a figure typical of unwanted emissions limits that manufacturers of mobile network apparatus adopt to ensure protection of other frequency bands allocated to mobile phone networks in order for them to minimise interference or adverse technical effects on the quality of the service they provide.

- Oscillations

Repeaters would need to be able to detect and mitigate oscillations. These can occur where there is an unintended path between the mobile phone repeater's two antennas (the uplink and downlink antennas). The PA report notes that where the gain of the repeater is of the order of 50 dB this risk becomes material. In our preliminary assessment, therefore, it is essential that mobile phone repeaters can automatically return to the standby mode in the event of oscillation occurring. This would be particularly important in the uplink, to prevent interference to the mobile network.

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<sup>12</sup> Within the coverage area of a cell there may be many more than 50 repeaters, however we think it is extremely unlikely that there will be more than 50 repeaters actively communicating with the base station at any instant in time.

It is also important to ensure oscillations are detected and mitigated quickly. We are therefore proposing that the required anti-oscillation mechanism would need to activate within 0.3 seconds in the uplink and 1 second in the downlink. We are minded to regard these short times as necessary because it is our preliminary assessment that these times are just sufficient to ensure oscillations are actually occurring while minimising the risk of undue interference or adverse technical effects to other mobile phone users in the vicinity unlikely.

We also propose to specify that the repeater must not resume operation after 5 restarts due to oscillations unless it is manually reset. This is because the most likely cause of the repeater continually going into oscillation would be if it is poorly located<sup>13</sup> and this would likely continue to happen until it is moved to a better location. A manual reset would give the opportunity for the user to be prompted to relocate the repeater before it is switched on again.

- 3.23 The other elements in Table 1 above are the result of discussions with repeater manufacturers/vendors around practical implementation.

### **Form of authorisation**

- 3.24 We propose to include mobile phone repeaters that meet the requirements set out in table 1 above in a revision of the Licence Exemption regulations. These regulations would refer to a new Interface Requirement (IR) covering this type of static mobile phone repeater intended for indoor use.
- 3.25 The Interface Requirement would take the form of a series of tables, with each table covering the frequency range licenced to a given operator in a given mobile band. There would be approximately 30 tables in all covering the frequencies for authorised mobile phone use (see Annex 5). Annex 6 gives an example of the table for the frequencies 791 - 796 MHz (downlink), 832 – 837 MHz (uplink) which are licenced to Hutchinson 3G (Three) at present.
- 3.26 Each table would contain the same conditions (as in table 1 above) to ensure transmissions fulfil the requirements of Section 8(4) of the WT Act,<sup>14</sup> though they would differ in the frequency ranges specified and in the uplink power limit that would apply. The repeater's uplink power limit would be taken as the same as that for a mobile phone handset authorised in the relevant frequencies (as specified in the licence exemption regulations for mobile phone handsets and their Interface Requirements). These uplink power limits are listed in Annex 5 where they have been copied from the relevant IRs (in the example in Annex 6 the uplink power limit is shown as 23dBm per channel, taken from IR 2090).
- 3.27 Mobile phone repeaters would, of course, also need to comply with the RED and any UK regulations. The relevant Harmonised Standard could be used to give a presumption of conformity and allow manufacturers to place mobile phone repeater

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<sup>13</sup> If the base station signal is too weak at the place where the repeater has been positioned, then the repeater will add significant amplification. In the case of a single unit repeater this amplified signal transmission could leak back into the antenna system through which the repeater is receiving the base station signal – and set up an oscillation.

<sup>14</sup> [http://www.legislation.gov.uk/ukpga/2006/36/pdfs/ukpga\\_20060036\\_en.pdf](http://www.legislation.gov.uk/ukpga/2006/36/pdfs/ukpga_20060036_en.pdf)

devices on the European market. The tables in the Interface Requirement would therefore also refer to the relevant ETSI standards<sup>15</sup> in this context.

## Questions

*Q1 Do you agree with Ofcom's proposal to authorise the use of static mobile repeaters intended for indoor use on a licence exempt basis?*

*Q2 Do you agree with technical requirements as set out in Table 1 above for licence exempt static mobile phone repeaters intended for indoor use?*

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<sup>15</sup> The application of Harmonised Standards is voluntary but has the advantage of giving "presumption of conformity" (if references are published in the Official Journal of the European Union under the RED) with the corresponding essential requirements that they aim to cover.

