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Response to:

***A Consultation on a Direction to Ofcom to
Implement the Wireless Radio Spectrum
Modernisation Programme (October 2009)***

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1 Summary

Unwired Insight welcomes the Government's consultation on its proposed Direction to Ofcom to implement the Wireless Radio Spectrum Modernisation Programme¹. If enacted, the Direction will have a profound impact on the mobile telecommunications industry.

This document contains Unwired Insight's response to the Government's consultation. Unwired Insight is an independent consultancy and research company, based in Cambridgeshire. The views expressed herein are those of Unwired Insight, and not of any client.

The proposals outlined in the Government's consultation document are extremely ambitious, far-reaching and complex, for example when compared with previous spectrum management activities. The proposals include the release of substantially more spectrum than the UK 3G Mobile Auction held in 2000 and also address the crucially important and challenging issue of 2G spectrum refarming. As such, the proposals are the most complex that have ever been attempted in the UK.

In this document we highlight a number of weaknesses in the proposals, which create a significant risk that the Direction will not deliver the best possible outcomes for mobile users and the UK in general. A number of factors, including the timing of a general election and the recent joint venture proposal by Orange and T-Mobile, suggest that a delay to a combined spectrum auction may be inevitable. While the rapid increase of data traffic in wireless networks creates a certain level of urgency, we believe that a delay would provide a welcome opportunity to ensure that the final proposals will be successful. Given the intention to offer indefinite licences to operate in various radio spectrum, it is critical that the Direction achieves the right solution.

At this juncture we believe that fresh ideas and new approaches are needed, and existing assumptions (particularly with regard to the level of competition within the mobile industry) need to be challenged and reviewed. We also believe that the proposals do not go far enough in encouraging rapid and extensive deployment of next-generation mobile technology, such as Long-Term Evolution (LTE). This will be essential to achieve a long term solution to the growth in mobile network traffic.

¹ *A Consultation on a Direction to Implement the Wireless Radio Spectrum Modernisation Programme*, Digital Britain Report, Department for Business Innovation and Skills (October 2009)

2 Fundamental Assumptions

Before looking at detailed aspects of the current proposals, we revisit some fundamental assumptions underlying the Spectrum Modernisation Programme. We believe that there are weaknesses in some of these assumptions and they need to be reconsidered.

2.1 We fully support the Government's desire to auction spectrum in a timely fashion and believe that the refarming 2G spectrum is particularly important

We welcome the Government's desire to award additional spectrum to UK mobile network operators. In order for potential bidders to be able to value spectrum effectively, it is highly desirable to hold a combined award of 800MHz and 2.6GHz spectrum, which would provide 2×100MHz of new paired spectrum. Furthermore, we see the refarming of 2G spectrum as an essential part of the process, because this involves an even greater bandwidth (2×106MHz of paired spectrum), which is currently being used for relatively spectrally-inefficient 2G services.

Access to additional spectrum will be an essential element to solving the looming capacity crisis in the UK mobile industry, as predicted in a recent Unwired Insight report². We forecast that traffic from 3G handsets and terminals, which has already seen substantial growth in the last 18 months, could increase by a factor 20 from the end to 2009 to the end of 2014, as shown in Figure 1. It has been widely reported that some UK mobile network operators have already been experiencing network congestion problems as a result of the rapid take-up and heavy data consumption of smartphones and mobile broadband services.

² *Will 3G Networks Cope? 3G traffic and capacity forecasts for 2009–2014*, Brydon A N and Heath M R, Unwired Insight (Sep 2009)

