Regulatory Challenges for the Future Mobile Landscape

Issue 1

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1. Introduction

Delivering the next generation of mobile broadband requires a radical rethink in the approach taken to spectrum allocation and network sharing

The Mobile industry is facing three major challenges for the future; first, meeting the exponential growth in demand for mobile broadband, second delivering the coverage levels and service levels that support emerging high bandwidth and time sensitive applications particularly for users indoors and in remoter regions, and third continuing to deliver effective competition. The current regulatory approach of separate national networks and fragmented spectrum, which has proved effective until now, is fundamentally inefficient to meet these challenges. Network sharing is becoming more extensive and spectrum sharing is also being seriously considered. Further sharing seems inevitable, though it could take several forms. A debate needs to start on changes in the regulation of network sharing and spectrum allocation to meet future needs.

Over the past decade, mobile broadband has grown quickly. It has accelerated with the arrival of smartphones, tablets, high bandwidth video based services and the next generation of network technologies LTE and LTE-A. Conservative demand projections forecast that the current physical network infrastructure will run out of capacity in the next four to five years. More aggressive but realistic demand projections anticipate the need for a step change in network density increasing cell site numbers by many times over the next ten to twenty years. This significant increase in network density brings with it other challenges including high investment cost, site location and access, provisioning adequate/cost effective backhaul and power. This paper examines how a single network approach is the most efficient way to address these challenges.

This paper analyses a number of shared network models for implementing a neutral host network. We find that as network density increases the business case for a single shared neutral host network becomes compelling. This approach also makes the most efficient use of scarce spectrum resources, avoids unnecessary duplication of sites, and optimises the use of backhaul and power. It also puts in place a network platform that is capable of supporting the widest range of mobile broadband data projections over the next ten to twenty years.

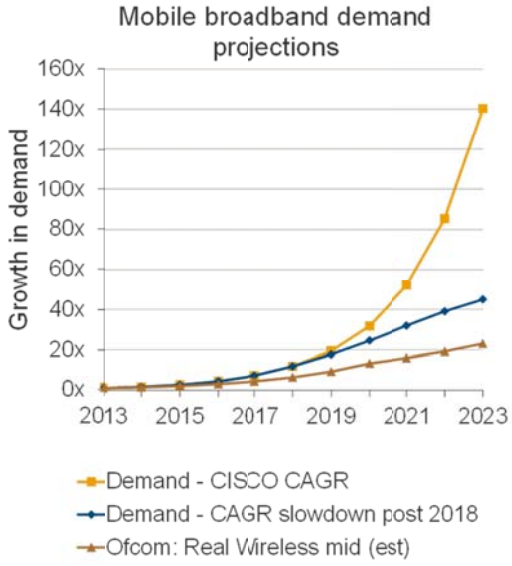
This paper also examines how regulators could facilitate shared network models. Implementing a neutral host network may require changes to how spectrum is released and has other regulatory implications, in particular in maintaining effective competition. Given the timelines involved in releasing spectrum and deploying network and device technologies the findings of this paper indicate an urgent need to review the regulatory framework to guide the deployment of the next generation of mobile broadband network.

In addition for UK plc, as the economy continues to become more digital and more mobile and more consumer and business services move into the cloud there will emerge an economic imperative to provide a ubiquitous network platform that can support increasingly more demanding service levels. Enabling the next generation mobile networks to support the digital economy will require the regulatory focus to also shift from network layer to the service layer.

2. The case for a neutral host network

Mobile broadband demand is forecast to rise in the UK by between 20x and 148x by 2023 and by as much as 300x by 2030.

Mobile broadband demand projections over the next ten to twenty years vary considerably. Higher end projections anticipate continued innovation in technology, proliferation of connected devices and increasing data usage per device and forecast up to 150x growth by 2023 and 300x growth in twenty years. Projections that are based on the existing device categories available today specifically broadband enabled PCs, smartphones and tablets and follow the penetration rates of these devices forecast growth in the range of 48x by 2023.

