Mobile Coverage Enhancers and their use in licensed spectrum

About Arqiva

Arqiva is the communications infrastructure and media services company operating at the heart of the broadcast and mobile communications industry and at the forefront of network solutions and services in an increasingly digital world. Arqiva provides much of the infrastructure behind television, radio and wireless communications in the UK and has a growing presence in Ireland, mainland Europe and the USA.

The company supports cellular, wireless broadband, video, voice and data solutions for public and private sector customers.

Arqiva is a founder member and shareholder of Freeview (Arqiva broadcasts all six Freeview multiplexes and is the licensed operator of two of them) and was a key launch technology partner for Freesat. We own Connect TV, the first company to launch a live IP streaming channel on Freeview. Arqiva is also the licensed operator of the Digital One – the national commercial DAB digital radio multiplex.

We are building and running a national Internet of Things (IoT) network, starting with 10 of the UK's largest cities. In addition our smart metering communications service, connecting 10 million homes using long-range radio technology, will be one of the UK's largest machine-to-machine deployments.

Arqiva operates shared radio sites throughout the UK and Ireland including masts, towers and rooftops from under 30 to over 300 metres tall as well as a number of international satellite teleports. In Arqiva WiFi we own one of the UK's largest Wi-Fi hotspot providers that enables us to build a unique proposition for Wi-Fi hotspot and outdoor Wi-Fi provision in the UK.

Our major customers include the BBC, ITV, Channel 4, Five, BSkyB, Classic FM, the four UK mobile operators, the Metropolitan Police, Airwave and the RNLI.

Arqiva is owned by a consortium of long-term investors and has its headquarters in Hampshire, with major UK offices in London, Buckinghamshire and Yorkshire.

Mobile Coverage Enhancers and their use in licensed spectrum

1. Executive Summary

Currently, repeaters can only be used in the UK with explicit permission from mobile operators. Overall there does not appear to be a need to fundamentally change from this position as the regulations that exist in this area seem to strike the right balance. In order to ensure that no consumers lose the coverage that they have today, repeaters need to be under the control of the mobile operators. This is already possible under the existing framework. Overall the adverse side-effects of unlicensed self-installed repeaters are likely to outweigh the benefits.

The existing position in the UK mirrors what is already possible elsewhere in the world. In the US, for instance, unlicensed consumer repeaters have been able to be legally be used for some time, but the FCC revised their framework in 2013 and now requires all users of repeaters to register and obtain permission. This is in acknowledge of the problems created by a more permissive regime.

It is also the case that one of the major purposes of repeaters is to support in-building coverage. There are already a variety of solutions that are used to improve in-building coverage such as Distributed Antenna Systems (DAS) and small cells. In addition the increasing use of WiFi is reducing the benefits of repeaters for improving indoor coverage. The various developments that are being put into place by the mobile industry, in particular around voice over WiFi are further reducing the need for repeaters.

2. Arqiva detailed comments

2.1. Consumer demand

"The consumer demand for improved indoor coverage solutions, especially repeaters, and the circumstances and locations under which they can provide the greatest net benefit"

As Ofcom is aware, the wider telecoms industry is experiencing an increasing demand for data, in particular in indoor situations. Arqiva has seen strong growth in the demand for indoor coverage and capacity in our existing DAS and public WiFi businesses and also for our emerging small cell solutions (both indoor and outdoor).

Arqiva generally agrees with the Ofcom-commissioned Real Wireless report on in-building coverage[1]. In particular we support Real Wireless' conclusion that WiFi is generally the best self-installed solution. This solution will be even more valuable once Voice/SMS over WiFi solutions are more broadly available towards the end of 2014 (see below).

Repeaters are technically a sub-optimal solution and should always be used as "last resort" due to the potentially negative impact on the existing "outside-in" macro network layer. Repeaters will always reduce the overall capacity available to a macro cell and pose the risk of causing interference if the radiated signal goes beyond the intended area.

The greatest benefit of repeaters generally will be in areas where fixed broadband with at least 0.5 Mbps for WiFi or femtocells is not available. Considering the various policy

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[1] Real Wireless 2013 Options for Improving In-Building Mobile Coverage

interventions to bring basic broadband to virtually all households in the UK, we believe the areas where there is a mobile signal but no broadband will reduce to a very small proportion of the UK's premises.

2.2. Operation

"The ways in which different types of repeater devices operate and the technical and other effects they have on networks and other mobile users."

Traditional consumer repeaters tend to be small, low cost, bi-directional amplifier units that users can place on their window ledge to pick up a "donor" mobile signal which is then "boosted" and retransmitted into the building.