## Section 4

# Proposals for low gain mobile phone repeaters, intended for in-vehicle use

4.1 This section sets out proposals for authorising use of low gain mobile phone repeaters intended for in-vehicle use. We begin by explaining the rationale for developing these proposals. We then set out the proposed technical conditions with which the repeater would need to comply, together with an explanation of the reasons for them. Finally, we explain the way we propose to authorise the use of these repeaters.

## Rationale for proposals

- 4.2 The radio-frequency attenuation of many modern vehicles can be high - typically 15 to 20 dB. The glass fitted to modern cars is intended to shield the interior from UV radiation and to reduce demands on the vehicle's climate control system. These same physical properties of the vehicle limit the ability to receive radio signals inside the vehicle. Ofcom has recently been approached by car manufacturers who would like to install low gain in-vehicle mobile phone repeaters to overcome the attenuation to radio signals that a car body and windows cause.
- 4.3 Ofcom has also become aware that other European car manufacturers are already installing a variety of low gain in-vehicle repeater. These are installed as an optional extra in a few, mainly high end, car models. To date, no cases of interference caused by these in-vehicle repeaters have been reported to Ofcom.
- 4.4 Nonetheless, it appears to us that, as with static mobile phone repeaters, there is a risk that the use of in-vehicle repeaters could cause undue interference or adverse effects on technical quality of service in practice. Again, that use is unplanned by the mobile phone network operators and the in-vehicle repeater can be located anywhere.
- 4.5 On that basis, and in light of the issues highlighted by the PA report, we are minded to regard it as necessary, to reap the benefits but not the disadvantages of the use of in-car repeaters, to impose additional technical constraints, over and above those in the relevant Harmonised Standards, on that use.

## Proposed Technical requirements

- 4.6 Low gain mobile phone repeaters intended for in-vehicle use typically consist of a specially designed cradle within the vehicle that is connected to an external antenna on the roof via a two-way amplifier. A mobile phone handset placed inside the cradle will therefore appear to the mobile phone network as if it were outside the vehicle. The consumer can therefore expect the same level of mobile phone coverage that is available outside the vehicle at the same location<sup>16</sup>.

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<sup>16</sup> In essence, this produces a similar set up to that which would be achieved if it were possible to plug the cable from the external aerial directly into the phone – however, with modern phones there is no socket into which it is possible to connect an external aerial (hence the need for the wireless connection between the cradle and the phone).

4.7 With these high-level points in mind, Table 2 below sets out the technical requirements we are proposing for in vehicle mobile phone repeater apparatus.

**Table 2: Proposed technical requirements for licence exempt low gain mobile phone repeater apparatus intended for in-vehicle use**

<p><b>Frequency band</b></p> <p>The amplified frequencies may include all relevant frequency bands listed (See Annex 5).</p>
<p><b>Transmit Power</b></p> <p>The transmit power shall be limited to:</p> <ul style="list-style-type: none"> <li>• In the uplink, it is limited to the maximum permitted power for a mobile phone handset for that particular frequency band in existing licence exemption regulations (see Annex 5).</li> <li>• In the downlink, the power is limited to 10 dBm.</li> </ul>
<p><b>Maximum Permitted Gain</b></p> <p>In both the uplink and the downlink the maximum permitted gain is limited to:</p> <ul style="list-style-type: none"> <li>• 21 dB in relevant frequency bands above 1 GHz; and</li> <li>• 15 dB in relevant frequency bands below 1 GHz.</li> </ul>
<p><b>Automatic Standby</b></p> <p>When the repeater is no longer serving an active device connection it must, after no more than 5 minutes, reduce any uplink noise power to no more than -70 dBm/MHz.</p>

4.8 In proposing these technical requirements, we have considered the following:

- **Transmit Power**

We propose to ensure that the uplink transmissions are limited in power to the same as that permitted for mobile phone handsets using the relevant frequencies. Again, this would enable the repeater to operate to the same effect as a mobile phone handset.

For downlink transmissions, we propose the limit of 10 dBm<sup>17</sup> on the basis of our provisional assessment that it would be sufficient to allow coverage within a vehicle, while being constrained enough to not interfere with the reception of handsets outside the vehicle (assuming the vehicle attenuation of 15 to 20 dB).

- **Gain**

We have proposed the maximum permitted gain at a level that would, in our preliminary view, overcome any signal loss between the antenna and the cradle and the coupling loss between the cradle and a mobile handset. Ofcom is mindful of the need to prevent undue interference or adverse technical effect on the technical quality of service to other mobile phone users outside the vehicle. Our provisional judgment is that these effects would be unlikely if we set the gain at this level.

