Vodafone Response to Ofcom Consultation:

"Mobile Phone Repeaters"

Mobile repeaters

Vodafone welcomes the opportunity to respond to Ofcom's consultation on further liberalising the usage of mobile repeaters. Vodafone did not support the initial liberalisation of mobile repeaters; instead we provided suggestions of how Ofcom could improve its approach if it was insistent on permitting usage beyond those under mobile operator control. Our concerns on allowing largely unfettered usage of mobile repeaters have not diminished. We have seen interference to the operation of blue-light services caused by repeaters that are incredibly difficult to track down. We have seen health authorities proposing to use repeaters that patently do not meet Ofcom's specifications, despite the seller's assertion that they do. We continue to see sales of multi-operator repeaters, despite usage of them currently being prohibited. Where mobile repeaters have been liberalised in our international markets, our partner operating companies have seen harmful interference to the operation of our mobile networks.

We cannot comment on whether Ofcom's technical analysis is rigorous enough, as insufficient detail is provided in the consultation. Ofcom's focus, however, has been on the potential for harm to mobile networks via interference to wireless signals, rather than the bigger picture of the harm to mobile networks via unexpected traffic demand precipitated by mobile repeaters, particularly in the context of commercial deployments. For residential deployments, we believe there is scope for consumer harm in that multi-operator repeaters may not improve weak network signals in the way that might be expected. Even if they do work, a better outcome could be achieved at no expense to the consumer by simply enabling Wi-Fi calling.

In this response we are supportive of Ofcom's plans to facilitate testing of repeaters, to allow vendors to assert compliance with the Ofcom Interface Requirement specification – we cannot disagree, given this is exactly what Vodafone proposed should be done as a minimum when Ofcom initially liberalised some repeater usage. We do not believe that this goes far enough, however, given that we are dealing with an industry sector with a history of misrepresenting the legality of using its equipment.

Instead, we propose that Ofcom adopts a light-licensing approach, in order that mobile repeaters are used only where they represent an appropriate solution, and so that where they are implemented, the mobile networks have knowledge so can appropriately adapt our macro networks. We do not consider the proposed licensing approach onerous, either from the perspective of operational burden to Ofcom, or cost burden to potential users.

We expand on these ideas in our responses to Ofcom's questions.

Answers to questions

Question 1: Do you agree that Ofcom should consider working with relevant industry partners to develop a voluntary testing standard, and publishing a list on our website of static indoor mobile phone repeaters that comply with our licence exemption requirements?

When Ofcom consulted on liberalising single-operator mobile repeaters, Vodafone predicted that absent a testing regime, there would be wholesale misrepresentation of the legality of products to end users[1]:

> *Vodafone's concern is that having a set of repeaters which are authorised for usage by Ofcom, without a suitable testing and enforcement regime, will simply lead to the less scrupulous suppliers slapping an "as approved by Ofcom" label on any mobile repeater equipment, regardless of whether it meets the specification.*

Sadly, this prediction has proved to be correct. When discussing coverage solutions, we are met with a steady stream of our customers that have been duped into buying equipment that it is illegal to use in the UK. The real solution would be for Ofcom to work with Government to make the import and sale of such equipment illegal – and to enforce that law – but as a stopgap measure, a quasi-"kite mark" scheme with Ofcom listing equipment tested by approved third parties to be compliant represents a step in the right direction. Any approval would need to be at the level of individual equipment type, however, rather than asserting blanket compliance by a given manufacturer or vendor.

Nevertheless, the liberalisation proposed by Ofcom to allow multi-operator devices plays into the hands of the peddlers of low cost non-compliant equipment. Today, when approached by our customers as to the legality of a given piece of equipment, it is a simple job for us to identify the bulk of non-compliant repeaters by the mere fact that they purport to repeat multiple operators' signals. If multi-operator repeaters are liberalised subject to certain technical conditions, it will become very complicated for us to determine which have been built to the Ofcom specification (and arguably impossible for the general public to accomplish this feat). The proposed testing regime will go some way, but where a piece of equipment is absent from the Ofcom list, we have no doubt the vendor will position this as being because "*testing hasn't completed yet*" or "*there's no need to demonstrate compliance to a third party*" rather than the more likely situation of the equipment not being even vaguely compliant with Ofcom's requirements.

