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L'ÉTUDE DE AETHA CONSULTING LIMITED & NERA ECONOMIC CONSULTING « REGULATIONS FOR AWARD OF THE 790-862 MHz BAND »

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Contexte

L'IBPT a fait appel à un consultant externe pour étudier la problématique de la bande 800 MHz en vue de formuler des recommandations pour la détermination des paramètres techniques et des règles pour la procédure d'attribution à implémenter au niveau national. Cette étude a été réalisée par Aetha Consulting Limited en collaboration avec NERA Economic Consulting et a donné lieu au rapport « Regulations for award of the 790-862 MHz band » du 31 octobre 2012.

L'IBPT publie ci-joint ce rapport.

Cette étude est basée sur les données les plus récentes et doit être considérée comme la version finalisée de l'enquête menée par les auteurs.

Il convient de tenir compte que les avis et propositions formulés dans cette étude doivent être attribués aux auteurs de celle-ci. Ils ne reflètent pas nécessairement le point de vue de l'IBPT. Ils ne reflètent tout aussi peu le point de vue des autorités belges en général.

Annexe

Le rapport est repris ci-après.

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Regulations for award of the 790-862MHz band

Report for BIPT

31 October 2012

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1 Executive summary

This report has been prepared by Aetha Consulting Limited (Aetha) and NERA Economic Consulting (NERA) for the Belgian Institute for Postal Services and Telecommunications (BIPT) as a summary of a study we have undertaken on the licence conditions and award process for the 790-862MHz band which will be laid down in a draft Royal Decree (hereinafter 'Royal Decree'[1]), proposed by the Minister of Economic Affairs (hereinafter "Minister"), on advice of the BIPT.

1.1 Background

The 790-862MHz band ("800MHz band") comprises six sets of 2×5MHz channels, giving a total of 2×30MHz of available spectrum. The band was created from frequencies that were historically used for television broadcasting as well as military tactical relay and wireless microphones (it is part of the so-called "digital dividend") and has been identified as a harmonised European band for electronic communications services. The 800MHz band is expected to be used for the deployment of Long Term Evolution (LTE) technology, complementing deployments of LTE in higher-frequency bands (1800MHz and 2.6GHz bands) by providing more cost-effective rural coverage and deeper indoor coverage.

The European Union's Radio Spectrum Policy Programme (RSPP)[2] includes a requirement for member states to carry out the authorisation of the 800MHz band by 1 January 2013. There are many decisions that each country needs to make in respect of the award process and, in March 2012, BIPT issued an industry consultation document[3] on many of these issues. The objective of this study is to make specific recommendations to BIPT and to the Minister on the 800MHz award (both the underlying licence conditions and the award process itself) taking account of both international best practice and the specific market situation in Belgium. In addition to the considerations concerning the award of the 800MHz band, our scope of work has included an assessment of how to best award the 2×15MHz of paired spectrum in the 2500-2690MHz band which remained unassigned following the auction held in November 2011.

As part of our work, we have developed a bottom-up discounted cash flow model to obtain indicative estimates of the value of the 800MHz and 2.6GHz spectrum to different organisations that may be interested in acquiring the spectrum (e.g. existing mobile operators, potential new market entrants[4]). We provide an overview of the approach applied to the modelling in this report but have not included details of the assumptions used or results from the work in order to ensure that our work does not distort the award process by introducing a bias to bidders' expectation of the value of spectrum. However the overall

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1 Note that the reference to the Royal Decree throughout the report is without prejudice to the internal allocation of powers between BIPT and the Minister (or the Government) or the legislator for the purpose of imposing conditions on the auctioning and licensing of the 800 MHz band.

2 See 'DECISION No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme'.

3 See 'Consultation organised by the BIPT Council of 21 March 2012 on the 800MHz band'.

4 Throughout this report, we use the term 'new entrant' to describe a potential applicant in the 800MHz award process which has no existing spectrum holdings in any of the bands that are harmonised for mobile services (900MHz, 1800MHz, 2.1GHz and 2.6GHz). These are (outside this report) often described as 'greenfield' new entrants. For the avoidance of doubt this definition of new entrant **excludes** Bidco and BUCD.

conclusions of the modelling work have informed several of the recommendations in this study and we make qualitative reference to these in the report where it is considered appropriate/possible.

1.2 Demand for spectrum

We have sought to estimate the likely demand for 800MHz spectrum and the unassigned 2.6GHz spectrum through assessing the current status of the Belgian telecoms market and international awards of 800MHz spectrum, reviewing the responses of stakeholders to BIPT's consultation document and from our business case modelling. Our overall findings in relation to demand for 800MHz spectrum are as follows:

- Belgacom, Mobistar and KPN Group Belgium (KPN GB) are likely to be interested in at least 2×10MHz of 800MHz spectrum – 2×10MHz channels ensure that the main benefits of LTE technology over UMTS/HSPA (3G) are realised – and even wider channels (2×15MHz and 2×20MHz) would provide additional spectral efficiency benefits.
- Telenet Tecteo Bidco (Bidco) could also be interested in 800MHz spectrum, but may be constrained by the required capital investment for network deployment.
- Additional demand from BUCD or a new entrant is possible, but unlikely.

In relation to the available 2.6GHz spectrum, we concluded that there is no pressing demand for 2.6GHz from existing operators, Bidco, BUCD or a new entrant. However it is possible that if Bidco, BUCD or a new entrant were to acquire 800MHz spectrum in the auction, these companies may then strongly benefit from access to 2.6GHz spectrum to meet capacity demands.

1.3 General licence terms

Our recommendations are as follows:

Licence duration	15 years from notification of granting and extendable by BIPT for an additional five years after expiry of the initial 15 year period (same terms as for 2.6GHz licences).
Service and technology deployments	Service and technology neutral licences – in line with EU legislation.
Tradability	800MHz spectrum should be fully tradable – within any limits set out by current/future spectrum caps.
Interference management	Usage conditions for the licences should follow EC Decision 2010/267/EU which specifies the baseline technical requirements for the use of the 800MHz band, making reference to CEPT Reports 29, 30, 31 and 32 that were developed for the European Commission.
Annual spectrum usage fees	Annual usage fees should be required, in line with the precedent set for other frequency bands. Licensees should be required to pay usage fees for their entire 800MHz holdings, regardless of the degree to which they are (or are not) utilising the spectrum. The annual usage fees should be set at the same level as for the 900MHz spectrum

(namely EUR174 850 per paired MHz per annum).

Payment of fee arising from award process

The terms of payment for the fee arising from the award process (e.g. the final auction price) should include options of paying the full fee upfront or paying an equal amount on an annual basis throughout the licence duration, with an interest rate equal to the market rate + 2% (same terms as for the 2.6GHz award process).

1.4 Coverage obligations

We recommend that the Royal Decree sets a standard coverage obligation that would apply to all 800MHz licensees and, if appropriate, sets an additional coverage obligation that would only apply to one of the licensees.

The objectives of the **standard coverage obligation** are to ensure that mobile services continue to be available to most of the Belgian population and also encourage network operators to rapidly deploy the latest mobile technologies (e.g. LTE) across the mobile network footprint, starting with those areas that currently lie outside the UMTS/HSPA (3G) coverage. Specifically we recommend a standard coverage obligation which is defined along the following criteria:

- Each licensee is required to maintain outdoor coverage of its mobile services across an area which covers 98% of the population with the following criteria for the quality of service:
  - Licensees acquiring 2×5MHz of spectrum should be required to provide mobile data services with an average downlink user throughput of 1.5Mbit/s.
  - Licensees acquiring 2×10MHz of spectrum (or more) should be required to provide mobile data services with an average downlink user throughput of 3Mbit/s.

- This coverage target should be met within the timelines detailed below. We recommend to relax the conditions for licensees which do not have access to a 900MHz network grid at the time of auction:
  - 33% of the population coverage target within 2 years of awarding the spectrum (3 years without existing 900MHz network).
  - 66% of the population coverage target within 4 years of awarding the spectrum (6 years without existing 900MHz network).
  - 100% of the population coverage target within 6 years of awarding the spectrum (9 years without existing 900MHz network).

- Furthermore, BIPT should identify a list of postcode areas which are currently covered by GSM (2G) services but are not covered by UMTS/HSPA services. Within these areas, 800MHz licensees would be required to provide mobile services meeting the above service criteria within the first 2 years of award of the spectrum (6 years for an operator without an existing 900MHz network at the time of auction).

- Each licensee can achieve / maintain this coverage obligation using any combination of the spectrum bands available to them.

- Each licensee has to fulfil this standard coverage obligation individually.

Given the characteristics of the 800MHz band, we have also considered the option for the Royal Decree to specify an **additional coverage obligation**. The objectives of such an additional coverage obligation would be to provide higher-speed broadband services to specific communities which lie outside the areas

where such speeds can be provided economically using fixed wireline network technologies (e.g. fibre, cable, DSL). We understand that the BIPT is currently undertaking a study (i) to establish an appropriate minimum broadband speed and (ii) to identify the specific postcode regions which wireline networks will not cover. However, we understand that the results of this study are unlikely to be available in time for the 800MHz award, and the inclusion of an additional coverage obligation is therefore difficult to realise. Moreover, the inclusion of such conditions for (at least) one of the 800MHz licensees should be subject to an economic assessment of the likely additional cost that this would place on the licensee which is difficult to foresee at this point in time.

1.5 Pro-competitive measures

We considered whether additional measures were required as part of the 800MHz award in order to protect downstream competition in the mobile market. Our conclusions were as follows:

Spectrum reservation

We recommend not reserving any spectrum for new market entrants as:

- The likelihood of a new operator entering the market is very low.
- The amount of 800MHz spectrum that is available is limited – and there is potentially a high opportunity cost of taking this spectrum away from any mobile operators that may be willing to pay more than an entrant bidder in an auction as this could weaken that operator's position in the market – and potentially result in a reduction in the overall level of market competition.
- Setting aside spectrum could attract a financial speculator to acquire the spectrum who would simply seek to re-sell this spectrum (at a profit) to one of the existing operators in the medium-term, once any controls preventing the sale of the spectrum have expired.
- Mobistar and KPN GB are part of multi-national operator groups who have shown interest in selling their European subsidiaries – promotion of new market entry by BIPT could therefore lead to reduced investment in the Belgian market by these organisations.
- With the exception of the Netherlands, there have not been any set-asides of 800MHz spectrum for new entrants in other European auctions – for the same/similar reasons as the above.

We also recommend that BIPT does not propose to set aside 800MHz spectrum for any of the organisations in Belgium that currently holds spectrum in one or more of the internationally harmonised mobile spectrum bands (900MHz, 1800MHz, 2.1GHz and 2.6GHz) but does not have a significant portfolio of spectrum in totality across all of these bands (i.e. Bidco and BUCD) as:

- Again, the opportunity cost of setting aside spectrum for either/both of these organisations is high. In effect, this would reduce the amount of spectrum that is available to Belgacom, Mobistar and KPN GB potentially weakening the competitive position of one or more of these organisations.

- The amount of mobile network infrastructure that has been deployed by Bidco and BUCD to-date is very limited. In reserving spectrum for these organisations, there is no guarantee that mobile network infrastructure deployments will occur in the short or medium term (again with the risk that overall levels of infrastructure competition could be reduced as a result of any set-aside of spectrum).

- The only European example of spectrum being reserved for a 'fourth operator' is that of the UK where there are major imbalances in current spectrum holdings – this is in contrast to Belgium where spectrum re-balancing will occur, leading to the fourth operator (Bidco) having access to 900MHz and

1800MHz spectrum which can be used for LTE network deployment. In addition, we note that Bidco had the opportunity to acquire 2.6GHz spectrum in the auction in 2011.

Spectrum caps

We recommend that a cap of 2×10MHz is imposed on the 800MHz band for the following reasons:

- This enables operators to acquire 2×10MHz of spectrum which is considered the minimum to achieve the main benefits of LTE technology and is the amount of 800MHz spectrum that almost all operators in Europe have acquired in previous auction processes.
- This ensures that there will be at least three competing 800MHz infrastructure providers – a key objective of the Minister and BIPT from the award process in order to maximise the degree of competition in the downstream mobile market. Setting a cap of 2×15MHz or 2×20MHz could potentially result in only two operators acquiring 800MHz spectrum (as was the case in Denmark).
- The use of a 2×10MHz cap was generally supported by operators in their responses to the consultation document – none of them highlighted the strong need to be able to compete for larger amounts of 800MHz spectrum.

Network sharing and frequency sharing

We recommend that BIPT considers network sharing and frequency sharing arrangements between operators as and when the operators make such requests. This is because such sharing arrangements are likely to be part of a wider arrangement than just the 800MHz band. In respect of frequency sharing, BIPT could indicate that it would be more inclined to support an application for frequency sharing if it were to lead to a significant increase in the quality of service to consumers in areas where broadband provision is limited.

For the reasons mentioned above, we do not expect the Royal Decree to set an additional coverage obligation specifying high data rates. However, if it were to do so this might require operators to deploy 800MHz carriers larger than 2×10MHz to achieve the obligation. These large carriers might be required from a technical perspective to achieve the required data rates and from an economic perspective to limit the number of incremental mobile sites which need to be built. In this instance, the applicable rules could mandate frequency sharing between two or more 800MHz licensees.

Mandated wholesale access

Mandated wholesale access would require the winners of 800MHz spectrum to offer wholesale LTE services across the 800MHz network to those operators that did not secure any 800MHz spectrum. Wholesale arrangements are typically achieved by operators on a purely commercial basis. Through mandated wholesale access, operators with 800MHz licences would be incentivised to achieve a commercial arrangement as the mandating would provide the option of recourse to the regulator in the event that a commercial agreement cannot be achieved directly by the parties concerned.

We recommend against mandating 800MHz licensees to provide wholesale access as:

- We believe the benefits of mandating wholesale access in Belgium are likely to be limited as the wholesale market appears to be functioning well in the absence of any regulatory intervention. In particular we note (i) the healthy growth in the numbers of subscribers to Mobile Virtual Network Operators (MVNOs); (ii) that Belgacom, Mobistar and KPN GB all host MVNOs; and (iii) that Telenet

recently extended its agreement with Mobistar to run until 2017 and that this includes LTE network access[5].

- We are concerned that this measure could be abused by organisations without any intention to deploy a mobile network. These organisations may judge that the risk of participating in the award process and actually acquiring 800MHz spectrum (at a cost) would be very low. In contrast, there would be a significant potential benefit of such 'purported' auction participation arising from obtaining the right to wholesale access.

- If the wholesale market were found not to be functioning in the future, this could be examined at that time by BIPT with mandated wholesale access remaining as a potential remedy following a market analysis.

Mandated national roaming

The principal objective of mandating national roaming is to assist an operator without existing mobile infrastructure[6], which is in the process of developing its network, with the acquisition of customers. We believe that the Royal decree should incorporate a national roaming provision in the 800MHz band regulations to ensure that, in case such an operator[6] does participate in the award process, it is supported by appropriate regulatory means. The provision should require existing mobile network operators ("roaming provider") with 900MHz infrastructure who are successful in acquiring 800MHz spectrum to be required to offer national roaming on their GSM (2G), UMTS/HSPA (3G) and 800MHz network infrastructure to an operator ("roamer") acquiring 800MHz spectrum which does not own any 900MHz infrastructure at the time of auction suitable for swiftly deploying an 800MHz grid. The national roaming provision would only apply whilst the roamer is building out its own network (from the point at which the operator has deployed coverage to 20% of the population using the 800MHz band) and remains in compliance with the coverage obligations of the 800MHz licence (as well as any other spectrum licences it owns). It is also limited to a duration of nine years following the auction. At that point in time, the roamer should have rolled out its network to 98% of the population and will not require national roaming any more.

We recognise that our recommendation for mandated national roaming offers access across a wide range of services and bands to potential roamers. However, we believe that there are strong reasons for the roaming requirement to be defined on such a broad basis:

- widespread national roaming access is offered as a means to reduce barriers to entry for operators and ensure they can quickly offer competitive services

- access to GSM (2G) is required to ensure ubiquitous mobile (voice) coverage, given that current GSM (2G) coverage levels for existing operators are typically higher than UMTS / HSPA (3G) coverage levels

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5 Mobistar and Telenet announced the extension of their existing agreement until 2017 in May 2012. More information is available on Mobistar's corporate news portal, via the following link: **http://corporate.mobistar.be/go/en/media_center/news/news_details.cfm?news_id=411&searchYear=&searchMonth=&categories_id=&theSearch=**. The agreement also includes Tecteo, thereby effectively applying to the entity we refer to as 'Bidco' throughout this report.

6 We note that, at the time of auction, this definition of an 'operator' is likely to apply to Bidco, BUCD as well as a new entrant.

- at the same time, the "roamer" is likely to compete in the mobile data segment, so it is critical to get access to UMTS / HSPA (3G) data services to be competitive immediately after the auction

- access to services on the 800MHz band is required to offer a level playing field for operators who do not have access to an existing low-frequency mobile network infrastructure but want to roll-out competitive services using this band.

1.6 Spectrum packaging and award format

We propose that the available spectrum is awarded in an auction. Auctions offer many benefits compared to beauty contests. While beauty contests would be used if there is a need to prioritise licence conditions, auctions in other circumstances have key advantages, including improved efficiency, transparency of the outcome to all observers, and robustness to legal challenge. Auctions also raise revenues commensurate with the market value of the scarce resource. Almost all regulators in Western Europe now use auctions as the primary mechanism for awarding spectrum suitable for mobile telephony and broadband. Notably, Belgium recently used auctions for the award of the fourth 3G license and for the 2.6GHz band.

In assessing the approaches that could be adopted for awarding the spectrum, we considered spectrum packaging and auction design options together because they are closely related decisions that cannot be taken in isolation, for example because the strengths and weaknesses of using a particular auction format vary depending on the structure of available lots. We considered a wide range of packaging options – including 2×5MHz and 2×10MHz lots (or a mixture of the two) – and a range of possible auction formats – including the simultaneous multiple round auction (SMRA), clock auction, combinatorial clock auction (CCA) and sealed bids. We evaluated these alternative options against the Minister's and BIPT's proposed overall objectives from the award process and recommend the following:

- The 800MHz band should be divided into three lots of 2×10MHz, each occupying pre-assigned frequencies within the band.

- If an additional coverage obligation is applied to one of the lots, this should be the lot at the upper end of the band. From an auction design perspective, including an additional coverage obligation on one lot is desirable, as it may stimulate competition in the auction even if there are only three bidders for the three available lots.

