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16 November 2011

RSPG Report on Improving Broadband Coverage

I. Introduction and scope

Article 2 of the Commission Decision establishing a Radio Spectrum Policy Group states that the RSPG shall assist and advise the Commission on radio spectrum policy issues, on coordination of policy approaches, on the preparation of multiannual radio spectrum policy programmes and, where appropriate, on harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the internal market.

This Report sets out some of the key issues facing EU Member States in the challenges they face in providing high speed broadband services to all citizens and consumers.

Taking forward the work done by RSPG on Wireless Broadband in 2009[1], it looks at the progress that Member States have made in meeting key public policy objectives for providing ubiquitous broadband services and, specifically looks at the contribution that wireless platforms have made to meet these objectives.

Europe is in the process of releasing significant quantities of spectrum to meet increasing business and consumer demand for wireless broadband services. As a result, the timing of this Report is timely in that it comes at a time when all Member States are assessing, or have assessed, how wireless solutions can help to meet the goal of broadband services for all as set out in the Digital Agenda.

The scope of this Report covers the wider context of both wired and wireless approaches to meeting public policy coverage goals before focussing on the role of wireless solutions. It looks at the various different methods that Member States have employed with wireless platforms and summarises the success that these approaches have achieved. Finally, with direct reference to the request for this Report, it considers two discrete issues of concern relating to competition in the wireless broadband market and the potential for under-utilisation of spectrum bands that are harmonised at a European level.

The Report also provides particular focus on the role of coverage obligations on mobile broadband services. This is a reflection of the recent developments at an EU (and, indeed a global) level toward the release of spectrum suitable for mobile broadband services. However, the potential importance of other wireless broadband platforms, both satellite and fixed wireless is also considered.

[1] RSPG09-284, *Position Paper on Wireless Broadband*

Structure of this Report

This Report is structured as follows:

- Section II sets out the background to this issue, including details of those key publications and policy initiatives that inform the work of this document;

- Section III outlines the key approaches to improving broadband coverage. It looks at both wired and wireless broadband platforms, describing different types of wireless solutions;

- Section IV looks at the different approaches to establishing coverage obligations to wireless broadband service providers and summarises what EU Member States have actually done in practice;

- Section V explores the experiences of Member States in meeting public policy goals as they relate to broadband coverage obligations. It describes what level of success Member States have had in achieving coverage targets as well as assessing how issues of measurability and enforcement have been overcome;

- Section VI sets out how Member States have addressed any competition issues that were identified as a result of establishing coverage obligations;

- Section VII discusses some of the issues relating to underutilisation of spectrum due to significant broadband penetration or other factors and what this might mean for future harmonisation initiatives; and

- Section VIII summarises the key points raised in sections III-VII.

II. Background

In February 2011, the RSPG adopted an Opinion (RSPG10-330[2]) that identified, amongst other things, the policy objective of ensuring that sufficient spectrum for coverage and capacity purposes is allocated within the EU so that all citizens and consumers could have access to ubiquitous high speed broadband.

Subsequently, in February 2011 the RSPG set out its Work Programme for 2011(RSPG10-346Rev[3]). That document stated that the RSPG should examine some of the spectrum implications of meeting this objective, bearing in mind the potential role for wireless networks. In addition, the work stream should address two discrete issues of particular concern, namely:

i) analysis of the impact of coverage obligations on competition in the wireless broadband market; and

[2] http://rspg.ec.europa.eu/_documents/documents/opinions/rspg10_330_rspp_opinion.pdf
[3] http://circa.europa.eu/Members/irc/infso/rspg/library?l=/public_documents/rspg_24/rspg_346_wp2011pdf/_EN_1.0_&a=d

ii) analysis of conflict between demand for more spectrum for broadband applications at the European level and the under-utilisation of current bands in some Member States as a result of extensive broadband penetration by other platforms.

RSPG Position Paper on Wireless Broadband, 2009

Much of the background for this Report can be found in the 2009 RSPG Position Paper (RSPG09-284[4]) on Wireless Broadband (the 2009 Broadband Position Paper). That document set out a number of crucial issues facing Member States in meeting the challenges of providing broadband services. It looked at the wider context of delivering high speed broadband services across a range of platforms, both wired and wireless. It assessed at a high level the relative advantages and downsides of these different types of delivery methods as well as focussing on some of the features of different wireless approaches.

The 2009 Broadband Position Paper also addressed the key elements of the digital divide, namely the *geographical divide* and the *quality divide* and summarised some of the key measures being taken by Member States to address these at that time. This touched upon the levels at which action can be directed to improve coverage and services.

This Report considers the further experiences of Member States in utilising these approaches. It assesses the success they have had in meeting their public policy goals in light of those experiences. Finally, it considers what lessons can be learned by policy makers over the coming years as spectrum is made available to support the deployment of mobile broadband services.

EU2020 vision and Digital Agenda

Europe 2020 is the EU's growth strategy for the coming decade. Its objective is for the EU to become a smart, sustainable and inclusive economy. The strategy restated the objective to bring basic broadband to all Europeans by 2013. It seeks to ensure that by 2020 all Europeans should have access to much higher internet speeds of above 30 Mbps with 50% of the EU population having access to ultra-fast broadband speeds in excess of 100 Mbps. The strategy comprises a number of flagship initiatives which include the Digital Agenda, which represents Europe's strategy for a flourishing digital economy by 2020. The central aim of the European Commission's Digital Agenda for Europe *is to deliver sustainable economic and social benefits from a digital single market based on fast and ultra fast internet and interoperable applications*[5].

One of the key challenges highlighted in the Digital Agenda is that more needs to be done to ensure the roll-out and take-up of broadband for all, at increasing speeds, through both fixed and wireless technologies, and to facilitate investment in the new very fast open and competitive internet networks that will be the arteries of a future economy.

The Digital Agenda states that wireless (terrestrial and satellite) broadband can play a key role in ensuring coverage of all areas including remote and rural regions. It notes that a problem central to development of wireless broadband networks is access to radio spectrum.

[4] http://rspg.groups.eu.int/_documents/documents/meeting/rspg19/rspg09_284_position_paper_wireless_broadband.pdf

[5] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF

Finally, the Digital Agenda states that a forward-looking European spectrum policy should, while accommodating broadcasting, promote efficient spectrum management, by mandating the use of certain digital dividend frequencies for wireless broadband by a fixed future date, by ensuring additional flexibility (also allowing spectrum trading) and by supporting competition and innovation.

The Radio Spectrum Policy Programme

The legislative regulatory framework for electronic communications[6] allows the European Commission, taking utmost account of the opinion of the RSPG, to submit a multi-annual Radio Spectrum Policy Programme (RSPP) to be adopted by the European Parliament and the Council of Ministers. According to Article 8a (3) of the Framework Directive, the RSPP should set out the policy orientations and objectives for the strategic planning and harmonisation of the use of radio spectrum in the Community.

In September 2010, the European Commission published its proposal for a Decision of the European Parliament and of the Council establishing the first RSPP[7]. Consistent with the RSPG opinion on the RSPP which identified the need to ensure sufficient capacity and coverage for wireless broadband applications, the RSPP proposal set out how the programme could realise the ambitious broadband coverage targets as set out in the Digital Agenda:

> *Recital 4: [The RSPP] is also a key action in the Digital Agenda for Europe which aims to deliver fast broadband internet in the future network-based knowledge economy, with an ambitious target for universal broadband coverage with speeds of at least 30 Mbps for all Europeans by 2020.*

Other EU policies

The Spectrum Decision provides an effective cooperation mechanism between European Commission and the CEPT (The European Conference of Postal and Telecommunications Administrations). This ensures that the development of relevant harmonised technical conditions for spectrum is achieved in a timely manner (for example, the technical harmonised conditions in the 900/1800 MHz and in the 800 MHz were developed on the basis of a CEPT response to a mandate from the European Commission).

As noted above, the last review of the electronic communications framework introduced, among others things, the RSPP which is currently under development.

III. Approaches to addressing the digital divide

The importance of broadband and the impact of the digital divide

In August 2010, the EU published its *Digital Agenda for Europe* communication[8] in which it set out the central role for a digital single market in recovering from the most recent economic

[6] Directive 2009/140/EC of the European Parliament and of the Council
[7] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0471:FIN:EN:PDF
[8] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF

recession. Broadband[9] services play a key part in electronic communications, providing a wide range of economic social and cultural activities and thereby providing substantial benefits to EU citizens and consumers. As such, the role of broadband services has been identified as critical by policy makers to future prosperity for both the economy and for society.

The 2009 Broadband Position paper described the political commitment that existed, at that time, to addressing the lack of access to high quality digital services by some people within the EU. This is known as the "Digital Divide" and can be a function of a range of criteria such as gender, age or socio-economic background. However, in respect of broadband services, the key drivers of the digital divide are principally twofold:

- the geographical divide: where some areas are without any broadband coverage; and
- the quality divide: where some areas do not have access to the most advanced broadband services (this is commonly closely linked to the geographical divide).

There are clear identified economic benefits to broadband services such as increased productivity and commercial opportunities through access to the internet marketplace. A recent study by the World Bank[10] suggested that every 10% increase in broadband penetration accelerated economic growth by 1.38%. Similarly, broadband services offer significant social benefits such as developments in health and safety. As a result of these factors, the need to address the digital divide has been a long term goal for both Member States and the European Commission. On 31 May 2011, Neelie Kroes, Vice President of the European Commission, set out the importance attached to this in a speech to the European Parliament[11]:

> *But, as society develops in the digital age, we cannot forget about social inclusion. We know that the internet is impacting on every element on new lifestyles. So the benefits of the internet must be spread to include everyone. We cannot leave some parts of society out of the digital revolution, stuck in the dial-up Dark Ages, cut off altogether from these opportunities.*

Wired platforms

Wired (or fixed) platforms remain the principle platform for delivery of broadband in many parts of the Union. The main wired platforms are:

i) Digital Subscriber Lines (DSL) - which use existing copper lines from legacy telephone networks;

ii) Cable – which use enhanced cable-TV networks which can deliver significantly higher headline speeds than DSL solutions; and

[9] According to the OECD, this is defined as a high-speed internet connection capable of downloading upwards of 256 kbs per second of data – *The Future of the Internet Economy, A statistical profile* (June 2011). However, some countries will use definitions with different data speeds and these definitions can change over time.