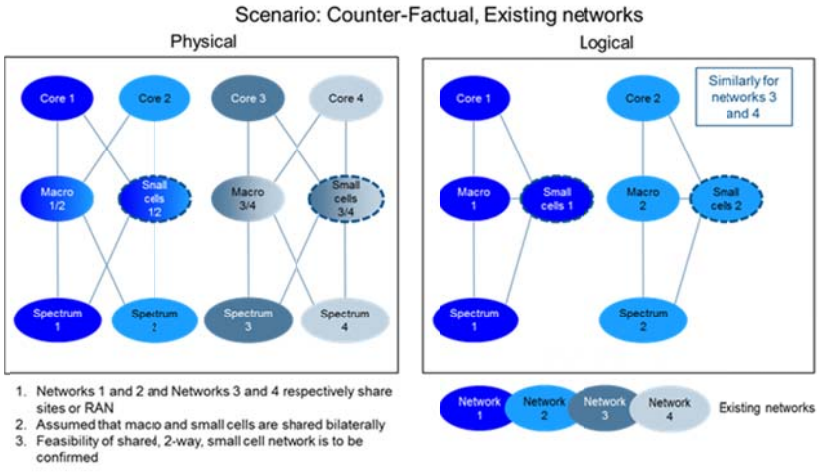


This paper models two growth scenarios: 48x growth and 100x growth by 2023 and four ways that the network could be implemented to support this.

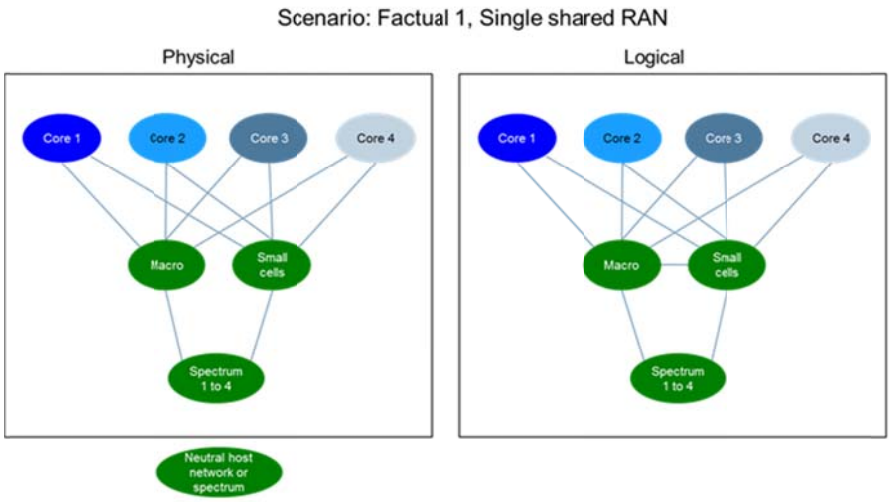
For this analysis we have taken both a 48x growth scenario and a higher case 100x growth scenario with the objective of identifying how and when higher levels of demand would influence the implementation choices made in deploying denser networks.

For the analysis we modelled a base scenario of extending the two existing UK networks and compared this with three possible shared network approaches – graphics illustrating the scenarios modelled are provided below:

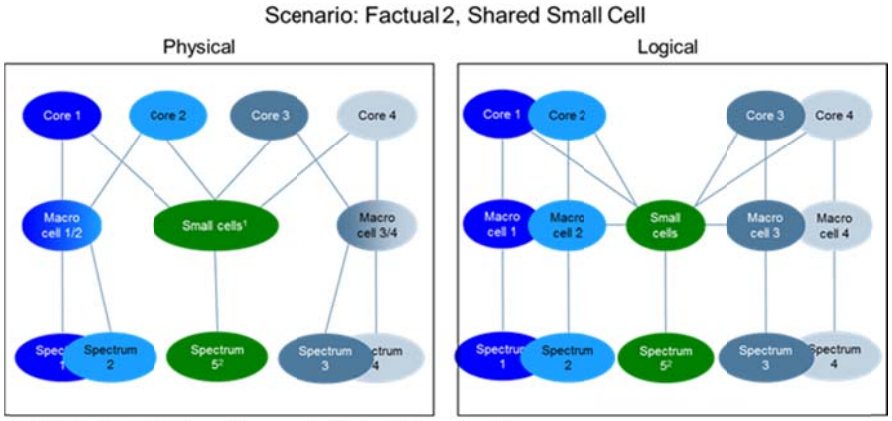
Case 1 - Extending the existing networks



Case 2 - Single Shared RAN (Macro and Small Cells)