- A 2×10MHz cap should be applied in the auction, meaning that no bidder can bid for more than one lot.

- The lots should be sold using a standard Simultaneous Multiple Round Auction (SMRA) format, which will determine both the frequencies awarded to each bidder and the price that each bidder must pay.

- In the event that 800MHz spectrum is won by a bidder (or bidders) that does not have 2.6GHz paired spectrum, the 2×15MHz of contiguous unsold 2.6GHz spectrum should be offered to that bidder (or bidders), using the following three-step process:
  - In the first step, any such bidder that acquires the lowest frequency 800MHz block should be offered a first right of refusal to acquire 1, 2 or 3 blocks of contiguous 2×5MHz spectrum in the 2.6GHz band
  - In the second step, any such bidder that acquires the middle frequency 800MHz block should be offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum in the 2.6GHz band and

  - In the third step, any such bidder that acquires the highest frequency 800MHz block should be offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum in the 2.6GHz band.

- If, after the conclusion of this process, there is still unsold spectrum in the 2.6GHz band, then this spectrum should be made available in a future award process. It is not practical to integrate such an auction into the current 800MHz process, as we understand that this would require revisions to the 4G Royal Decree, and this process may cause unnecessary delay to the 800MHz auction.

Given that the approach we are recommending for the 800MHz band is similar to that used in previous Belgian spectrum auctions, we have conducted a preliminary review of the auction rules used for the 2010 Belgian 2.6GHz auction (which, we understand, were based on the rules for 2.1GHz award from 2001) with a view to identifying what rules might need to be adapted for this award. Our main observation is that the rules require some updating to bring them into line with latest thinking on best practice for conducting spectrum auctions using SMRAs; notably, the rules on bid increments and transparency are out of step with revisions to the format widely adopted by regulators in the last ten years.

1.7 Reserve price

We recommend that BIPT set the reserve price at a level which provides a minimum expected return – under this approach, which has been widely used in spectrum auctions around the world, reserve price levels are set at a significant discount to the estimated value of a licence to a marginal winning bidder, but at a level that will still ensure a significant revenue return for taxpayers if all licences are sold. This approach strikes a good balance between efficiency of outcome, avoiding unsold lots and obtaining adequate revenues.

Identifying the exact level for the reserve price under this approach is more an art than a science. As many other countries have sold equivalent spectrum, international benchmarks on a pop per MHz basis typically provide a good guide on plausible reserve price levels. These can then be compared against the results of Belgium-specific valuation models to check that these reserve prices are achievable.

Our recommendation is that BIPT sets a reserve price at around EUR90million per 2×10MHz lot. This translates into a price of about EUR0.41/MHz/pop and falls comfortably within the range of prices achieved in other European 800MHz auctions (which range from about EUR0.28 to EUR0.81 per MHz per pop) and the reserve prices set in other auctions for mobile spectrum (which range from EUR0.003 to EUR0.58 per MHz per pop).

We believe that at such prices, the risk of any spectrum remaining unsold is limited. The results of our valuation modelling work also clearly indicate that there should be sufficient spectrum demand at such a reserve price level.

1.8 Summary of recommendations

Based on the findings of our study, Figure 1-1 and Figure 1-2 summarise our recommendation of the award of the spectrum in the 800MHz and 2.6GHz bands.

Figure 1-1: Recommendations for award of 800MHz band

Packaging of spectrum	Three lots of 2×10MHz each
General licence conditions	15 years licence from notification of granting and extendable by BIPT for an additional five years after expiry of the initial 15 year period Service and technology neutral Fully tradable – subject to limits set out in spectrum caps (see below) Annual usage fees of EUR174 850 per paired MHz apply Mandated national roaming for operators with existing 900MHz infrastructure to provide GSM (2G), UMTS/HSPA (3G) and 800MHz national roaming to operators who: • have acquired 800MHz spectrum • do not own any existing 900MHz mobile infrastructure • are meeting the coverage obligations associated with any of their mobile spectrum licences • have deployed services using the 800MHz band to at least 20% of population
Standard coverage obligation	Deploy and maintain a network providing average downlink user throughput outdoors of 3Mbit/s across an area which covers 98% of the population Timescale for implementation: • 33% of the population coverage target must be achieved within 2 years of spectrum award (3 years allowed for an operator without an existing 900MHz network grid) • 66% of the population coverage target must be achieved within 4 years of spectrum award (6 years without existing 900MHz network) • 100% of the population coverage target must be achieved within 6 years of spectrum award (9 years without existing 900MHz network) • Postcode areas identified by BIPT as being covered by GSM (2G) services but are not covered by UMTS/HSPA services must be covered within 2 years of spectrum award (within 6 years for an operator without an existing 900MHz grid) This coverage obligation can be achieved/met using any combination of the spectrum bands available to the licensee
Award process	Simultaneous Multiple Round Auction (SMRA) format, which will determine both the frequencies awarded to each bidder and the price that each bidder must pay Spectrum cap of 2×10MHz Reserve price of EUR90million per 2×10MHz lot Payment of full fee upfront or paying an equal amount on an annual basis throughout the licence duration, with an interest rate of equal to the market rate + 2%

Figure 1-2: Recommendations for award of unassigned 2.6GHz spectrum

Packaging of spectrum	Three generic 2×5MHz lots
Licence conditions	Same licence conditions as for existing 2.6GHz assignments
Award process	Any bidders that win 800MHz spectrum but do not already have 2.6GHz paired spectrum should be given the option to acquire 2.6GHz paired spectrum according to the following order of precedence: • Step 1: any such bidder that acquires the lowest frequency 800MHz block offered right of refusal to acquire 1, 2 or 3 blocks of contiguous 2×5MHz spectrum; • Step 2: any such bidder that acquires the middle frequency 800MHz block offered right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum; and • Step 3: any such bidder that acquires the highest frequency 800MHz block offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum. In each step, bidders must select specific frequencies and these must be contiguous. Reserve price of EUR2.5million per 2×5MHz lot (no change) If all bidders that win 800MHz spectrum already have 2.6GHz paired spectrum or no 2.6GHz spectrum is assigned in the above steps, then the 2.6GHz spectrum should be sold in a separate auction.

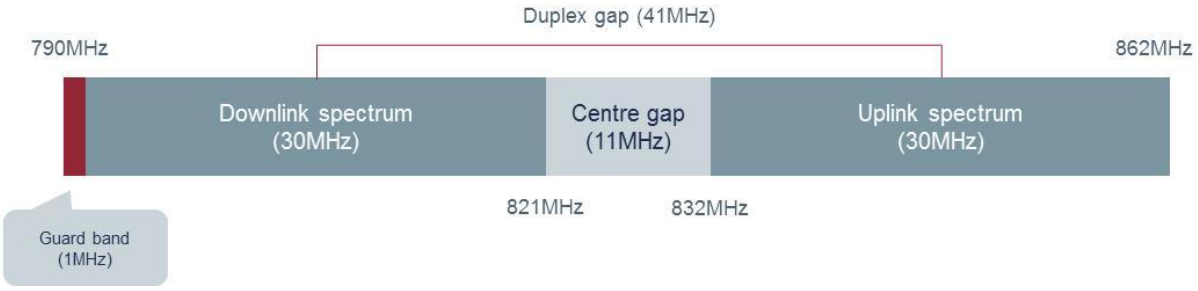
2 Introduction

This report has been prepared by Aetha Consulting Limited (Aetha) and NERA Economic Consulting (NERA) for the Belgian Institute for Postal Services and Telecommunications (BIPT) as a summary of a study we have undertaken on the licence conditions and award process for the 790-862MHz band.

2.1 Background

The switch-off of analogue terrestrial television has resulted in the creation of the so-called 'digital dividend' which is partially being utilised to provide additional television channels but is also being utilised to create a new internationally harmonised frequency band for electronic communications services in the frequency range 790-862MHz – the so-called "800MHz band". In its Report 31[7], the CEPT discusses different band plan options for the 800MHz band. The CEPT's preferred option for a harmonisation of the band essentially comprises six sets of 2×5MHz channels[8] giving a total of 2×30MHz of spectrum for use, as shown in Figure 2-1 below.

Figure 2-1: Overview of 790-862MHz band plan



There is also an alternative configuration of the band plan available comprising a single block of 65MHz of unpaired spectrum. However, all regulators in Europe to date have used the CEPT's preferred band plan and all 800MHz equipment available which would integrate into the operators' existing networks is configured for this plan. As a result, we have not further considered an alternative unpaired configuration of the 800MHz band in this report.

The European Union's Radio Spectrum Policy Programme (RSPP)[9] includes a requirement for member states to carry out the authorisation of the 800MHz band by 1 January 2013. There are many decisions that each country needs to make in respect of the award process and in March 2012, BIPT issued an industry consultation document[10] on many of these issues. The objective of our study is to make specific recommendations to BIPT on the 800MHz award process taking account of both international best practice

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7 CEPT (October 2009), Report 31, 'Technical considerations regarding harmonisation options for the digital dividend in the European Union'.

8 The smallest unit at which Long Term Evolution (LTE) services, the designated technology for the 800MHz band, can be efficiently used is 2×5MHz.

9 See 'DECISION No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme'.

10 See 'Consultation organised by the BIPT Council of 21 March 2012 on the 800MHz band'.

and the specific market situation in Belgium. In our work, we have taken into consideration the responses of stakeholders as part of BIPT's consultation document.

The 800MHz band is a key band across Europe for the deployment of Long Term Evolution (LTE) technology – complementing higher frequency (2.6GHz and 1800MHz) bands by providing more cost-effective rural coverage and deeper indoor coverage. At the time of writing[11], the 800MHz band has been awarded in nine European countries to-date and there is an existing ecosystem for network and consumer equipment. As of July 2012, 90 consumer devices (both handsets and dongles) were available for the 800MHz band[12] and this number is expected to rapidly increase in the coming months. As the European market is one of the main adopters of the 800MHz band, most of these devices should be available to European operators subject to commercial arrangements. Mobile operators in other countries have considered the spectrum to be extremely valuable resulting in auction prices of up to EUR0.81 per MHz per pop.

2.2 Scope of and approach to the study

In this study, we make recommendations on both the underlying regulations that would apply to the use of the 800MHz spectrum (licence conditions) as well as the regulations that apply to the assignment of the spectrum (award process). Our work has included consideration of issues such as the appropriate licence duration, the packaging of the available spectrum, any limits that might apply to the amount of spectrum that can be acquired by any one organisation, whether to reserve spectrum for any types of organisation (e.g. potential new market entrant[13]), the pricing of the spectrum and the main rules applying to the award process.

Whilst the precise approach we have used to develop our recommendations on each specific issue varies, the general approach we have used is to consider the market situation in Belgium, consider the alternative approaches used in other European markets, identify a series of potential options that could be adopted in Belgium and then make a final recommendation taking account of the pros and cons of each alternative option.

In this report, we have generally sought to present each key issue in a sequential manner, however in practice many of these issues are inter-dependent on recommendations made on other issues. We have sought to highlight the main linkages in this report – and, to the extent possible, have structured this report such that issues where the optimum approach is primarily dependent on other issues are presented following discussion of (and the making of preliminary recommendations) of these other issues.

In addition to the considerations concerning the award of the 800MHz band, our scope of work has included an assessment of how to best award the 2×15MHz of paired spectrum in the 2500-2690MHz band which remained unassigned following the auction held in November 2011. Specifically, we consider

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11 With several auctions being planned for late 2012 and early 2013 (e.g. Ireland, the Netherlands, United Kingdom), we note that this number may have increased at the time of reading.

12 Source: 'REPORT: Status of the LTE Ecosystem, July 3, 2012' by the Global mobile Suppliers Association (GSA).

13 Throughout this report, we use the term 'new entrant' to describe a potential applicant in the 800MHz award process which has no existing spectrum holdings in any of the bands that are harmonised for mobile services (900MHz, 1800MHz, 2.1GHz and 2.6GHz). These are (outside this report) often described as 'greenfield' new entrants. For the avoidance of doubt this definition of new entrant excludes Bidco and BUCD.

whether this spectrum could be included in a 'combined award' with the 800MHz band or whether it should be awarded in a separate process.

As part of our work, we have developed a bottom-up discounted cash flow model to obtain indicative estimates of the value of the 800MHz spectrum to different organisations that may be interested in acquiring the spectrum (e.g. existing mobile operators, potential new market entrants). In Section 4.2, we provide an overview of the approach applied to this modelling. We have not included any specific details on the assumptions pertaining to this work in this report in order to ensure that our modelling work does not distort the award process by introducing a bias to bidders' expectation of the value of spectrum. However, the overall conclusions of the modelling work have informed several of the recommendations in this study and we make qualitative reference to these in the report where it is considered appropriate/possible.

2.3 Structure of this document

The remainder of this document is structured as follows:

- Section 3 summaries our understanding of the Minister's and BIPT's objectives for the 800MHz award process
- Section 4 details our assessment of the demand for 800MHz and 2.6GHz spectrum
- Section 5 contains our recommendations on the general licence conditions
- Section 6 discusses the options in relation to coverage obligations to be placed on the licences and our recommendations concerning the most suitable coverage obligation for BIPT
- Section 7 highlights the alternative options available to BIPT in relation to the 800MHz band that could help to ensure a competitive downstream market for mobile services
- Section 8 discusses the options available for and makes recommendations on spectrum packaging and the award process
- Section 9 presents our recommendations on the reserve price for the spectrum
- Section 10 contains an overall summary of the project's recommendations.

3 Objectives of 800MHz award process

In this section, we discuss the objectives of the Minister and BIPT in relation to the award process. In Section 3.1, we discuss the general objectives that the Minister and BIPT are likely to consider for the awarding of the 800MHz band and, in Section 3.2, we present our understanding of the overall priorities in this regard, particularly as some of the objectives presented in Section 3.1 will conflict with each other. Finally, in Section 3.3, we discuss the scope for use of the 800MHz band to achieve the Digital Agenda targets.

3.1 Overview of regulatory objectives

We consider the main policy objectives in awarding the 800MHz band to be as follows:

- to award the spectrum to the most efficient users
- to encourage widespread network deployment and therefore minimisation of any digital divide in Belgium
- to ensure all the spectrum is awarded during the assignment process – in particular to avoid 'choking off' demand which could result in any spectrum remaining unassigned
- to ensure the spectrum is used in the most technologically efficient way
- to maximise the level of competition in the mobile market following the award process
- to facilitate greater competition in the fixed broadband services market from mobile operators
- to ensure a fair return for the government from the assignment of the spectrum as it is a valuable public resource
- to award the spectrum using a transparent, objective, non-discriminatory and fair process
- to minimise the degree of complexity and cost to the government/BIPT regarding the execution of the award process
- to minimise the timescales required for the award process.

There are inherent conflicts in several of the above objectives – in particular there is always a trade-off between maximising the extent of network deployment, ensuring the highest possible level of competition in the market (number of competing infrastructure operators) and the level of proceeds received by the government. Additionally, maximising the number of competing infrastructures has to be traded-off with ensuring the spectrum is used in the most technologically efficient way. For example, in the case of LTE, the greatest spectral efficiency is obtained through the use of wider channels. In the following section, we set-out our assumptions in relation to the balance between specific priorities.

3.2 Balance of priorities

In this section, we highlight several areas where there are potential conflicts between the award process objectives and discuss our assumptions on the Minister/ BIPT's position.

Spectrum available per operator and spectral efficiency

As discussed in Section 4, mobile operators typically seek at least 2×10MHz of spectrum in the 800MHz band in order to generate significant performance benefits from LTE (over that which is available from existing 3G HSPA+ networks). An objective of the award process is to minimise the risk that a participant in the award process wins 2×5MHz of spectrum when targeting 2×10MHz (or more) of spectrum.

Ideally operators would seek 2×20MHz channels to gain the maximum performance (spectral efficiency) from LTE, however only 2×30MHz of spectrum is available in the 800MHz band in total.

Number of competing operators versus spectrum available per operator

The Minister and BIPT would welcome the entry of a fourth national mobile network operator in the market in order to maximise the degree of infrastructure-based competition. However, it should be noted that (i) the amount of 800MHz spectrum is limited and (ii) the business case for the network roll-out by a potential fourth national operator is questioned publicly[14] (we discuss this further in Section 4). Therefore, as a minimum the award process should result in at least three different bidders acquiring spectrum in the 800MHz band. At the same time, our recommendations take into account considerations to facilitate entry in the market through appropriate means (e.g. mandated national roaming for a limited period of time).

Final price for the spectrum versus risk of spectrum remaining unsold

Revenue maximisation is not the prevalent objective of the award process. However the price paid for the spectrum should reflect the value of the spectrum to the winning bidders. This is particularly relevant as spectrum is a scarce public resource and the government should receive a fair return for allowing mobile operators to make use of this resource.

At the same time, it is important that the price of spectrum is not set too high and would risk choking-off demand from existing operators such that the spectrum remains unsold. This is particularly relevant for the determination of reserve prices as outlined in Section 9.

3.3 Scope for use of the 800MHz award process to meet Digital Agenda targets

The European Union has set a series of broadband coverage targets as part of its Digital Agenda. This includes a requirement for 100% of EU citizens to have access to 30Mbit/s connections by 2020 and 50% of citizens to have access to (more than) 100Mbit/s at the same point in time. It is anticipated that the 30Mbit/s is likely to be met using a combination of wireline networks (fibre, cable, copper), terrestrial wireless networks (using fixed wireless and/or mobile technologies) and satellite networks.

One key question that has arisen is whether mobile (LTE) networks can be used as an efficient means of meeting the 30Mbit/s target. Furthermore, as a large number of the citizens that will not have access to

[14] In an article in May 2012, a representative for Telenet stated that the time and cost of rolling out a mobile network would be too large and that Telenet considered the 2.1GHz spectrum acquisition a bargaining chip in wholesale negotiations. See: **http://datanews.knack.be/ict/nieuws/eigen-spectrum-telenet-is-pasmunt/article-4000089209184.htm**

terrestrial wireline technologies are likely to be located in less populated/more rural areas, low frequency bands (such as the 800MHz band) are expected to be used to provide coverage on a cost-effective basis.

Consequently, one question being considered by the Minister and BIPT is whether the 800MHz award process can be used as a means of meeting the Digital Agenda targets. Our view is that the specifications for LTE as currently available will not be able to do this. Whilst theoretical maximum headline speeds of up to 300Mbit/s[15] are cited, this typically requires a set of optimal criteria to be met at the same time as (i) the mobile operator will have to deploy (at least) a 20MHz LTE channel, (ii) the user must be located very close to the cell base station and (iii) the user must be the only user in the cell. It follows that a very large number of (practically dedicated) LTE base stations would need to be deployed to meet the Digital Agenda targets based on the performance of today's LTE technology.