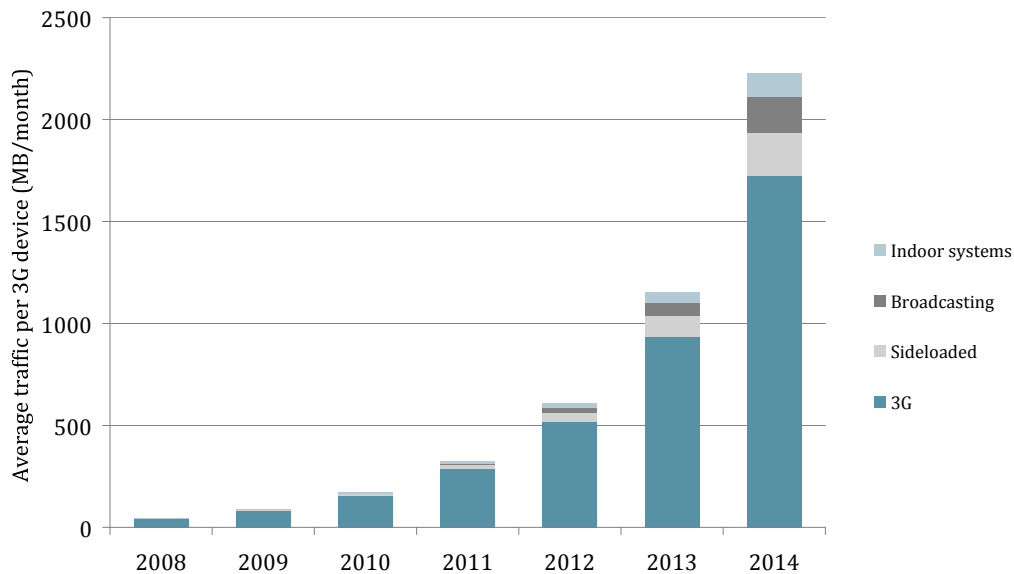


Figure 1: Forecast average traffic per 3G device, split by delivery method, in a wireless-only scenario, 2008–2014 [Source: Unwired Insight, 2009]

Low-frequency (800MHz and/or 900MHz) spectrum will play a crucial role in enabling a cost-effective roll out of mobile broadband services to rural areas, to address the clear coverage gap that currently exists between today's mobile broadband services and 2G voice services (where over 99% population coverage is provided).

Next-generation mobile broadband services will bring significant economic benefits to the UK, particularly if they are deployed rapidly and on a widespread basis. Technologies such as LTE offer an order of magnitude (up to 25 times) improvement in spectral efficiency compared with 2G systems and have the potential to deliver peak speeds in excess of 100Mbps. Effective deployment of LTE, alongside legacy 2G and 3G services, will require the availability of a substantial amount of spectrum for each mobile network operator, given that a bandwidth of 2×20MHz is necessary for LTE to achieve its optimum performance (to maximise instantaneous data rates, average throughput and spectral efficiency).

2.2 We believe it is inevitable that there will be delays to the proposed spectrum auction, and a combined auction in 2011 is more realistic

The Government has expressed its desire to hold a combined auction of 800MHz and 2.6GHz spectrum during 2010. However, a number of factors make an auction in 2010 unlikely, including:

- the timing of a general election
- the uncertainty over the proposed joint venture between Orange and T-Mobile
- the challenging economic environment, which could mean that an acceptable return to the taxpayer is not possible from an early auction.

Given that an election must take place by 3rd June 2010, we believe that there is insufficient time for the Government to define clear proposals (taking account of the responses to this consultation process) and to undertake a spectrum auction before an election takes place. In retrospect, the Digital Britain initiative was commenced too late in the Government's period of office to allow for a spectrum auction to be undertaken before the general election.

The proposed joint venture between Orange and T-Mobile was announced in September 2009, by which time a significant amount of thinking had already been undertaken as part of the Digital Britain initiative. The consultation document makes a number of hastily-prepared proposals to deal with the situation in which the joint venture goes ahead (such as increases to spectrum caps). However, we believe that a joint venture would require a more radical, and considered, reappraisal of spectrum auction policy. For example, if Orange and T-Mobile were not required to hand back a considerable amount of spectrum, we expect that existing mobile network operators would be extremely unhappy with the current proposals. Even if Orange and T-Mobile were required to hand back a considerable amount of spectrum, a merger would significantly change the dynamics of the auction, by reducing the number of bidders and significantly increasing the amount of spectrum on offer. It may take considerable time until it is known whether the proposed merger is acceptable to the competition authorities and what conditions would be necessary for merger approval (such as handing back radio spectrum). Due to the complexity of the proposed merger, we anticipate that a two-stage process will be required, with a 90-day review period, meaning that a decision about the merger would not be reached until around mid-May 2010. It is no surprise to us that a merger of this kind has arisen in the UK market and we believe that further consolidation is highly likely in the future. Therefore, it is crucial that the Spectrum Modernisation Programme is designed with this in mind.

Following the UK's longest and deepest recession, the profitability of UK mobile network operators is under significant pressure, which has resulted in them undertaking substantial cost reduction programmes. With great uncertainty over the economic environment, an early spectrum auction in 2010 could result in a very low return to the UK Government. While we believe that the very high spectrum values achieved in the UK 3G Mobile Auction in April 2000 are not realistic (and could further damage the UK mobile industry), recent European auctions of 2.6GHz spectrum have achieved very low returns for national Governments. There is a risk that an early auction could result in revenues that are dramatically lower than

in 2000, and significantly below the true long-term economic value of the spectrum on offer. In the UK 3G Mobile Auction in 2000, the value of spectrum was the equivalent of about GBP2.61 per MHz per head of population. In the recent Finnish auction (of 190MHz of 2.6GHz spectrum), the value of spectrum was about GBP0.003 per MHz per head of population – nearly 800 times lower than the UK 3G figure.