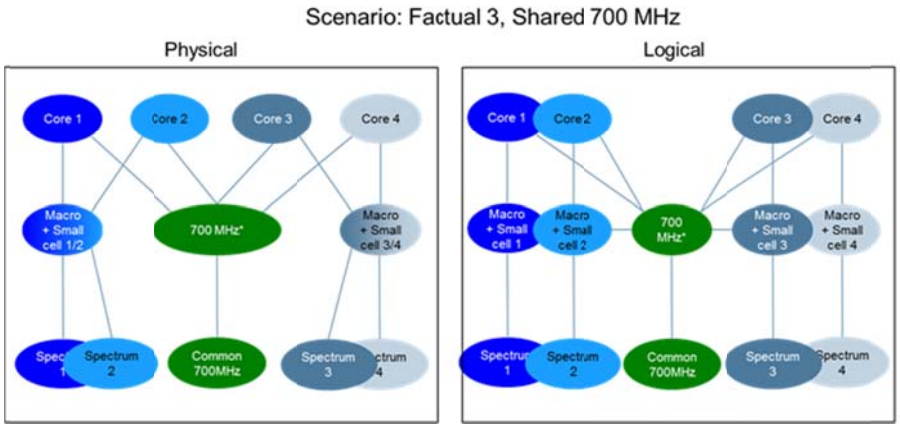


Case 3 – Shared Small Cells Network



1. Technical feasibility of shared, 4-way small cell network to be confirmed
2. Small cells assumed to have access to dedicated spectrum

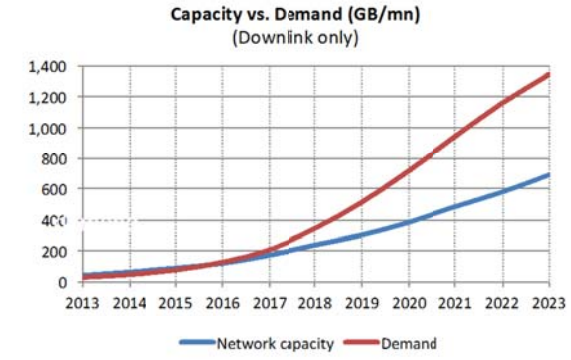
Case 4 - Shared 700 MHz



In the 48x case, demand exceeds capacity in 2016 and by 2023 an additional 10-15,000 sites could be needed if capacity is provided using small cells

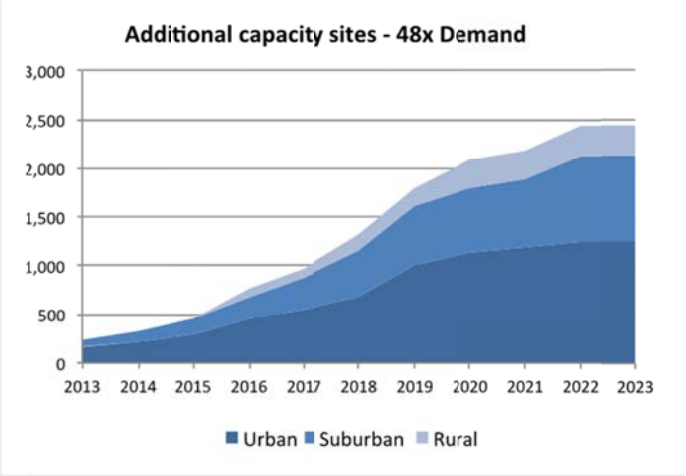
Taking the 48x growth forecast, demand starts to exceed the capacity of current networks by 2016. This assumes that capacity continues to be added through the normal approaches, for example, deploying new spectrum, re-farming, cell splitting and technology upgrade. At this point, either additional capacity sites need to be added or small cells need to be implemented to keep up with demand.

Projecting the model out over ten years the networks would need to be extended by of the order of 2,500 additional "capacity sites" per network. However, if small cells were used to provide the additional capacity then the number of new sites could be of the order of 10-15,000 additional sites.



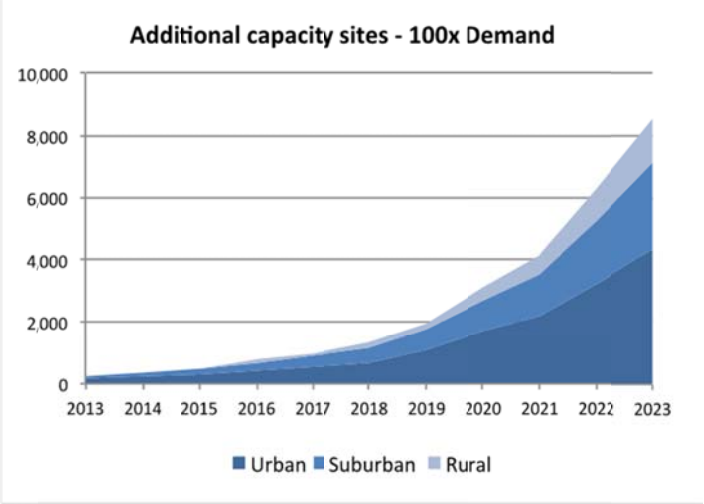
Ratio of capacity to demand

2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1.47	1.34	1.15	0.95	0.83	0.69	0.58	0.53	0.51	0.50	0.51



In the 100x case, by 2023 an additional 20-50,000 sites could be needed if capacity is provided using small cells

Taking the 100x demand growth case it would require an additional 8,500 capacity sites to support the growth in demand, which in practice will mean that the only realistic way to realise this will be through a small cell layer. A small cell layer could add as many as an additional 50,000 additional cell sites per network by 2023.