It is likely that LTE technology will evolve considerably over time, as the performance of UMTS/HSPA (3G) technologies has considerably increased between 1999 and today. One recent presentation by a mobile network equipment vendor[15] indicated that LTE could potentially be used to meet the Digital Agenda 2020 30Mbit/s targets however this required (i) the use of LTE-Advanced technology which is not available today (ii) the deployment of 4x4 MIMO antenna technologies (iii) the use of a 2×60MHz channel using low frequency spectrum (i.e. twice the amount of spectrum that is available in the 800MHz band in total).

Given all these technological limitations and uncertainties, we believe that requiring the licensees of 800MHz spectrum to commit to meet the Digital Agenda 2020 targets would result in an unacceptably high level of risk associated with acquiring the licences. In the worst case, this could result in spectrum remaining unsold, even at a very low reserve price.

We therefore recommend against the 800MHz award process being used as a means of achieving the Digital Agenda 2020 targets. We believe that technological solutions to this will arise over time. For example, it could be that a variant of LTE technology designed for communicating with fixed wireless stations powered by main electricity located on the walls/roofs of homes rather than with mobile hand-portable devices (as current LTE mobile technologies are designed for). However, making use of existing mobile network base station sites will not provide an economically cost-effective solution to meeting the Digital Agenda targets.

That being said, there may be a role for the 800MHz band to help eliminate areas which are currently underserved by fixed broadband services (termed 'zones blanches' in French translating into 'white zones' in English). We understand that BIPT is currently studying these white zones with the aim of identifying (a) a minimum acceptable speed for broadband (in advance of the Digital Agenda 2020 target) and (b) mapping the precise locations of these white zones. It is possible that the 800MHz award could play a role in improving broadband availability in these areas provided that such information is available in time to be incorporated in the award process (it is unlikely to be beneficial to delay the realisation of the major economic benefits from making 800MHz spectrum available for electronic communications services in order to accommodate this research). We discuss this possibility further in Section 6.

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15 See 'Bringing Mobile Broadband to Rural Areas', presentation by Ulrich Rehfuess, Head of Spectrum Policy and Regulation, Nokia Siemens Networks, presented at WIK Mobile broadband – Competitive dynamics and policy implications conference, 11-12 September 2012.

4 Spectrum demand in Belgium

In this section, we analyse the expected level of demand for the spectrum available as part of this award process.

We first summarise our understanding of the Belgian telecoms market to establish the basis of our assessment. As mentioned in Section 2.2, we have also assessed the demand for spectrum by means of a valuation model which estimates the value of different amounts of 800MHz and 2.6GHz spectrum to both existing operators and potential new entrants. In Section 4.2, we provide a high-level overview of the methodology applied in order to assess the spectrum demand quantitatively.

We then focus on the demand from a range of potential bidders for 800MHz in Belgium by looking at the evidence from 800MHz awards in other countries, reports from technical experts as well as the responses from stakeholders to BIPT's consultation on the 800MHz band. Furthermore, we consider the likely interest expressed in the 2.6GHz spectrum which remained unsold in the previous award carried out in November 2011. Where appropriate, these qualitative assessments are supported by the results of our valuation modelling.

4.1 Overview of Belgium telecoms market

In this section, we present our understanding of the Belgian fixed and mobile telecommunications market. This background is highly relevant to the assessment of demand for 800MHz and 2.6GHz spectrum.

4.1.1 Mobile operators

Three mobile network operators (MNOs) have deployed significant mobile infrastructure in the Belgian mobile market to date:

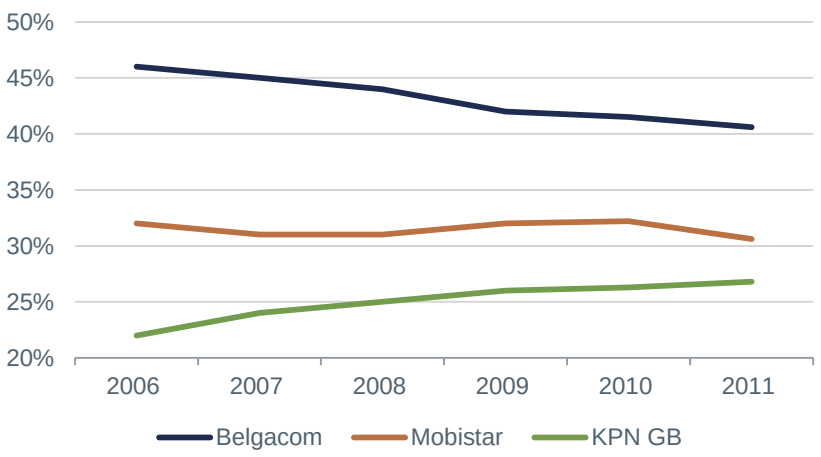
- Belgacom, operating under the 'Proximus' brand
- Mobistar, which is part of the France Telecom Group
- KPN Group Belgium (KPN GB), operating under the 'BASE' brand.

The evolution of the respective subscriber market shares of the above three operators is illustrated in Figure 4-1.

Figure 4-1:

Subscriber market shares for MNOs in Belgium

[Source: BIPT, 2011]



Whilst there has generally been a convergence of market shares, we note that KPN GB's subscriber base is more biased towards prepaid users and its share of market revenues may therefore be lower than subscriber market share. However, all operators hold market shares significantly above 20% and have reported profitable mobile operations over the last years. This is likely to positively influence the demand from each of the three operators for 800MHz spectrum to ensure a continuation of their current operations. We evaluate this demand in Section 4.3.2.

Further, in July 2011, BIPT granted a spectrum licence to a fourth operator, Telenet Tecteo Bidco (Bidco). The operator gained access to spectrum in the 2.1GHz band as well as an option to gain access to spectrum in the 900MHz and 1800MHz bands from November 2015. We understand that Bidco has taken up this option which will lead to a distribution of spectrum between these four operators as shown in Figure 4-2.

Figure 4-2: Expected spectrum holdings in Belgium as of November 2015 [Source: BIPT, 2012]

	900MHz	1800MHz	2.1GHz	2.6GHz (FDD)	Total spectrum
Belgacom	2×10MHz	2×20MHz	2×15MHz	2×20MHz	130MHz
Mobistar	2×10MHz	2×20MHz	2×14.8MHz	2×20MHz	129.6MHz
KPN GB	2×10MHz	2×20MHz	2×14.8MHz	2×15MHz	119.6MHz
Bidco	2×4.8MHz	2×10MHz	2×14.8MHz	-	59.2MHz

At this point in time, as far as we are aware, Bidco has not made a significant deployment of mobile network infrastructure to become a fourth network operator. With the spectrum it has acquired, we would expect that Bidco will strive to become a challenger operator to the existing operators in the future. To that end, Telenet has signed an extension to its existing wholesale agreement with Mobistar which also extends

to future LTE services[16]. The agreement also includes Tecteo, thereby effectively applying to the entity we refer to as 'Bidco' throughout this report.

By the end of 2011, Telenet had acquired a subscriber market share of about 2% as an MVNO which could be migrated to a Bidco-owned network once deployment has begun. We could thus expect further demand from Bidco for 800MHz spectrum to strengthen its current spectrum portfolio. We further evaluate the demand for 800MHz spectrum from Bidco in Section 4.3.3.

Finally, a fifth operator, BUCD, acquired unpaired spectrum in the 2.6GHz awards in late 2011. To date, little is known about the ambitions of this operator, whose potential demand for spectrum we explore further in Section 4.3.4.

4.1.2 Development of mobile broadband services

One critical aspect of the mobile market which will influence the demand for 800MHz spectrum is the development of mobile data services. In 2011, BIPT estimated mobile data services penetration to be around 19% of population, an increase of 6.1 percentage points from 2010[17]. This penetration estimate is largely driven by the increase in smartphones sold over the course of the year.

Whilst smartphones could be a potential key driver of mobile data services in the future, the penetration of 'data-only' devices, such as mobile dongles and tablets in Belgium appears to be significantly below the European average. The EC Digital Scorecard reports a penetration of 3.3% in 2011 compared to a European average of about 8.1%[18]. Similarly, Belgacom reports a tablet penetration of 4% in the residential market in its 2011 annual report[19].

It thus appears that, although smartphone sales continue to drive increases in mobile broadband penetration, Belgium generally appears to have a less strongly developed mobile data market than other European countries. It is not clear how this will impact on the demand for 800MHz spectrum. On the one hand, with the country lagging in the development of the mobile data sector, operators might consider that the value of 800MHz spectrum (and LTE mobile data services) can only be realised in a few years' time and will therefore discount the value of the benefits associated with spectrum acquisition. At the same time, operators could be attracted by the opportunity to take a first-mover advantage through a leading deployment of LTE services in the 800MHz band. Overall, we believe that the benefits of the market potential in combination with a strong increase in smartphone penetration are indicators of a growing interest for mobile data services in Belgium and are likely to contribute to strong demand for 800MHz spectrum.

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16 See: **http://corporate.mobistar.be/go/en/media_center/news/news_details.cfm?news_id=411**

17 Source: 'Economische situatie van de telecom sector 2011', published by the BIPT in June 2012. Available at: **http://www.bipt.be/ShowDoc.aspx?objectID=3788&lang=nl**

18 As reported on the homepage of the European Commission for the Digital Agenda. Comparing the reported values for 'Mobile broadband take-up - Penetration of dedicated data service cards/modems/keys only'. Available at **http://scoreboard.lod2.eu/**.

19 See Page 10 of 'Belgacom: Annual Report 2011'.

4.1.3 Fixed telecommunications market

One reason for the relatively modest penetration of 'data-only' mobile devices to date in Belgium could be the strong development of the fixed telecommunications market as there are two operators deploying next-generation broadband networks. Belgacom is pushing forward its deployment of an FTTC/VDSL network and Telenet is upgrading its cable infrastructure to DOCSIS 3.0. According to its 2011 annual report, Belgacom provides services with speeds of up to 30Mbit/s to 81% of population. At the same time, 73% of Telenet's customer base can now access connections with speeds of up to 30Mbit/s[20]. Both operators have announced further investments in the network over the coming years to contribute towards the Digital Agenda targets.

The implication of these investments is that Belgium has taken a leading position in Europe with regard to providing high-speed broadband connectivity. According to the EC Digital Scorecard, about 30% of lines actually experience broadband speeds of more than 30Mbit/s, only trailing Romania, Lithuania and Latvia. With Belgium having a similar strong position across several other indicators (e.g. households with more than 10Mbit/s, broadband penetration), we conclude that average fixed broadband services are significantly above the European average.

In view of the extensive deployment of high-speed fixed wireline technology in Belgium and the inherent limitations in network capacity on mobile networks, we expect that mobile operators will expect to capture a limited share of the fixed broadband services market in areas covered by these high-speed wireline networks. At the same time, LTE services could be an attractive proposition to customers in more rural areas currently underserved by fixed broadband.

We understand that work is currently being undertaken by the Belgian Government to identify these so-called 'white zones (zones blanches) and we discuss in Section 6 how the 800MHz award could be used to help covering the identified areas with an alternative to existing fixed networks.

4.2 Overview of valuation modelling

In this section we present an overview of the approach taken to estimate the value of the 800MHz spectrum available as part of this award process. The model has been developed with sufficient flexibility to reflect the different situation for a set of potential applicants (e.g. existing mobile network operators or a new entrant).

Within our modelling, we have assessed the incremental value to a potential applicant's business case resulting from spectrum acquisition in the 800MHz and 2.6GHz bands. We calculate this incremental value by assessing the delta in free cash flows generated by the mobile business as a consequence of having acquired additional spectrum.

Our analysis compares the net present value of these different cash flows over the entire licence period using an appropriate discount rate. We typically consider three sources of value to generate the difference in cash flows:

- **Technical value**: The technical value captures any network cost savings potentially arising from the additional capacity (per mobile site) or the superior coverage characteristics of the acquired spectrum. The key technical benefit of 800MHz spectrum is the resulting reduction in the cost of covering rural

[20] See: Telenet Annual Report 2011

(i.e. less populated) regions or providing superior indoor coverage relative to a network which is based on the use of higher frequencies. High frequency networks typically require an increased density of sites to (partly) replicate the levels of coverage achieved through the use 800MHz spectrum. The network costs savings arise both, from lower capital expenditure due to not deploying any additional sites (e.g. the avoided cost of civil works, radio equipment, antennas) as well as the savings in operational expenditure from operating a network with fewer sites (e.g. less site rental costs and lower equipment maintenance). In addition, any additional spectrum provides incremental capacity to existing sites. Again, the increased capacity per site leads to a reduced number of required overall capacity sites and resulting network cost savings.

- **Commercial value**: The commercial value entails the incremental profit margin which is generated from acquiring access to (scarce) spectrum. In our modelling, we assume that – for the assumed licence period – the 800MHz, 1800MHz and 2.6GHz bands are most likely bands to be used for the deployment of next generation (LTE) mobile service. By gaining access to the 800MHz band, operators are thus able to offer high-quality ubiquitous LTE coverage. In contrast, if an operator were not to acquire this spectrum, it is likely that the perception of customers about the quality of the operator's network would reduce, as none of the other bands is likely to be able to replicate the coverage levels achievable by deploying services in the 800MHz band[21]. Operators would then be faced with significant commercial pressure which could then result in a range of different commercial impacts: a decrease in market share, a lower willingness of customers to pay for access to an operator's network or less retention of customers (i.e. higher churn). The avoidance of such commercial impacts from acquiring 800MHz spectrum and the resulting larger revenues and profits are captured under the commercial value.

- **Strategic value**: Finally, it is perceivable that operators could consider that participation in the auction could have a wider strategic impact on their position in the mobile (data) market. For example, by acquiring a large amount of spectrum, operators could keep potential new entrants out of the market or could ensure that their competitors' spectrum holdings are limited. This would place them in a better commercial position on conclusion of the auction. Similar to the commercial value, such strategic value would manifest itself in increased revenues / profit margins.

Within our valuation modelling, we have not considered any strategic value from spectrum acquisition as this requires detailed insights into the commercial strategies of the potential bidders. More importantly, it could introduce a positive bias into our valuation analysis and could lead us to overestimate the demand for spectrum.

It is inevitable that there will be some margins of error in our analysis as we have not had access to detailed commercial and technical data from parties interested in the spectrum. To reflect this uncertainty in our valuations and to avoid overestimating the demand for spectrum in Belgium, we have chosen conservative assumptions (i.e. assumptions leading to a relatively low spectrum value) for many of the parameters. This is based on our experience of carrying out similar exercises in other European countries. Our valuations may still differ from the actual views of Belgian operators as:

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21 Whilst a lack of 800MHz spectrum could be partially offset by building additional 1800MHz/2.6GHz sites, we believe that there would remain a notable difference in the overall depth of coverage provided by an operator's mobile data network.

- inherently we are making assessments about the strategies each user of spectrum would adopt under alternative spectrum scenarios – these may differ in practice
- there are many market development variables (e.g. future mobile traffic levels, timescale for availability of LTE technology in individual bands, value placed by end user on higher data rates etc) which have a high degree of uncertainty.

This uncertainty about the value of spectrum to operators has also been reflected in our reserve price recommendation in Section 9.

4.3 Demand for 800MHz spectrum

Two key questions have influenced our recommendations on the award of the 800MHz band:

- Which parties do we expect to be interested in the available spectrum?
- How much spectrum are individual parties likely to require to efficiently use the available spectrum?

Within this section, we first look at the second question taking into account evidence from 800MHz auctions in other European countries and technical reports. We then individually consider the different types of organisation who we expect could be interested in acquiring 800MHz spectrum.

4.3.1 Demand for 800MHz spectrum in other European countries

To date, regulators in nine European countries have awarded spectrum in the 800MHz band. An overview of the outcomes of these auctions regarding the allocation (but not prices, which are covered in Section 9) of spectrum is provided in Figure 4-3.

Figure 4-3:

Overview of 800MHz awards in Europe to date

Country	Spectrum allocation	5MHz lots available?	Participating bidders
Denmark (06/12)	20,10	✓	3
France (12/11)	10,10,10	✓	4
Germany (05/10)	10,10,10	✓	4
Italy (08/11)	10,10,10	✓	4
Portugal (12/11)	10,10,10	✓	3
Romania (09/12)	10,10,5[22]	✓	5[23]
Spain (07/11)	10,10,10	✓	3
Sweden (03/11)	10,10,10	✓	3
Switzerland (02/12)	10,10,10	✓	3

Out of 26 winning bidders across these nine auctions, 24 bidders acquired 2×10MHz of 800MHz spectrum. This is despite smaller lots of 2×5MHz being available in all auctions and the fact that, in several of the

22 In the Romanian auction, 5MHz of spectrum remained unsold. This is likely as a result of the reserve prices for the spectrum being perceived as too high by some of the bidders.

23 Although five bidders participated in the auction, it is likely that only three operators actively bid for 800MHz spectrum whilst the remaining operators focused on very specific licences.

auctions, more than three operators bid (strongly) for the available spectrum. This provides very strong support to an assumption that mobile operators have a preference for 2×10MHz of spectrum in the 800MHz band.

One of the main reasons often quoted for this preference of at least 2×10MHz is the superior performance relative to (existing) HSPA (3G) services. For example, several evaluation studies by the 'Next Generation Mobile Networks Alliance' (NGMN) on the performance of HSPA (3G) and LTE services in different configurations and environments show that a 10MHz LTE carrier can provide an average user speed which is more than 3 times higher than for a typical HSPA (3G) carrier[24]. It is this significant improvement in data service quality which provides the value of LTE. As the 800MHz band is the main low-frequency band designated for providing coverage, operators have looked to acquire the band to guarantee reliable coverage for mobile data services to their customers.

4.3.2 Demand from Belgacom, Mobistar and KPN GB

As described in Section 4.1, there are currently three mobile network operators with national networks in the Belgian mobile market. In order to remain competitive in the medium to long term, all three operators are expected to deploy LTE services and will require suitable spectrum for this. Although all three operators have access to 1800MHz and 2.6GHz spectrum, they are highly likely to require low-frequency spectrum to complement these holdings. As shown in Figure 4-3, the vast majority of operators in the nine countries where spectrum was awarded have looked to acquire 800MHz spectrum, typically 2×10MHz.

In their responses to the consultation organised by the BIPT Council in March 2012, mobile network operators generally expressed their interest in 800MHz spectrum. Belgacom's response confirms the conclusions drawn in Section 4.3.1 by stating that Belgacom considers 2×5MHz in the 800MHz band as too narrow.