[10] Chapter 3, *Information and Communications for Development: Extending reach and increasing impact.* World Bank (2009) http://go.worldbank.org./NATLOH7HV0

[11] High level conference on Broadband for All: Full text of speech at http://europa.eu/rapid/pressReleasesAction.do?reference=SPEECH/11/401&format=HTML&aged=0&language=EN&guiLanguage=en

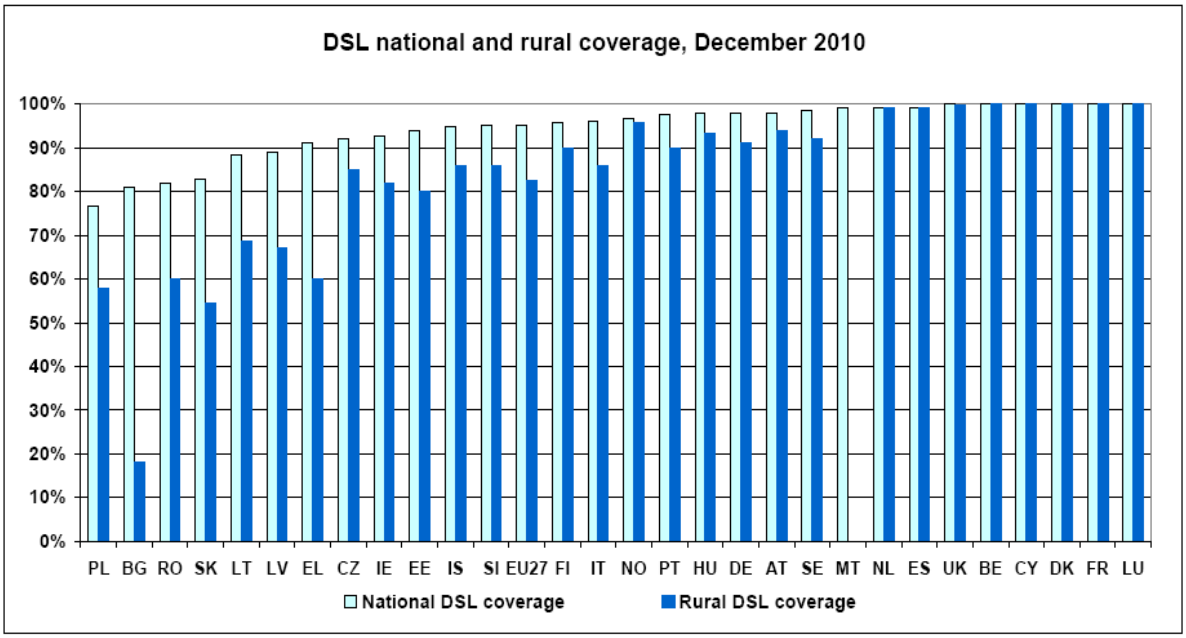
iii) FTTH (Fibre to the Home) and FTTB (Fibre to the Building) – where fibre reaches the boundary of the living space or the boundary of the building. These networks can deliver very high broadband speeds.

Other forms of fibre networks are outlined below in this main section setting out possible hybrid platform solutions for the delivery of broadband services.

Fibre networks are still in a relatively early stage of development in a number of EU countries. They represent modest recent increases in European coverage with 17% of existing broadband lines being accounted for by fibre to the home (FTTH)[12]. However, they do play an increasingly central role on national plans for the delivery of broadband services.

According to latest figures, wired platforms provide a significant level of coverage within the EU. A survey carried out by the European Commission in 2011[13], compiling data provided from each Member State, showed that level of broadband coverage for fixed DSL networks are as follows:

Figure 1: Fixed broadband coverage via DSL connection in December 2010



These figures show that there are still 23.5 million citizens in the EU who do not have access to basic broadband services over fixed networks. Of this number, 18 million live in rural areas, thereby illustrating the continuing geographical divide as set out in the 2009 Broadband Position Paper.

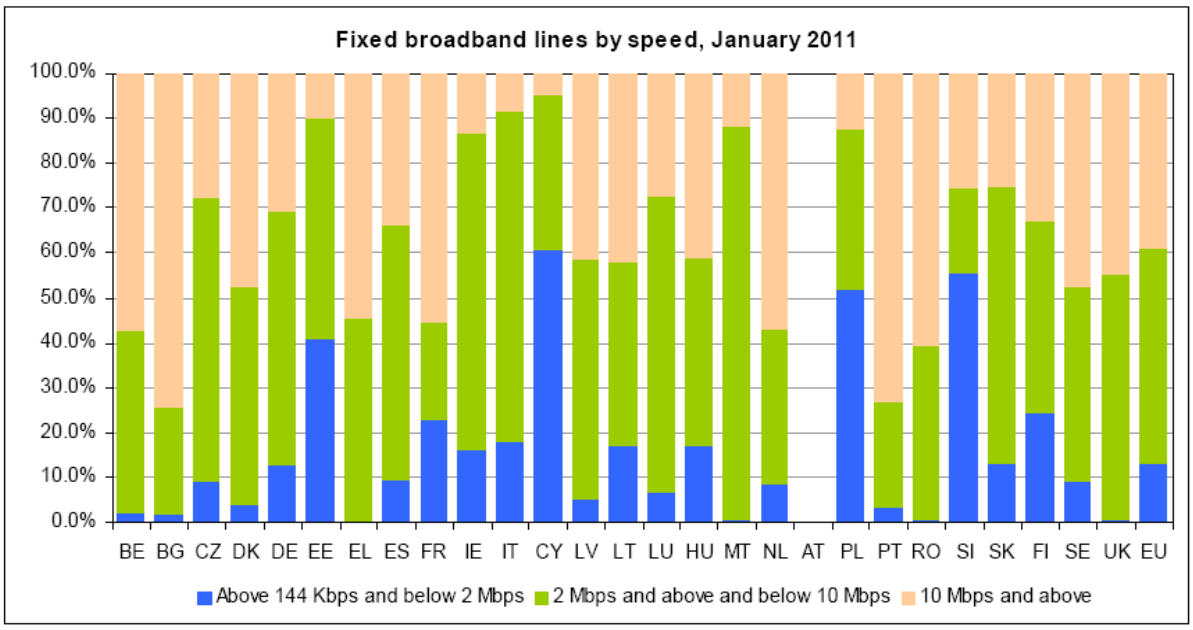
The same survey also discovered that there are a more significant number of users who have access to broadband speeds of less than 2 Mbps over fixed networks (more than 50% of citizens in some Member States falling in to this category) which indicates that there is still a quality divide issue related to the use of wired networks. The chart below, also from the 2011

[12] OECD Working part on Communications Infrastructure and services policy – *Fibre Access: Network Developments in the OECD Area*, March 2011

[13] http://ec.europa.eu/information_society/digital-agenda/scoreboard/

European Commission survey, sets out the coverage of broadband services with data rates below 2 Mbps and below 10 Mbps.

Figure 2: Fixed broadband lines by speed January 2011



The two charts above show that, whilst fixed broadband services are available to most of the population of the EU, there is still a significant minority of people without access. Of those who do have access, many are using connections that offer *relatively* low data speeds.

The decision whether to adopt wired and/or wireless solutions to ensure improved broadband coverage will depend on a number of factors. In most cases, a wired solution (particularly fibre) will tend to offer a higher download speed than a wireless one. However, a wireless network may offer relatively high speeds more cost effectively than its wired counterpart particularly in providing services to rural areas.

According to a recent OECD report, focussing on fibre technology[14] *broadband network operators have said that, in many geographical regions, the cost of deploying [wired] NGAs is too high relative to the expected revenue so that investment would be unpopular*.

Wireless platforms

Wireless platforms are, at the highest level, divided into terrestrial and satellite networks with both platforms using the airwaves to deliver broadband services. Their key features are:

i) *Terrestrial networks*: these can be either mobile, fixed or local area networks.

   Mobile broadband services currently operate primarily over 3G networks with refarming and planned future releases of spectrum likely to see an increase in the use of these and new LTE services[15].

[14] OECD High Level Meeting Paper, *Next generation access networks and market structure* (June 2011)
[15] Long Term Evolution (LTE) technology is now being introduced in Europe, with Germany and Sweden the first markets to provide services based on this technology. Whilst LTE is commonly referred to as 4G, it does not meet the requirements for 4G as set out by the ITU.

Fixed broadband services, such as Broadband Wireless Access (BWA), offer either point to point or point to multi-point services. These technologies provide broadband data access by wireless means to consumer and business markets.

Wireless LANs (local area networks with very low coverage) typically use spectrum on an unlicensed basis and allows users to operate nomadically with support of available radio access points. The most well known version of a Wireless LAN is Wi-Fi.