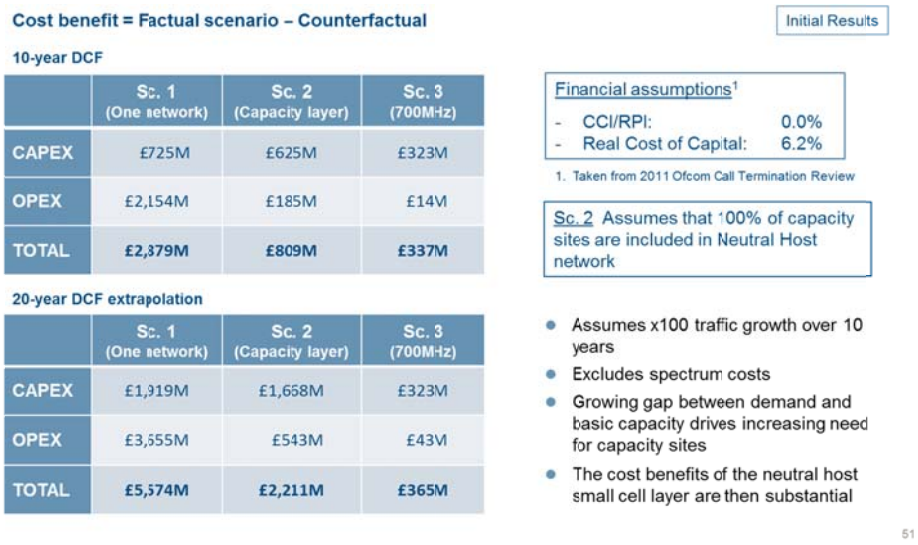


Large scale small cell networks will be implemented most cost effectively and efficiently through a shared network approach

What the analysis indicates is that although conventional capacity solutions can address lower end growth forecasts in the short term, in the long run small cells will be required to deliver the level of capacity required. In addition, it appears likely that individual operators will implement small cell networks independently, in part because this emerging technology solution will be more challenging to implement in a shared mode for technical and other reasons. If this happens the number of small cells will grow far beyond the projections in this paper.

If one accepts that large volumes of small cells are going to be implemented, the important question to be addressed is how to optimise the approach to implementing networks of this scale and density. This paper finds that the most cost effective and efficient approach is to implement a single shared network that avoids the inefficiency of allocating spectrum in small blocks leading to site and equipment duplication, along with the challenges of competing for suitable sites and provisioning backhaul and power.

The analysis indicates that over the ten year period the benefits of a single shared capacity layer network are substantial of the order of £800m and if the analysis is extended through the twenty year period it is £2.2bn. The benefits are even more significant if the single network also incorporates 700MHz.



The results of this analysis are influenced by a range of factors including the assumptions for spectrum allocation, re-use of spectrum, small cell density, projected unit costs of equipment, backhaul and power. Changes in these assumptions may have a significant impact on the results. However, the direction of travel appears to be clear. Networks will need to become much denser to deliver the capacity and service levels required and small cells will be a significant part of the technical solutions taken to deliver this. Once small cells are deployed at scale, then the most cost effective and resource efficient way to deliver this would be through a shared small cell network approach.

The regulatory framework has not yet adjusted to these emerging changes in how networks will evolve

Spectrum awards have for the most part not recognised the changes in the network that the industry is anticipating and have led to some recent unplanned outcomes. Although many factors affect auction results and drawing general conclusions is not straightforward, one can observe developments that may not be in the best interests of the consumer in the long term. For example, the restrictions introduced for sub 1GHz spectrum may have forced operators into inefficient, complex solutions to circumvent these restrictions, e.g. joint bidding, spectrum pooling. Also, there has been aggressive bidding to dominate sub 1GHz spectrum holdings where this has been allowed which indicate the importance of being able to deliver capacity in the future in the most cost effective way.

There are signs of change however. In Sweden, Telenor and Tele2 were allowed to bid jointly for 800MHz and share the spectrum in their net4Mobility joint venture. The Mexican regulator is planning to award the whole 700MHz band to a wholesale-only open access network and Kenya has established a public private consortium to deploy a 4G network as an open access shared network. Finally, in Canada, Bell and Telus are also sharing spectrum, Band IV (1700MHz).

