

Annex 2: Possible alternatives to spectrum are inadequate substitutes

1. Section 3 of the Response explains why it is not feasible to deploy additional macro sites to make up for a shortfall in spectrum compared to competitors. This annex explains why it is equally not feasible to use other technological or commercial options.

A. Technological options

2. Three accepts that technological improvements are part of the solution to improving data speeds, but implementing such improvements cannot come close to rectifying the impact of a severe spectrum imbalance.

Small, pico and femto cells

3. It is not feasible to cost effectively or practically match the speeds achievable with additional spectrum in a given geographic area by deploying small cells either in combination with or independent from macro-cells. Reasons for this are similar to those that apply in relation to macro sites, as discussed in Section 3 of the Response and associated technical annexes.
 4. Three considered the practical and commercial feasibility of developing a small cell solution based on its LTE 1800MHz spectrum and concluded that they can bring capacity relief only to targeted hotspots. In addition, this option would face a number of other specific challenges:
 - Deploying small cells is a more complex task in practice for Three than for other MNOs as, in contrast to EE and Vodafone, Three has no available spare spectrum to deploy a small cell layer. As such, the spectrum imbalance between MNOs is itself one reason why small cells are of limited value to Three at this time.
 - Small cells offer limited coverage as they suffer from both limited theoretical coverage (around 100m from an antenna) and significant signal obstruction as a result of lower antenna heights.
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- In urban areas, small cells require fixed infrastructure, and traffic hot spots may occur in locations where suitable infrastructure is not available. Further, Three's analysis indicates that small cell deployment is simply not feasible in a number of more congested areas.
 - Practical deployment and coordination issues will also limit the achievable rate of deployment of small cells.
 - The rights to use suitable assets (concessions) have been sold to multiple parties by local councils and other bodies. This fragmentation of the market for small cell services means that economies of scale are difficult to achieve, significantly lowering the number of physical deployments possible in practice.
 - Small cells have higher ongoing site operating costs when compared to macro sites in order to achieve a given level of coverage. ✂
5. In addition to small cells, Three has considered the potential of pico and femto cells to help address the gap in data speeds in the absence of sufficient spectrum. Pico cells behave very similarly to conventional small cells and suffer from the same disadvantages. Femtocells are already being used by Three to extend coverage (as opposed to capacity). ✂. Femtocells cannot be used to address capacity issues as customers already use home broadband or WiFi for data services.

WiFi solutions

6. There is an ever increasing availability of WiFi hot spots in concentrated traffic locations, such as city centres and shopping malls. However, contrary to popular opinion, WiFi solutions offer limited capability to offload traffic from a mobile network in practice. Ofcom's Connected Nations Report 2015 showed that the amount of traffic on public WiFi hotspots represents only 5% of the total amount of data sent over mobile networks, having remained at this level over the last three years¹.

¹ According to the Connected Nations report (December 2015), the total data carried over UK mobile networks in June 2015 was 72.9m GB (Figure 25), whereas 3.3m GB of data was uploaded and downloaded on public WiFi hotspots in the same month (Figure 27); see here https://www.ofcom.org.uk/data/assets/pdf_file/0028/69634/connected_nations2015.pdf. By comparison, the total data carried over UK mobile networks in June 2014 and June 2013 was 44.3m GB and 28.9m GB, respectively, compared to 2.3m GB and 1.5m GB of data uploaded and downloaded on public WiFi hotspots in the same periods.

7. Similar to small cells, public WiFi hotspots have limited coverage, and an infeasibly large number of WiFi hotspots would be needed to ensure a service at a consistent data speed, making public WiFi solutions uneconomic in practice.
8. Further, building a new WiFi network would likely be more expensive than building a mobile network outright. MNOs best placed to deploy a WiFi layer would be integrated fixed-mobile operators, which could rely on a fixed network to offload traffic. For example, BTEE has millions of customers with home WiFi routers which can be adapted to a Femtocell layer to offload mobile calls and data traffic. It also has a large number of public hotspots which it could use without its customers having to make a manual selection.
9. In contrast, Three currently has no WiFi access infrastructure² and discussions with public WiFi service providers have not led anywhere. Although Three has a WiFi proposition, *Three in Touch*, it is focused on enhancing in-building voice and text coverage using customers' home, office and manually-selected public WiFi hotspots. As such, it doesn't address speed and capacity issues within the mobile network.

Increased sectorisation

10. Additional antennae and supporting equipment can be installed at a macro site to increase the volume of traffic that can be served by that site, but it cannot improve peak data speeds and therefore only improves average speeds indirectly in the same way as adding new macro sites.

11. ✂.

12. ✂.

² With the exception of the back-end infrastructure used to authenticate Three customers using the WiFi provided by Virgin Media on the London Underground.

MIMO

13. Trials of MIMO technology have shown that the use of MIMO with 4G spectrum has the potential to significantly increase spectral efficiency and therefore improve the capacity and data speeds available to users. However, in practice, most people's use of mobile data services occurs through smartphones and smartphones can currently house a maximum of two antennae in most cases due to their size and weight.

14. ✂

15. ✂

Use of licence-exempt and shared spectrum

16. Licence-exempt spectrum is spectrum designated by Ofcom for low-power use on an unlicensed basis in the 2.4GHz and 5GHz bands. It has no protection against interference from other users, which is problematic for a commercial MNO requiring the ability to provide quality of service.

17. Further, due to its high frequency, this spectrum suffers from low coverage and poor in-building penetration, making it suitable mainly for WiFi solutions or similar technologies. However, Three's customers already use WiFi spectrum indoors, and public WiFi provides a relatively small impact on capacity for the reasons discussed above including because of the very small coverage area of each WiFi hotspot. Therefore, the possibility of sharing spectrum in the licence-exempt bands offers little potential to further alleviate demand for traffic on mobile networks.

B. Commercial measures to reduce data usage

18. Three's network carries 39% of mobile data traffic in the UK despite only having a 12.5% share of subscribers. It has been suggested by others that this unusually heavy data usage is as a result of offering all you can eat (AYCE) data tariffs but this is very much an oversimplification. It would be incorrect to assume that Three could significantly increase data speeds for its customers by making changes to the data allowances it offers, or by adjusting its prices.

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19. Hence, we conclude that traffic management policies and reconfiguration of AYCE tariffs are not sufficient measures to address congestion and poor data speeds on Three's network at present or in the future. We consider each of the reasons set out above in more detail below.



C. Conclusions

20. Whilst Three will always look to implement technological improvements, and to take appropriate commercial measures, those steps can never be sufficient to overcome a substantial imbalance in spectrum for the reasons given above.