Taking all factors into account, we believe that a **combined spectrum auction in 2011** is a more realistic aim. A delay would provide a welcome window of opportunity to review policy towards the allocation of wireless radio spectrum, when the full implication of industry consolidation is understood and when the economic environment is more conducive to delivering a fair return for the UK tax payer.

With more time, current mobile network operators (and potential new entrants) would be better informed, and more able to value spectrum accurately. In the UK 3G Mobile Auction in 2000, we believe that many players overbid for licences, due in part to limited understanding of the business case for 3G services. Giving more time to potential bidders will help to avoid a repeat of this situation.

2.3 The objectives of the Spectrum Modernisation Programme require further definition, and the Programme must be strongly focused on achieving them

One of our concerns with the current proposals is that the objectives are not sufficiently clear, specific and stretching to deliver a compelling vision of widespread next-generation broadband service availability. We believe that the current proposals may fail to deliver key outcomes, including the creation of an effective industry structure and the early, widespread deployment of next-generation broadband networks. A well-designed spectrum auction will be an essential part of achieving a number of critical outcomes, including:

- securing an acceptable financial return to the UK government from what is a substantial amount of highly valuable wireless radio spectrum
- ensuring the most efficient use of spectrum, through the widespread deployment of the latest wireless technologies (for example, LTE)
- supporting forecast massive growth in mobile traffic levels, avoiding a capacity crisis
- making available high-quality next-generation mobile broadband services to a large proportion of the population, so that population coverage at least matches 2G services

- providing high speeds and high service reliability, so that mobile services can effectively complement and (where necessary) substitute high-speed fixed network broadband services
- creating an effective and sustainable industry structure that is commensurate with delivering the outcomes listed above.

2.4 3G licensing and regulation has failed to encourage investment

Despite the initial hype surrounding the introduction of 3G networks and services in the UK, and the exorbitant licence fees bid in 2000, 3G has not yet lived up to our expectations, particularly in regard to the coverage and quality of service offered. We believe that there has been significant under-investment in 3G networks.

There has been an underlying assumption that a large number of mobile network operators in the market would lead to more positive outcomes than a small number of operators. The UK licensed a large number of 3G operators and unlike other countries, such as Germany, early market consolidation did not occur. As a result, the UK continues to have five mobile network operators (which is more than most other countries), plus a significant number of MVNOs. The presence of a relatively large number of players has led Ofcom to adopt a 'soft touch' approach to regulation, based on the assumption that competition would deliver desired outcomes without the need for more intrusive regulation.

While it is true that competition has imposed downward pressure on prices, and has encouraged innovation in branding and services, there is little evidence to suggest that it has helped the widespread deployment of high quality 3G networks and services. Since the launch of 3G services in the UK nearly seven years ago (in March 2003), network roll-out and service take-up have been disappointing, particularly in comparison with leading markets such as Japan.

Currently, the majority of mobile users still rely on 2G networks for their mobile services. In its report 'The Communications Market 2009 – Telecoms', published in August 2009, Ofcom reported that only 23.2% of mobile users were on 3G networks by the end of 2008. In comparison, NTT DoCoMo in Japan reported that in March 2009, 89.8% of its mobile customers used 3G networks. It expected this to increase to 95% or more by the end of March 2010.

The roll-out of 3G network coverage has been particularly disappointing and network operators have been slow to encourage migration of 2G users to 3G networks. 3G population

coverage still substantially lags 2G coverage for all UK mobile network operators. In part this was a consequence of relatively undemanding 3G coverage conditions, set as part of the 3G licence conditions. 80% population coverage (which is woefully short of the 99%+ population coverage offered by 2G voice services) had to be achieved by 31st December 2007.

Of all the UK mobile operators, 3 and Orange claim the highest 3G population coverage, at about 93% of the UK population. In contrast, NTT DoCoMo in Japan has made substantial investment in its 3G network to achieve high levels of coverage. By March 2004, 3G coverage already reached 99% of the population and this rose to 99.9% by the end of 2004. In March 2007, NTT DoCoMo announced that it had reached 100% population coverage with its 3G network. By March 2009, NTT DoCoMo had deployed 48,500 outdoor base stations and 19,900 indoor base stations.