With the exception of the Romanian auction, all 800MHz spectrum available for auction has been sold to date. In combination with the responses as part of the consultation, we strongly believe that all three operators are highly likely to express an interest in (at least) 2×10MHz of 800MHz spectrum assuming a non-prohibitive reserve price[25].

This conclusion is strongly confirmed by our valuation modelling, which shows that there is significant demand from all existing MNOs for spectrum in the 800MHz band, resulting from a combination of technical and commercial value, as described in Section 4.2.

4.3.3 Demand from Bidco / BUCD

In addition to the existing mobile network operators, Bidco has shown interest in developing its own mobile infrastructure-based business. This has been confirmed by its acquisition of 2.1GHz spectrum in 2011. In that respect, the 800MHz band could provide complementary value to the 1800MHz spectrum to

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24 For example, the white paper "UMTS/HSPA to LTE Migration" published by Motorola (available at **http://www.motorola.com/web/Business/_Documents/static%20files/UMTS_to_LTE_Migration_White_Paper.pdf**) discusses the results of some of the NGMN studies on Page 7. It also highlights the benefit of larger channel sizes for LTE.

25 We discuss our recommendation on the reserve price for 800MHz spectrum in Section 9.

which Bidco exercised its option[26] in light of a potential mobile (data) based strategy which includes UMTS/HSPA (3G) as well as LTE services. It is also worthwhile to note that there are commercial aspects (e.g. upsell to existing subscriber base, offering of quad-play services) which could be further sources of 800MHz spectrum value for Bidco.

This potential interest is further strengthened by the comments submitted by Bidco in the consultation document. Within its response, Bidco mentions in several places its general interest in 800MHz spectrum, for example as a means to correct what it perceives as 'current spectrum imbalances'.

Although there are clear indications that Bidco is interested in 800MHz spectrum, it is difficult to fully establish whether Bidco would participate in an award. Our key concern regarding participation by Bidco stems from the significant spectrum portfolio Bidco acquired in the 2011 award. At this point, Bidco has not yet made use of its acquired holdings, which consist of a reasonable mix of low- and high-frequency holdings. Bidco also requires significant capital investment to deploy the relevant mobile infrastructure to meet any associated coverage obligations with the spectrum. In fact, Bidco has publicly stated in several instances that it considers the investment required to roll-out a mobile network as very burdensome[27] and that it might therefore consider the cost of additional spectrum acquisition as too onerous at this point in time. Ignoring such budget constraints, our valuation model confirms that there are credible scenarios where Bidco could realise significant value from acquiring 2×10MHz of 800MHz spectrum.

We do not consider it likely that there will be significant demand for 800MHz spectrum from BUCD. Although it acquired unpaired 2.6GHz spectrum, it has not shown any interest in the consultation and did not acquire paired 2.6GHz spectrum which would be more complementary to the available 800MHz spectrum.

4.3.4 Demand from a new entrant

We believe that demand from a new entrant for 800MHz spectrum is unlikely:

- There was no demand from new entrants other than Bidco as part of the 2.1GHz award.
- None of the previous 800MHz auctions in Europe have seen any interest from a new entrant despite offering:
  - more spectrum (e.g. Switzerland)
  - a larger addressable market (e.g. France, Germany), or
  - a more developed mobile data market (e.g. Denmark, Sweden).
- Given that there are already three existing national mobile network operators in Belgium and a fourth operator with significant spectrum holdings, it is unlikely that a new entrant would consider that it could build up sufficient scale to develop a profitable mobile business in the long term (which would involve a high level of capital investment in mobile infrastructure)
- Within our valuation modelling, there are few credible technical and commercial scenarios which showed a positive NPV for a new entrant. .

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26 See: **http://www.broadbandtvnews.com/2011/06/28/telenet-and-tecteo-win-mobile-broadband/**

27 For example, see: **http://datanews.knack.be/ict/nieuws/telenet-wil-dat-bipt-bemiddelt-rond-3g/article-4000089831793.htm** or **http://datanews.knack.be/ict/nieuws/eigen-spectrum-telenet-is-pasmunt/article-4000089209184.htm**

At the same time, there are means for the Ministry/BIPT to implement a set of licence conditions and award process rules which reduce the barriers to entry for operators who intend to enter the market. Within Sections 6 and 7, we discuss how such rules and pro-competitive measures can be set to help encourage new market entry (e.g. by allowing more time to meet the coverage obligations and by mandating existing operators to provide national roaming to new entrants). By introducing these measures, new entrants will be able to develop a stronger business case.

4.3.5 Impact of radio emissions restrictions in Brussels

The regional government in Brussels adopted several decrees[28,29] which set out stringent emission thresholds in Brussels in March 2007 (taking effect in March 2009) and in October 2009. The decrees specify a maximum exposure to electromagnetic radiation of 3V/m at the 900MHz band. This limit applies cumulatively to all mobile operators. As per these decrees, each of four operators is allowed to emit approximately 25% of this limit.

Based on our analysis and research on the topic, we understand that the three national mobile network operators have in the past exceeded this limit and are currently in a period of transition where they apply for environmental licences to operate each base station in Brussels within the allowed limits. Contrary to the situation in many other countries, it therefore follows that the availability of 800MHz will not allow operators to deploy additional spectrum at each base station site. Instead, each operator will have to face the choice between not using the 800MHz spectrum in Brussels or replacing a carrier using another frequency band on a base station with an 800MHz carrier. The substitutability of spectrum will depend on a number of factors, such as power levels applied and antenna directionality.

With regard to the award of 800MHz spectrum, it is critical to assess how the emission limits in Brussels affect the overall demand for this spectrum. The emissions limitation is amongst (and is possibly the) strictest emission limit in the world and consequently presents considerable challenges to the mobile operators on how they can introduce new network technologies such as LTE. This is likely to result in the need for compromises to be made – for example reduction of the network capacity provided using other frequency bands/older network technologies.

In summary, our analysis has concluded that, whilst there is likely to be some impact on the incremental value of 800MHz spectrum to an individual operator, it is not likely to materially affect our conclusions in the above sections on the levels of demand for the spectrum, since the limitations apply to all existing operators. However the emissions limitations do have a negative impact on the *overall* economic benefits that result from the use of mobile communications services, by effectively limiting the network capacity that can be provided at each base station site.

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28 Government of Region Bruxelles-Capitale (2007), "Ordonnance du 1er mars 2007 relative à la protection de l'environnement contre les éventuels effets nocifs et nuisances provoqués par les radiations non ionisantes". Further information is provided via the e-justice portal of the Belgian government accessible via: **http://www.ejustice.just.fgov.be/cgi_loi/change_lg.pl?language=fr&la=F&cn=2007030138&table_name=loi**

29 Government of Region Bruxelles-Capitale (2007), "Arrêté du 30 octobre 2009 du Gouvernement de la Région de Bruxelles-Capitale relatif à certaines antennes émettrices d'ondes électromagnétiques". Further information is provided via the e-justice portal of the Belgian government accessible via: **http://www.ejustice.just.fgov.be/cgi/article_body.pl?language=fr&caller=summary&pub_date=2009-11-18&numac=2009031544**

The key difference here is to differentiate between an absolute value impact and an incremental value impact. The emission thresholds set out in Brussels could materially affect the business case for mobile operators in Belgium. Within one of their largest urban markets, operators are significantly affected in the level of services they can deploy. Effectively, the emissions limitations places limits on the overall quality of service that operators can provide which could strongly impact the take-up of new and existing services as well as the willingness of people to pay for mobile (data) services. As a result, the emissions limitations prevent the full economic value of the mobile market in Brussels from being realised.

At the same time, the main thing that is of relevance to assessing the value of 800MHz spectrum from an individual operator's perspective is the incremental value of 800MHz spectrum. In particular, we believe that this value is derived from two main sources:

- The technical value (savings in network operating expenditure and capital expenditure over the licence period) of providing superior coverage characteristics compared to other bands. The emission limits may restrict the ability to provide deep indoor coverage in Brussels. However, the main technical benefit of this band is more likely to be realised in rural areas (i.e. outside Brussels) and the technical value of the 800MHz band is thus unlikely to be strongly impacted by the current emission limit regime.

- The commercial value (improvements in market share relative to a scenario with less spectrum) resulting from improved network quality. If the 800MHz spectrum cannot be used in Brussels, we expect there not to be any commercial impact of spectrum acquisition in that region as all operators in the market will not be able to use the spectrum so each operator's relative competitive position remains the same as if each operator had access to 800MHz spectrum. Furthermore, the population in Brussels is only about 10% of the total Belgian population, so we would expect that potentially up to 90% of the commercial value arising from 800MHz spectrum in could still be realised.

As a result, we concluded from our analysis that whilst there could very well be a material impact on the total economic benefits that are generated from the mobile market in Belgium[30], it is likely that the value of 800MHz spectrum to individual operators is not likely to be significantly impacted by the regulations on emission limits in the Brussels region.

We understand that emission limits have also been specified in Flanders and Wallonia, but that these are not as restrictive as the regulations in Brussels. We have therefore not further considered these constraints in our analysis but assume that operators can use the 800MHz spectrum outside Brussels without being significantly impacted in their ability to operate other bands on the same base station.

4.3.6 Conclusions

Based on our analysis of the Belgian mobile market, we believe that:

- Demand from each of Belgacom, Mobistar and KPN GB will be at least 2×10MHz i.e. a minimum of 2×30MHz in total

- Bidco could also be interested in 800MHz spectrum but could be constrained by the required capital investment in a new network

30 This issue is a wider problem outside the scope of this project.

- Additional demand from BUCD or a new entrant is possible but highly unlikely.

These qualitative conclusions are supported by the quantitative valuation analysis carried out by Aetha Consulting as part of this study.

All recommendations in the remainder of this report are based on this understanding of the Belgian mobile market and the resulting spectrum demand.

Although not explicitly referenced as part of our demand assessment, we have also considered possible partnership scenarios between the various potential applicants – for example the combination of one of the three existing MNOs with another organisation (e.g. Bidco, BUCD or a new entrant). Despite the large range of potential permutation of sharing scenarios, we do not believe that these scenarios fundamentally change the conclusions expressed above.

4.4 Demand for 2.6GHz spectrum

In addition to the award of 800MHz, BIPT is also considering options for a renewed award of the spectrum which remained unsold as part of the 2011 auction. In total 2×15MHz remains available, with the existing holdings in the 2.6GHz band being distributed across the following operators:

- Belgacom and Mobistar acquired 2×20MHz of paired spectrum each
- KPN GB acquired 2×15MHz of paired spectrum
- BUCD BVBA acquired the unpaired spectrum (45MHz) in the centre gap of the band.

Analogous to our approach in Section 4.2, we evaluate the potential demand from existing parties for this spectrum and also consider whether Bidco, BUCD or a new entrant might consider applying for this spectrum.

4.4.1 Demand from Belgacom, Mobistar and KPN GB

We believe that there are two key reasons why demand for 2.6GHz spectrum from the existing mobile network operators is likely to be limited.

First, international awards have shown a strong decline in interest for this spectrum. The 2.6GHz spectrum was initially awarded in Scandinavian countries. At the time of these auctions, the 2.6GHz band was considered the main band for providing LTE services. In particular, operators felt that they needed this spectrum to offer the highest speeds (using carriers of 20MHz) and to provide sufficient capacity to meet data traffic demand. This demand was reflected in highly competitive auctions in Sweden (2008) and Denmark (2010), which resulted in prices of around EUR0.16-0.18 per MHz per pop which translates into the equivalent of about EUR17-20million per block of 2×5MHz spectrum in Belgium. However, over recent years, the 1800MHz band has evolved as the alternative high-frequency capacity band and demand for 2.6GHz spectrum has reduced significantly. This is reflected in significantly lower prices fetched at recent auctions and spectrum even remaining unsold in the recent Romanian spectrum auction.

Second, the maximum carrier size at which LTE can be used is 20MHz, which means that Belgacom and Mobistar would not derive significant benefits from this additional spectrum for LTE services at present. KPN GB however might benefit from an incremental 2×5MHz. In the longer-term, Carrier Aggregation Technology (CAT) may mean this spectrum is of more interest, but the timing of availability of such

technology is uncertain and the value operators are likely to prescribe on this potential option is likely to be limited.

Combining the above reasons with the fact that the operators already hold spectrum in the band leads us to conclude that demand from existing operators is likely to be limited. This is also somewhat reflected in the responses to the consultation as Belgacom states that it feels that the award of additional 2.6GHz spectrum would be premature and none of the operators express their willingness to acquire additional spectrum in the consultation responses.

Our valuation modelling also showed very limited value for 2.6GHz spectrum for existing operators given the availability of 1800MHz as a substitute band. It should also be note that the 1800MHz band offers better propagation characteristics and a growing device ecosystem (e.g. the latest iPhone).

4.4.2 Demand from Bidco / BUCD

As with the 800MHz band, it is difficult to assess the potential demand for 2.6GHz spectrum from Bidco. Bidco might have strong demand for 2.6GHz spectrum if it were to target an aggressive roll-out of LTE in the short to medium term with a traffic-intensive commercial service proposition. In such a scenario, Bidco could require 2.6GHz spectrum to complement its (potential) 800MHz and 1800MHz holdings to meet capacity requirements in densely populated areas.

At the same time, we note that Bidco has recently acquired a significant amount of spectrum suitable for the provision of HSPA (3G) data services and it has also the option to use 2×10MHz in the 1800MHz band for LTE capacity from 2015 onwards. This means that it has an attractive spectrum portfolio which it will first need to utilise before it would seek to derive value from additional spectrum, e.g. in the 2.6GHz band.

The latter point is supported by Bidco's response in the consultation which states that Bidco is not in favour of another 2.6GHz award in the short term.

Also, we note that demand for paired 2.6GHz spectrum from BUCD is unlikely given that is has not made use of the opportunity to acquire such spectrum in the 2011 award.

4.4.3 Demand from a new entrant

The lack of interest from new entrants in paired 2.6GHz spectrum[31] was apparent in the outcome of the 2011 auction. Based on the international evidence from spectrum awards in 2012, we do not believe that this level of interest is likely to have changed. Given the propagation characteristics of the 2.6GHz spectrum it is simply too costly to deploy a network without suitable complementary low-frequency spectrum.

As a result, we believe that the main demand from an additional new entrant for 2.6GHz spectrum would be in combination with an acquisition of 800MHz spectrum. In such a scenario, the new entrant would strongly benefit from additional capacity spectrum to meet its traffic demand in densely populated areas. The incremental capacity provided by the 2.6GHz band could help towards the development of a positive business case.

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31 We note that BUCD as a new entrant only acquired unpaired 2.6GHz spectrum.

However, as we have established in Section 4.2 that we believe that the demand for 800MHz spectrum from a new entrant is likely to materialise and likewise, we do not believe that there will be demand for 2.6GHz spectrum from a new entrant.

4.4.4 Conclusions

In summary, our analysis suggests that there is no pressing demand for 2.6GHz spectrum from existing operators, Bidco, BUCD or a new entrant. This view is supported by the evidence from recent spectrum awards in the band as well as from our valuation modelling.

This conclusion may be somewhat surprising in view of discussions regarding the release of additional spectrum, e.g. the European Commission's Radio Spectrum Policy Programme (RSPP) specifying a target of making a total of 1200MHz available for mobile services[32]. However, there are two issues between which we need to differentiate:

- Our analysis shows strong demand for low-frequency spectrum in Belgium. This is confirmed by the demand for such spectrum in recent auctions.
- We believe that there is no pressing demand for 2.6GHz spectrum in the short term. This demand might evolve over the coming years depending on the development of mobile data traffic and operator capacity requirements. It is therefore important to continue with the identification of additional spectrum bands which could be made available to mobile services in 5 – 10 years, if required.

We note, however, that in the event that Bidco, BUCD or a new entrant were to acquire 800MHz spectrum, then such an organisation might strongly benefit from access to additional 2.6GHz spectrum to meet capacity demands. This interdependency is further reflected in our recommendations on the 2.6GHz award process, as discussed in Section 8.

32 For further information on the RSPP, please access their online portal available at the following address: **http://ec.europa.eu/information_society/policy/ecomm/radio_spectrum/rspp/index_en.htm**

5 General licence terms

In this section we outline our recommendations on several key licence terms – namely licence duration (Section 5.1), services and technologies that can be deployed in the 800MHz band (Section 5.2), the tradability of licences (Section 5.3), interference management (Section 5.4), annual usage fees for the spectrum (Section 5.5) and payment terms for the main licence fees (Section 5.6).

5.1 Licence duration

We recommend that the duration for the 800MHz licences is the same as the 2.6GHz licences i.e. 15 years from notification of granting and extendable by BIPT for an additional 5 years after expiry of the initial 15 year period.

Alternative options we were considered included:

- Alignment of the end date of the 800MHz licences with the 2.6GHz licences. However, we did not identify any specific advantages to be gained from following this approach.
- A 20-year fixed duration. Mobistar raised this option in its response to BIPT's consultation document. We believe that a 15-year period is sufficiently long for licensees to ensure a reasonable return on any network infrastructure deployed using the 800MHz band. Also, new equipment is likely to need to be deployed after this initial time period in any case due to the replacement cycles of such equipment. Further to this, we note that the Royal Decree can provide the possibility for BIPT to grant a five-year extension to the initial 15-year period.

5.2 Service and technology deployments

We recommend that the licences for use of the 800MHz band are service and technology neutral. This is in line with EU legislation which requires such an approach to be adopted. We also note that applicants for the 2.6GHz band spectrum were required to indicate in their applications which technology they would use, though no restrictions were imposed on the technology that could subsequently be deployed.

5.3 Tradability of spectrum

We recommend that the 800MHz spectrum is fully tradable – within any limits set out by current/future spectrum caps. This is in line with EU spectrum policy which requires all mobile spectrum bands to be tradable. The 2.6GHz band spectrum is fully transferable and the Royal Decree allowing spectrum trading in Belgium was approved in February 2010.

In the event that some 800MHz spectrum were to be set aside for an operator as part of the award process, there is a risk of encourage speculators to acquire the spectrum in the event that it could subsequently be sold to the other operators in the market. Additional restrictions may therefore need to be placed on the timing from which any set-aside spectrum could be traded.

5.4 Usage conditions

We recommend that the usage conditions for the licences follow EC Decision 2010/267/EU which specifies the baseline technical requirements for the use of the 800MHz band, making reference to CEPT Reports 29, 30, 31 and 32 that were developed for the European Commission.