The proposed testing regime would be of little use if it was not well-communicated to potential purchasers of mobile repeaters. Ofcom needs to ensure that when someone carries out an internet search for "mobile repeater" – or anything related – the first entry is Ofcom's advice page setting out the legal regime and listing which equipment has been demonstrated as compliant. This is not the case today, with primary links being to repeater vendors who obviously will put their own spin on the legal framework.

[1] "Vodafone response to Ofcom Consultation:Mobile Phone Repeaters Indoor and in-vehicle", June 2017

Question 2: Do you agree that we should modify IR 2102.1 to allow for 'provider specific' mobile phone repeaters? If you do not agree, please explain your reasons

We acknowledge that there is a superficial technical attraction to this modification – it can be argued that there is little difference in the interference characteristics of two individual single-provider repeaters adjacent to one another, versus a single piece of equipment automatically modifying the gain for each provider's specific signals according to the signal received from that provider's network.

However, the problem is not merely a technical one. We cannot expect potential purchasers of repeaters – who in the vast majority of cases are not RF engineers – to understand the distinction between a provider-specific repeater and a multi-operator repeater. This is particularly the case when we know that some vendors of repeater equipment are deliberately misleading customers as to the capability and compliance of their equipment. As such, although we have sympathy with the technical argument, Vodafone considers that the only viable position from a consumer protection perspective is for Ofcom to treat provider-specific and multi-operator repeaters in the same way.

Question 3: Do you agree that we should make 'multi-operator' mobile phone repeaters complying with the technical requirements outlined above (and set out in the draft UK Radio Interface Requirement IR 2102.3 at Annex A3) licence exempt? If you do not agree, please explain your reasons.

Vodafone does not agree with the proposal.

We have reviewed the analysis as set out in the Annexes to the consultation, but there is insufficient detail to conclude whether its narrow conclusions regarding radio interference with the mobile network are reasonable. However, we have doubts:

1. In Annex A1.6, Ofcom states
   "As explained in Section 4, this analysis focuses on the potential impact that 'multi-operator' repeaters could cause to MNO networks. We have analysed the impact on two network deployments, one based on the Beacon grid (i.e. either Vodafone or Telefonica/O2) and one based on the MBNL grid (i.e. either Three or BT/EE)."

   However, it's not clear why the analysis fails to consider both grids together. Taking Beacon as an example, simplistically every base station is broadcasting both Vodafone and Telefonica signals (leaving to one side unilateral deployments). Based on this assumption it would be expected that, at any given location, a deployed repeater would receive downlink signals of equal level from each of Vodafone and Telefonica networks. The repeater sets its gain based on the composite received signal so it's unclear whether Ofcom is really exercising the full functionality of the repeater in its analysis. An analogous argument applies to the MBNL network. As the Beacon and MBNL networks are not coordinated, taking them together is the most realistic scenario – we concede that this may make no difference to the network harm analysis, but any analysis must be reflective of real-world deployment to be of value.

2. Ofcom's description of calculating the uplink noise rise to the base station is not one that's familiar to Vodafone (we do not assert that it is incorrect, rather that it doesn't align with usual practise).

3. The assumption on repeater placement (i.e. random within the building) is questionable. It is to be hoped that a consumer repeater would include installation instructions that would advise the purchaser where and how to install the device. That advice would probably be to locate the repeater close to a window and experiment with different window locations to maximise the signal strength shown on the handset - in effect to try to minimise the building entry losses thereby skewing the loss distribution towards its lower end. Ofcom needs to better explain its noise rise calculations and then, assuming they are reasonable, repeat the analysis showing the results for zero building entry losses. This is not because we assert that there are no building entry losses, but instead because we do not know what the building entry loss will be at random deployments, hence need to understand how sensitive the model is to the assumptions made.

Our concerns about liberalising mobile repeater usage do not, however, stem narrowly from the prospect of radio interference with the mobile network.

Ofcom's frame of reference when considering mobile repeaters appears to be that they will predominately be used in consumer contexts to improve coverage in domestic premises. This is one use case for repeaters, albeit one that is increasingly redundant, with wider rollout of mobile networks (for example via the Shared Rural Network) and support of Wi-Fi calling capability being the norm: we also believe that repeaters compliant with the technical specification are unlikely to be price-attractive for this domestic use case. However, the far more prevalent use case will be in non-domestic scenarios, in commercial settings such as shopping centres and offices. We can categorically state this, as the bulk of multi-operator devices we have encountered, which the sellers have purported to be legal, have been deployed by our customers in non-domestic environments.