<sup>17</sup> Ofcom expects the maximum gain permitted to be the limiting factor on the transmitted power. However, an absolute power limit is necessary for equipment compliance.

- **Automatic Standby**

Our further proposal is that an automatic standby feature would need to be enabled. This would ensure that when the repeater is not in active use, it is not likely to add noise to the network. We propose that a level of  $-70$  dBm/MHz would be sufficient in this respect. Again, we take note that it is a figure typical of unwanted emissions limits in mobile phone systems.

## Form of authorisation

- 4.9 We propose to include in-vehicle mobile phone repeaters, that meet the requirements set out above, in a revision of the Licence Exemption regulations. These regulations would refer to a new Interface requirement covering this type of low gain mobile phone repeaters intended for in-vehicle use.
- 4.10 The form of the Interface Requirement would be equivalent to that for the static mobile phone repeater described in section 3. It would contain the technical conditions set out in table 2 above with separate tables for each frequency range licenced to a given operator in a given mobile band. There would be approximately 30 tables in all. Annex 7 sets out an example for the frequencies 791 - 796 MHz (downlink) and 832 – 837 MHz (uplink) which are licenced to Hutchinson 3G (Three) at present.
- 4.11 These in-vehicle mobile phone repeaters would also, of course, still need to comply with the RED and any UK regulations. Again, the relevant Harmonised Standards can be used to give a presumption of conformity and allow manufacturers to place the devices on the European market. The tables in the Interface Requirement would therefore also refer to the relevant ETSI standards<sup>14</sup> in this context.

## Questions

*Q3 Do you agree with Ofcom's proposal to authorise the use of low gain mobile phone repeaters intended for in-vehicle use on a licence exempt basis?*

*Q4 Do you agree with technical requirement set out in Table 2 above for licence exempt low gain mobile phone repeaters intended for in-vehicle use?*

## Annex 1

# Responding to this consultation

## How to respond

- A1.1 Ofcom would like to receive views and comments on the issues raised in this document, **by 5pm on 06 June 2017**.
- A1.2 We strongly prefer to receive responses via the online form at <https://www.ofcom.org.uk/consultations-and-statements/category-2/mobile-phone-repeaters>. We also provide a cover sheet (<https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet>) for responses sent by email or post; please fill this in, as it helps us to maintain your confidentiality, and speeds up our work. You do not need to do this if you respond using the online form.
- A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to [mobile.repeaters@ofcom.org.uk](mailto:mobile.repeaters@ofcom.org.uk), as an attachment in Microsoft Word format, together with the cover sheet (<https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet>). This email address is for this consultation only, and will not be valid after 6 June 2017.
- A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.
- Jack Hindley  
Ofcom  
Riverside House  
2A Southwark Bridge Road  
London SE1 9HA
- A1.5 If you would like to submit your response in an alternative format (e.g. a video or audio file), please contact Jack Hindley on 020 7 981 3810, or email [mobile.repeaters@ofcom.org.uk](mailto:mobile.repeaters@ofcom.org.uk)
- A1.6 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.
- A1.7 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.
- A1.8 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 3. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.
- A1.9 If you want to discuss the issues and questions raised in this consultation, please contact Jack Hindley on 020 7981 3810, or by email [tomobile.repeaters@ofcom.org.uk](mailto:tomobile.repeaters@ofcom.org.uk)

## Confidentiality

- A1.10 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk), as soon as we receive them.
- A1.11 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.
- A1.12 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.13 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further at <https://www.ofcom.org.uk/about-ofcom/website/terms-of-use>.

## Next steps

- A1.14 Following this consultation period, Ofcom plans to publish a statement in July 2017.
- A1.15 If you wish, you can register to receive mail updates alerting you to new Ofcom publications; for more details please see <https://www.ofcom.org.uk/about-ofcom/latest/email-updates> <http://www.ofcom.org.uk/email-updates/>

## Ofcom's consultation processes

- A1.16 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.
- A1.17 If you have any comments or suggestions on how we manage our consultations, please email us at [consult@ofcom.org.uk](mailto:consult@ofcom.org.uk). We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.18 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact Steve Gettings, Ofcom's consultation champion:

Steve Gettings  
Ofcom  
Riverside House  
2a Southwark Bridge Road  
London SE1 9HA

Email: [corporationsecretary@ofcom.org.uk](mailto:corporationsecretary@ofcom.org.uk)



## Annex 2

# Ofcom's consultation principles

**Ofcom has seven principles that it follows for every public written consultation:**

### **Before the consultation**

A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. 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**

A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.3 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 for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A2.6 If we are not able to follow any of these seven principles, we will explain why.