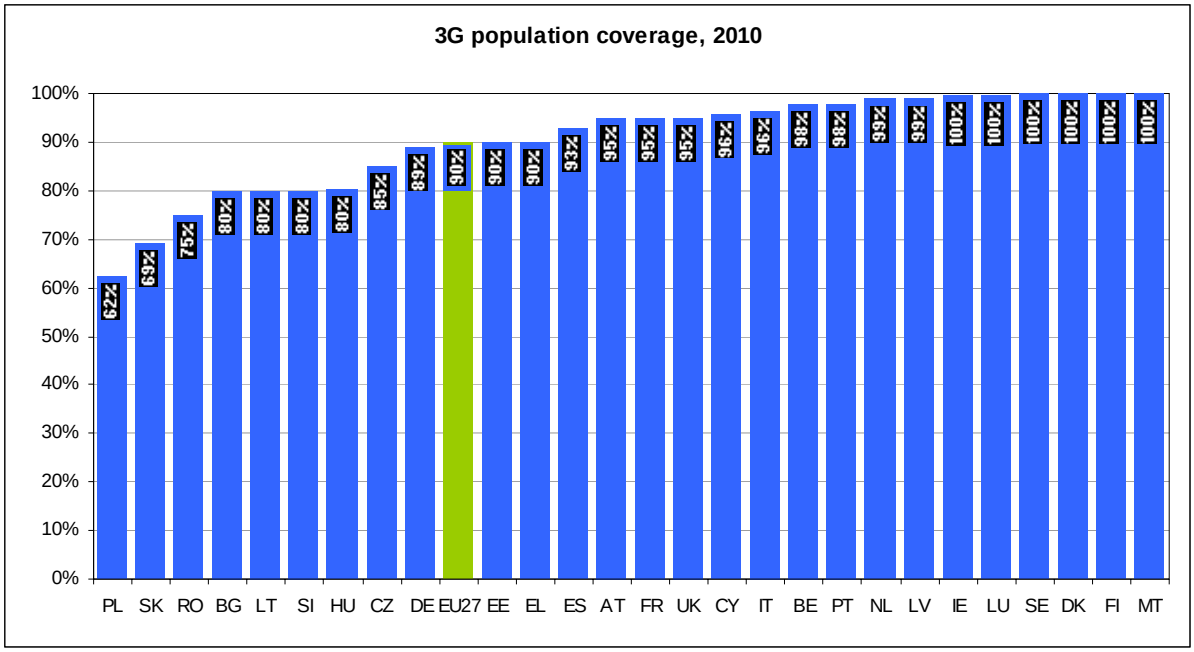
ii) *Satellite networks*: these are a relatively marginal provider of broadband services albeit with the potential to provide blanket services in Europe. At the time of the 2009 Broadband Position Paper, satellite offered typical speeds of up to 2 Mbps. Currently a number of operators are now advertising broadband services which they claim are able to provide improved speeds of up to 10 Mbps using spot beams. The growing potential for satellite services to help meet the coverage objective of the digital agenda was recognised in the European Commission proposal on the RSPP which set out a specific role for satellite services in meeting those targets.

Mobile networks have historically had an advantage over their satellite counterparts of being able to offer higher data speeds and to be able to offer services to consumers at a lower retail price. Nevertheless, the level of investment from network and satellite operators largely differ as the importance of coverage levels differs between both platforms. Lower retail prices should be considered in context and on a case by case basis according to the nature of end user usage and is not necessarily *always* to the advantage of the mobile network. The retail pricing contrast, however, was at least partly a function of the differing service offerings and business models adopted by both platforms.

The most notable advantage of satellite networks has been their ability to offer coverage over wide areas, including those remote locations that are commercially less attractive for terrestrial networks. In terms of weaknesses, the known issue of latency is currently being addressed by the satellite industry to try to establish levels more comparable to terrestrial networks. Indeed, there may be some blurring of lines between services over the coming years as current satellite networks offer improved data download speeds and as LTE technology rolls out over the lower frequencies in the 800 MHz bands in the next few years.

Wireless platforms play an increasingly key role in ensuring that the provision of broadband services is extended to as many businesses and consumers as possible. The table below from the 2011 European Commission survey illustrates the penetration of 3G mobile broadband by EU Member States in 2010. It shows that the average across all Member States is 90% population coverage outdoors with 19 countries offering 90% or above coverage.

Figure 3: Mobile broadband coverage 2010



Hybrid platform solutions

Broadband services are commonly provided by a combination of different platforms where these are the most cost-effective way of ensuring access to the end user. These combinations can consist of a combination of wired approaches, a combination of wireless approaches or combinations where either wired or wireless platforms operate with LANs providing broadband services to the end user. Examples of this in practice are:

i) Combinations of wired platforms: one example of combinations of wired platforms is HbbTV (Hybrid Broadcast Broadband TV). This is used generically to refer to systems which integrate traditional broadcast infrastructures with modern broadband technologies. Various hybrid systems may be described by this term (IPTV platforms featuring access to broadcast content, OTT platforms of Broadcasters, Televisions featuring Broadcast and IP frontends);

ii) Combination of wireless platforms: there is increasing recognition that combining satellite and mobile broadband services could be an effective way of improving broadband coverage. For example, the RSPP as proposed by the European Commission envisaged that both satellite and mobile broadband could have a part to play in meeting the coverage goals of the Digital Agenda[16]. Possible future examples of such combinations may include the expected future deployment of new mobile satellite services as a result of Commission Decision 626/2008/EC. It is envisaged that satellite services at 2 GHz could be augmented by terrestrial networks where frequencies can be reused – known as complementary ground components (CGCs). Other higher frequency systems, such as O3b MEO system (as mentioned above) could provide more bandwidth and operate with more transponders; and

[16] http://ec.europa.eu/information_society/digital-agenda/index_en.htm

iii) Combination of wired and/or wireless platforms and LANs: LANs could provide a key role in "off-loading" high speed data and alleviating demand, whether combined with wired platforms such as Fibre[17], DSL or with fixed wireless solutions such as BWA. There is growing recognition that demand for data is likely to increase at a significant rate over the coming years. The advent of smart phones and parallel demand for video streaming and downloads has contributed to a marked increase in demand for data at a rate that is expected to continue for the foreseeable future. Some recent figures from various NRAs revealed an increase of data traffic above some initial forecasts.

IV. Different approaches to promoting improved broadband coverage using wireless platforms

In light of the commercial barriers to achieving ubiquitous broadband coverage, Member States might need to explore the viability of achieving this key public policy goal through alternative approaches. The 2009 Broadband Position Paper highlighted a number of ways of how this might work in practice. These were:

- making spectrum available which would be suitable for extensive geographical coverage (in particular, frequencies below 1 GHz);
- placing coverage licence obligations on operators who deploy wireless high speed broadband services;
- stimulating private investment in communications networks through public subsidies;
- public procurement of broadband services in areas with no broadband coverage (Ireland and France previously being named as examples of where this has happened); and/or
- promoting infrastructure sharing.

Making spectrum available for broadband services below 1 GHz

Since the 2009 Broadband Position Paper, two key developments have occurred that has led to more spectrum being made available at those frequencies which would be more suitable for rural coverage (that is, frequencies lower than 1 GHz):

- Commission Decision 2010/267/EU mandated harmonised technical terms of any release of spectrum in the 800 MHz band (790-862 MHz). This has led to Member States realising the increased value of this spectrum by either awarding the spectrum in competitive awards or by preparing for such awards[18]; and
- the spectrum initially harmonised EU-wide for GSM at 900 MHz (880-915 and 925-960 MHz) benefits from new harmonised technical conditions published by Commission Decision 2009/766/EC so that UMTS or other compatible broadband services could be deployed in those frequencies. This liberalisation was extended to LTE and WiMax systems by Decision 2011/251/EU.

As a result of these two Decisions, a significant amount of spectrum will be made available on an EU-wide basis that could be deployed for mobile broadband services and which has propagation characteristics that lends itself to providing relatively favourable coverage. However, for a number of Member States (with specific geographic and demographic characteristics) the availability of lower frequency spectrum will not, on its own, be sufficient to achieve the goal of broadband for all without some further intervention. Such intervention could ensure that

[17] In particular, Fibre to the Node (FTTN) or Fibre to the Curb (FTTC).

[18] On 28 October 2011, a provisional RSPP text was informally agreed bewteen the European Council and Parliament. This set out a deadline of 1 January 2013 for awarding this spectrum EU wide with some specific time-limited derogations for Member States who have demonstrable border co-ordination issues or difficulties in deploying spectrum within their territory. This is subject to final agreement.

high speed services are available in all locations, including remote rural ones where 3G roll-out is not commercially feasible.

This section further assesses the further steps that Member States have taken to improve broadband coverage within their boundaries and focuses on the approaches that have been identified above.

Coverage obligations in operator's spectrum licences

The commonly used approach to promoting wider wireless broadband service coverage is through the introduction of specific obligations in spectrum licences that are issued to operators. The 2011 Joint RSPG /BEREC[19] Report on Economic and Social Value of Spectrum is based, in part, on a questionnaire (the 2011 Spectrum Value questionnaire) sent to all Member States to determine, amongst other things, what coverage obligations had been put in place in past mobile spectrum awards. The result of that questionnaire informs much of the assessment below as it gives an up-to-date picture of what Member States are planning for future awards as well as a comprehensive picture of what was done in the past to promote broadband coverage. A summary of its results is set out in the Annex to this Report.

Coverage obligations should be carefully designed in a way that delivers benefits for consumers in response to regulatory and policy objectives but also in a way that can be measured to ensure compliance. If the obligation is poorly specified, then it is possible that operators can comply with the obligation, but this might not mean that consumers have a service and the objective of the obligation will not have been met.

In the case of mobile broadband, other parameters will affect the availability and quality of the mobile broadband service. Specifying appropriate values for these parameters could be difficult in situations, particularly where there is uncertainty about the technology, costs and practicalities of deployment and considerable uncertainty about what value consumers might derive from different types of service. Nevertheless, actual implementation of coverage obligations has shown some success in responding to the key objective for mobile broadband coverage.