Where there is poor mobile coverage, for example in shopping centres, the optimal approach is to deploy a coverage solution, either in the form of an in-building design, or beefing up the macro-network environment against a planned demand. However, when speaking to building owners, we have frequently seen alternate solutions put forward of deploying multiple mobile repeaters, which in the current regulatory environment would not be allowed. Were Ofcom to liberalise multi-operator mobile repeaters, then this barrier would be removed and inevitably the owners of such buildings would go with the superficially attractive cheap repeater solution. However, where such a repeater solution is deployed, it then relies on mobile signals from the macro-mobile network, and in a licence-exempt approach mobile operators would have no visibility of the repeater solution until there is a surge in demand when it is powered up. There is thus a high risk that the macro-network will be congested by significant volumes of connections that will inherently be at the cell-edge, necessitating investment by the mobile operators to remedy the situation. This forces the bulk of consequent costs onto mobile networks, and degrades service for our customers until such a time that this investment happens. Even then, re-engineering the macro-network to support a pin-point demand at the repeater antenna is unlikely to have been the optimal way of serving users at the location. In contrast, a

properly engineered coverage solution would resolve the issue more holistically for the long term, would be future-proof to technology changes, would not impair service for other users in the short term.

Our principal concern, therefore, is that particularly in commercial environments, unfettered deployment of multi-operator mobile repeaters effectively takes the design of the mobile macro-network out of the hands of mobile operators, and turns it into a reactive exercise of patching congestion caused by unanticipated repeater deployments. It also removes any chance of a meaningful dialogue between mobile network operators and large commercial premises around sharing the cost burden of improving indoor coverage at their commercial enterprise.

Even in a domestic environment, we question whether multi-operator mobile repeaters actually provide the user benefit anticipated by Ofcom, or instead could result in consumers being misled. The key driver for this consultation is to liberalise cheaper repeater devices. The gain of the multi-operator repeater is determined from the composite received power levels of all of the signals of the different operators' networks. This means is that if there is a significant difference between the signals received from two operators – which will be the case because of the uncoordinated nature of the MBNL and Beacon grids - the strongest input signal will determine the repeater gain, which in many cases will then be too low to really help provide coverage of the weaker signal. It is likely that the purchaser of a repeater will be a customer of the network with the weaker signal and, therefore, less likely to get the benefits expected.

Ofcom uniquely holds the data to validate this thesis: it has predicted signal strengths for all mobile networks so could examine how prevalent the situation is where there is satisfactory indoor mobile coverage from one network and poor coverage from others[2], compared to the theoretical situation where multi-operator repeaters could be effective, i.e. where all networks present poor coverage. Whilst this could be characterised as a *caveat emptor* issue, Ofcom has a duty to protect consumers, and hence we believe that Ofcom has a duty not to encourage the purchase of devices if they don't deliver the purported benefits (and, in turn, a duty to establish whether devices will generally deliver the claimed benefits).

Moreover, whether in a domestic or commercial or domestic environment, we have concerns about the suitability of repeaters for today's complex mobile networks. The concept of a repeater is that it receives a weak signal from outdoors and re-broadcasts it indoors. For simple 2G/3G networks that transmit relatively simple signals, the logic is fairly straightforward. However, as we move to 4G and 5G networks the fundamentals of the radio interface are considerably more complex. Communications between the network and device are occurring over multiple spatially diverse paths with the network and device dynamically adapting as the radio environment changes, e.g. MIMO and M-MIMO with beamforming antennas, to exploit the optimum performance. A repeater cannot amplify and re-broadcast these complex spatially diverse signals due to fact that it is fixed at a single location and has only a single amplifier chain. It will amplify

[2] To be of value, the signal strength would need to be such that it provides good outdoor coverage but poor indoor coverage.

something, perhaps just one of the paths, but the amount of benefit the repeater might provide is not obvious.

For these reasons, Vodafone believes that Ofcom should focus on the provision of information of how to improve access to mobile services – encouraging take-up of Wi-Fi calling in domestic premises, and facilitating coverage solution deployments where needed in commercial environments. Making multi-operator repeaters licence-exempt is the wrong solution even if all repeaters on the market complied with Ofcom's technical specification, and the evidence is the situation will be even worse because of non-compliance.