The remainder of this paper examines the spectrum allocation and regulatory considerations if a neutral host network model were implemented.

3. Potential regulatory responses

The previous section set out our analysis that the current mobile industry structure may be stretched to breaking point in meeting fairly moderate assumptions of future mobile broadband demand. Current developments such as active network sharing and spectrum sharing may help in these cases, but there are realistic, higher demand scenarios where only new approaches, such as neutral host networks, might allow mobile broadband demand to be met affordably.

A neutral host model could be introduced alongside the current multiple wholesaler model and generate significant benefits – a plurality of approaches is possible and pragmatic. The key is to create the space for innovation and then competition would allow its effects to diffuse through the market.

In practical terms, the best opportunity for regulators to facilitate a neutral host approach may be through awards of new spectrum and we set out some potential opportunities for introducing a neutral host below.

However, as we said above there needs to be a debate on how regulation should change to meet future needs whether the correct model is active network sharing, spectrum sharing, shared neutral hosts, or some combination of all three. Regulators need to maintain effective competition in the light of this pressure for increased sharing. Hence, we also set out a potential approach to address this, regulated wholesale access, and highlight some of the key issues in its application to sharing and neutral hosts.

3.1 A neutral host network using 2.3GHz and 3.4GHz spectrum

2.3GHz and 3.4GHz represent an opportunity to unleash a step change in mobile broadband capability through a neutral host network.

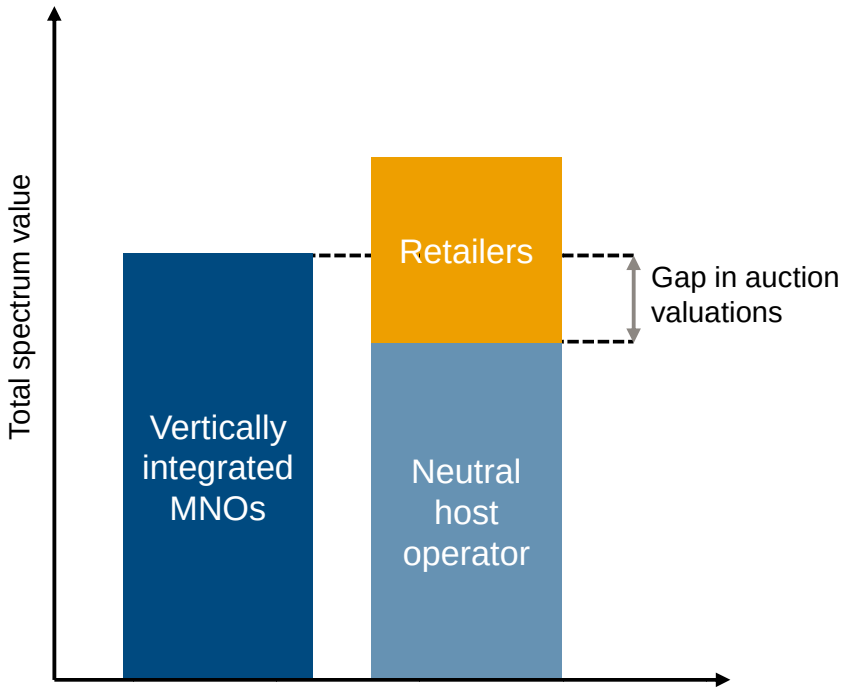
Our analysis suggests that, in a situation where the mobile sector as currently structured would struggle to meet demand, a neutral host network would significantly reduce the cost of meeting demand: by about £800 million over a 10 year period in our 100x demand scenario. This could be the difference between whether this level of demand was affordable or not.

Hence, we believe that the award of the 2.3GHz and 3.4GHz bands could be an important opportunity. A substantial amount of spectrum (190MHz) will be available, more than enough to allow a neutral host network to take full advantage of spectrum efficiencies while leaving spectrum for other wholesale operators. We reiterate that the neutral host would have to be appropriately regulated to protect effective competition, as explained below in section 3.4.

There could be benefits to reserving the 2.3GHz band and part of the 3.4GHz for a shared neutral host network.

There may be a case for reserving spectrum for a neutral host. Without reservation, there is a risk that an auction may lead to an inefficient outcome. This is because the value of the spectrum to a neutral host network only reflects part of the value to society; it is based on the provision of wholesale services and excludes the value of retail services. On the other hand, the value of the spectrum to vertically integrated MNOs depends on both wholesale and retail services. Hence, the potential users would not be bidding on the same basis with regard to the overall efficiency of the spectrum. The diagram below provides a simple illustration of the problem.