Therefore, in practice the regulator needs to strike a balance between setting out clearly the obligations on operators in terms of geographical/population penetration and minimum data speed deployment while ensuring that these obligations are being met. Coverage obligations may be limited by the principles of service and technology neutrality but this can be addressed by imposing less prescriptive coverage obligations in order to comply with the need to meet public policy goals. However, coverage obligations do need to balance the need to meet public policy goals whilst recognising the principles of service and technology neutrality

An assessment of the experiences of Member States in establishing coverage obligations suggests that there are three key and recurrent themes that need to be addressed. They are:

i) what the factors are which determine whether coverage obligations should be imposed in the first place;

ii) how any coverage obligation should be defined to ensure that defined goals are effectively met; and

[19] Body of European Regulators for Electronic Communications

iii) how operators' performances against coverage obligations can be accurately measured and how to establish robust enforcement measures.

Determining whether coverage obligations should be established

The first spectrum to be harmonised for mobile services were the 900 and 1800 MHz bands in 1987[20] and 1993[21] respectively. The initial uses of these bands predated the introduction of broadband services and were therefore focused on voice services only. This was subsequently followed by the introduction of the GSM standard which, in addition to voice traffic, later on offered SMS services. Subsequent generations of 2G technologies, notably GPRS and EDGE, did provide mobile data services.

Broadly speaking, the impetus for the setting of these coverage obligations came from three considerations, namely:

- fulfilling Government social policy objectives of ensuring wider service coverage;
- ensuring that networks were deployed in a timely fashion, thus ensuring that hoarding of spectrum did not occur; and
- elements of both the above, where relatively modest coverage obligations were set to stimulate network deployment with a view to competition between operators driving much wider service coverage.

These three objectives have remained central to decisions amongst Member States as to whether coverage obligations should be imposed on operators' licences. The history of coverage obligations, up to and including the ongoing 800 MHz and 2.6 GHz awards, has shown that Member States continue to view these factors as crucial elements in deciding whether it is appropriate to set coverage obligations in operators' licences.

At a high level, there is some evidence that the objectives of ensuring wider coverage have been focussed on lower frequencies. A number of Member States stated in their responses to the 2011 Spectrum Value questionnaire that this was the specific goal of establishing coverage obligations in the 900 MHz band and, indeed, in the ongoing 800 MHz awards. The ambitious population coverage levels (usually above 90%) suggest that, broadly speaking - though not in all cases- the primary focus of these obligations is to promote wider roll-out of mobile broadband, including in rural areas.

Although this is, to some extent, repeated in the 1800 MHz band there are some coverage obligations that are of a lower magnitude (for example, Belgium at a maximum of 60% population, Denmark at 45% population and Poland at maximum 30% population). This suggests that 1800 MHz, on its own, is not as widely favoured for wide scale broadband coverage as is spectrum below 1 GHz.

In the case of the 2.1 and 2.6 GHz bands, the primary objective of the coverage obligations appears to be to stimulate network deployment and avoid spectrum hoarding. In some

[20] Directive 87/372/EEC
[21] ERC/DEC/(95)03

countries, the coverage obligations as set out in these licences are, accordingly, more modest in the scope of their coverage ambition (usually between 25-50 % population coverage, although sometimes as much as 75%). It should also be noted that, in some cases, wide scale 3G national coverage has been achieved by network operators fulfilling their licence obligations as a result of fulfilling obligations they had made as part of the beauty contest process.

A few Member States, such as Sweden, UK, Portugal, Denmark and Finland have decided not to establish coverage obligations at all in the 2.6 GHz band, citing the unfavourable technical characteristics of the spectrum. Of those Member States who have established obligations in the 2.6 GHz band, some have done so with the objective of targeting specific locations such as Austria (urban areas) and Poland (to address specific areas where there is an identified absence of coverage).

The authorisations granted in the 3.4 GHz band relate primarily to fixed broadband coverage objectives with a number of them being granted in the mid 2000s. The ambition of these coverage obligations were also modest in their total national population and/or area coverage due to the nature of the frequencies and expected level of usage. They tended to be targeted on specific populations with a view to providing services to either rural areas or pre-defined towns and cities. In some cases, the obligations focussed on a specified number of deployed base stations.

The third motive for establishing licence coverage obligations, whereby modest coverage obligations were set with a view to competition driving much more ambitious network roll-out has been adopted, amongst others, by Germany and Ireland. Germany set its coverage obligations at 50% for the 1.8 GHz, 2.1 GHz and 2.6 GHz bands in the expectation that actual roll-out would be significantly higher than this stipulated level. Ireland has a similar approach where it proposes to set its coverage obligations at 70%, although in this case the operators would have the option of meeting this by using any one of the bands being awarded (800 MHz, 900 MHz and 1800 MHz).

Defining coverage obligations

As noted above, when defining the specifics of coverage obligations there is an inherent challenge both in ensuring that the obligation meets the relevant policy goals and in achieving this in a way that reflects the overall public policy. Member States have approached this in a number of different ways:

- by reference to covering a proportion of population;
- by reference to covering a proportion of area;
- by reference to covering key national infrastructure such as roads and ports;
- by reference to covering specific locations which have been identified as not having access to quality broadband services or no service at all. These range from regions and towns to individual addresses; or
- any combination of the above solutions.

Most Member States have opted for the first approach above by establishing a population obligation, although all of the approaches have been followed on more than one occasion. The purpose for focussing on populations is clearly to ensure that services are provided to those areas of a country where they are most likely to be in demand.

Policy makers are also considering whether coverage obligations have a part to play in providing broadband services of key infrastructural importance to Member States. As demand for data increases, so does the expectation that broadband services should be available for users in a greater variety of circumstances. As a result of this, some administrations have determined that coverage obligations should apply to roads, ports and other waterways. These include France (900 MHz obligation to cover 57,000 Km of main roads); Greece (900 MHz obligation to cover 85% of roads), and Netherlands (900 MHz and 2.1 GHz obligation to cover major roads, waterways and ports).

Finally, there have been examples of operators being obliged to provide broadband coverage to specified towns (as in the case of Italy's 3.4 GHz award), area codes and even individual addresses (in the case of Sweden in its 800 MHz award). These examples apply to both spectrum below and above 1 GHz – with this approach being notably popular with coverage obligations in the 3.4 GHz band.

Measuring operators' performance against coverage obligations and enforcement processes

For any coverage obligation to be credible there would have to be mechanisms in place to monitor whether obligations were being met. Separately, there would have to be enforcement powers in place so that operators had sufficient incentive to fulfil those coverage obligations.

According to the responses to the 2011 Spectrum Value questionnaire, in most cases the approach to measurability is twofold. Firstly, there is a form of self-declaration from operators themselves in which they provide evidence that they have met the coverage obligations as set out in their licences. This may be followed up by a form of measurement by the authority which can take the form of field measurements or computer monitoring.

With regards to enforcement, the two sanctions that are commonly used (and, in a number of cases, *both* sanctions are available to Member States) are:

- the ability to fine operators in accordance with the provision as set out with National law; and/or

- the ability to vary or revoke licences (rights of spectrum use).

There are some informative examples of where Member States investigated whether they may have to take enforcement action:

- one operator in the UK failed to meet its obligation to provide 80% 3G coverage in the 2100 MHz band – only reaching 75.69% of the population. In Februrary 2008, the UK spectrum authority, Ofcom, issued the operator with a warning that it had to comply with the terms of its licence or be faced with a £40m fine. Ofcom confirmed that the operator had met its coverage obligation in May 2008; and

- in 2008, The Danish authority, NITA, revoked two licenses assigned to a mobile network operator due to non-compliance with the terms in its license (70 % geographic coverage). In this instance, the operator submitted insufficient documentation to the authority. After several enforcement notices, the operator stated that it was unable to comply with the coverage obligation as a result of a shut down of its network.

Public procurement of broadband services

The 2009 Broadband Position Paper gave two examples, Ireland and France, of where Members States had improved broadband coverage through direct government procurement. We update those examples below:

Ireland

The Irish National Broadband Scheme (NBS) was launched in December 2008 with the award of the contract by the government to 3 Ireland and completed in October 2010. The objective of the scheme was to make access to broadband services available to certain target areas in Ireland in which broadband services were deemed to be insufficient. Under the contract, the scheme operator is required to provide services to all premises in the NBS area who sought a service. In order to facilitate competition in the area, they are also required to provide wholesale access to any other authorised operator who wishes to serve premises in the NBS area.

The scheme cost €223 million with the government contributing €79.8m to the cost of the project over the 68 month contract period. The project attracted EU co-funding under the ERDF 2007-2013 of approximately €30m, reducing the net cost to the Exchequer to approximately €50m.

In May 2011, the government announced a new Rural Broadband Scheme which aims to identify the remaining individual premises in rural Ireland that are unable to obtain a broadband service and to provide a service to those premises where requested. This Scheme will be carried out in cooperation with the Department of Agriculture, Fisheries and Food under the Rural Development Programme co-funded by the European Agriculture Fund for Rural Development.

The Scheme aims to ensure that universal broadband access is provided in Ireland by the end of 2012. While the completion of the Government's National Broadband Scheme (NBS) means that broadband services are now available throughout the country, there are remaining un-served rural premises which could not be included in the NBS or which are difficult to reach for mainly technical reasons. The Rural Broadband Scheme is designed to identify those premises through a public application process and, ultimately, to bring a broadband service to them either through existing private sector service providers or through a service provider procured by Government.

France

The France Numérique 2012[22] plan set out, amongst other objectives such as mobile broadband for all, policy objectives to reduce the digital divide. They were based on increasing competition and on initiatives involving local authorities to improve competition and broadband coverage in their territories (public/private partnership initiatives as part of an overall strategy of extension of wired broadband internet coverage).