Despite the importance of coverage, Ofcom has taken many years to publish independent 3G coverage maps. In July 2009, Ofcom pledged “further consumer protection for mobile users” by publishing 3G mobile coverage maps for the first time, which have highlighted the significant weaknesses in 3G population coverage of mobile operators, particularly O2 and Vodafone.

Recently, it has been reported that some UK mobile operators have suffered network congestion problems. 3G traffic volumes have increased significantly within the past 18 months, driven by the rapid take-up and heavy data consumption of smartphones (such as the iPhone) and mobile broadband services (using dongles). Sadly, traffic management (which degrades the quality of service achieved in peak hours) is the most likely approach to addressing these capacity issues in the short term. Currently, Ofcom does not independently measure and report on the performance and quality of service experienced by mobile users, although we believe that it should.

Any hope that we would see a major expansion in 3G coverage (particularly from O2 and Vodafone) has been dashed by the economic recession. The relatively large number of mobile network operators in the UK has inevitably had an adverse impact on the profit margins of UK operators, which reduces their desire to undertake major network expansion. As economies of scale are very important in the mobile industry, it is not surprising that there is generally a correlation between the number of customers of a mobile operator and its profitability³. For example, in the six months ending December 2009, Vodafone’s EBITDA in the UK was 23.2%, compared with 39.5% in Germany and 48.4% in Italy, where Vodafone

³ *Mobile Operator Performance Benchmarks*, Heath M R and Brydon A N, Analysys Research (Nov 2006)

has a significantly higher market share and where there are fewer mobile network operators. Mobile network operators in the UK are currently focused on cost reduction and the recent proposed joint venture between Orange and T-Mobile demonstrates how far some will go to improve financial performance. With the current market structure we see little appetite among the UK operators for early, widespread deployment of next-generation mobile broadband technologies such as LTE.

There is, therefore, a huge gulf between the Government's aspirations and the slow, cautious roll-out of 3G networks, coupled with a strong focus on cost reduction in a highly competitive market. We do not believe that the current proposals can achieve the step-change that is required and we fear a gloomy outlook, in which:

- there will be very slow and limited deployment of next-generation wireless technologies, such as LTE
- intense competition at the retail level will continue to drive decreases in ARPU (for example in the quarter ending December 2009, Vodafone experienced a 4.9% decline in UK service revenue compared with the previous quarter), forcing operators to continue cost cutting and reduce network investment
- inefficient 2G networks will continue to operate for many years, with mobile operators using them to provide universal coverage to support their more patchy 3G networks
- the need to support legacy GSM services for a significant number of mobile users will severely limit the extent to which spectrum (particularly at 900MHz) can be refarmed for next-generation mobile broadband services
- the introduction of a new entrant (for example, operating a WiMAX network) will further dilute the business case for all mobile network operators considering the deployment of next-generation mobile broadband services in rural areas, since they would have to assume an even lower market share
- there will be continued network congestion problems, with significant increases in 3G traffic from mobile broadband and smartphone usage adversely affecting quality of service.

It is crucial that the Spectrum Modernisation Programme and its related conditions and regulation ensure that this gloomy scenario does not materialise. In particular, it is important that the industry is able to evolve to a structure that enables network operators to invest adequately in their networks to deliver widespread broadband services, while maintaining an adequate level of competition.

2.5 There is a need to reassess the level of competition in the UK mobile market, considering the need for network operators to invest adequately in their networks

A fundamental assumption underpinning the current proposals (and regulation to date) is the need for a relatively large number of mobile network operators to achieve the best outcomes for mobile users and the UK.

While it is true that competition (up to a point) at the retail level helps to lower prices, it is important to recognise that economies of scale play a crucial role in the deployment of mobile networks. With a smaller number of networks, large fixed investment costs can be divided among a greater number of mobile users. It is far from clear that a market containing a large number of mobile networks can deliver universal availability of high quality wireless broadband services. Further work is required to understand whether the existing industry structure (or an even greater number of mobile network operators) would be conducive to the Government achieving its objectives.

We see a plausible argument for enabling a reduction in the number of mobile networks. For example:

- The successful introduction of MVNOs in the UK has successfully increased competition at the retail level, with benefits for consumers, without the need for additional mobile networks.
- The existence of a relatively large number of mobile networks is not a prerequisite to low mobile charges. For example, in April 2009 the regulator in Finland undertook an assessment of mobile broadband prices in 19 European countries and found Finland to have the lowest mobile broadband pricing. Yet, there are only three mobile network operators in Finland.⁴
- A smaller number of mobile network operators may minimise the environmental impact of mobile telecommunications, particularly as denser networks will be required in the future to deliver improved indoor coverage.