5.5 Annual spectrum usage fees

We recommend that the 800MHz licences are required to pay annual usage fees, in line with the precedent set for other frequency bands. However we recommend that the operators are required to pay any usage fees for their entire 800MHz holdings, regardless of the degree to which they are (or are not) utilising the spectrum. In respect of the level of these fees, we recommend that this is set at the same level as for the 900MHz spectrum (namely EUR174 850 per paired MHz per annum).

We believe that the annual spectrum fees provide an on-going incentive to free-up the spectrum if it is not required – though we note that this incentive is relatively weak in view of the modest level of the fees. We are concerned that the current practice of requiring licensees to only pay the annual fees for any spectrum they are using could create false incentives. For example, the deployment of a second UMTS/HSPA (3G) carrier in network capacity hotspots may have been delayed by operators due to the need for a nationwide fee to be paid as soon as one transmitter station using the frequency was deployed. In holding rights to use 800MHz spectrum, the licensee is depriving another party from being able to use the spectrum (opportunity cost) regardless of whether the licensee is actually using the spectrum. Therefore, the annual spectrum fee, which should partly account for this opportunity cost, should apply in any case.

This issue was also raised by Mobistar as part of the consultation process and we recommend applying a more incentive-driven approach to the 800MHz band.

5.6 Payment of fee arising from award process

We recommend that the terms of payment for the fee arising from the award process (e.g. the final auction price) could be made on similar terms to the 2.6GHz award process. This would mean that there is the option of either paying the full fee upfront or paying an equal amount on an annual basis throughout the licence duration, with an interest rate equal to the market rate + 2%.

The risk of our recommended approach is that it leads to the possibility of subsequent default by a licensee whilst having elected to pay off the total fees over the licence period. In this case, the Belgian Government would not be able to recover the full set of 800MHz fees. One option that could be considered to minimise this risk would be to require licensees to provide a bank guarantee for the outstanding amount.

We also note that in view of the interest rate terms, licensees in the 2.6GHz auction all decided to make an upfront payment for each licence. Similarly, no interest in this payment option was voiced during the consultation process, so we expect that few operators will consider this as an option.

As summarised in Figure 5-1, most other countries have required licensees to make full payment immediately following the completion of the auction process. The main exception to this was Denmark, where licensees are able to make staged payments over an 8 year period (at 0% interest rate).

Figure 5-1: 800MHz fee payment terms

Country	Payment terms
Denmark	Option to pay in full or pay 20% immediately with the following 80% spread over 8 years
France	Payment due immediately
Germany	Payment within 5 banking days of auction close
Italy	Payment immediately upon award
Netherlands	Payment within 2 weeks of invoice
Portugal	Two thirds of payment bid due immediately with the option to delay payment of the final third over up to 5 years at an interest rate of 6.08%
Sweden	Payment within 30 days of auction close

6 Coverage obligation

Within this section, we assess whether the introduction of a coverage obligation could be a suitable instrument in the context of the 800MHz award in Belgium.

We first discuss the aim and impact of coverage obligations (Section 6.1). Following a discussion of international approaches to coverage obligations in 800MHz awards (Section 6.2), we assess the level of current mobile and fixed broadband coverage in Belgium (Section 6.3). We then recommend what we consider to be an appropriate coverage obligation based on these assessments (Section 6.4).

6.1 Aim of a coverage obligation and impact on spectrum demand

A coverage obligation can be used to achieve a varied set of objectives:

- Continuation of existing services:
  - through previous spectrum acquisition, e.g.in the 900MHz band, operators will be required to meet specific standards regarding the quality of service and depth of coverage of their mobile services
  - a new coverage obligation can be used to effectively extend such coverage obligations and add new quality standards which are reflective of the latest technologies
  - in the case of the 800MHz band, one example of such an update would be to require a provision of mobile data services which reflect the potential capabilities of LTE.

- Addressing gaps in service provisioning:
  - in the absence of a coverage obligation, operators might roll-out their mobile services only to a smaller (more profitable) part of the country. As a result, less populated/wealthy areas might suffer from a lack of coverage. Regulators can use the coverage obligation to overcome such commercial roll-out limitations and ensure that the vast majority of the population can access all mobile technologies
  - LTE services provide the opportunity to provide an alternative to (basic) fixed broadband services. The coverage obligation could therefore be used to increase broadband coverage in areas which currently suffer from a lack of basic broadband services (we refer to these areas as 'white zones').

- Providing incentives to actively use acquired spectrum:
  - bidders might acquire spectrum for reasons other than using it for providing mobile services
  - for example, speculative bidders might look to acquire spectrum to sell it for more money at a later stage
  - also, existing mobile operators might look to hoard spectrum to strengthen their position in the mobile market vis-à-vis new entrants or smaller operators
  - by setting a coverage obligation specific to the acquisition of spectrum, regulators apply an opportunity cost to acquiring spectrum. This can strongly reduce the incentives for participating bidders not to use the spectrum for mobile services.

When designing a coverage obligation, regulators should ensure that they define the coverage obligation at an appropriate level:

- operators will assess the incremental cost caused by such an obligation relative to their planned roll-outs (in absence of such an obligation) in their approach to valuing the spectrum ahead of the auction
- depending on the conditions associated with the coverage obligation, operators might be required to build additional mobile sites

- if the requirements are defined too burdensome and the cost of a coverage obligation could outweigh the value of spectrum, operators might decide not to buy any spectrum.

In developing the recommendation for the coverage obligation, we have closely considered the points mentioned in this section.

6.2 International approach to coverage obligations for 800MHz spectrum

As part of the regulations concerning previous (and planned) 800MHz awards in Europe, regulators have frequently applied coverage obligations to the available spectrum. Figure 6-1 provides a summary of the most notable approaches taken in those countries which have awarded (or plan to award) the 800MHz band.

Figure 6-1: International approach to coverage obligations for the 800MHz band

Country	Coverage obligation	Quality of Service	Packaging
Denmark	• Within identified areas (low broadband availability): – 98% of geographic area – 99.8% of households • To be completed in 3 years • Could be achieved with any band	• Experienced outdoor downlink speeds ≥10Mbit/s	Awarded as 3 separate obligations
France	• Priority zones are areas of low 3G coverage • 40% of priority zones within 5 years, 90% within 10 years • 98% of total population within 12 years, 99.6% within 15 years • Use of 800MHz band required	• Peak theoretic downlink (95% probability of successful connection) based on spectrum acquired – 30Mbit/s (2×5MHz), – 60Mbit/s (2×10MHz)	Opportunity for bidders to 'opt in' coverage obligation (increased bid score)
Germany	• Areas underserved by traditional broadband split in 5 priority zones • 90% of population within each priority zone must be covered before operators can move to next zone • In addition, operators have to cover 50% of population by 1 January 2016 (~5.5 years) • Obligation is fully technology neutral	• Broadband strategy by German government defined 'broadband' as services with speeds in excess of 1Mbit/s	Applied to all lots as a joint obligation
Ireland	• Existing operators to cover 70% population within 3 years • New operators to cover 35% within 3 years, 70% within 7 years • Could be achieved with any band	• Coverage assessed against distinct technical criteria	Applied to all lots
Italy	• 30% of municipalities with less than 3,000 residents to be covered within 3 years, 75% within 5 years. • Municipalities requiring coverage are split between operators and are exchangeable • Use of 800MHz band required	• Coverage assessed against distinct technical criteria	Applied to all lots
Netherlands	• 0.7% of geographical area within 2 years, 18% within 5 years • Use of 800MHz band required	• Average downlink speeds of 2Mbit/s to 90% of the population of each municipality	Applied to 5 of 6 blocks
Spain	• 90% of population in towns (<5,000 residents) by 1/1/2020 (~8.5 years) • Use of 800MHz band required	• No detail provided	Applies cumulatively per acquired block

Country	Coverage obligation	Quality of Service	Packaging
Sweden	• Coverage to all buildings lacking a basic broadband connection: • 25% of buildings within 1 year, 75% within 2 years, 100% within 3 years. • Use of 800MHz band required	• Peak downlink speeds of 30Mbit/s	Applies to operators with at least 2×10MHz of 800MHz spectrum
United Kingdom	• Required to cover 98% of population in indoor areas (99.8% outdoor) • This includes at least 95% of each nation, by 31 December 2017 • Obligation is technology neutral	• Average downlink speeds of 1 Mbit/s	Applied to 1 specific lot

Across these different countries, a number of observations can be drawn:

- regulators have used a range of different approaches to define the 800MHz coverage obligations
- the obligations have typically focused on covering areas which suffer from a lack of fixed broadband
- the obligations are highly specific to the requirements of the country and focus on a clearly defined set of coverage areas
- the obligations typically specify the provisioning of services at relatively low average downlink speeds (1-2Mbit/s). Any obligations which mention speeds close to the requirements of the Digital Agenda targets are defined in terms of (theoretic) peak downlink requirements.
- higher-speed obligations have only been applied to bidders winning at least 2×10MHz in the 800MHz band.

The benchmark in particular highlights the need for the coverage obligation to be tailored to the individual requirements of the country in which the auction takes place. Over the course of the following sections, we look to identify clearly how we believe such a 'Belgian' coverage obligation should be structured.

In addition, the approaches applied by the different regulators lend support to our recommendation that the Royal Decree should focus on average user speeds rather than (theoretic) peak downlink speeds. It is this average user speed which determines the user experience and should thus be at the core of the definition of any quality-of-service based coverage obligation. The examples also highlight the uncertainty around the actual performance which can be delivered by next generation mobile technologies such as LTE, as the average downlink requirements have typically been defined within the range of 1-2Mbit/s (with the exception of Denmark which took a more aggressive approach). Within our recommendation, we have followed this more conservative approach towards defining a coverage obligation to ensure that the cost to licensees will not unduly reduce the demand for 800MHz spectrum.

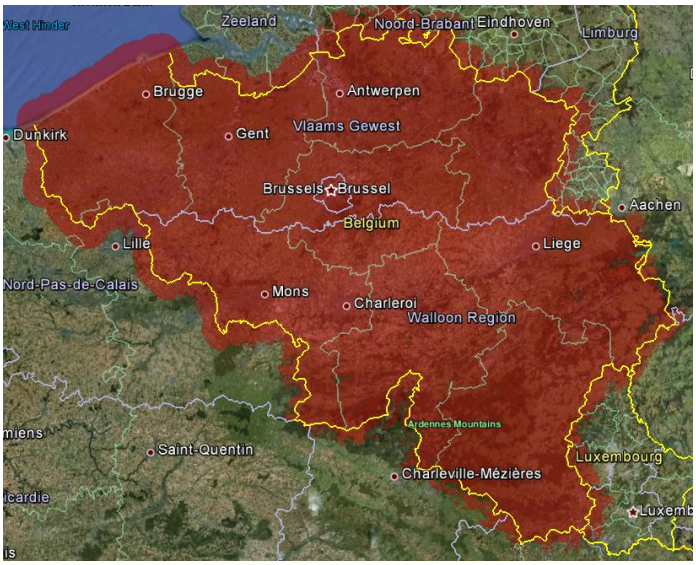
6.3 Current coverage levels

At this point in time, the three existing network operators offer GSM (2G) and UMTS/HSPA (3G) services with the spectrum they have acquired in the past. Based on information received from BIPT, we understand that the overall coverage levels for GSM (2G) services are nearly ubiquitous, with operators reaching levels in excess of 99.5 % of population. An example for the overall coverage levels achieved with GSM (2G) services is shown in Figure 6-2.

Figure 6-2:

Example of GSM (2G) coverage levels currently provided by Belgian mobile operators

[Source: BIPT, 2012]



The key thing to note is that operators are currently using a combination of 900MHz and 1800MHz spectrum to achieve these GSM (2G) coverage levels. Following the award of the 800MHz band, operators are most likely to use a combination of 800MHz and 1800MHz/2.6GHz spectrum to provide LTE coverage and 900MHz and 2.1GHz spectrum to provide UMTS/HSPA (3G) coverage. Taking into account the link budget characteristics of the available spectrum for the different technologies, this means that an operator with 800MHz spectrum should be able to replicate the extent of current GSM (2G) coverage with other technologies using the operator's existing 900MHz/1800MHz network grid. It thus follows that operators should be able to maintain current coverage levels (with respect to the percentage of population covered) in the future using different technologies without being required to build a significant number of additional sites. We will further discuss the implications of this observation in the following sections.

Regarding current coverage of UMTS/HSPA (3G) services, we understand that there are still some areas, especially in the southern part of Belgium, which are not covered at this point in time. One of the key reasons for this could be that operators have not yet been able to re-farm sufficient low-frequency spectrum (in the 900MHz band) in these areas to deploy these services efficiently. We will address this concern in our recommendation on the coverage obligation.

With respect to the levels of fixed broadband coverage, Section 4.1 outlined that general fixed broadband coverage in Belgium is significantly above the European average. As mentioned in Section 3.3, we are aware that BIPT is currently identifying a set of areas which are potentially underserved by fixed broadband today and are unlikely to be served through market mechanisms in the coming years. Within this section, we outline how these 'white zones' could possibly be taken into account in the design of an 800MHz coverage obligation. However, it should be highlighted that this would pose difficulties regarding a timely implementation of the award process.

6.4 Recommendation on 800MHz coverage obligation

In light of the current situation in Belgium, we recommend a two-staged approach to the coverage obligation:

- the first stage implements a 'standard' mobile coverage obligation which applies to all licensees. The main aim of this obligation is to ensure a continuation of mobile voice services at current coverage levels and ensure that the operators provide mobile data services which make use of the capabilities of

LTE technology. At the same time, the obligation would ensure preferential treatment of areas currently underserved by mobile data technologies.

- as a second stage, an 'additional' coverage obligation could be considered which would be targeted at ensuring that 'white zones' are covered through an alternative wireless service which provides the required broadband speeds. This could potentially be applied to just one licensee, as network duplication in these low population areas may offer little if any benefit.

6.4.1 Standard coverage obligation

We recommend a standard coverage obligation which is defined along the following criteria:

- Each licensee is required to maintain outdoor coverage[33] of its mobile services across an area which covers 98% of the population with the following criteria for the quality of service:
  - Licensees acquiring 2×5MHz of spectrum should be required to provide mobile data services with an average downlink user throughput of 1.5Mbit/s[34].
  - Licensees acquiring 2×10MHz of spectrum (or more) should be required to provide mobile data services with an average downlink user throughput of 3Mbit/s.
  - More information on how these criteria are measured is provided in Section 6.4.4.

- This coverage target should be met within the timelines detailed below. We recommend to relax the conditions for licensees which do not have access to a 900MHz network grid at the time of auction:
  - 33% of the population coverage target within 2 years of awarding the spectrum (3 years without existing 900MHz network).
  - 66% of the population coverage target within 4 years of awarding the spectrum (6 years without existing 900MHz network).
  - 100% of the population coverage target within 6 years of awarding the spectrum (9 years without existing 900MHz network).

- Furthermore, BIPT should identify a list of postcode areas which are currently covered by GSM (2G) services but are not covered by UMTS/HSPA (3G) services[35]. Within these areas, 800MHz licensees would be required to provide mobile services meeting the above service criteria within the first 2 years of award of the spectrum.

- Each licensee can achieve / maintain this coverage obligation using any combination of the spectrum bands available to them.

- Each licensee has to fulfil this coverage obligation individually.

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33 We have intentionally refrained from basing our recommend coverage obligation on indoor coverage as there are different means for operators to increase the signal strength indoors through solutions such as repeaters, WiFi or femtocells. In addition, it is significantly more difficult to unambiguously define what 'indoors' exactly means.

34 Although our recommendation in Section 8 is to only use spectrum packages of 2×10MHz, our recommendation on the coverage obligation is kept more broadly to provide options to the Minister/BIPT in case they decide not to follow our recommended packaging format.

35 This could also comprise areas where UMTS/HSPA (3G) coverage is poor/"patchy".

The recommended coverage level has been designed to address the situation in the Belgian market whilst, at the same time, not being strenuous to achieve for existing operators. In particular, one reason for setting a coverage obligation that is neutral as to the spectrum bands used to achieve the obligation is to enable coverage to be provided in Brussels given the strict emissions limitations. We expect that operators will find solutions to deploy mobile data services achieving the required throughput levels in the largest addressable market within the country.

In particular, the cost of implementing this coverage obligation should not be prohibitive. As discussed above, all existing operators already provide ubiquitous access to voice services to their subscribers. This implies that there should be a limited incremental cost to meeting the criteria of the coverage obligation.

One key question regarding the target is the average downlink speed specified in the coverage obligation. Operators today provide between 1-2Mbit/s using UMTS/HSPA (3G) services. The coverage obligation should reflect the technology advances expected through next generation mobile services and define a requirement which is above that for current mobile data services. At the same time, these new technologies have not been tested to date and the full extent of the improvements which can be achieved are not clear to date. As a result, we have decided to set a cautious target[36] noting that future spectrum awards (e.g. 2.1GHz, 700MHz) could be used to increase the requirement if required. Again, we note that this target seems particularly achievable for mobile operators with existing site portfolios and might actually be exceeded as part of their commercial ambitions. We have further adjusted the requirement depending on the amount of 800MHz spectrum acquired to reflect the performance differences resulting from different LTE carrier sizes[34].

As mentioned in Section 4.3.4, the licence conditions should take into account differences between applicants to ensure a level playing field. The fact that this coverage obligation is more difficult to achieve for applicants without an existing low frequency network grid should therefore be reflected in the coverage obligation. We thus recommend increasing the time allowed to meet the coverage obligation in light of the required investments and operational constraints for licensees without an existing low-frequency grid.

Furthermore, with the availability of additional low-frequency spectrum, we expect that the coverage of areas currently underserved by UMTS/HSPA (3G) should not come at a significant cost and could be achieved as part of the initial 2-year roll-out phase of the standard coverage obligation.

We note that the design of the coverage obligation also reflects the comments made by operators in their responses to BIPT's consultation on the 800MHz band:

- allowing operators to use any spectrum band to achieve the coverage obligation should address Belgacom's comments around the concern that a 90% population coverage target appears ambitious in light of the emission restrictions in Brussels.
- some operators voiced their concerns about a target of 30Mbit/s, in particular if applied as an average bitrate. However, Bidco quoted that an average speed of 5-12Mbit/s had been achieved in the US.
- Belgacom and KPN GB agreed that all bands should be taken into consideration when fulfilling the coverage obligation.