This recommendation was legally implemented on 17 December 2009[23], and established a series of Local Digital Development Plans (SDTAN). Those plans intend to promote both consistency in policy initiatives and their effectiveness within a private investment framework. They contain an inventory of existing electronic communication networks and their related service areas and set out a strategy to develop those networks. These are based primarily on fixed and mobile broadband networks but also include satellite networks to ensure that the desired level of coverage is achieved. SDTAN are developed at a regional or at a departmental level and to ensure the effectiveness of these plans, there cannot be more than one SDTAN for each region/department. A part of the development strategy could be supported financially by the Local Digital Development Fund.

Private investment through public incentives /subsidies

Sweden held its auction for the 800 MHz band at the beginning of 2011. To ensure full coverage for businesses and consumers, it identified those addresses where specific measures would need to be taken by an operator to ensure that a broadband service would be provided.

The addresses are derived from an annual ”Broadband Survey” by the Swedish authority, PTS, and covers households and fixed places of business. Areas lacking coverage were defined in 250 metre squares where there was no connectivity for broadband services[24].

The identified addressees are asked if they have any demand for broadband services and based on the responses, PTS compiled the list. Based on this list, it is determined that the licence holder should cover:

- at least 25% of permanent homes and fixed places of business on the list no later than 31 December 2012;
- at least 75% of the permanent homes and fixed places of business on the list no later than 31 December 2013; and
- all of the permanent homes and fixed places of business on the list no later than 31 December 2014.

A new list will be compiled every year. One licence was set aside for this purpose with a 2 x 5 MHz bandwidth and a 300 million SEK investment cap, to be held by the operator. The winning operator of that package can deduct capital expenditure relating to rolling out its network to the households and fixed places of business from that investment cap[25]. In terms of how to actually cover the households and places of business, the focus is for coverage to be

[22] See http://francenumerique2012.fr/.
[23] law n°2009-1572
[24] Broadband, here, is defined as 1 Mbps.
[25] http://www.pts.se/en-gb/Documents/Decisions/Radio/2011/Decision-on-the-assignment-of-licenses-in-the-frequency-band-791-821832-862--dnr-10-10534/

achieved within the 800 MHz band. However, for the 250 homes and places of business which are the most costly to cover, the licence holder may provide coverage by using alternative frequency bands where the operator itself has a licence. Alternatively, it could adopt a different technology to spectrum by deploying wired solutions. For the 20 most costly homes and places of business, the licence holder may also consider providing coverage by using satellite solutions if this is clearly less costly.

Other examples include Austria, who currently supports investments in broadband infrastructure covering rural areas. The support is granted through subsidies to private investors or communities. The source of the financial aid is though the EU, federal and regional governments. According to the provisions of the EU and of the federal government the regional administrations are responsible for the processing of the subsidies. Similar examples are evolving in Italy, where projects (most of them regarding fixed networks) are coordinated by the Government and implemented by regional administrations. These are aimed at reducing the digital divide by using both European and national public funds.[26]

Infrastructure sharing

In June 2011, the RSPG and BEREC published their Report[27] (the 2011 Infrastructure Sharing Report) on infrastructure and spectrum sharing in mobile networks. That Report set out, amongst other things, some of the potential advantages that could be realised by mobile operators through passive infrastructure sharing (that is the common use of masts, sites and/or other infrastructural elements).

Sharing agreements could offer benefits to end users by facilitating improved coverage and/or quality of service whilst reducing costs for operators and thereby prices to consumers. Because of the significant costs involved in building a network, sharing could also be a way of facilitating new entrants into the market for wireless broadband service provision. This could be achieved by new entrants sharing investment risks with other operators.

Sharing agreements should comply with competition law, in particular Article 101 of the TFEU[28]. NRAs need to ensure that any sharing agreements between operators do not distort competition such that there is a significant impact on competition in the relevant wholesale and retail access markets.

The Report outlined the current practices throughout the EU with all 27 Member States confirmed as having agreements based on passive network sharing. Progress has been made in making such agreements to the extent that they are now considered commonplace. Examples of how regulation has been used to promote infrastructure sharing, examples were given, are:

- Germany putting in place positive regulation in 2001 (updated in 2010) for the sharing of infrastructure[29]. Since December 2009, BNetzA[30] has been providing an infrastructure atlas which contains spatial data on infrastructure of over 100 companies and institutions. This includes fibre optic lines, empty ducts, radio towers and masts as

[26] For more information see www.sviluppoeconomico.gov.it/images/stories/pdf_upload/DIGITAL-ITALY.pdf
[27] http://circa.europa.eu/Members/irc/infso/rspg/library?l=/public_documents/rspg_meeting_documents/rspg11-374_reportpdf/_EN_1.0_&a=d
[28] Previously Article 81(1) of Treaty of the Functioning of the European Union
[29] Title: *Shared use of wireless infrastructure and spectrum resources.*
[30] Bundesnetzagentur

well as radio stations. Upon application, BNetzA will provide authorised users with information about the infrastructure contained in the atlas. Additionally, with the launch of its broadband strategy, it is also providing a broadband atlas[31] whereby everybody can get information on accessible broadband technologies and prospective bandwidths at certain locations.

- Sweden lifting its limit, in March 2011, on allowing no more than 70% of one's own network to be shared; and

- a legal obligation on operators in France to favour infrastructure sharing when they roll out new networks in specific areas.

Infrastructure sharing has the potential upside for Member States objectives' of promoting improved broadband coverage in that it provides significant cost savings for operators (the 2011 Infrastructure Sharing Report indicating overall savings of between 15-30%). This could help facilitate more ambitious coverage obligations to be applied to licences in a way which might make network deployment commercially viable. As a result, regulatory frameworks could investigate ways of ensuring that such practices do not create adverse competition implications.

V. Member States experiences of meeting coverage goals

This section assesses how successful the different methods of improving broadband coverage, as mentioned above, have been in light of the experiences of Member States.

The success of meeting coverage obligations in operators' licences

As noted above, the setting of coverage obligations in operators' licences is designed to incentivise wider mobile broadband coverage, ensure network deployment or ensure deployment with a view to competition stimulating wider coverage. The responses to the 2011 Value of Spectrum questionnaire give us valuable insight into how well these objectives have been met.

Ensuring wider mobile broadband coverage

The responses to the questionnaires suggest that Member States are confident that they have both effective monitoring processes to ensure that coverage obligations are being met and available sanctions where operators are not meeting those licence obligations.

With that in mind, the success or otherwise of whether meeting the objective of wider coverage through spectrum licences *could* be assessed by:

- how frequently sanctions have been invoked by Member States for operators who were able to deploy a network but failed to cover the required coverage population and/or area because of the challenging nature of the obligation itself; and/or

[31] http://www.zukunft-breitband.de/BBA/Navigation/Breitbandatlas/breitbandsuche.html

- whether rights of use for radio frequencies has been returned by operators because, whilst they could deploy a network, they could not meet their coverage obligations due to the challenging nature of the obligation.

Because there have been no cases of either of the above scenarios taking place, this indicates that licence coverage obligations, as they relate to the specific aim of ensuring wider coverage, have broadly been met successfully.

Ensuring network deployment

However, in terms of the objective of ensuring that networks are deployed and services made available, the picture is different. On a number of occasions, spectrum has been returned by operators before they had deployed networks and offered services to end users. There appears to be two key reasons as to why this happens, namely:

- the commercial circumstances of the operator itself changes such that it is no longer in a position to provide broadband services in that spectrum. An example of this is in the Netherlands where there was a consolidation in the market so that the five competing operators reduced to only three. Because of underutilisation of spectrum, parts of the usage rights were returned after further investigation. Similar examples occurred in Denmark where one 3G operator left the market in 2005 and returned its licence and in Italy in 2002 where an operator left the market and returned its GSM licence; and

- the business plan of the operator was contingent on providing services that were based on a technology that didn't penetrate the market as expected. This is most clearly seen in the number of examples in the 3.4 GHz band where an industrial eco-system failed to emerge as expected. Here, spectrum has been returned by a number of operators primarily because the technology expected to deploy in these frequencies, WiMax, did not emerge in the timescales expected by the operators.

The surrendering of spectrum for these reasons relate to the implications of harmonised spectrum being underutilised. We address this issue in more depth in section VII.

The success of meeting coverage obligations through government procurement

The Irish National Broadband Scheme initiative has brought a broadband service to 1,028 areas where previously coverage was deemed to be insufficient. It provides a service with a minimum download speed of 1.6Mbps and maximum of 6.8Mbps with a contention ratio of 22:1. It has been made available to 235,000 premises across every county in Ireland, creating 170 jobs in the process. Built into the contract is a provision that speeds will be increased to a maximum of 10 Mbps by October 2012.

In terms of the Irish Rural Broadband Scheme, the objective is to ensure that the remainder of rural premises will be able to get a broadband service and to make broadband available to anyone who wants it by the end of 2012.

In terms of the French broadband initiative, the initial picture suggests that this has met with some success in achieving its goals. In particular, as of the 7 June 2011, ARCEP has been

informed of 70 territorial (SDTANs) initiatives[32] where avoidance of investment of duplication and financial support appear to have made the approach cost effective.

The success of meeting coverage obligations through public subsidies/incentives

In Sweden the relevant operator's licence is subject to coverage obligations to cover all permanent homes and fixed places of business that do not have data services with a bit rate of 1Mbps (identified by the PTS) by the end of 2014. The success of this approach will become clearer nearer that time. Similarly, the success or otherwise of the approach adopted by Austria will become evident in the near future.

The success of infrastructure sharing

The 2011 Infrastructure Sharing Report discussed Member States experiences with regulatory and/or government policies as they relate to improving broadband coverage. That Report was informed, in part, by questionnaires which were submitted by Member States. The indication given by a number of respondents[33] was that cost reductions and better network coverage was being realised by such agreements because of the ease in which new sites could be established.