Illustration of differences in spectrum valuations of a neutral host and vertically integrated MNOs



Source: Coleago

In theory, the disparity between neutral host and other bidders could be addressed by bidder credits. However the regulator may face significant scope for error in setting an appropriate bidder credit, as Ofcom notes in the context of its statement on the award of 800MHz and 2.6GHz[1]; the award of the spectrum may become unnecessarily complex as a result.

The precise amount of spectrum to be reserved will need to be resolved after further analysis on the potential spectrum requirements for a neutral host network. However, we suggest that a proportion of the 3.4GHz band and all of the 2.3GHz band should be reserved for a neutral host. Since only 40MHz is available at 2.3GHz, we believe there is a strong risk that fragmenting this band would significantly reduce efficiency.

If spectrum is not reserved, looser spectrum caps (if there are any) should be applied to neutral host bidders.

Although we consider that there is a good case for reserving spectrum, we recognise that Ofcom may reach a different conclusion. In that event, we propose that if spectrum caps are applied, as Ofcom has suggested in its Consultation on the 2.3 and 3.4GHz spectrum award[2], a more flexible spectrum cap should be applied for neutral host bidders than the 36% of total spectrum noted in the Consultation.

The best mechanism to award this spectrum may not be an auction, as there are additional sources of value that an auction may not bring out.

A beauty contest (or a hybrid approach) may be a good alternative to an auction and may be able to reveal sources of value that would be less easily captured in an auction. For example, it could assess factors such as potential innovation and factors which will affect the value that retailers derive from using the neutral host network such as commitments to provide capacity, coverage and the speed of rollout.

Further, if the number of potential participants in an award for reserved spectrum is low, the rationale for holding an auction is weaker because of the strong incentives for strategic behaviour, particularly given the likely interrelationships between potential bidders.

[1] http://stakeholders.ofcom.org.uk/consultations/award-800mhz-2.6ghz/statement/
[2] http://stakeholders.ofcom.org.uk/consultations/2.3-3.4-ghz/

A rollout obligation or use-it-or-lose-it condition could provide a safeguard for network rollout, but may be challenging to implement effectively

A neutral host network should have an incentive to maximise its profits from wholesale services by deploying its network as fast as possible to meet demand from other operators. However, there is a risk that a neutral host operator could have incentives to behave anti-competitively either: by acquiring the spectrum to prevent deployment of a competing wholesale network by another operator (anti-competitive hoarding) or targeting the rollout of the neutral host network on the needs of its downstream business to the detriment of retail competitors.

If these risks were material, a rollout obligation could help address this issue, assuming it could be implemented effectively. Since a neutral host network in 2.3 and 3.4GHz would focus on providing capacity, a blanket coverage obligation would not be appropriate. In theory, the regulator would need to second guess the market, i.e. to predict where and how much additional capacity was needed which would be challenging. Use-it-or-lose-it conditions might appear to be a simpler alternative to rollout obligations, but would likely encounter similar problems in fully addressing the issue.

In summary, imposing a rollout obligation for a neutral host in this spectrum could be challenging. Further, in our judgement, the risks that anti-competitive behaviour might limit deployment of the neutral host network appear low: the benefits of behaving anti-competitively would have to be considerable for it to be worth outbidding an operator with a genuine desire to implement the neutral host model.

3.2 Allocation of 700MHz spectrum to neutral host network and PPDR network

A neutral host network in 700MHz could increase efficiency and bring wider benefits to society.

We believe that the 700MHz band also represents a good opportunity to apply the neutral host approach, in conjunction with providing a Public Protection and Disaster Relief (PPDR) service. The arrangements could vary from allocating the band to PPDR and allowing the neutral host to dynamically share the spectrum to a split allocation of the spectrum, say 2x30MHz of the 700MHz band for a neutral host network and 2x10MHz for PPDR with or without dynamic sharing. In each case, we would suggest that the neutral host operator was required to build and operate the PPDR network.

In our view, this could lead to more efficient spectrum use and increase the wider benefits to society from use of the 700MHz band, particularly if direct public funding for PPDR use is unlikely.

Fragmenting 700MHz is inefficient because it leads to poorer performance at cell edges and within buildings.

Our research summarised above indicates that a shared neutral host network at 700MHz would be more efficient than splitting 700MHz among several networks, particularly given the high levels of demand expected in the future.

This is because a network with access to a larger amount of 700MHz spectrum would be able to provide a higher minimum level of service, which would support higher performance end-user applications, particularly where providing coverage is challenging, at cell edges and inside buildings.