In the event that Ofcom does wish to legitimise the usage of repeaters, we strongly favour the usage of a light-licensing approach. Under this approach, anyone wishing to make use of a mobile repeater would need to apply to Ofcom, setting out the nature of the deployment (single repeater/multiple repeaters being used in the deployment, domestic or commercial premises, location, device type). Ofcom could then:

- Inform the customer whether the device has been tested to be compliant with Ofcom's specification, and warn them of the ramifications if it is not compliant;
- In the case of a domestic installation, use coverage mapping data as provided by the mobile operators to assess whether a repeater is likely to improve coverage;
- In the case of commercial installations, carry out simple checks to assess whether a repeater solution is likely to be suitable (e.g. how many are already in the area, is the applicant deploying multiple repeaters that could overload the macro-network to the detriment of other users) and if there is any doubt liaise with the mobile network operators; and
- Keep a log of repeaters deployments approved so that if there is undue interference, or congestion to macro networks, the mobile operators at least have an idea that the presence of repeaters may be a factor.

We do not believe that this process needs to be onerous, and we do not propose that Ofcom levies a fee which is anything other than at an administrative level. Such an approach would also mean that users deploying repeaters are treated on the same regulatory basis as other stakeholders:

1. Mobile operators are expected to keep and make available records of where we transmit our licensed frequencies;
2. Where we deploy customer femtocells, we're expected to keep records, and these have been requested by Ofcom under its information gathering powers;
3. Where third party innovators have sought to deploy in frequencies licensed to mobile operators but superficially not used, there are well-established principles that the mobile operator in question is consulted to see if there's likely to be any change in the usage of that spectrum prior to a Local Access Licence being issued. The licensee is then expected to keep records of its masts.

In case (3) in particular, if multi-operator mobile repeaters were to be fully liberalised the effect would be to say that you're allowed to use mobile downlink spectrum so long as you're rebroadcasting mobile operator signals without their consent, but if you wish connection of the signals to/from the public network to be via any other route then you must apply for a Local Access Licence – this is not regulatory consistency.

We consider our proposals to be pragmatic, allowing Ofcom to meet its statutory duties as UK spectrum manager.

Question 4: Do you agree with our provisional view as set out in paragraph 3.48 above? If you do not agree, please explain why you think the requirement is not necessary.

Firstly, we note that the issues raised by this section of the consultation emphasise the difficulty of deploying mobile network technology independent of the mobile network operators. Neither the equipment manufacturers/vendors, nor the users of mobile repeaters, have any knowledge of the closure plans for 2G/3G networks and, unlike the mobile networks, they also do not have visibility of the terminals (hence terminal capabilities) using the mobile network.

For example, Vodafone is withdrawing its Suresignal 3G femto capability, but we are doing so with careful communication around Wi-Fi calling support, knowledge of the terminals that are currently using such devices and knowledge of their location. In contrast, if technology-specific repeaters are deployed on a licence-exempt basis, there would be no information as to their location hence impact as the macro network evolves. A light-licensing regime would provide that visibility.

We consider that Ofcom's proposals on 4G-only repeater devices probably represents a "least worse" approach.

Question 5: Do you agree that it would not be appropriate to allow the use of licence-exempt repeaters in the 2.6 GHz band? If you do not agree, please explain your reasons.

Vodafone fully agrees, indeed under our alternative light-licensing approach we would similarly not allow usage of repeaters in the 2.6GHz band (and, by extension, 3.4GHz band) due to the risk to safety-of-life radar operations. Were Ofcom to allow 2.6GHz operation on a licence-exempt basis, in principle there would be nothing to prevent deployment of a multi-operator multi-repeater solution within, for example, the terminal buildings at Gatwick airport, with subsequent risk to aircraft operations. In contrast, as a 2.6GHz licensee, Vodafone is required to comply with onerous coordination requirements involving analysis of the cumulative impact of our network around radar installations – such cumulative analysis is simply not possible when licence-exempt operation means the location of and volume of repeaters is unknown.

Question 6: Do you agree that we should allow the use of static indoor mobile phone repeaters (on a licence-exempt basis) in the paired 700 MHz mobile band?

As Vodafone is not a licensee in the band, we are not directly a stakeholder. However, we see no reason that 700MHz be treated any differently to the other mobile bands.

Vodafone UK
July 2021