⁴ *Mobile Phone Service Prices 2009 International Comparison*, Finnish Communications Regulator, May 2009

- With economies of scale critical to mobile networks, a smaller number of networks could boost the financial business case for deployment of next-generation mobile broadband technology in rural areas. There are only three mobile network operators in Japan, and NTT DoCoMo (with a 50.8% market share in March 2009) has deployed an extensive 3G network.
- A smaller number of operators would result in greater amounts of spectrum per operator, which would make it much easier to deploy the fastest and most-efficient next-generation mobile networks alongside legacy 2G and 3G networks. For maximum performance and spectral efficiency, LTE requires a spectrum allocation of 2×20MHz.

From a network infrastructure perspective, the presence of three (or even two) stronger, more profitable, mobile network operators could enable more extensive and capable next-generation mobile networks than five (or possibly six if there is a new entrant) operators that are less profitable and less able to make substantial investment, particularly in rural areas.

We think there is a need for further analysis of the options for the industry structure and allocation of spectrum, so as to achieve the necessary economies of scale. Alternative approaches could be a single national network, regional licences, or the use of public money to bolster investment in particular aspects of network deployment.

3 Comments on specific proposals

As discussed in the previous section, we believe that there is a need to reconsider some of the fundamental assumptions of the Spectrum Modernisation Programme, and this may have a significant impact on the more detailed aspects of the proposals. For example, there may be changes required to allow for an evolution to a smaller number of mobile network operators, each with more spectrum. However, in this section we review various aspects of the current detailed proposals that we think will remain relevant. In doing so, we make the following general comments:

- Some of the proposals are unnecessary and require regulation that would be extremely complex to manage, for example, forcing mobile network operators (in some circumstances) to provide wholesale access.
- While the scope of the proposals is inevitably broad, we believe that some of the details are unnecessarily complex and there are significant opportunities for simplification. For example, we show that it may be possible to simplify minimum coverage and performance requirements.
- Some of the proposals are too prescriptive (when there is no particular benefit from this) and, therefore, do not provide mobile network operators with the necessary flexibility to maximise performance and coverage for mobile users in a cost-effective manner.
- Finally, the efficient use of spectrum is an important objective for Government and mobile network operators, to avoid a network capacity crisis. We believe that the current proposals do not sufficiently encourage the rapid migration from relatively inefficient 2G technology (e.g. GSM) to next-generation mobile technology (e.g. LTE).

3.1 Minimum coverage and performance requirements should be simplified and made more challenging

Consultation question 1: Are the coverage parameters described for 2.1GHz licences i) appropriate in the context of the Government's objectives; ii) suitably well defined? If not explain why and suggest alternative specifications

Consultation question 8: Are the coverage parameters described for 800MHz and relinquished 900MHz spectrum licences i) appropriate in the context of the Government's objectives around maximising mobile broadband coverage and maintaining the competitive intensity in the

market place; ii) capable of striking the right balance between benefits for consumers and burdens on operators; iii) suitably well defined?

Adequate coverage is an important requirement for mobile users. As discussed earlier, we consider that the minimum coverage requirements set for UMTS in the UK 3G Mobile Auction were not sufficiently demanding. Therefore, we support the introduction of more challenging minimum coverage conditions as part of the Spectrum Modernisation Programme. However, we have a number of concerns regarding the current proposals.

The current proposals contain a number of minimum coverage requirements for discrete frequency bands (for example, a 90% population coverage requirement by mid-2013 for 2.1GHz licences and a 99% population coverage requirement for 800MHz licences within three years of the nationwide availability of the entire 800MHz spectrum). Surprisingly, there are no proposed minimum coverage requirements for refarmed 2G spectrum (900MHz or 1800MHz) or 2.6GHz spectrum. We believe that setting individual minimum coverage requirements for each frequency band is not necessary, and will deprive mobile network operators of the necessary flexibility that they require in cost-effectively rolling out their networks in their own particular circumstances. There are (and will continue to be) considerable differences between mobile network operators in terms of:

- their existing networks (and coverage levels already provided)
- the frequency bands in which they operate
- the amount of spectrum allocated to them in each frequency band
- their use of alternative methods to deliver multimedia content to their users (for example, WLAN, femtocells, dedicated mobile broadcasting networks and sideloading).