Linking the award of 700MHz with provision of a PPDR network is the most efficient and effective way to secure the wider social benefits from providing PPDR.

Discussions are currently underway over allocating 700MHz spectrum for PPDR. If these discussions are successful, the costs of setting up a UK PPDR network at 700MHz would be considerably lower due to international harmonisation. We believe that requiring the neutral host network to provide and operate the network for PPDR in the 700MHz band is an efficient and effective way to deliver a mobile data network for PPDR and could generate considerable value for society.

Government could decide to fund the deployment of PPDR at 700MHz directly. However, it will be much more efficient for a commercial 700MHz operator to deploy and operate a PPDR service than a separate provider because of the synergies between the two. Linking the provision of the PPDR service to the award of 700MHz spectrum for commercial use is also likely to be significantly faster and cheaper than a separate public procurement process.

A commercial operator might not need the full 2x30MHz of 700MHz to make providing the PPDR service viable, however, awarding the full amount to a neutral host provider

minimises the risk that the burden of building the PPDR network makes the neutral host financially unviable, given that we believe award the full 2x30MHz is likely to be the most valuable use of the spectrum.

A coverage obligation should be applied to 700MHz as a safeguard to promote widespread deployment

There is a case for applying a coverage obligation to the neutral host network. Although coverage obligation was applied to the licensee of one block of the 800MHz spectrum in the UK, 700MHz has better propagation characteristics and the neutral host network would have significantly more spectrum than the amount of 800MHz held by any individual operator; hence it could deliver significantly better end-user performance in areas where the network is coverage limited.

The precise format of the 700MHz coverage obligation will need to be decided closer to the date, when there is more detailed information on future end-user demand in terms of usage and service quality.

3.3 Pooling of existing spectrum for a shared neutral host network

Operators should be allowed to pool existing spectrum with a neutral host under the same regulatory framework

There may also be efficiency benefits from pooling existing spectrum with new spectrum awarded for a neutral host network. We believe that operators should be given this flexibility as long as the neutral host network is appropriately regulated to protect consumers and competition as set out in more detail below.

3.4 Promoting effective competition in the context of greater sharing through regulated wholesale access

3.4.1 Neutral host networks

In view of the advantages of a neutral host network, regulated access should be imposed to ensure effective competition and that efficiency benefits are passed onto consumers.

Although the neutral host networks described above would only control a part of the available mobile spectrum, they could have significant advantages in providing additional capacity (following the capacity crunch), high quality coverage and end-user performance. The neutral host may be able to deliver higher volumes and quality, and it may be able to provide them at lower cost than other wholesale networks.

Hence, we believe there is a strong case for imposing regulated wholesale access on neutral host networks to guard against the risk of an adverse effect on competition. For example, anti-competitive behaviour could take the form of discrimination in favour of a downstream retail business (if the neutral host is not solely a wholesale provider) or excessive pricing. Imposing access regulation should benefit consumers by promoting effective competition and ensuring cost efficiencies are passed onto consumers.

We do not consider that it is necessary to define precisely the relevant wholesale market at this point or to carry out a market review, particularly given the forward looking nature of our concerns. Both Ofcom and the European Commission have recognised that competition concerns could arise if a limited number of operators have the ability to provide wholesale services that give them an advantage in the market and cannot easily be replicated by competitors. For example, Ofcom's assessment of future mobile competition for the award of 800MHz and 2.6GHz and the EC's review of the T-Mobile, Orange merger in the UK.

As part of the regulated access framework, the neutral host should offer services on a non-discriminatory basis and publish a reference offer.

The neutral host should be required to provide services on a non-discriminatory basis so that competitors are not disadvantaged either through excessive pricing or by receiving a poorer quality wholesale service than the downstream business of the neutral host (assuming there is one). The neutral host should be required to publish a reference offer setting out the wholesale services offered, their prices and the technical conditions under which they are offered.

The range of services offered should cover the differing needs of providers such as MVNOs, MNOs, etc. and should be offered at a range of geographical levels, however further work will be needed to assess the specific needs of the market.

Non-discrimination can take different forms and, in fixed network regulation, Ofcom has implemented aspects of two forms of non-discrimination:

- A strict form of non-discrimination – exactly the same service is provided to competitors as to a downstream business; and
- A weaker form – "no undue discrimination" i.e. that differences in terms and conditions offered can reflect differences between customers, but not unduly so – e.g. this could mean that difference in access charges could be allowable if they reflected differences in the underlying long run incremental costs of providing a service to different customers.