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36 The target of 3Mbit/s is based on the lower bound of expected LTE performance at the cell edge. For example, see Nokia Siemens' view on performances of LTE in rural areas: **http://www.wik.org/fileadmin/Konferenzbeitraege/2012/Mobile_broadband/Rehfuess_LTE_20120911_final.pdf**

- Belgacom and Mobistar did not object to the proposed timelines for the coverage obligation. Bidco's comments on a longer timeframe required have also been taken into account in the design of the obligation.

6.4.2 Additional coverage obligation

In addition to the standard coverage obligation, an additional coverage obligation could also be introduced which would be focused on making available an alternative wireless service which provides the required broadband speeds to 'white zones'. Such an approach has been used in some historic 800MHz awards, for example in Germany, Sweden, Italy and Romania.

This additional coverage obligation could include more stringent criteria on the quality of service provided. For example, the Royal Decree could specify that households in white zones could be guaranteed a 'minimum' (rather than average) service level of (for example) between 3-5Mbit/s. Depending on the number of households included in the definition of the 'white zones', it might be considered whether this obligation is applied to one or several bidders. The proposal would have to consider the trade-off between increasing the cost of the coverage obligation to licence holders and the desire for infrastructure-based competition in underserved areas. Unless the white zones covered a very large area, we would recommend applying the obligation to just one operator, as there is most unlikely to be an economic case for constructing duplicate mobile infrastructure in such areas, and customers would presumably benefit anyway from mobile prices set at a national level regardless of whether there is a choice in provider within any particular zone.

However, this coverage obligation relies on a very specific definition of the areas which form part of the coverage obligation. We understand that BIPT is currently researching this area but that this information may not be available for some time. In order to ensure that the 800MHz award process proceeds on a timely basis, BIPT may decide that it is not possible for such an additional coverage obligation to be further considered as part of the award of the 800MHz band, particularly since any delay to the award of the 800MHz band leads to a corresponding delay in the realisation of the significant benefits arising from making the band available for electronic communications services.

We also note that in their responses to BIPT's consultation document, none of the operators were in favour of introducing a coverage obligation focused on introducing mobile services as a replacement of fixed services in specific priority areas.

If it is decided to introduce an additional coverage obligation that applies only to one rather than all available licences, this will need to be reflected in the decision on spectrum packaging and the award process design. We explore how this could be done in Section 8.

6.4.3 Alternative approaches that were considered

In addition to the recommended coverage obligation, there would be some alternative options available which we do not recommend:

- It could be decided not to introduce a coverage obligation. However, we believe that this would not provide the right incentives for operators to use their spectrum holdings efficiently and it would reduce the barriers for speculative entry.

- It could be decided to introduce a coverage obligation based on peak speeds (rather than average throughputs). As explained in Section 6.2, we do not believe that such peak speeds are a relevant metric to the overall user experience.

- It could be decided to introduce a coverage obligation designed to assist in meeting the Digital Agenda targets. The European Commission has defined a set of ambitious targets to generate wider access to high-speed broadband service across Europe (e.g. ubiquitous access to 30Mbit/s by 2020). However, as discussed in Section 3.3, at this point in time it is not proven that LTE services can provide the performance necessary to meet the targets of the Digital Agenda, in particular with regard to average throughput. A material risk of an ambitious coverage obligation designed with the Digital Agenda targets in mind would be that the 800MHz spectrum could remain unsold.

6.4.4 Measuring the coverage obligation

We recommend that BIPT uses the following criteria for measuring the compliance of mobile operators with the criteria defined in the coverage obligation:

- Operators have to comply with the coverage obligation by offering the average speed specified by the licence conditions across the required coverage area in the period from 07:00 to 23:00 (CET).

  – This effectively ensures that, throughout the coverage area and the most relevant time of day, consumers benefit from the specified service criteria. The period from 07:00 to 23:00 (CET) has been chosen in light of the fact that it will cover the vast majority of mobile data usage.

  – We realise that, at times during the specified period ("peak usage hours"), mobile data throughput across the operator's network could possibly drop below the specified average speed threshold. This will be particularly likely to happen during peak hours when many subscribers access the network simultaneously.

  – However, by defining the obligation based on "average" rather than "minimum" speeds, operators can compensate for such temporary reductions in service quality by providing a higher level of services across the remainder of the day ("off-peak usage hours").

- BIPT requires operators to provide, at the critical points of the defined timelines (2, 4 and 6 years after awarding the spectrum in the case of existing mobile network operators), a set of detailed documents which prove that the operators comply with the criteria of the coverage obligation. These documents should be based on either:

  – Detailed software simulations carried out by the operators based on the actual network design parameters used by the operators. The operators should provide accompanying documentation including information on relevant simulation inputs such as site locations, power levels and the assumed link budgets.

  – The results of several drive tests or other forms of performance measurement. Consideration should be given to the fact that the provided tests are based on a representative sample of times (reflecting the split of "peak usage" and "off-peak usage" hours).

- Should BIPT have any concerns about the accuracy of the information provided, it should at any point in time reserve the right to commission audits confirming the results of the analysis submitted by the mobile operators. In this respect, please note that greater consideration might be given to

measurements of actual performance (e.g. drive tests) than theoretical estimations of network performance (e.g. propagation simulation software).

  - If drive-tests or other forms of measurement of actual performance are carried out (as opposed to theoretic modelling of the operator's network performance), the sample of measurements should be weighted to accurately reflect the relation of "peak usage" and "off-peak usage" hours within the specified period.

These recommendations are based on the approach taken by regulators in other 800MHz awards where coverage obligations and measurement procedures have been specified as part of the award conditions. In particular, regulators in the following countries have considered in detail how to measure compliance with a coverage obligation by mobile operators:

- **Denmark** – Operators are required to provide documentation to the regulator at the time that they have met the coverage obligation targets. They are allowed to provide direct evidence of the functioning of the network (e.g. drive tests), or are alternatively offered the option to instead provide an estimate of current service levels by means of a simulation model.

- **Ireland** – Compliance reports have to be submitted annually by operators, At the time that the coverage obligation within an area is first met, mandatory drive-tests have to be included as part of the reports. In addition, the reports have to provide coverage maps, a list of base stations and the results of the performed coverage tests. The exact measurements required for the reports are determined in discussions between the regulator and operators. The quality of service for the coverage requirements is defined as an outdoor signal 1.5m above ground which is guaranteed in over 95% of the coverage area at 95% of the time.

- **Sweden** – Compliance reports have to be submitted annually by operators. These reports have to detail current and expected coverage areas for the calendar year. Coverage maps should be added to the reports, whilst the regulator is allowed to request further information to verify the accuracy of the coverage information provided.

- **UK** – Operators are required to supply detailed network data which allows the regulator to perform theoretic coverage testing. The tests are planned to be performed at the cut-off point for the coverage requirements, as specified in the licence conditions. The regulator, using a publicly available methodology and model, then determines whether the coverage obligation has been fulfilled.

7 Pro-competitive measures

In this section, we present alternative options and preliminary recommendations on several key policy issues relating to the 800MHz band that are likely to impact downstream competition in the mobile market. Specifically, we discuss the issue of whether to reserve spectrum for an operator (Section 7.1), the imposition of spectrum caps (Section 7.2), network and frequency sharing (Section 7.3), mandated wholesale access (Section 7.4) and national roaming (Section 7.5).

7.1 Spectrum reservation

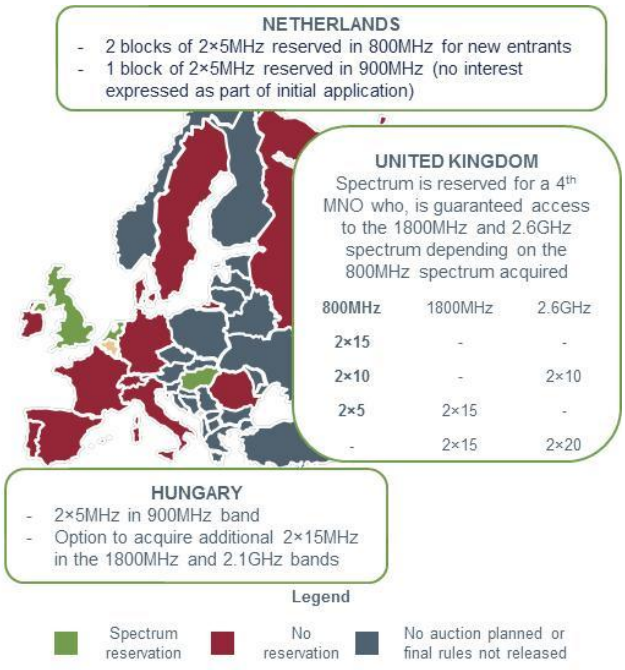
Spectrum can be reserved (set-aside) for one or more operators without existing spectrum holdings or suitable mobile infrastructure in order to maximise the likelihood of an additional mobile infrastructure provider in the market after the auction. In a competitive auction process, a set-aside ensures that the existing operators cannot bid strategically to prevent such an additional operator from entering the market. The ultimate objective of promoting these operators is to create a sustainable new market player leading to increased levels of infrastructure-based competition and lower prices/better services for consumers in the downstream mobile market. In addition to considering the case of whether spectrum should be set aside for an operator, we noted that in its submission to BIPT's consultation, Bidco suggested that a two stage auction process should be adopted (similar to that adopted for the 2.1GHz spectrum in 2011). This would effectively give operators who do not currently hold any 900MHz or 1800MHz spectrum 'first refusal' on the 800MHz spectrum. We have therefore considered the merits of this proposal in our assessment.

The main disadvantage of setting aside spectrum is that the existing operators do not have the opportunity to acquire and make use of this spectrum. In the case of the 800MHz band this is a major consideration as the total amount of spectrum available in the band is limited to 2×30MHz and individual operators will typically each seek 2×10MHz of spectrum in order to derive the main benefits (peak data rate and spectral efficiency) from deploying LTE technology. A spectrum set-aside would therefore create a significant opportunity cost, as we have discussed in Section 4.3.2 that demand from the three existing MNOs for at least 2×10MHz of 800MHz spectrum is likely to be significant.

As shown in Figure 7-1 below, spectrum reservations in recent spectrum award processes in other European countries have been very limited. In the case of the 800MHz band, so far only the Netherlands have set aside spectrum for new market entrants (two blocks of 2×5MHz have been reserved for new entrants). However, this is within the context of a multi-band (800MHz, 900MHz, 1800MHz, 2.1GHz and unpaired 2.6GHz)) spectrum auction where the overall amount of spectrum available amounts to more than 300MHz.

Figure 7-1:

Spectrum reservations in European 800MHz auctions



Our overall recommendation is that the Royal Decree does not reserve any spectrum for new market entrants for the following reasons:

- The likelihood of a new entrant entering the market is very low – we are not aware of any organisations seeking to enter the market and our business modelling work suggests that the business case for such an organisation is challenging.
- The amount of 800MHz spectrum that is available is limited – and there is potentially a high opportunity cost of taking this spectrum away from any mobile operators that may be willing to pay more than an entrant bidder in an auction as this could weaken that operator's position in the market – and potentially result in a reduction in the overall level of market competition.
- Setting aside spectrum could attract a financial speculator to acquire the spectrum who would simply seek to re-sell this spectrum (at a profit) to one of the existing operators in the medium-term, once any controls preventing the sale of the spectrum have expired.
- Mobistar and KPN GB are part of multi-national operator groups who have shown interest in selling their European subsidiaries – promotion of new market entry in addition to existing operators could therefore lead to reduced investment in the Belgian market by these organisations.
- With the exception of the Netherlands, there have not been any set-asides of 800MHz spectrum for new entrants – for the same/similar reasons as the above.

Note that although spectrum is not specifically reserved for a new entrant, this does not prevent such an organisation from participating in the award process, based on the strengths of its business case for use of the spectrum.

We have also considered whether it would be appropriate to set aside spectrum for any of the organisations in Belgium that currently holds spectrum in one or more of the internationally harmonised mobile spectrum bands (900MHz, 1800MHz, 2.1GHz or 2.6GHz) but does not have a significant portfolio of spectrum in

totality across all of these bands (i.e. Bidco and BUCD). Our recommendation is that there is no set-aside 800MHz spectrum for these organisations, for the following reasons:

- The opportunity cost of setting aside spectrum for either/both of these organisations is high. In effect, this would reduce the amount of spectrum that is available to Belgacom, Mobistar and KPN GB potentially weakening the competitive position of one or more of these organisations.
- The amount of mobile network infrastructure that has been deployed by these organisations to-date is very limited. In reserving spectrum for these organisations, there is no guarantee that network infrastructure deployments will occur in the short or medium term[14] (again with the risk that overall levels of infrastructure competition could be reduced as a result of any set-aside of spectrum).
- No European countries have set aside spectrum for a 'fourth operator' with the exception of the UK where a fourth operator is to be guaranteed a 'minimum spectrum portfolio' in the forthcoming auction. We note that Ofcom has taken this action in the UK in view of the current distribution of spectrum holdings, as shown in Figure 7-2.

Figure 7-2:

Overview of current mobile spectrum holdings in the UK

[Source: Ofcom, 2012]

Operator	900MHz	1800MHz	2.1GHz[37]
O_2	2×17.4MHz	2×5.8MHz	2×10MHz
Vodafone	2×17.4MHz	2×5.8MHz	2×15MHz
EE	-	2×60MHz	2×20MHz
Three	-	-	2×15MHz

It can be seen only two operators currently have access to low frequency (sub 1GHz) spectrum that is key for cost efficient network coverage. One UK operator has a very large proportion of spectrum in the 1800MHz band and the fourth operator only has access to spectrum in the 2.1GHz band. By contrast, Belgium has taken a similar approach to that adopted in many other European countries, and has undertaken a re-balancing of spectrum holdings to ensure that four network operators have access to spectrum across several frequency bands. Consequently, we do not believe that a 'minimum spectrum portfolio' approach needs to be implemented in the 800MHz award process in Belgium given that:

- Bidco will have access to 2×4.8MHz of 900MHz spectrum from November 2015 – this spectrum can be used to deploy a wide coverage LTE network in the event that Bidco is unsuccessful in acquiring 800MHz spectrum (though we note that it would only be possible to deploy a 5MHz LTE carrier using this spectrum and consumer equipment availability in the 900MHz band is not guaranteed).
- Bidco will also have access to 2×10MHz of 1800MHz spectrum from November 2015 – whilst the propagation characteristics of this band are not as strong as sub 1GHz spectrum, the combination of 2×4.8MHz of 900MHz spectrum and 2×10MHz of 1800MHz means that Bidco has a credible alternative LTE deployment plan in the event that it does not acquire 800MHz spectrum in the forthcoming award process.

37 This excludes unpaired 2.1GHz spectrum holdings.

  - Bidco previously had the opportunity to acquire 2×15MHz of 2.6GHz spectrum in the auction in 2011, but chose note to participate.

- Most importantly, the lack of a set-aside does not prevent either Bidco or BUCD from competing to acquire 800MHz spectrum in the award process on the respective strengths of their business case.

7.2 Spectrum caps

As shown in Figure 7-3, spectrum caps have been imposed in all European 800MHz auctions in view of the limited amount of spectrum available and the corresponding risk that one or more participants would seek to acquire a large amount of the band in order to gain a significant competitive advantage in the downstream mobile market. The spectrum caps either apply to the 800MHz band or are considered as a joint low-frequency (sub 1GHz) spectrum cap covering both the 800MHz and 900MHz bands. The latter approach has typically been applied either in countries where the 800MHz and 900MHz band were awarded simultaneously or where there is an uneven distribution of existing 900MHz holdings (e.g. in the UK or Germany).

Figure 7-3: Spectrum caps in European 800MHz band auctions

Country	Number of operators	Spectrum cap
Denmark (06/2012)	3	800MHz spectrum cap of 2×20MHz
France (12/2011)	4	800MHz spectrum cap of 2×15MHz
Germany (05/2011)	4	Spectrum cap of 2×20MHz across the 800MHz and 900MHz bands[38]
Ireland (Q3 2012)	4	Sub 1GHz spectrum cap of 2×20MHz, with a total cap of 2×50MHz
Italy (08/2011)	4	Sub 1GHz spectrum cap of 2×20MHz
Netherlands (Q3 2012)	3	Two lots of 2×5MHz set aside for new entrants, the remaining spectrum available to any operator
Portugal (12/2011)	3	800MHz spectrum cap of 2×10MHz
Spain (07/2011)	4	Sub-1GHz spectrum cap of 2×20MHz
Sweden (03/2011)	4	800MHz spectrum cap of 2×10MHz
United Kingdom (Q1 2013)	4	Sub-1GHz spectrum cap of 2×27.5MHz with a total cap of 2×105MHz

In addition to whether or not to impose a cap, the Royal Decree also has to provide for an appropriate level for the cap. In view of the (relatively) equitable distribution of 900MHz spectrum in Belgium, we recommend that the spectrum cap should focus on the 800MHz band.

[38] Effectively, the spectrum cap was actually 2×22.5MHz in Germany given T-Mobile's and Vodafone's holdings in the 900MHz band.

The setting of the level of spectrum cap for the 800MHz is essentially a trade-off between the number of competing infrastructure providers deploying 800MHz spectrum and the individual network performance/spectral efficiency that is achieved (as larger channel widths support higher peak data rates and provider greater spectral efficiency in LTE networks). Typically European operators have sought a minimum of 2×10MHz of spectrum in the 800MHz band so appropriate levels of cap in Belgium could be 2×10MHz, 2×15MHz and 2×20MHz.

On balance, we recommend that the Royal Decree imposes a cap of 2×10MHz for the 800MHz for the following reasons:

- This enables operators to acquire 2×10MHz of spectrum which is considered the minimum to achieve the main benefits of LTE technology and is the amount of 800MHz spectrum that almost all operators in Europe have acquired in previous auction processes.
- This increases the chances that there will be at least three competing 800MHz infrastructure providers – a key objective of the Minister and BIPT from the award process in order to maximise the degree of competition in the downstream mobile market. Setting a cap of 2×15MHz or 2×20MHz could potentially result in only two operators acquiring 800MHz spectrum (as was the case in Denmark).
- The use of a 2×10MHz cap was also proposed by Belgacom and KPN GB in their responses to the consultation document – none of these operators highlighted the need to be able to compete for larger amounts of 800MHz spectrum.

The downside of limiting the cap to 2×10MHz (rather than 2×15MHz, for example) is that it could result in the level of competition in the award process being very limited. We discuss this risk and its implications of this aspect further in Section 8.