### **After the consultation**

A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

## 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 3

# Consultation question

*Q1 Do you agree with Ofcom's proposal to authorise the use of static mobile repeaters intended for indoor use on a licence exempt basis?*

*Q2 Do you agree with technical requirements as set out in Table 1 above for licence exempt static mobile phone repeaters intended for indoor use?*

*Q3 Do you agree with Ofcom's proposal to authorise the use of low gain mobile phone repeaters intended for in-vehicle use on a licence exempt basis?*

*Q4 Do you agree with technical requirement set out in Table 2 above for licence exempt low gain mobile phone repeaters intended for in-vehicle use?*

## Annex 4

# Impact Assessment

- A4.1 This Annex describes options Ofcom has considered in formulating our proposals for the Licence exemption of certain mobile phone repeaters.

## Introduction

- A4.2 Alongside the rest of this consultation document, the analysis in this Annex represents an impact assessment as defined in section 7 of the Communications Act 2003 (the Act). You should send any comments on this impact assessment to us by the closing date for this consultation. We will consider all comments carefully before deciding whether to implement our proposals.
- A4.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on our website:  
<https://www.ofcom.org.uk/consultations-and-statements/better-policy-making-ofcoms-approach-to-impact-assessment>

## The citizen and/or consumer interest

- A4.4 The citizen and consumer interests we have focussed on in this consultation relate to their ability to access their mobile network of choice within their home or vehicle, and in those networks operating without undue interference and adverse effects on the technical quality of service.

## Ofcom's regulatory policy objective

- A4.5 There is a clear consumer demand for repeater products. Some consumers have purchased unauthorised devices. These have the potential to cause harm to the mobile networks and to reduce the capacity for other consumers to access these networks.
- A4.6 Our regulatory policy objective is to facilitate the ability of consumers to improve their mobile coverage within the home and in vehicles, without giving rise to the risk of the kinds of deleterious effects described in this consultation document. We seek to facilitate the provision of a service to a consumer in the home or vehicle that is equivalent to that available outdoors at the same location. This is just one of a number of different initiatives Ofcom is undertaking to support improved coverage in general.
- A4.7 Subject to the responses we receive to this consultation, we propose to bring forward proposals for new regulations in the autumn of 2017 and for these regulations to be in place by the end of 2017.

A4.8 Ofcom conducts market surveillance of radiocommunications products placed on the market. We would consider this policy proposal a success if we see a reduction in the sale and use of unlawful apparatus in the UK and of the numbers of complaints to Ofcom about interference and other adverse effects caused by repeaters.

## Analysis of the different options

A4.9 Ofcom is required by section 8 of the Wireless Telegraphy Act 2006 to make regulations for the licence exemption of apparatus where we are satisfied, amongst other things, its use is unlikely to cause harmful interference or adverse effects on the technical quality of service. Given this, and the consumer demand for repeaters, we have considered two options:

- not making any exemption regulations; and
- identifying a set of technical parameters that would enable us to achieve our objective and making licence exemption regulations based on them.

A4.10 We would adopt the first of these options if we could not identify a set of technical parameters that would achieve our objective. If we could not do so, owing to the risks to undue interference or other adverse effects to mobile networks and other users, we would not be required to make licence exemption regulations (and would not do so).

A4.11 Our provisional assessment is that the likely impact of taking this course would be continued limited coverage for some consumers and continued demand for and use of unauthorised repeater devices by them. They might themselves obtain better mobile coverage under these circumstances, but there would be continued negative effects on networks and other consumers overall. Ofcom would continue to take enforcement action where possible, but it is likely that the manufacture and sale of repeaters who use would be unlawful would also continue.

A4.12 Our further provisional assessment is that the PA Consulting Report and our engagement with mobile network operators and repeater manufacturers enables us to identify appropriate technical parameters. Adopting them and making appropriate licence exemption regulations would enable us to secure our objective.