In the UK these units can be purchased legally and can already be legally deployed with permission from the mobile operators. When the mobile operators consider whether to permit the use of these devices they rightly consider the impact on other mobile consumers, in particular interference to the macro-cellular networks (the donor network). For the mobile operators if a consumer repeater does not negatively impact on the other consumers using the macro network then allowing the repeater to be deployed will lead to an improvement in coverage at no cost to them.

In practice, even when approved, interference from consumer repeaters are likely to be more significant in these devices than in operator-deployed repeaters as:

- These units tend to be broadband units working across a number of operators
- The operator has no direct control over precisely where the unit is used and its settings
- The low cost and small form factor of the unit means that the same level of skilled installation and setup associated with operator deployed repeaters to minimise interference cannot be achieved

Generally the low cost and small form factor of these units means that there is not good isolation between the two opposite facing antennas in the unit which in turn limits the amplification that can be achieved without having feedback issues. This, combined with the placement of the unit on a window ledge rather than having an antenna external to the building, will impact the levels of service improvement achieved.

Overall the current regulations relating to repeaters in the UK strike a suitable balance between allowing consumers to deploy repeaters (including the advanced products that are coming to the market) while allowing the MNOs a reasonable level of control over their macro networks to minimise unintended side-effects to other consumers.

2.3. Technology evolution

"The current operation and likely evolution of different types of repeater and other coverage enhancing devices such as multi operator open femtocells. One of the drawbacks for consumers of current femtocells is that they typically only enhance the coverage of a single MNO's network so a household buying services from more than one MNO would need multiple femtocells"

In broad terms future mobile networks will be organised around three layers:
- **Macro network** for the main coverage
- **Small cell network** for targeted coverage and capacity in-fills, mainly "outside-in", but also "inside-in" for large buildings (DAS in certain circumstances)

- **WiFi** for self-deployment in households, smaller buildings and public areas, with voice and SMS services enabled through IMS and/or smart phone apps

Only in rare circumstances where no sufficient broadband (where sufficient means 0.5 Mbps or greater) is available for stable WiFi or femtocell connectivity there may be a need for operator-approved, consumer-installed **smart repeaters**. However, allowing this does not require changes to the current regulatory framework.

The current situation of licenced spectrum for mobile operator controlled networks on the one side and licence-exempt spectrum for self-deployed WiFi on the other side is working well and will further improve once advanced Voice/SMS over WiFi solutions are more widely deployed. The relevant products are already available on the market from a variety of providers:

- Telefonica/O2 already has had its TU GO solution in the market since early 2013 (as noted in the Real Wireless report).
- Hutchison/Three has recently launched a similar, app-based solution called inTouch[2]
- EE is in advanced stages of deploying an IMS-based solution to offer calls and SMS over any WiFi network without any additional app required[3]
- In addition, MVNOs such as Virgin Mobile/Media offer similar WiFi-based products such as Smartcall[4].

Once these solutions are established in the market, it may lead to the use of femtocells declining in favour of the more cost effective and ubiquitous voice/SMS over WiFi solutions. The UK's high smart phone penetration will facilitate this further and it may be more cost effective for mobile operators to offer customers a smartphone with the relevant app instead of a femtocell.

Finally, as the Real Wireless report rightly notes, multi-operator femtocells are unlikely to be available in the market any time soon, mainly due to complexity and cost and the potentially small and diminishing market owing to advanced Voice/SMS over WiFi solutions.

2.4. Consumer utility and benefits

"The potential utility of end-user deployed repeaters compared to alternative approaches for enhancing mobile coverage…and the benefits that different types of indoor coverage enhancement solutions, and repeaters in particular, can provide to consumers"

As already noted, WiFi is the preferred self-deployed indoor coverage solution, particularly in combination with the existing and upcoming voice/SMS over WiFi solutions. In certain circumstances where no sufficient broadband is available, but a strong enough mobile signal can be received, the use of smart repeaters may be beneficial. However, these areas will be limited and the current regulatory situation already allows these repeaters to be deployed in a way that ensures the best outcome for all consumers.

We are not aware of other developed countries where a relaxation of consumer repeater regulation has resulted in significant consumer benefit. However as discussed further below it is important to note that the FCC has tightened the regulation to reduce the harmful effects they were seeing from uncontrolled consumer repeater deployment.