In terms of specific examples, the Report pointed to the agreement in Spain between Orange and Vodafone whereby radio access network (RAN) sharing was facilitating the provision of broadband services to small towns with populations of fewer than 25,000 people. Similarly, France, who had initiated a 2G roaming scheme between Mobile Network Operators (MNOs) in the early 2000s to provide coverage to rural areas, has seen the signing in 2010 of a RAN sharing agreement between four MNOs for the provision of 3G services.

VI. Were any competition implications identified?

Work done by Member States on establishing coverage obligations suggest that there are a number of competition issues that have to be considered and addressed, where necessary. The key identified areas of concern are:

- ensuring that obligations are not too onerous such that there would be insufficient commercial case for an operator to enter the market;
- ensuring that obligations are not set in a way such that operators are put at an undue competitive advantage or disadvantage over other operators;
- ensuring that provisions for infrastructure sharing do not distort competition; and
- differences in public policy approach whereby the focus in urban areas is on competition but is on coverage in rural areas.

Ensuring that coverage obligations do not remove operators' commercial incentives

Where coverage obligations have been established with the goal of ensuring provision of wireless broadband services to rural or hard-to-reach areas, the costs to operators for rolling out those networks will inevitably

[32] http://www.arcep.fr/index.php?id=10463

[33] Those Member States identified as giving this feedback were Netherlands, Denmark, Finland, Sweden, France and Italy.

increase. These increases in costs will impact on the commercial viability of rolling out networks. Member States, as result, have to balance the objective of ensuring that broadband is available to as much of their populations as possible with the requirement to ensure that the provision of that service will be sufficiently commercially attractive so that an operator will be prepared to fulfil that obligation.

Although the value of rights of use of spectrum to an operator would be expected to decrease as a result of challenging coverage obligations, in the context of a competitive award, this should manifest itself by lower bidding for that spectrum from those operators that were prepared to deploy networks in the relevant frequencies.

As noted above in Section V, no operator has had its rights of use of spectrum revoked, where it was in a position to provide the services envisaged but could not meet the stipulated coverage level because it was deemed to be too challenging. In this respect, the regulatory authorities have also, on occasions, exercised a degree of proportionality in their approaches to enforcement action on those occasions where operators have encountered such difficulties. As a result, it is reasonable to conclude that coverage obligations have not been set in the past at a level which has disincentivised operators from providing services.

There are a number of factors that will determine what level of coverage will offer a commercially viable business model for an operator. These will include the existing or potential penetration of other broadband platforms, the proportion of a population that lives in rural areas; the likely demand for broadband services, and the propagation characteristics of spectrum that the coverage obligation relates to. A failure to assess these criteria correctly could lead to the coverage obligation being set too high leading to a lack of interest from operators and an inefficient underutilisation of spectrum. Setting the goal too modestly could lead to public policy coverage goals not being met although, as noted above in section IV, some Member States have deliberately set modest coverage obligations in the expectation that competition will drive wider service coverage.

There have been a range of approaches adopted by Member States to ensure that the above factors are taken into account when setting the actual levels of coverage obligations. Clearly, the most ambitious obligations have applied to spectrum awards at 800 MHz and 900 MHz although some Member States have also applied challenging targets to awards of frequencies at 1800 MHz. Most coverage obligations in frequencies below 1 GHz have been set at 90% of population or higher. For a number of those with a population target above 90% (such as France and Belgium) these ambitious roll-out obligations have been phased in over time to ensure that they remain achievable and therefore commercially viable.

At higher frequencies, and particularly those above 2 GHz, the need for coverage obligations differ between countries and this is reflected in the different targets that have been set for operators as well as whether obligations have been set at all. Furthermore, in light of the relatively unfavourable propagation characteristics of these higher frequencies and the increased costs in deploying wider networks, Member States take into account the increased difficulty in framing coverage obligations so as not to undermine an operator's ability to construct a viable commercial business case. Italy has taken an alternative approach in its 800 MHz award by allowing any new entrants an additional 2 years to meet their coverage obligations. In the case of the 2.6 GHz award it has allowed one year extra for new entrants.

A number of Member States allow coverage obligations to be met by a combination of different platforms which allows operators to choose the most efficient commercial method of complying. Examples of this can be found in:

- *France*: mobile networks Operators can use their frequencies in the 900 MHz band to comply with their coverage obligations in the 2.1 GHz band in order to provide broadband services. The same approach has been replicated in the 4G award procedure where licensees can use their spectrum in any of the 800 MHz and 2.6 GHz bands in order to comply with their mobile ultra-broadband coverage obligations. This is set out in their 4G licenses except where coverage obligations relate to a priority roll-out zone which has to be covered by the use of frequencies in the 800 MHz band.

- *Ireland*: proposing that in the competition for liberalised licences in the 800/900/1800 MHz bands planned for end 2011/early 2012 successful applicants will be permitted to meet the coverage and roll-out requirements using any combination of frequency bands, including the existing 2.1 GHz assignments, so long as 50% of the coverage obligation is met through use of the 800/900/1800 MHz bands.

- *Germany*: coverage obligations can be met by using any combination of frequency bands licensed to a single operator. In certain areas listed in the license obligations for the 800 MHz band, alternatives to mobile technologies (e.g. fixed links, cable) can be used to meet the obligations.

- *Sweden*: where the 800 MHz coverage obligations, as described earlier, can be (for a part of the obligation) fulfilled by other means.

Ensuring that operators are not unduly advantaged or disadvantaged such that competition is distorted

Some coverage obligations are designed in such a way that a bidder for one package of frequencies will not derive a competitive advantage over a rival operator in a way that might distort competition.

For example, France seeks to ensure that no operator will derive such an advantage by establishing the same high coverage obligations for all upcoming licensees in the 800 MHz band (99.6 % of the national population, 90 % of the population in each department and 90 % of the population of a priority roll-out zone which consists of 63% of the Metropolitan territory, and 18% of the population located in the most rural areas). Furthermore it has set up measures to accommodate infrastructure sharing arrangements in most rural areas. Similar approaches have also been followed by Germany and Greece.

Another approach, as noted above, has been put forward by Ireland, who is attempting to prevent "cherry-picking" by operators of more favourable spectrum for coverage purposes by placing a 70% minimum population coverage requirement on all operators with a longer roll-out period for new entrants.

Ensuring that infrastructure sharing does not distort competition

The competition implications attached to infrastructure sharing are set out in the previous section. However, it is worth emphasising that the 2011 Infrastructure Sharing Report notes that passive sharing is now encouraged in almost all EU countries. This suggests that this approach to improving coverage and reducing costs can be adopted, to a certain extent, without creating harmful distortions in competition in compliance with EU competition law. However, whether the competition is reduced or not depends on the sharing model.

Sweden, for example, has ten years of experience of infrastructure sharing between operators in the 2.1 GHz band. As to date there has been no indication that the infrastructure sharing setups in Sweden have distorted the downstream competition.

Difference in approaches to rural and urban areas

Generally speaking, consumers can benefit from vibrant competition in the provision of broadband services. This not only applies to competition between choices of mobile broadband providers, but also between different platforms such as fixed wireless and wired. Such competition drives lower prices and more innovative services. However, where the objective is to promote broadband coverage to rural or hard-to-reach areas there is an inevitable focus on ensuring that a service is actually made available and less is left to competition driven by the market.

In practice, owing to a lack of a business case to roll-out a network in some rural areas and in the absence of some other measure of government intervention, there may be limited or no coverage in such areas. Furthermore, any service that is provided is likely to be through a wireless platform, meaning those rural populations may well have access to services not matching the service offerings available for their urban counterparts. This could lead to lower broadband speeds being provided than set out as the policy target. Urban populations will typically (though not always) have ready access to both wired and wireless networks. This has some implications for the goals of the Digital Agenda which states, amongst other things, that high speed broadband access (30 Mbps) should be available for <u>all</u> users by 2020.

There will be a public policy imperative on EU Member States to extend high speed broadband access to all its citizens by 2020, possibly underpinned by the legislative tool of the RSPP. Combined with this, there may be enhanced competition between operators to ensure that as many consumers are covered as possible. However, there may still be populations in rural areas where the marginal costs to operators or governments of meeting coverage levels at the ambitious levels set out in the Digital Agenda are significant.

Policy makers will be faced with a question as to what, then, would be an acceptable level of broadband service which would breach the digital divide for those consumers where provision of fast broadband were, indeed to prove commercially unattractive.

VII. Harmonisation and under-utilisation of spectrum

There are a number of reasons why spectrum harmonisation across the EU has been identified as a desirable policy goal. These include:

- enabling economies of scale;
    - to ensure that its highest value is realised by allowing services to be provided to as many citizens, consumers and businesses as possible
    - to allow equipment to be made that can be used across borders and in a way that means that services can be provided in a technically seamless way
    - to allow less complex terminal equipment and cost effective production
    - to stimulate further harmonisation on a global level by giving visibility to ongoing regional R&D initiatives.

- effective management of interference; and

- to simplify cross border coordination between Member States.

At a basic level, harmonisation of conditions for using frequency bands for wireless broadband will stipulate common technical conditions. Harmonisation measures may also set out specific frequency band plans that operators would be obliged to adopt. Depending on the circumstances, these band plans could ensure that services are available quicker than might otherwise have been the case (as in the case of the 800 MHz band). However, we analyse this further in light of Member States' experiences of where harmonised band plans have been adopted and where they have not been adopted.

There have been occasions where conditions for using frequency bands have been harmonised at an EU level but where the desired goal of wide scale deployment of wireless services has not emerged. This section explores the reasons behind this, describes the implications of this happening and explores ways of minimising any spectrum inefficiencies that occur as result.