In our view, services should be provided on an equivalence of inputs (EOI) basis, i.e. service is provided using the same network components, to the same timescales to all customers including a neutral host's downstream business. This relates to a stricter form of non-discrimination.

Ofcom has departed from EOI where it would have required extensive re-engineering of existing processes, e.g. leased lines delivered by legacy technologies. However, we believe this is unlikely to be the case for the neutral host network.

Some price discrimination may be economically efficient if it does not have anti-competitive effects. For example, the EC suggests that differential pricing in the form of volume discounts should only be acceptable if the discount offered to a downstream business is no more than the highest given to a third party access seeker. Our initial view is that it may be sufficient to require that prices are not unduly discriminatory, subject to these reservations.

Consistency with fixed telecoms regulation

A form of EOI was implemented in the BT Undertakings in 2005 and is applied in NGA, but is not applied to some products e.g. PPCs. Along-side this Ofcom applies the standard of undue discrimination as set out in its Discrimination guidelines of 2005 – the major impact is on allowing some pricing flexibility.

Regulated access charges should be based on cost orientation and cost recovery in the absence of a strong alternative competitive constraint

We consider that regulated access charges for neutral host networks should be cost oriented, and should allow cost recovery, in order to promote effective competition and ensure that efficiency benefits from neutral host networks are passed onto consumers. Cost orientation also reflects the EC's guidelines on regulated wholesale pricing for SMP operators.

Regulators have imposed less onerous conditions than cost orientation, such as retail minus pricing and/or margin squeeze tests, where the competitive constraint from alternative providers has been considered strong enough to limit competition concerns, but not so strong as to entirely remove them.

However, we believe that the risks to competition are sufficient to justify cost orientation and that it is better for consumers to take a precautionary approach that can be reviewed later in the light of more information on how competition from alternative networks would develop.

Cost oriented charges should be based on efficiently incurred costs and allow for appropriate recovery of common costs.

Cost oriented prices should be based on the efficiently incurred long run incremental costs (LRIC) of the wholesale services provided. In addition to LRIC there are several other issues that can be considered in setting regulated prices.

In order to allow for efficient cost recovery, the neutral host should be allowed to recover efficiently its common costs; however there is a risk that this could be abused for anti-competitive purposes – for example, if common costs were recovered disproportionately from some services in order to limit competition in a particular segment of the downstream market.

Margin squeeze tests can address this risk by ensuring that wholesale charges are not set at levels that would prevent downstream competitors of the neutral host from making reasonable returns.

Where the provision of regulated wholesale services is subject to risk, particularly if future demand is uncertain, EC and Ofcom allow scope to reflect investment risks in the rate of return used to calculate access charges. This has been a particular issue

with the pricing of "passive" products, e.g. access to ducts and fibre in Next Generation Access.

Our initial view is that allowing for investment risk may not have a significant impact on the appropriate rate of return for a neutral host network, though this may benefit from further investigation closer to the time. The more developed the mobile broadband market is, and the better understood the potential evolution of demand and revenues, the lower the need to allow pricing flexibility in regulating wholesale prices (e.g. the freedom to trial different prices to see how it affects demand) in order to stimulate investment.

Consistency with fixed telecoms regulation

The pricing of many of BT's regulated wholesale products from current generation wholesale broadband access to business connectivity / leased lines is cost oriented. Ofcom has allowed more flexibility in pricing "active" NGA wholesale products such as VULA where the market is in its early stages, demand is highly uncertain and significant investment is necessary.

3.4.2 Active network sharing and spectrum sharing

Active network sharing and spectrum sharing could complement a neutral host network approach

Active network sharing and spectrum sharing raise competition concerns, because of the degree to which information, such as traffic patterns and future network plans, could be shared. Greater information sharing creates the potential for operators to coordinate in the retail market which could result a reduction in competitive intensity. Concerns over competitive intensity will be heightened if competition is already weak in the wholesale market.

Such concerns could be mitigated by the way network or spectrum sharing was structured, so each case will have to be taken on its own merits – for example, giving operational control of the network to a third party may sufficiently limit the extent to which operators can share sensitive information.

Where there is a material risk to competition, regulators should allow active network and spectrum sharing on condition of regulated wholesale access.

However, given that greater network and spectrum sharing seem almost essential even with fairly moderate assumptions of future mobile broadband demand, we believe that regulators should encourage active network sharing and spectrum sharing. Where there is a material risk to competition, regulators should allow sharing on the condition that the shared network is subject to regulated wholesale access on a similar basis as our recommendations for neutral host networks. This will address competition concerns and the efficiency benefits of sharing to be realised both for operators and consumers.