A4.13 In our assessment, the likely impact of this course would be that manufacturers would respond to the consumer demand by developing such repeaters where there is economic benefit to their doing so. In those circumstances, there should be no overall cost to manufacturers and the impacts would include:

- an increase in the ability of consumers to take steps to improve the mobile coverage they receive, by self-installing and using licence exempt-repeaters;
- where they exercise that ability, an improvement in coverage for those consumers, without deleterious effects on mobile networks and other users;
- a reduction in the need for consumers to resort to the purchase of repeaters who use is unauthorised and unlawful; and
- where demand for such repeaters is reduced, a decline in the offering of them for sale in the UK.

A4.14 In the circumstances, our provisional view is that these proposals would further citizens' and consumers' interests. We are therefore minded to adopt this option.

## Annex 5

# Current National Frequency bands and National Interfaces for Mobile use

- A5.1 Annex 5 has been published as a separate document. Please see:  
[https://www.ofcom.org.uk/\\_resources/documents/consultations/category-2/100208-mobile-phone-repeaters/associated-documents/secondary-documents/Annex-5-Current-National-Frequency-bands-and-National-Interfaces-for-Mobile-use.pdf](https://www.ofcom.org.uk/_resources/documents/consultations/category-2/100208-mobile-phone-repeaters/associated-documents/secondary-documents/Annex-5-Current-National-Frequency-bands-and-National-Interfaces-for-Mobile-use.pdf)

## Annex 6

# Proposed National Interface Requirement for Licence Exempt Static Mobile Phone Repeaters, Intended for Indoor Use

Below is an example of the table from a proposed National Interface Requirement for licence exempt static mobile phone repeaters intended for indoor use

<b>Proposed minimum requirements for the use of: licence exempt static mobile phone repeaters intended for indoor use operating in the XXX MHz band</b>			
	<b>Nr</b>	<b>Parameter</b>	<b>Description</b>
<b>Normative part</b>	1	<b>Radiocommunication Service</b>	Mobile
	2	<b>Application</b>	Static mobile phone repeaters intended for indoor use
	3	<b>Frequency band</b>	791 - 796 MHz (Downlink) 832 - 837 MHz (Uplink)
	4	<b>Channelling</b>	Not specified
	5	<b>Modulation / Occupied bandwidth</b>	Not specified
	6	<b>Direction / Separation</b>	Repeater transmit/receive
	7	<b>Transmit power / Power density</b>	Uplink 23 dBm Downlink 10 dBm



8	<b>Channel access and occupation rules</b>	<b>Transmit Gain Control</b> The uplink and downlink gain in dB of a single operator repeater, referenced to its input and output ports, shall not exceed BSCL-30. Where BSCL cannot be determined, the repeater must not transmit  The uplink and downlink gain of a single operator repeater referenced to its input and output ports shall not exceed 100 dB.	Where BSCL (base station coupling loss) is the path loss between the base station and the repeater, the apparatus shall determine this value by calculating the difference between the carrier power received at the repeater and the carrier power transmitted from the base station. E.g. The carrier power transmitted by the base station may be determined from the system information messages sent by the base station on its control channels.
		<b>Automatic Standby</b> When the repeater is no longer serving an active device connection it must, after no more than 5 minutes, reduce any uplink noise power to no more than -70 dBm/MHz. <b>Anti-Oscillation</b> Repeaters must be able to detect and mitigate (i.e. by automatic gain reduction or shut down) any oscillations in uplink and downlink bands. Oscillation detection and mitigation must occur automatically within: <ul style="list-style-type: none"> <li>• 0.3 seconds in the uplink band; and</li> <li>• 1 second in the downlink band.</li> </ul> In cases where oscillation is detected, the repeater must continue this mitigation for at least one minute before restarting. After five such restarts, the user-installed mobile phone repeater must not resume operation until manually reset. <b>Single Operator configuration</b> The amplified frequencies shall be limited to those licensed to a single mobile network operator.	The equipment may be re-configured to alternate frequencies, but may only operate using frequencies licensed to a single operator when configured.
9	<b>Authorisation regime</b>	Licence Exempt	

	<b>10</b>	<b>Additional essential requirements</b>	Nil
	<b>11</b>	<b>Frequency planning assumptions</b>	Not specified
<b>Informative part</b>	<b>12</b>	<b>Planned changes</b>	
	<b>13</b>	<b>Reference</b>	EN 303 609 EN 301 908-11 EN 301 908-15
	<b>14</b>	<b>Notification number</b>	
	<b>15</b>	<b>Remarks</b>	