Under-utilisation of spectrum in bands harmonised for wireless broadband

The responses to the 2011 Spectrum Value questionnaire shows that there has been conditions for using radio frequencies which have been harmonised for mobile broadband which, in some Member States, has either not been used or not been used as envisaged at the time of award. There are also specific instances where an operator has failed to realise its business plan for reasons other than the harmonisation measures in place. However, these lie outside the scope of this Report and are not investigated further.

Key identified reasons for underutilisation of harmonised spectrum reasons include, amongst others:

- the technology that the operators planned to base their services on did not emerge in the timescales that they expected (as was the case with the 3.4 GHz band and TDD spectrum at 1900 MHz);

- there was insufficient demand for the services that the harmonised spectrum was suitable for supporting, in particular because those services are already being provided by other platforms;

- technical licence conditions may not have been proscriptive enough to provide sufficient regulatory certainty to manufacturers and operators (eg this, arguably, may have been the case in 3.4-3.8 GHz band where there was no harmonised band plan);

- the size of the band being harmonised/licensed (5MHz) is not compatible with mobile broadband systems and may not have been sufficient for significant market penetration when compared to the

resources necessary for operators to invest in that band (as may have been the case with 1900-1920 MHz and 2010-2025 MHz); and/or

- the restrictions on coexistence with adjacent users may have proved too difficult to overcome (as, again, may have been the case with 1900-1920 MHz).

In this section we explore in some further depth particular cases where underutilisation of harmonised spectrum has occurred, namely the 2.1 GHz and 3.4 GHz bands.

Where technology does not emerge to support operators' business plans

3.4 GHz

The most prevalent examples of spectrum being returned to the regulator because of technology and market demand not emerging as expected by operators are in the 3.4 GHz band. Decision 2008/411/EC harmonised the conditions for availability and use of this band. That Decision led to these frequencies being made available across the EU[34] for ECS, with an expectation that BWA[35] would be deployed across Member States. As noted above, that Decision did not cover the frequency arrangement, providing technical licence conditions (BEMs) which were primarily developed to ensure the deployment of BWA systems.

Responses to the 2011 Social Value questionnaire show a number of instances where operators were awarded spectrum in the 3.4 GHz band but then did not deploy networks and provide broadband services as they had expected. More specifically, operators had expected to provide WiMax based BWA services but the development of this technology or market demand did not take place as expected, leading to the return of the spectrum. A number of questionnaire responses further suggested that the development of LTE technology had somewhat undermined the case for the development of WiMax technology. Member States that experienced return of spectrum include Austria, Germany, Sweden and Finland. From outside the EU, this also occurred in Switzerland.

However, some Member States such as Ireland, deployed services in this band to an extent that important public policy coverage goals *were* effectively supported.

Other reasons for the underutilisation of this spectrum because of the non-emergence of this technology could be posited as being because of issues not *directly* attributed to the harmonisation measure itself, such as:

- price sensitivity from consumers when compared to alternatives, such as DSL or UMTS; or

- restrictions caused by the existence of legacy users in the band (such as satellite fixed links in the UK).

An alternative approach could be to stipulate technical conditions suitable for larger bandwidth systems (perhaps between 20 and 40 MHz) which could support a wider range of mobile broadband services. As well as suitable technical licence conditions, a harmonised frequency band plan could also be considered although, as we note below with the example of

[34] The Commission draft of the RSPP mandates in Article 6 that the 3.4 GHz band should be authorised for ECS, under the terms of 2008/411/EC by 1 January 2012, although this is subject to change in the final text.
[35] CEPT report 15 in response to a mandate from the European Commission set out the technical conditions relating to the provision.

the 1900 MHz unpaired band, there are risks inherent with that approach (in that case, due to coexistence of TDD and FDD operators.)

2.1 GHz (unpaired bands 1900-1920 MHz and 2010-2025 MHz)

The rights of use of radio frequencies in the 2.1 GHz band were packaged for award amongst Member States so that unpaired 5 MHz packages of spectrum suitable for TDD applications could be used. Most of the authorisations were issued 10 years ago for the 1900–1920 MHz band but very few authorisations have been granted in the 2010-2025 MHz band. Services at a pan-European level have, so far, failed to emerge in these frequency bands[36].

Research and development of mobile technology suitable to use the 2.1 GHz band was clearly focussed on UMTS-FDD services after 2000. This meant that there was relatively little initial development of UMTS-TDD services in most areas[37]. One result of this is that, broadly speaking, there is a trend for a continuing focus by industry on developing FDD-based technology.

The example reveals that, despite similar regulatory conditions, one market has largely succeeded in the 2.1 GHz paired bands whereas the other market has, to date, failed to emerge in the unpaired bands. In reality, the emergence of such a market could not take place without sufficient interest and involvement from a large number of industry players.

In the context of the 2.1 GHz unpaired bands, there are complex interference issues relating to TDD and FDD coexistence at 1920 MHz and a lack of demand at 2010-2025 MHz (exposed in the auctions process). When an industrial eco system fails to emerge, interests for the rights of use of radio frequencies will tend to decrease notably, including the potential tradability of those rights. It may therefore be appropriate to investigate, further to an assessment of what demand there is for services that could use this spectrum, suitable conditions to ensure an effective usage of these bands and to develop effective related harmonised conditions.

Where there is a low level of demand in a Member State for wireless services

At present, EU harmonisation measures apply to all Member States to ensure that the greatest value of spectrum can be realised for citizens, consumers and industry. This harmonisation is based on setting conditions for all Member States based on the level of demand within the wider Union. However, there may be occasions where spectrum is harmonised for mobile services across all Member States and the spectrum is left unused or used sparely because there is a lack of demand for the wireless services in some countries which would be supported by that harmonisation. This could happen for a number of reasons including:

- there is significant penetration by wired or alternative wireless platforms rendering further wireless services less important for providing ubiquitous coverage;
- there are variations in demand for services between Member States; or
- the size of national market does not require the full bandwidth being harmonised.

[36] This issue is being considered by the European Commission at present with a view to proposals being made as to how to stimulate more efficient use of this spectrum.
[37] This is not the case today in all countries. India for example has a nationally rolled-out UMTS-TDD network.

The 2009 Broadband Position Paper sets out the option for government programmes to stimulate demand in those Member States where low demand is caused by lack of service awareness. However where demand for mobile services can already be satisfied by some parts of harmonised frequency bands, then there is a question as to whether significant value is being added by mandating the harmonisation in that Member State.

Policy makers could consider whether harmonisation could proceed on the basis that *harmonisation should apply only where demand for services is sufficient to justify this approach*. Where there is evidence that spectrum harmonisation would lead to spectrum underutilisation on a temporary and/or geographical basis a more nuanced approach could be taken. One approach could be to allow those relevant Member States to use on a temporary and/or geographical basis the spectrum for services that fulfil national needs as long as they do not constrain the use of services in those Member States who have harmonised their spectrum for mobile services.

However, there are likely to be limitations to this working effectively in practice because both the ITU Radio Regulations and relevant EU Decisions give a signal to industry to invest in future suitable mobile technology in designated bands. These signals could deter investment in other services or technologies, even in Member States where demand for mobile services is currently low.

Lessons learned from above examples emphasises that harmonised conditions may need to be reviewed or reconsidered by the European Commission when a market fail to emerge. The objectives of this review should assess why the market has failed to emerge and to identify other highest demand for alternative measures of harmonisation and to update harmonised technical conditions accordingly.

Finally, some thought could be given as to how underutilised spectrum in these circumstances could be made available for existing services or technologies which *would* be in a position to deploy. One example of this could include short term use of wireless cameras which typically require spectrum between 2 GHz and 4 GHz for broadcasting and special events purposes or others services/applications where a spectrum demand is identified (e.g. PPDR).

VIII. Summary of key issues explored in this Report

This Report explores and analyses a number of issues with respect to the role of wireless broadband services, in particular mobile broadband, in the context of the wider policy goal of improving broadband coverage for all EU citizens, consumers and businesses. It notes the significant economic benefits arising from wider deployment of broadband services and highlights the different platforms over which services are being provided. In this regard it notes that mobile broadband services in particular are increasingly used by a growing proportion of the EU population.

The report in Section IV explains the different approaches that Member States have employed to improve broadband coverage levels. It also explores some key themes relating to the availability of spectrum for wireless broadband such as the methods used by Member States to enhance broadband coverage. In particular, it examines the varying reasons why coverage obligations are incorporated into mobile network operators' licence conditions.

Section V sets out some of the key elements in setting coverage obligations. It notes that the most ambitious targets tend to be set at lower frequencies below 1 GHz, whilst tentatively concluding that some methods of improving broadband coverage (licence obligations on population or territory coverage and government procurement) have met with some levels of success. The success or otherwise of public incentive initiatives will become clearer in the near future. Competition issues brought about by the implementation of coverage obligations are discussed in Section VI.

Evidence is given in Section V that infrastructure sharing is playing an important role in facilitating wider deployment of mobile network services. However, Member States, in encouraging infrastructure sharing, should continue to balance anti-competitive concerns with positive effects on coverage. Indeed, in line with the regulatory frameworks, they might investigate ways of ensuring that such practices do not create adverse competition implications.

In Section VII, the Report noted that there may be occasions where spectrum is harmonised for mobile services across all Member States, but where the spectrum is left unused (in particular, the 2.1 GHz unpaired bands) or used sparely (in particular, the 3.4 GHz band) because there is a lack of demand for the wireless services in some countries which would be supported by that harmonisation. With a view to avoiding further such instances of unused spectrum, a possible different approach to harmonisation could be put forward whereby spectrum harmonisation measures are put in place only for those Member States where demand is clearly demonstrated. This option could allow Member States to more carefully consider whether underutilised spectrum could be allocated on a temporary or geographical basis to alternative existing services. This would, clearly have to be in a way that does not conflict with the terms of any relevant existing or future European Commission Decisions on the rights of use of that spectrum.