We believe it is important to allow flexibility for mobile network operators in terms of how they optimise each individual frequency band to deliver the best overall coverage to their users. Furthermore, mobile users will be more concerned with the overall coverage offered by an operator, irrespective of the frequency used to deliver the service. Therefore, we recommend that there should be a single overall minimum coverage requirement, which sets a minimum level of coverage that should be achieved, but imposes no constraints on the frequencies that are used by an operator.

We believe that wholesale agreements and network sharing agreements will become much more important with next-generation mobile networks, with the realisation that the best way to cover some rural areas is to share the cost of investment in some way, so that significant capital investment is divided among a larger number of customers to make such

investment viable. We strongly recommend that mobile network operators be allowed to include such agreements, and the enhanced coverage they provide, in meeting the minimum population coverage requirement.

Our view is that the minimum population coverage requirements are not sufficiently challenging, and are wrongly focused on encouraging the weakest operators to improve coverage rather than motivating the market leaders. For example, we do not understand the motivation for defining a minimum 90% population coverage requirement for 2.1GHz licences. This would result in a coverage far below 2G population coverage levels and would not motivate mobile network operators (such as Orange and 3) that already offer population coverage in excess of this proposed minimum requirement (albeit that this coverage is not linked to the specific performance targets defined in the proposals). We therefore recommend that there should be an overall minimum coverage requirement of 99.9% for next-generation mobile networks by 2016. By allowing wholesale and network sharing agreements to be included and not specifying minimum coverage requirements for individual frequencies, we believe that reaching such an overall minimum coverage requirement is perfectly achievable.

We believe that setting a challenging, overall minimum coverage requirement will motivate mobile network operators to optimise their spectrum assets and networks and to seek out agreements with other mobile network operators to deploy next-generation mobile networks that reach virtually all of the UK population.

3.2 Minimum performance requirements should be simplified and made more challenging

As with the population coverage requirements, we have similar concerns over the proposed minimum performance requirements defined in the consultation document. The proposal contains a number of minimum performance requirements for particular frequency bands (for example, a minimum 768kbps downlink speed for 2.1GHz licences and a minimum 1.5Mbps downlink speed for 800MHz licences). There are no proposed minimum performance requirements for refarmed 2G spectrum (900MHz or 1800MHz) or 2.6GHz spectrum.

We do not advocate setting minimum performance requirements for each separate frequency band, as this will deprive mobile network operators of the flexibility to roll out their networks according to their own particular circumstances. It is better to allow flexibility to mobile network operators in terms of how they optimise each individual frequency band to deliver the best overall performance for their users. Mobile users will be

more concerned with the overall performance offered by an operator, irrespective of the frequency used to deliver the service. We therefore recommend that there should be overall minimum performance requirements for the service as a whole, which define the minimum downlink speed that should be achieved, irrespective of the frequencies used. Furthermore, we strongly recommend that mobile network operators be allowed to include wholesale and network sharing agreements in meeting the minimum performance requirements.

We propose that a minimum speed of 1.5Mbps (outdoor) should be achieved for our recommended target of 99.9% population coverage by 2016. However, setting a single minimum speed requirement does not sufficiently motivate mobile network operators to improve depth of coverage (for example, to enhance indoor coverage in urban and suburban areas) or to allow their customers to fully benefit from the high downlink speeds possible from next-generation mobile technologies (such as LTE). We, therefore, recommend that a more challenging minimum performance requirement should be set for a lower proportion of the population, for example requiring mobile network operators to achieve a minimum speed of 3Mbps (outdoor) for 90% of the population. Given that this is an outdoor measurement, the corresponding indoor downlink rates may be considerably lower, so it is important that the outdoor requirement is sufficiently challenging to guarantee acceptable indoor performance.

We note that the proposed minimum performance requirements are for lightly loaded base stations. As discussed previously, some UK operators have been experiencing network congestion, which has significantly affected the quality of service to mobile users (particularly users of mobile broadband services and smartphones). We believe that mobile network operators should be more motivated to provide adequate network capacity to avoid network congestion. Therefore, we suggest that the Government should also consider the introduction of minimum performance requirements for networks at busy times. Further work is required to define realistic targets.

3.3 Operators should be motivated more strongly to refarm GSM spectrum for widespread LTE deployment

While the awarding of new spectrum to mobile network operators is a welcome step to help support the future increases in traffic volumes forecast, this additional spectrum will not be sufficient on its own. 2×59.4MHz of paired 2.1GHz spectrum was allocated for UMTS services by the UK 3G Mobile Auction in 2000. The current proposals provide a further 2×100MHz of paired spectrum. While this is a sizeable amount, we forecast that mobile traffic will increase by a factor of 20 between the end of 2009 and the end of 2014. Refarming of 2G spectrum for

LTE deployment will be essential to avoid a capacity crisis. Currently, a total of 2×106 MHz of spectrum is allocated to relatively inefficient 2G (GSM) technology.