## Annex 7

# Proposed National Interface Requirement for Licence Exempt Low Gain Mobile Phone Repeaters, Intended for In-Vehicle Use

Below is an example of the table from a proposed National Interface Requirement for licence exempt low gain mobile phone repeaters intended for in-vehicle use

<b>Proposed minimum requirements for the use of: Low gain mobile phone repeaters intended for in-vehicle use operating in the XXX MHz band</b>			
	<b>Nr</b>	<b>Parameter</b>	<b>Description</b>
<b>Normative part</b>	1	<b>Radiocommunication Service</b>	Mobile
	2	<b>Application</b>	Low gain mobile phone repeaters intended for in-vehicle use
	3	<b>Frequency band</b>	791 - 796 MHz (Downlink) 832 - 837 MHz (Uplink)
	4	<b>Channelling</b>	Not specified
	5	<b>Modulation / Occupied bandwidth</b>	Not specified
	6	<b>Direction / Separation</b>	Repeater transmit/receive
	7	<b>Transmit power / Power density</b>	Uplink 23 dBm Downlink 10 dBm
	8	<b>Channel access and occupation rules</b>	<b>Maximum permitted Gain</b>  In both the Uplink and the Downlink the maximum permitted gain is:  <ul style="list-style-type: none"> <li>• 21 dB in relevant frequency bands above 1 GHz; and</li> </ul>

			<ul style="list-style-type: none"> <li>15 dB in relevant frequency bands below 1 GHz.</li> </ul>
			<p><b>Automatic Standby</b> When the repeater is no longer serving an active device connection it must, after no more than 5 minutes, reduce any uplink noise power to no more than -70 dBm/MHz.</p>
	9	<b>Authorisation regime</b>	Licence Exempt
	10	<b>Additional essential requirements</b>	Nil
	11	<b>Frequency planning assumptions</b>	Not specified
<b>Informative part</b>	12	<b>Planned changes</b>	
	13	<b>Reference</b>	EN 303 609 EN 301 908-11 EN 301 908-15
	14	<b>Notification number</b>	
	15	<b>Remarks</b>	



## Annex 8

# FCC rules (background)

- A8.1 The regulations relating to Mobile phone repeaters in the USA, are set out on the FCC website home page for Signal Boosters<sup>18</sup>.
- A8.2 The technical regulations in the USA cover both “Wideband Consumer Signal Boosters” and “Provider-Specific Consumer Signal Boosters”. In both cases, they allow for the repeater to work in static and mobile scenarios.
- A8.3 The FCC regulations (Rule) set out a number of technical spectrum access and mitigation rules that are intended to ensure that repeaters do not cause undue harm to the mobile networks. These techniques include;-
- Self-monitoring – to ensure compliance with applicable noise and gain limits and either self-correct or shut down automatically if their operation exceeds those parameters.
  - Anti-oscillation - to detect and mitigate any unintended oscillations in uplink and downlink bands (such as may result from insufficient isolation between the antennas).
  - Power Down - to automatically power down or cease amplification as they approach any affected base station
  - Automatically limit the noise in adjacent frequency bands
  - Automatically limit the gain to prevent harm to the network
  - Limit the out of band emissions
  - Transmit power off, when not functioning
- A8.4 In particular, the dynamic limits on adjacent band noise and the limits on in-band gain are key elements in ensuring the device is capable of enhancing the consumer experience in all use cases, whether operating far from a base station or nearby.
- A8.5 Further, in the USA there is a non-technical requirement that repeaters be registered. However, those same FCC regulations permit the maximum power of a device to be 30 dBm. Our proposals are to limit the power to that permitted for handsets in any particular authorised band of operation (typically 24 dBm). Further, our proposed limitation of gain to 30 dB below the base station coupling loss is based on a conservative assumption of a high number of concurrent repeaters being in use.
- A8.6 Ofcom’s provisional assessment is that the technical regulations proposed would fulfil the requirements of section 8 of the WT Act. Ofcom therefore is not proposing any central registration database as part of our proposed licence exemption.
- A8.7 It is Ofcom’s understanding that the Provider-Specific Consumer Signal Boosters have had a wider take-up with consumers in the USA, as compared to wideband

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<sup>18</sup> <https://www.fcc.gov/wireless-telecommunications/signal-boosters>

repeaters. Presumably, this is due to the overall enhanced user experience these repeaters can bring, over a wideband device that has to limit its own gain based on its sensing signals over a wider bandwidth.