Further exploring the implications of such spectrum underutilisation, the Report identifies potential benefits in the European Commission, carefully assessing the impact of when this occurs on a case by case basis. Such an assessment would be based on potential demands for the spectrum and would look at suitable conditions to ensure its most effective use. It could, where appropriate, lead to updated harmonisation measures depending on the levels of flexibility present in each case.

Finally, the Report outlines in Section III the potential for satellite services to provide higher speed broadband services whilst recognising the importance of addressing known technical issues such as latency. Satellite services might provide wider broadband coverage and could help some populations to access high speed broadband services. It will be interesting, therefore, to monitor the progress that these services make.

Annex

Summary of licence coverage obligations

Member State	900 MHz GSM	1800 MHz GSM	2100 MHz	3400 MHz	900 MHz Re-award	1800 MHz Re-award	800 MHz	2600 MHz
Austria	**90% pop**	**90% pop**	**50% pop (by 2005)**	**Specified villages**	**No re-award**	**No re-award**	**Yes (Details to be confirmed)**	**25% pop (by 2013)**
Belgium	**99% pop (by 8 years)**	**60% area and 90% pop (by 4 years)**	**85% pop (by 8 years)**	**None**	**No re-award**	**No re-award**	**Under consideration**	**None**
Cyprus	**75% area (by 4 years)**	**75% area (by 4 years)**	**60% area (by 10 years)**	**Specified rural areas and high schools**	**No re-award**	**No re-award**	**Under consideration**	**Under consideration**
Czech Rep			**Yes (in a specified area)**	**None**	**No re-award**	**No re-award**	**Yes (Details to be confirmed)**	**Under consideration**
Denmark	**95 % geo**	**45 % geo**	**80 % pop**	**Specified zip codes**	**No obligations**	**No obligations**	**Under consideration**	**No obligations**
Estonia	**None**	**Deployment of 30 base stations**	**30% pop (by 7 years)**	**None**	**No re-award**	**No re-award**	**Under consideration**	**Yes (Details to be confirmed)**
Finland	**None**	**None**	**None**	**None**	**No re-award**	**No re-award**	**Under consideration**	**None**
France	**90% pop (combined with 1800 MHz)**	**90% pop (combined with 900 MHz)**	**75% pop (by 8 years)**	**Not applicable**	**99% pop in 2G (Combined with 1800 MHz)** **75% in 3G + operators commitments**	**99% pop in 2G (combined with 900 MHz)**	**99.6% pop (by 15 years)** **90 % pop each department (by 12 years) + operator commitments to 95%** **90% e pop in "priority roll-out zone" (by 10 years)**	**75% pop (by 12 years)**

Member State	900 MHz GSM	1800 MHz GSM	2100 MHz	3400 MHz	900 MHz Re-award	1800 MHz Re-award	800 MHz	2600 MHz
Germany	**Highest was 98% pop with 88% pop in former GDR**	**Highest was 98% pop with 88% pop in former GDR**	**50% pop**	**25% (municipalities in specified area)**	**No re-award**		**90% pop (by 2016 in graduated roll out)**	**50% pop (By 2015)**
Greece	**95% pop (by 6 years)** **85% roads (by 10 years)**	**95% pop (by 6 years)** **85% roads (by 6 years)**	**50% pop (by 5 years)**	**20% pop (by 3 years)**	**re-award process on process**	**re-awardprocess on process**	**Under consideration Subject to the outcome of the techno-economic advisor running until Feb2012**	**Under consideration Subject to the outcome of the techno-economic advisor running until Feb2012**
Hungary			**New operators towns > 30,000 pop and major roads (by 3 years)**	**None**	**Incumbents 95% area (by 2 years)** **New operators towns > 30,000 pop and major roads (by 3 years)**	**New operators towns > 30,000 pop and major roads (by 3 years)**	**Under consideration**	**Under consideration**
Ireland	**99% (Combined with 1800 MHz)** **92 % area.**	**48% pop**	**'A' licence = 80% pop min** **'B' licences = 53% pop min**	**None**	**Proposed 70% pop (May be combined with other bands)**	**Proposed 70% pop (May be combined with other bands)**	**Proposed 70% pop (May be combined with other bands)**	**None**

Member State	900 MHz GSM	1800 MHz GSM	2100 MHz	3400 MHz	900 MHz Re-award	1800 MHz Re-award	800 MHz	2600 MHz
Italy	**90% pop**	**90% pop**	**All regional and provincial capital cities (by 5 years)**	**Towns with limited presence of 3G mobile networks**		**None**	**90% pop of up to 30% of all towns with less than 3000 inhabitants within 3 years and up to 75% within 5 years with 800 MHz. Of the above, 50% of the task possible also with other bands with possibility to complete the coverage within 5 additional years. Two additional years to reach coverage obligations for new entrants for the first and the second milestone.**	**20% national pop within 2 years and 40% pop within 4 years with 2600 MHz, diffused in all regions. Of the above, 50% of the task possible also with other bands if available with possibility to complete the coverage within 7 additional years. One additional year to reach coverage obligations for new entrants for the first and the second milestone.**
Latvia	**Yes (Details to be confirmed)**	**Yes (Details to be confirmed)**	**Yes (Details to be confirmed)**	**Yes (Details to be confirmed)**			**Under consideration**	**Under consideration**
Lithuania	**90% area**	**5 largest municipal areas**	**5 largest cities (by 6 years)**	**90% pop (by 10 years)**			**Under consideration**	**15 specified cities (by 5 years)**
Luxembourg	**95% pop** **95% area**	**95% pop** **95% area**	**95% pop** **95% area** **(Result of operator's commitments)**	**None**				

<table>
<tr><th>Member State</th><th>900 MHz GSM</th><th>1800 MHz GSM</th><th>2100 MHz</th><th>3400 MHz</th><th>900 MHz Re-award</th><th>1800 MHz Re-award</th><th>800 MHz</th><th>2600 MHz</th></tr>
<tr><td>Malta</td><td></td><td></td><td>50% of area (within 2 years)
99% area
(within 5 years)</td><td>99% of area (within 2 years)</td><td>99% area (combined with 1800 MHz by 2 years)</td><td>99% area (combined with 900 MHz by 2 years)</td><td>Not applicable</td><td>99% after 36 months</td></tr>
<tr><td>Netherlands</td><td>60% pop

All main roads, waterways and airports</td><td></td><td>275 km^2 area
(by 5 years)</td><td>300 base stations
(by 18 months)</td><td>2567 km^2
(by 5 years)</td><td>367 km^2
(by 5 years)</td><td>20% area
(by 5 years)</td><td>200 km^2 area
(by 5 years)</td></tr>
<tr><td>Poland</td><td>80% pop and 650 rural areas < 50,000 pop
(by 2012)</td><td>30% pop
(by 2012)</td><td>Yes
(Details to be confirmed)</td><td>Yes
(Details to be confirmed)</td><td></td><td></td><td>Under consideration</td><td>50% pop
(by 2014)</td></tr>
<tr><td>Portugal</td><td colspan="2">Coverage obligations were established for voice and data up to 9600 bps (75%, 99% and 99% were the original coverage obligations).

In the licenses renewal made in 2006 and 2007, two operators were obliged to maintain at least the levels of coverage they ensured at the time the licenses were renewed (above the original 75% and 99% coverage obligations).

The renewal of the third mobile operator will be in 2012.</td><td>The mobile operators have the following population and area obligations, for data rates up to 144 kbps and 384 kbps:
<table><tr><th rowspan="2">OPERATOR</th><th colspan="2">POPULATION (%)</th><th colspan="2">AREA (%)</th></tr><tr><th>144 kbps</th><th>384 kbps</th><th>144 kbps</th><th>384 kbps</th></tr><tr><td>A</td><td>99.3</td><td>78.9</td><td>83.5</td><td>49.9</td></tr><tr><td>B</td><td>77.3</td><td>7.7</td><td>38.3</td><td>0.07</td></tr><tr><td>C</td><td>60.8</td><td>29.7</td><td>23.8</td><td>7.8</td></tr></table></td><td>None</td><td>No re-award (880-890/925-935 MHz band was not awarded earlier).

However the operator can use this spectrum to fulfill coverage obligations imposed on the 800 MHz band.</td><td>No re-award

No coverage obligations for spectrum to be awarded in the multi-band auction.</td><td>Yes

For each lot of 2 x 5 MHz the operator is obliged to cover a maximum of 80 borough councils areas out of 480 without adequate broadband coverage (of a total approximately 4000).</td><td>None</td></tr>
</table>

Member State	900 MHz GSM	1800 MHz GSM	2100 MHz	3400 MHz	900 MHz Re-award	1800 MHz Re-award	800 MHz	2600 MHz
Romania	**Yes (Details to be confirmed)**	**Yes (Details to be confirmed)**	**Yes (details not known)**				**Under consideration**	**Yes (Details to be confirmed)**
Slovakia	**85% pop 50% area**	**85% pop 50% area**	**None**	**70 district cities**	**No re-award**	**No re-award**	**Under consideration**	**Under consideration**
Spain	**€832 M investment in rural areas and major roads**				**€433 M investment in towns < 5,000 pop**	**€300 M investment**	**90% (Equivalent 98% pop) of towns < 5,000 pop (by 2020) @ 30 Mbps**	**None**
Sweden			**None**	**None**	**Maintain previous levels**	**None**	**100% of identified rural demand (by 2014)**	**None**
UK	**90% pop**	**90% pop**	**80% pop**	**None**	**No re-award**	**No re-award**	**95% pop (under consultation)**	**None**
Norway				**None**			**Under consideration**	**None**
Switzerland			**25% pop**	**None**			**50% pop**	**None**