7.3 Network and frequency sharing

As shown in Figure 7-4, full scale network sharing arrangements (of active equipment as opposed to site sharing arrangements for passive components) are becoming increasingly common across Europe as way of managing costs at times when revenues/growth is under pressure. Such agreements tend to be set-up/work best when executed at the start of a technology refresh cycle (e.g. introduction of LTE).

Figure 7-4: Examples of network sharing arrangements in Europe

Country	Network sharing information
Denmark	Mast/site sharing mandated under national law – public wholesale price agreements
France	Interest from France Telecom to enter infrastructure sharing agreement
Ireland	Commercial agreements exist between Vodafone & Three as well as Eircom & O_2
Sweden	Commercial agreements exist between Telia &Tele2 as well as Telenor & Hutchison
United Kingdom	Commercial agreements exist between O_2 & Vodafone as well as Everything Everywhere & Three

We do not recommend that the Royal Decree imposes any specific measures in relation to network sharing as part of the 800MHz auction process for the following reasons:

- Network sharing arrangements tend to be put in place in advance of spectrum award processes (e.g. through establishment of joint ventures to bid in an auction) rather than as a result of mandated licence conditions.
- Such sharing arrangements often relate to one or more technologies (e.g. UMTS, LTE) and can apply across multiple frequency bands.
- BIPT can assess any network sharing arrangements as and when an application is made by operators. In this respect, we note that site sharing is imposed by existing legislation[39] and that BIPT has previously published guidelines on infrastructure sharing[40].

Frequency sharing arrangements are relatively rare[41] (see Figure 7-5 for further details). The primary example of such an arrangement being promoted as part of a spectrum award process is that of France where the 800MHz licences mandated the holders of the lower 20MHz of the band to share frequencies when approached by another licensee, under reasonable commercial terms and only for the purpose of covering priority roll out zones as part of their coverage obligation.

Figure 7-5: Examples of frequency sharing arrangements in Europe

Country	Frequency sharing information
Denmark	Not mandated but allowed if negotiated commercially (providing approval is granted by the regulatory authority)
France	Operators holding the lower 20MHz of the 800MHz band are mandated to share frequencies when approached under reasonable commercial terms. Frequency sharing is only permitted to cover priority roll out zones – sparsely populated areas (18% pop. in 63% area)
Ireland	Considered by the regulator and competition authority on a case by case basis
United Kingdom	No plans to allow frequency sharing

We recommend that BIPT only considers applications for frequency sharing arrangements between operators as and when they arise. At the same time, BIPT could indicate that it would be more inclined to

39 Articles 25 to 27 (Section 3) within the Act of 13 June 2005 on electronic communications provide a set of articles through which mobile operators are strongly encouraged to share their antenna sites (including amongst others access to the mast/pylons). The law further imposes on the operators the requirement to make their competitors aware of a new aerial whilst in the process of installing a new antenna site. These requirements are designed to provide sufficient time to the operators to consider sharing the facility.

40 See: **http://www.bipt.be/ShowDoc.aspx?objectID=3666&lang=nl**

41 We refer here to frequency sharing between different mobile network operators. Frequency sharing between different uses of spectrum (e.g. between satellite services and microwave fixed links) is very common and increased levels of sharing between different uses are being actively encouraged by the European Commission in order to make more efficient use of the spectrum.

support an application for frequency sharing if it were to lead to a significant increase in the quality of service to consumers in area where broadband provision is limited (e.g. the white zones).

In the event that the Royal Decree were to set an additional coverage obligation (see Section 6) specifying high data rates, this might require operators to deploy large 800MHz carriers to achieve the obligation. These large carriers might be required from a technical perspective to achieve the required data rates and from an economic perspective to limit the number of incremental mobile sites which need to be built. In this instance, BIPT could mandate frequency sharing between two or more 800MHz licensees.

7.4 Mandated wholesale access

Mandated wholesale access means that the winners of 800MHz spectrum are obligated to offer wholesale LTE services across the 800MHz network to those operators that did not secure any 800MHz spectrum.

Such wholesale arrangements can be achieved by operators on a purely commercial basis. Through mandated wholesale access, operators with 800MHz licences are incentivised to achieve a commercial arrangement as the mandating would provide the option of recourse to the regulator in the event that a commercial agreement cannot be achieved directly by the parties concerned. Mandated wholesale access should not be confused with national roaming. We discuss the concept of national roaming further in Section 7.5.

The mandating of wholesale access is, under the European framework for the regulation of electronic communications framework, usually considered as a remedy in markets where significant market power exists. However mandated wholesale access has been included in 800MHz award processes in some countries as an ex-ante regulatory measure. Figure 7-6 provides an overview of the mandated wholesale access arrangements for 800MHz spectrum that have been specified in Europe.

Figure 7-6: Examples of mandated wholesale access arrangements in European 800MHz awards

Country	Mandated wholesale access regulation
France	Bidders winning (at least) two lots were mandated to provide access to operators who hold 2.6GHz spectrum and had participated in 800MHz auction but were not awarded spectrum
Italy	Operators must accept reasonable requests for access in areas where the 800MHz spectrum is being under-utilised
Portugal	Bidders winning 2×10MHz required to offer wholesale access and national roaming to other operators
Romania	Coverage obligation relaxed in exchange for commitment to offer wholesale access. Specifically the mobile broadband speed requirement was reduced (to provide 1Mbit/s instead of 2Mbit/s to 60% of population by 2019, with an extra 2 years to raise speeds to 2Mbit/s)

The principal risk associated with mandating wholesale access as part of the 800MHz auction award process is that organisations could potentially seek to take advantage of such a provision. They could do so by participating in the award process simply to acquire the benefit of guaranteed wholesale access without ever having had the intention to acquire spectrum (or even roll out a network). Given the expected demand from existing operators, participation in only the initial round of the auction carries a very low risk of actually winning spectrum. Such behaviour would be in sharp contrast to the intention of mandated wholesale access which is to reward organisations that had intended to acquire 800MHz spectrum and deploy their own networks but had been unsuccessful in the award process.

Balancing the benefits of mandating wholesale access against the above risk, our overall recommendation is that the risks outweigh the benefits and the Royal Decree should therefore not mandate wholesale access. This is because:

- We believe the benefits of mandating wholesale access in Belgium are likely to be limited as the wholesale market appears to currently functioning well in the absence of any regulatory intervention. Specifically we note that:
  - There has been healthy growth in the number of subscribers to Mobile Virtual Network Operators (MVNOs). MVNOs account for 4.9%[42] of the total mobile subscriber base and Telenet had 275 400 subscribers at the end of Q2 2012 (up from 238 700 in 2011) at a long-term growth rate (since 2007) of 43% per annum.
  - Belgacom, Mobistar and KPN GB all host MVNOs i.e. three operators are providing wholesale market services Furthermore the MVNOs have commented that they are satisfied with overall market competitiveness[43].
  - Telenet recently extended its agreement with Mobistar to run until 2017 and this includes LTE network access.
- Given the expressed levels of demand for 800MHz spectrum by Belgacom, Mobistar and KPN GB, compared to the limited supply (2×30MHz), it is possible that other organisations may judge that the risk of participating in the award process are limited relative to the benefit from mandated wholesale access. This means that there is a real risk that the inclusion of a mandated wholesale access provision could result in the award process being abused.
- If the wholesale market were found to not be functioning in the future, this could be examined at that time by BIPT in the context of a market analysis with mandated wholesale access being imposed as a potential remedy for BIPT to apply at the time.

7.5 Mandated national roaming

The principal objective of mandating national roaming is to assist an operator without existing mobile infrastructure[44] which is in the process of developing its network with the acquisition of customers. This is achieved through the provision of wholesale access to a competitor's network when customers seek to use services outside the coverage area of the operator's network. National roaming is a key provision to support such operators as many customers would not consider acquiring mobile services if service availability was limited to the geographic footprint of the operator during the network build-out stage.

In the 800MHz band award, national roaming should be applicable in the case where an operator without existing low-frequency infrastructure seeks to utilise its 800MHz spectrum for deploying LTE technology – and wishes its customers to be able to fall-back onto an appropriate service layer whilst deploying its

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42 Source: Operator financial reports.

43 Source: EC Digital Agenda Scorecard. See: **http://ec.europa.eu/information_society/digital-agenda/scoreboard/docs/2012/BE_Country_Chapter_17th_Report.pdf**

44 We note that, at the time of auction, this definition of an 'operator' is likely to apply to Bidco, BUCD as well as a new entrant.

own network infrastructure. The roaming agreement should also consider that an operator without existing low-frequency infrastructure will be at a disadvantage compared to existing MNOs as the time required to develop the coverage network is longer (as it typically takes more time to deploy new sites than upgrading existing sites with a new technology).

Although our work suggests that it is not clear whether there will be significant demand for 800MHz from Bidco, BUCD or a new entrant, the Royal Decree should incorporate a national roaming provision in the 800MHz band regulations. This is to ensure that, in case any of the operators seeks to participate in the award process, it is supported by appropriate regulatory means.

To limit the risk of abusing the national roaming provision, we recommend to define a strict timeline over which national roaming has to be supplied. Such an approach was adopted in the Italian auction whereby the existing mobile operators were obliged to provide national roaming on both the 800MHz and 900MHz bands to a new entrant that won blocks in the 800MHz band for a period of 30 months over the entire national network and for a period of 60 months in those areas that were not covered by the new entrant. Also, the existing mobile operators that won spectrum in the 1800MHz or 2.6GHz band in the Italian auction were obliged to offer national roaming access on the 1800MHz and 2.1GHz bands to any new entrant that won spectrum in the 1800MHz, 2.1GHz or 2.6GHz spectrum bands. Effectively this would have allowed a new entrant deploying an 800MHz and 1800MHz or 2.6GHz LTE network to also benefit from (i) the competitors' own LTE network deployments (e.g. in 800MHz and 1800MHz bands) and (ii) the competitors' existing GSM (2G) and UMTS/HSPA (3G) networks in the 900MHz, 1800MHz and 2.1GHz bands.

Based on these considerations, we recommend that the Royal Decree specifies the following:

- Mandated national roaming should be granted to all operators ("roamers") that acquire 800MHz spectrum and do not own any 900MHz infrastructure at the time of auction.
- The obligation to provide mandated national roaming should apply to all bidders ("roaming providers") that acquire 800MHz spectrum and own any 900MHz infrastructure at the time of auction.
- Mandated national roaming should include a requirement for roaming providers to offer access to their GSM (2G), UMTS/HSPA (3G) and 800MHz infrastructure to roamers.
- Mandated national roaming would apply in areas outside the roamer's own network coverage.
- Mandated national roaming would only apply whilst the roamer is building out its own network and only from the point at which it has deployed coverage to 20% of the population using the 800MHz band.
- Mandated national roaming would only apply whilst the roamer remains in compliance with the coverage obligations of the 800MHz licence. If a roamer owns a 3G licence (e.g. in the 2.1GHz band), its right to mandated national roaming to UMTS/HSPA (3G) networks would only apply whilst the roamer remains in compliance with the coverage obligations of such a licence.
- The right to mandated national roaming expires after 9 years, at the point where the "roamer" is supposed to cover 98% of the population as per the recommended 800MHz coverage obligation.

We recognise that our recommendation for mandated national roaming offers access across a wide range of services and bands to potential roamers. However, we believe that there are strong reasons for the roaming requirement to be defined on such a broad basis:

- widespread national roaming access is offered as a means to reduce barriers to entry for operators and ensure they can quickly offer competitive services
- access to GSM (2G) is required to ensure ubiquitous mobile (voice) coverage, given that current GSM (2G) coverage levels for existing operators are typically higher than UMTS / HSPA (3G) coverage levels
- at the same time, the "roamer" is likely to compete in the mobile data segment, so it is critical to get access to UMTS / HSPA (3G) data services to be competitive immediately after the auction
- access to services on the 800MHz band is required to offer a level playing field for operators who do not have access to an existing low-frequency mobile network infrastructure but want to roll-out competitive services using this band.

We are aware that this national roaming provision potentially could reduce the commercial incentives for Bidco to deploy sufficient mobile infrastructure to meet its coverage obligation as specified in the 2.1GHz licence acquired in 2011. As an LTE800 network band can provide better and faster mobile data coverage than an HSPA2100 network, it could be argued that fulfilling the 2.1GHz licence coverage obligation would require incremental investment in providing coverage through inferior means. However, the 2.1GHz coverage obligations were designed to provide the correct incentives for bidders, e.g. stimulating infrastructure-based competition and preventing speculative bidding. These incentives are fully in line with our rationale for adding a coverage obligation to the 800MHz band as explained in Section 6. Most importantly, we believe that, where possible, existing licence conditions should not restrict the Minister / BIPT in developing licence conditions for the 800MHz band which are aimed at providing a level playing field between operators following the award of the 800MHz band. There are a number of regulatory instruments available to BIPT to address a potential future situation where Bidco acquires 800MHz spectrum and does consequently not fulfil its 2.1GHz licence conditions.

8 Spectrum packaging and award format

Auctions offer many benefits compared to beauty contests. While beauty contests would be used if there is a need to prioritise licence conditions, auctions in other circumstances have key advantages, including improved efficiency, transparency of the outcome to all observers, and robustness to legal challenge. Auctions also raise revenues commensurate with the market value of the scarce resource. Almost all regulators in Western Europe now use auctions as the primary mechanism for awarding spectrum suitable for mobile telephony and broadband. Notably, Belgium recently used an auction for the award of 2.6GHz spectrum.

In this section, we outline the potential approaches that BIPT could adopt for packaging and auctioning the spectrum at 800MHz and, if relevant, also the remaining 2.6GHz spectrum. We tackle packaging and auction design together because they are closely related decisions that cannot be taken in isolation, for example because the strengths and weaknesses of using a particular auction format vary depending on the structure of available lots. We also discuss how decisions on packaging and auction design are linked to decisions on other measures, such as new entrant reservation, spectrum caps, and coverage obligations.

We begin in Section 8.1 with a brief discussion of the common inputs into packaging and auction format choice – namely the objectives of the government, the supply of spectrum and anticipated demand conditions – which draws on the analysis in previous sections of the report. We then provide a general analysis of options for packaging (Section 8.2) and auction formats (Section 8.3) for the 800MHz band. Throughout this analysis, we make reference to the approaches adopted by other Western European countries for the award of the 800MHz band, as illustrated in Figure 8-1.

We use this analysis to identify a limited number of candidate options, combining packaging, auction format, and other key award features for the 800MHz band (Section 8.4). We then discuss how an award of remaining 2.6GHz paired spectrum might be integrated into the 800MHz award (Section 8.5). We conclude in Section 8.6 with a recommendation on the approach that we think is most likely to deliver the best outcome for Belgium. As part of our recommendation, we provide a brief comparison with the rules used for the 2010 Belgium 2.6GHz auction, and highlight those areas of rules where changes would be appropriate.

Figure 8-1: Approaches adopted by other countries in Western Europe for award of 800MHz

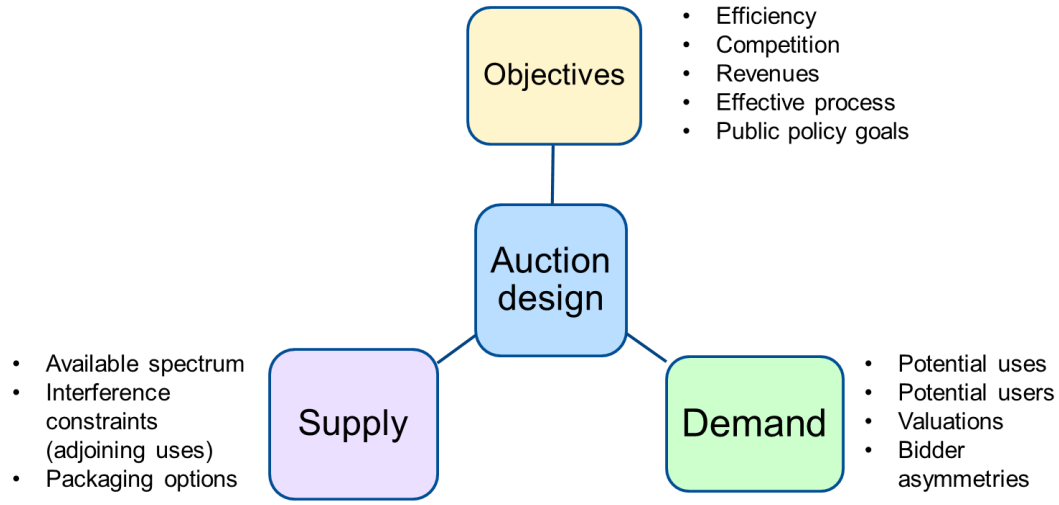
Country	Packaging	Generic lots?	Format	Pricing rule	Assignment round
Denmark	2×5 & 2×10	✓	CCA	Second price	Sealed bid
France	2×5, 2×10 or 2×15	×	Sealed bid package	First price	Not required
Germany	2×5	✓	SMRA	Pay your bid	Industry negotiation
Ireland	2×5	✓	CCA	Second price	Sealed bid
Italy	2×5	✓	SMRA variant	Pay your bid	Ranking

Country	Packaging	Generic lots?	Format	Pricing rule	Assignment round
Netherlands	2×5	✓	CCA	Second price	Sealed bid
Spain	2×5	✓	SMRA	Pay your bid	Industry negotiation
Sweden	2×5	×	SMRA variant	Pay your bid	Not required
Switzerland	2×5	✓	CCA	Second price	Sealed bid
United Kingdom	2×5 & 2×10	✓ (except 2×10)	CCA	Second price	Sealed bid

8.1 Key inputs into decisions on packaging and auction format

The key inputs into decisions on packaging and auction format can be grouped under three broad headings, as illustrated in Figure 8-2: the government's objectives for the award; supply of available spectrum; and anticipated demand conditions. We briefly discuss each set of inputs in turn.

Figure 8-2: Key inputs into packaging and auction design [Source: NERA presentation to the CEE Regional Working Group, Bucharest, 30 March 2012]



8.1.1 Policy objectives

The policy objectives for this award have been outlined in Section 3. With respect to packaging and auction format choice, the following objectives are particularly relevant:

- **Outcome efficiency.** The most important objective, as mandated under European law, is to promote the long-term efficient use of the spectrum. Accordingly, the spectrum must be packaged in a way that makes it accessible to the most likely users, and the auction format should support allocation and assignment to the users that can generate the greatest long-term value for Belgium. Absent concerns

about market power, it is generally recognised that willingness to pay in an auction should be a good proxy for future efficient use.