In order for mobile network operators to support forecast traffic levels, just as important as having a large amount of spectrum available is ensuring that the most spectrally efficient mobile technology is widely deployed in that spectrum. Substantial improvements have been made in mobile technologies, and we estimate that the spectral efficiency (i.e. throughput per MHz of spectrum) of LTE is about 25 times that of GSM. Therefore, it is important to encourage the rapid migration of spectrum from 2G to next-generation technology, as illustrated in Figure 2. The figure shows the effective downlink bandwidth available, relative to deploying HSPA in the same bandwidth, and how this could change over time as LTE is deployed in each frequency band. It shows that 2G technology contributes relatively little to total capacity today (despite having a substantial amount of spectrum allocated to it), and refarming of this spectrum would provide a significant uplift.

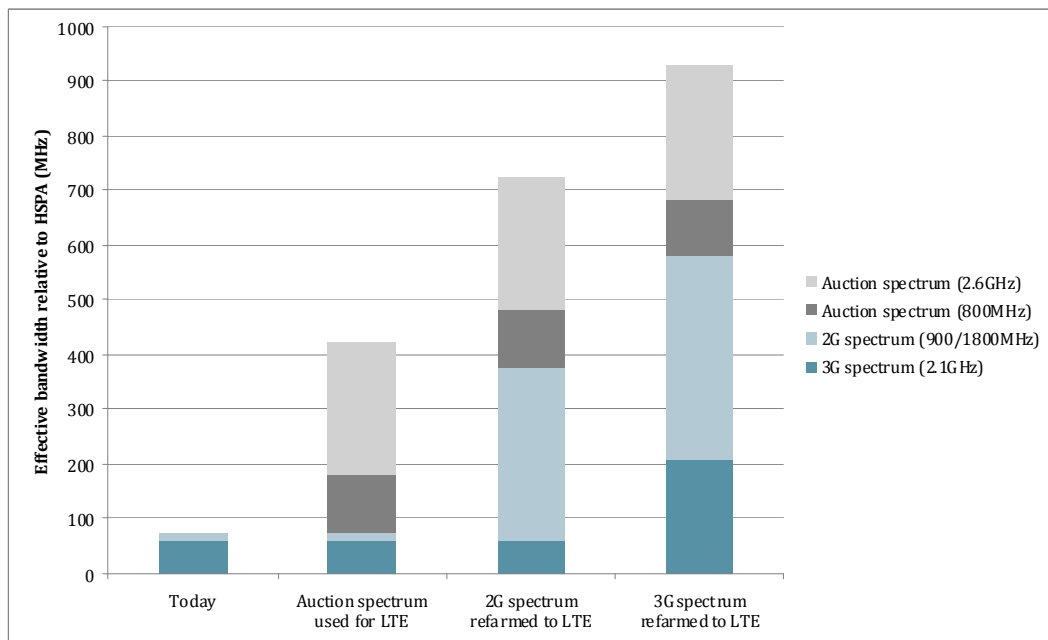


Figure 2: Effective bandwidth of available spectrum as LTE is deployed
 [Source: Unwired Insight, 2010]

One factor that will inevitably slow the refarming of 2G spectrum is the need to support 2G mobile users for as long as they continue using 2G networks. Therefore, mobile operators need to encourage their customers to migrate away from 2G services. Setting the minimum coverage and performance requirements outlined earlier will ensure that next-generation networks will eventually rival the coverage offered by 2G networks. This, in turn, will strengthen the case for mobile operators to migrate users from 2G to 3G services and subsequently to turn off their 2G networks. However, these minimum coverage and

performance requirements will not be sufficient on their own. We, therefore, also recommend two further measures:

- setting a closedown date for 2G networks
- setting an interim deadline, by which time a significant amount of spectrum should be refarmed by all 2G operators.

In the broadcasting industry, the introduction of more spectrally efficient digital technologies has enabled broadcasters to transmit a significant number of TV channels in the bandwidth previously occupied by one analogue TV transmission. The formal switch-off of analogue TV services provides certainty for the broadcasting industry and has encouraged the rapid evolution of digital TV networks and services. We recommend that a closedown date for 2G services of December 2015 is defined, which will ensure that 2G spectrum is completely refarmed to help meet our recommended minimum coverage and performance requirements for 2016. In Japan, NTT DoCoMo will terminate its 2G service (launched in 1993) in March 2012.