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[2] See: http://www.three.co.uk/discover/three_intouch/
[3] See: http://ee.co.uk/our-company/newsroom/EE-announcing-live-trials-of-phone-calls-over-WiFi-and-4G-as-part-of-275-million-pound-voice-investment
[4] See: http://store.virginmedia.com/discover/phone/smartcall.html

2.5. Impact on networks and other mobile users

"The impact of different types of indoor coverage enhancement solutions, particularly repeaters, on networks and other mobile users, and especially the risks that end user installed repeaters will have adverse effects outside the premises in which they are deployed"

While Ofcom is aware of an average of around 80 incidents per year[5], it seems likely that there is a greater impact from undetected use and interference of sub-optimally installed and illegally used consumer repeaters. This is due to the fact that affected other users may not be aware that the negative impacts that they are experiencing stem from repeaters, given that the performance of mobile networks can vary significantly due to a number of other factors anyway (cell load, maintenance, weather etc.). Furthermore, even the MNOs may not always be aware of those repeaters that cause less severe issues, but still degrade the service for other users.

Ofcom should also be clear that the impact on networks is not just a narrow consumer issue. One of the biggest concerns to the MNO's ability to plan a network would be for small/medium enterprises in cluttered urban areas, particularly in mixed tenant accommodation who can't afford, whose landlords won't permit, or the where the MNOs won't connect to, DAS systems. As with all repeater deployment, the drain on capacity effectively warps the footprint of the cell, making optimisation of the cell challenging.

2.6. Solutions that could minimise any impacts on networks and other mobile users

"The potential for technical solutions or practical installation steps, again in relation to repeaters in particular, that could be used to minimise any detrimental impacts on other mobile users"

Again, it is clear that WiFi, in combination with new voice/SMS over WiFi solutions, is the best option for a consumer self-installed solution. The technology is inherently designed for this use case as opposed to the mobile networks. The other industry and public policy initiatives for increasing fixed and mobile network coverage will be sufficient in the near future to bring a high level of connectivity services to virtually all UK households. The existing regulation is adequate to enable the careful use of smart repeaters as a "last resort" where no other solution is available.

2.7. Spectrum management impacts

"The impact of repeater deployment on spectrum management, including spectrum re-farming and where macro enhancement techniques such as MIMO are in use, and means by which any such impact may be reduced"

One of the ways in which licenced spectrum awards enable services to be deployed in a way that creates value for consumer is by giving operators a high degree of certainty and control over how the spectrum is used (within certain parameters). The wide-spread unmanaged use of consumer repeaters would reduce that certainty. The potential side effects in terms of the impact on coverage and the reputation of mobile operators would significantly reduce the experience for many mobile customers.

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[5] See Call for Input, paragraph 1.18

This may be further complicated if there is a large installed base of repeaters and mobile operators want to upgrade the RAN technology (e.g. re-farming, MIMO, LTE advanced, 5G etc.), which may render many repeaters useless and therefore irritate consumers, who would be likely to blame mobile operators (despite the repeaters being outside of the operators' control).

Such a risk could by partially mitigated by deploying more sophisticated repeaters and by consumers replacing them in line with network upgrades, but would also make repeater solutions more expensive and, again, inferior to self-installed WiFi or femtocells. This contributes to repeaters' role as solutions of "last resort" in very specific circumstances and then only done with the approval of the mobile operators as is already possible today.

2.8. International developments

"The scope for international co-ordination...evidence of the impact of international developments including repeater use in Australia, US and across the EU.

USA

The FCC has previously permitted the relatively unregulated use of consumer repeaters. However, the FCC has recently adopted new rules to improve consumer repeater design to stop devices causing interference to donor wireless networks.

The FCC also adopted new rules about what cell phone users need to do before using a signal booster. For legacy repeater users consumers will be required to register signal boosters with their MNO. The FCC has always had the power to ask a consumer to turn off their repeater if it is believed to be causing interference and the repeater must remain off until the interference problem can be resolved.

New consumer repeater products governed by the new FCC rules will be authorised by the MNOs for use of their respective networks. They will be clearly marked with an information label explain the need to obtain permission before using the equipment.

Overall the FCC has acknowledged that its previous regime was not working and that there was a need to impose a significantly greater level of control.

Australia

There are strict restrictions for repeater operation in Australia governed by the Australian Communications & Media Authority (ACMA). As "ACMA has prohibited the operation, supply and possession of mobile phone boosters, which are claimed to enhance the performance and coverage of mobile phones."[6] In practice repeater products are available from the MNOs themselves. As it stands the regulations in Australia appears to be stricter than the status quo in the UK at this stage.

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[6] ACMA Fact Sheet on "Mobile Phone Boosters":