We also recommend that a deadline for partial spectrum refarming should be set. We believe that refarming of 2×10MHz of spectrum by each 2G operator by 2013 is a realistic goal. This would provide mobile network operators with sufficient spectrum to deploy LTE services with reasonable performance, and could subsequently be enhanced once full closure of 2G networks took place. Earlier Ofcom proposals^{5,6} recommended that 900MHz spectrum should be redistributed to other operators (which would then be able to use this spectrum for next-generation technologies). While we support the Government's aim to liberalise 900MHz (and 1800MHz) spectrum in the hands of the incumbents, which will avoid over-fragmentation of spectrum, one advantage of the Ofcom proposal was the certainty it would bring in ensuring that more spectrally-efficient mobile technology would be used instead of GSM.

⁵ *Application of spectrum liberalisation and trading to the mobile sector, including liberalisation of the Radio Spectrum Committee Decision on 900MHz and 1800MHz, September 2007.*

⁶ *Application of spectrum liberalisation and trading to the mobile sector – a further consultation, Ofcom, February 2009.*

3.4 Wholesale access conditions are unnecessary

Consultation question 9: Are the wholesale access conditions described appropriate to maintain competition in a period of changing spectrum markets?

We believe that the Government should avoid regulation that necessitates complex involvement in the commercial operation of the mobile industry or that, perhaps inadvertently, discourages the early deployment of next-generation mobile networks. Therefore, we question the need for wholesale access conditions. We believe that wholesale agreements between mobile network operators will become increasingly prevalent as a matter of course, and will provide an important mechanism to deliver extensive population coverage of next-generation mobile networks. However, wholesale agreements should be formed through mutual agreements between operators on a 'win win' basis, as is currently the case with MVNOs.

There are a number of MVNOs in the UK market (including Virgin Mobile and Tesco Mobile), which have achieved significant market share. These MVNOs have entered the market without the need for regulation, through commercial agreements made directly with mobile network operators.

We fear that the introduction of wholesale access conditions could demotivate mobile network operators from rapidly rolling out next-generation mobile broadband networks.

3.5 New entrants should not receive favourable treatment

We understand that some potential new entrants are concerned that the current proposals do not, in their view, sufficiently encourage new entrants. For example, the proposed minimum coverage and performance requirements may seem particularly challenging for new entrants, as it may be difficult for them to quickly roll out nationwide networks. We, therefore, expect that potential new entrants will seek to have the proposed minimum coverage and performance requirements relaxed.

We strongly believe that new entrants should not be favoured, and that minimum coverage and performance requirements should not be relaxed for them, for a number of reasons:

- If new entrants are unable to meet the same minimum coverage and performance requirements as other operators, it is difficult to understand what benefit they are bringing to consumers.

- There is a significant opportunity cost from the market entry of new players. Inevitably, allocation of spectrum to new entrants means that less spectrum is allocated to existing mobile network operators, which could significantly impair their ability to deliver a high-quality service to consumers, for example, by preventing them having sufficient contiguous spectrum (e.g. a minimum of 2×20MHz) required for LTE optimum performance or preventing them from having sufficient 800MHz spectrum to deliver services in rural areas.
- Proactively seeking to attract new entrants may significantly impair the business case for all mobile network operators for the deployment of next-generation mobile networks, particularly in rural areas.

About the authors

Dr Mark Heath and **Dr Alastair Brydon** co-founded Unwired Insight Limited in 2001 after many years of experience within mobile network operators and equipment vendors. They provide consultancy to leading companies in the mobile industry and are authors of over 40 major reports, including 'Will 3G Networks Cope? 3G traffic and capacity forecasts for 2009–2014', '3G-Infrastructure Sharing: the future for mobile networks', '3G Network Evolution from 2007 to 2012: HSPA+, LTE, WiMAX and femtocells', 'Femtocells in the Consumer Market: business case and marketing plan' and 'The Business Case for WiMAX'.



Prior to Unwired Insight, Mark held a number of marketing and business development roles in Nokia, ultimately defining strategy and business development for Europe, Middle East and Asia. Previously, Mark was responsible for business planning at BT Cellnet in the UK, after spending six years at BT in wireless systems research and development. He holds BSc and PhD degrees from the University of Leeds, winning the University prize for his research in telecommunications. Mark also holds an MBA, graduating as top student from Henley Management College.

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