- **Sustainable competition.** One of the policy objectives proposed is to maximise long-term sustainable competition in mobile services. Its general view is that, for this award, this means ensuring that a critical mass of operators all gain access to sufficient 800MHz spectrum to compete vigorously in providing LTE services. Auctions can be used to promote new entry, for example through set-asides or caps on existing operators; however, while such rules could be applied for this award, the case for this level of intervention appears weak.

- **Fair revenues.** Our understanding is that revenues are not a primary objective for this award, but that the government does expect an award to generate a return commensurate with the market value of the scarce resource being sold. Also, it may be preferred that bidders buying similar spectrum should pay similar amounts, with any price differences primarily reflecting real differences in value created by differences in coverage obligation or frequency position.

- **Broadband policy.** Mobile broadband has an important role to play in facilitating universal availability of broadband. By combining packaging and coverage obligations, it may be possible to realise objectives for universal coverage as part of the auction process.

- **Cost effective, efficient process.** Simple, cost effective approaches to auction implementation are preferred, provided that other objectives are fulfilled.

8.1.2 Supply of spectrum

There is a total of 2×30MHz of spectrum available at 800MHz. Under the CEPT band plan, adopted across Europe, this may be divided into up to six 2×5MHz blocks, suitable for deploying LTE mobile technology. The band is located immediately above spectrum allocated for digital terrestrial TV (DTT) across Europe. As a result, the lower blocks, especially the lowest block, may be subject to interference from or require mitigation techniques to prevent interference to DTT. However, as adoption of the DTT service in Belgium is limited, such effects, if any, will likely be modest.

8.1.3 Anticipated demand for spectrum

We provide an extensive study of potential demand for spectrum in Belgium in Section 4. The key conclusions pertinent to spectrum packaging and auction design were as follows:

- The band is most likely to be used for the deployment of LTE. Other potential uses could not plausibly generate nearly as much value as LTE. Furthermore, demand for 800MHz spectrum for LTE can reasonably be expected to at least equal supply. Therefore, when deciding the approach to packaging and auction format, it is entirely reasonable to focus on the requirements for LTE users, notwithstanding any broader commitments to technology neutrality.

- LTE operators currently require a minimum channel size of 2×5MHz. There is no plausible demand for carriers with smaller frequency allocations.

- Operators have a general preference for acquiring 2×10MHz of 800MHz spectrum, which offers a significant technical upside relative to existing UMTS technology. However, we cannot entirely rule out the possibility that an operator may want to acquire only one block of 2×5MHz. There are

significant diminishing returns from acquiring additional blocks beyond the second one, unless the acquisition is to prevent competitors from having access to the 800MHz band.

- For operators acquiring multiple blocks, there is a strong preference for receiving contiguous spectrum assignments.

- In Belgium, we may anticipate that there will be demand for at least 2×10MHz spectrum each from the three established national mobile network operators – Belgacom, Mobistar and KPN GB – and potentially also from other parties.

When comparing supply and demand, one obvious issue is that there may be a natural market outcome consisting of Belgacom, Mobistar and KPN GB each acquiring 2×10MHz. If other potential bidders believe this is the likely outcome, there is a possibility that the auction may not be very competitive. That does not mean that such an outcome would be a bad one, as it may maximise sustainable competition, but it may imply a need for reserve prices to be set at a level which ensures a fair return is received by the Belgian government for a scarce public resource.

8.2 Potential packaging options for 800MHz band

Given the demand profile for LTE, it is clear that the spectrum should either be packaged into 2×5MHz blocks or larger blocks that combine 2×5MHz blocks. As a further step, we can rule out having blocks of 2×15MHz or greater, as this would greatly constrain the possible range of auction outcomes for no obvious benefit.

Accordingly, we consider that there are four plausible approaches to packaging the 800MHz band in Belgium:

- Option 1: Three lots of 2×10MHz

- Option 2: Six lots of 2×5MHz

- A mix of 2×5MHz and 2×10MHz lots, either:
  - Option 3: Four lots of 2×5MHz and one lot of 2×10MHz; or
  - Option 4: Two lots of 2×5MHz and two lots of 2×10MHz.

These are illustrated in Figure 8-3, together with possible options for introducing an additional coverage obligation approach as we proposed in Section 6.4.

In Figure 8-4, we compare the advantages and disadvantages of each approach, taking into account five relevant factors: the role of the market in determining allocation; aggregation risk for bidders seeking at least 2×10MHz; scope for competition in the auction; impact on downstream competition; and compatibility with our additional coverage obligation proposal.

Figure 8-3: Potential options for packaging 800MHz, with and without additional coverage obligation

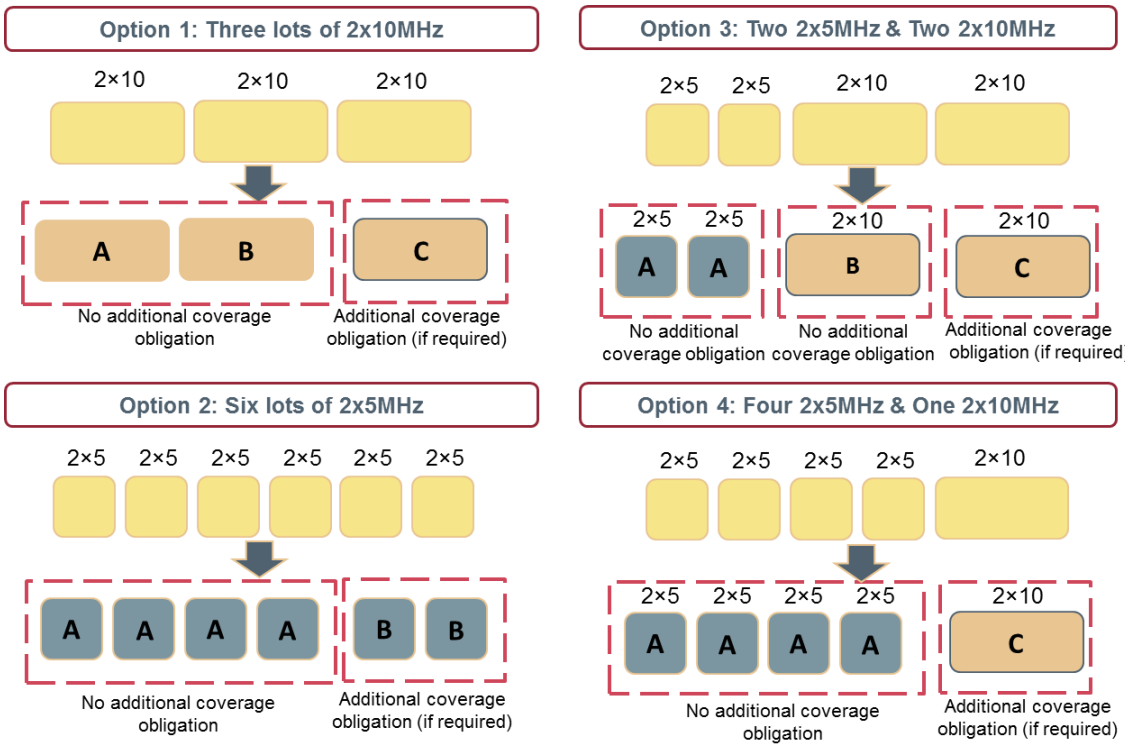


Figure 8-4: Comparison of packaging options

Issue	Option 1 (Three lots of 2×10MHz)	Option 2 (Six lots of 2×5MHz)	Option 3 (Two lots of 2×5MHz, two lots of 2×10MHz)	Option 4 (Four lots of 2×5MHz, one lot of 2×10MHz)
Role of the market in allocation	Restricted – structure of spectrum allocation across bidders is fixed before auction	Maximum flexibility for auction to determine structure of spectrum allocation across bidders	Some flexibility for auction to determine structure of spectrum allocation across bidders	Significant flexibility for auction to determine structure of spectrum allocation across bidders
Scope for competition in the auction	At most three winners; other bidders may be deterred from participating	Scope for more than three winners may encourage entrant participation	Scope for more than three winners may encourage entrant participation	Scope for more than three winners may encourage entrant participation
Impact on downstream competition	If combined with cap of 2×10MHz, three player symmetric outcome is guaranteed if three or more bidders	Potential for asymmetric spectrum allocation – impact on downstream competition is ambiguous	Potential for asymmetric spectrum allocation – impact on downstream competition is ambiguous	Potential for asymmetric spectrum allocation – impact on downstream competition is ambiguous

Issue	Option 1 (Three lots of 2×10MHz)	Option 2 (Six lots of 2×5MHz)	Option 3 (Two lots of 2×5MHz, two lots of 2×10MHz)	Option 4 (Four lots of 2×5MHz, one lot of 2×10MHz)
Aggregation risk for bidders seeking at least 2×10MHz	No aggregation risk	Risk that bidder only acquires 2×5MHz unless addressed tough auction rules	Two bidders can avoid aggregation risk by focusing on 2×10	Only one bidder can avoid aggregation risk by focusing on 2×10 (and may have to accept additional coverage obligation)
Compatibility with additional coverage obligation (if required)	Simple to impose additional coverage obligation on one 2×10MHz lot	Option to impose additional coverage obligation one or two lots, but risk that winner may not acquire 2×10MHz	Simple to impose additional coverage obligation on one 2×10MHz lot	Simple to impose additional coverage obligation on one 2×10MHz lot

As can be seen, each option has relative advantages and disadvantages.

Option 1 stands out from the others. If combined with a 2×10MHz spectrum cap, it guarantees a symmetric three player outcome, which may be a positive outcome for promoting sustainable competition. On the other hand, this inflexibility rules out the scope to test alternative allocation outcomes in the market and may deter bidders from participating because they may believe the outcome is too predictable.

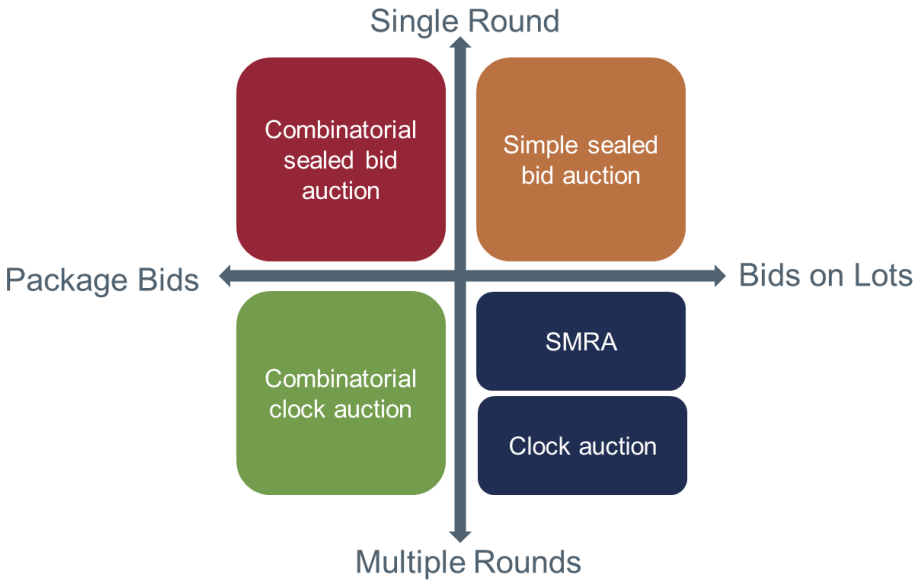
The strengths and weaknesses for options 2, 3 and 4 are all quite similar. Each allows some role for the market in deciding how much spectrum goes to each operator, and all would be compatible with a spectrum cap of either 2×10MHz or 2×15MHz. However, all may lead to asymmetric outcomes in which 800MHz holdings vary across operators. Option 2 with six 2×5MHz lots gives maximum flexibility and has been the approach used by the majority of European regulators; however, it would be the more difficult approach to adopt if applying an additional coverage obligation.

Accordingly, we proceed with our analysis on the basis that any of these four packaging approaches might be used.

8.3 Potential auction formats for 800MHz band

There are many different auction designs that have been used for selling radio spectrum. Early on most auctions used the simultaneous multiple round auction (SMRA) format pioneered by FCC in the USA. However, over the last 12 years, there has been a considerable amount of innovation that provides a wider choice of auction formats. Figure 8-5 outlines some of the main choices available based on a simple two dimensional grid.

Figure 8-5: Auction formats along two dimensions [Source: NERA Economic Consulting]



There is no single best auction format. Choice is guided by objectives and made in conjunction with other elements of the auction process such as spectrum packaging. Below we outline a number of key choices in auction design in the context of the Belgian 800MHz auction. This analysis leads us to conclude that either an SMRA or a clock auction would be best for this award. We also address the options for using generic or specific lot bidding and how this is affected by choices of packaging structure and auction format.

8.3.1 Sealed bid or multiple rounds

In the boxes below, we provide an overview of single round (or "sealed bid") and multiple-round auction formats. In our view, the multiple-round auction is better suited for this award than the sealed bid auction. There are a number of reasons for this:

- Multi-round auctions facilitate price discovery, which is generally desirable from the perspective of bidders. They facilitate a more efficient outcome, because bidders can refine their bidding in response to information released each round.
- Depending on how the auction is set up, the simpler multi-round auction formats (SMRA or clock) can give bidders considerable flexibility to switch their bids in response to differences in prices among lots and with the benefit of information released through the rounds. No such response is possible in a sealed bid, where use of package bidding may be necessary if bidders are to be able to express value differences between lots.
- This is a high-value band, so ensuring the most efficient outcome is particularly important.
- While there are additional costs of running a multi-round process (e.g. procuring on-line bidding software) versus a sealed bid, these are very small compared to the value of the spectrum being sold.
- First-price sealed bid auctions are sometimes preferred as a way of encouraging entrant participation, as entrants may consider their prospects of winning greater when incumbents bidders are uncertain how much to bid. However, the downside is that the auction outcome may not be efficient, as final bids may not accurately reflect relative valuations because different bidders shade their bids relative to

value to different degrees. To the extent priority is given to the objective of promoting efficiency, we do not think the potential for facilitating an entrant bidder in this case is strong enough to justify a sealed bid.

In conclusion, we recommend that BIPT award 800MHz spectrum using a multi-round auction format, rather than a single round or sealed bid auction. In this context, it may be noted that the overwhelming majority of regulators in Western Europe – for example, Denmark, Germany, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland and the United Kingdom – have opted for multi-round auction formats for the award of 800 MHz spectrum. One exception is France, which used a first price, sealed bid approach, with a package bidding element.

Sealed bid auctions

In a sealed bid auction, bidding takes place in a single round. In the simplest version, the *single unit, sealed bid*, each bidder submits a single bid during a defined bid window. At the close of the window, all bids are opened and the item is awarded to the bidder with the highest bid. The winning bidder either pays the amount of their bid (first price) or a price equal to the second highest bid (second price). Note that the first price auction is more strategically complex for bidders, as bidders must trade off bidding higher to maximise their probability of winning versus bidding lower so that they pay the least if they win the item. By contrast, in the second price auction, there are no conflicting incentives as bidders do best by simply bidding their valuation. Both approaches can be used to maximise revenues if there is a sufficient number of bidders.

More complex rules are required for multi-unit sealed bids. If all units are identical and bidders are limited to buying one lot each, then the same simple auction formats will do. For example, with three identical lots, these could be awarded to the three highest bidders in the sealed bid. There are now three plausible pricing rules: pay-your bid; all pay the price of the third highest bidder (the marginal winner); or all pay the price of the fourth highest bidder (the marginal loser). With a pay-your bid rule, winning bidders may end up paying very different prices for the same item. Under the other approaches, bidders pay an identical amount. The pay-your-bid rule is multi-unit equivalent of the first price rule in the single unit auction and is as strategically challenging, whereas the marginal loser approach is strategically equivalent to the second price rule, and encourages bidders to bid their valuations. The marginal winner approach offers a compromise between the two extremes.

Implementing a sealed bid becomes much more complex if the items available are not identical and/or bidders may want to buy more than one lot, as may be the case in this award. In this case, it may not be practical to invite bidders to make only one bid, given the need to understand bidder preferences between lots and between different amounts of lots. The sealed bid, package auction provides a mechanism for such package structures, with each bidder able to make multiple but mutually exclusive bids. For example, for this award, one might imagine a bidder simultaneously submitting two bids for 2×10MHz, one with and one without an additional coverage obligation, and a separate bid for only 2×5MHz. In such an auction, an algorithm may be required to identify the highest value combination of bids received, subject to taking at most one bid from each bidder. Again there is a choice between ‘first price’ and ‘second price’ rules; the latter typically requires an algorithm to determine not only the winning combination but also the prices paid on the basis of the bids placed by the highest bidding losers.

Multiple round auctions

In a multiple round auction, bidders are invited to submit bids at successive price points, with bidding continuing until a point is reached when all remaining demand can be satisfied. In the simplest version, the *single unit, multiple round ascending auction*, each bidder may submit one bid in each round of the auction at a given price (this could be a minimum price, or more typically in spectrum auctions, a fixed price). If demand exceeds supply, the price point is increased. Bidding continues until there is just one bidder remaining. Tie-break rules are required in case all remaining bidders drop out simultaneously.

One of the key differences between the multi-round and sealed bid auctions is that bidders can observe the outcome of previous rounds and update their valuations accordingly. This process, known as price discovery, helps give bidders confidence in their decisions and may lead to more efficient auction outcomes. It is particularly important in settings where bidders have related values but there is uncertainty over valuation, which is arguably the norm in spectrum auctions.

For multi-unit auctions, there are two main variants: the SMRA and the clock auction. In an SMRA, bids are prices. In a round, bidders make (price) bids on specific lots, and, at the end of the round, high price bidders are selected for each lot. The auction continues if there is excess demand for any single lot. By contrast, in a clock auction, bids are quantities. In a round, bidders simply state the number of lots in each category that they want to buy at the prices announced by the auction manager. There are no high bidders. Bidding continues if aggregate demand exceeds supply in any category. The clock auction requires that lots in a category be identical. An SMRA in which a single price bid is allowed each round is equivalent to a clock auction. Generally, the SMRA may be preferred in situations where lots are close but not perfect substitutes.

In situations where there are strong complementarities between lots, bidders in a simple SMRA may be significantly exposed to aggregation risk. For example, in this award, if there were six 2×5MHz lots, a bidder pursuing 2×10MHz would need to bid for two blocks, and may be exposed to winning only one block, i.e. only half of its demand. The clock auction mitigates aggregation risk, but in its simple form offers no opportunity for a bidder pursuing 2×10MHz at a high price to drop back to 2×5MHz at a lower per unit price. The combinatorial clock auction (CCA), which is a variant of the clock format that allows multiple-round package bidding, is designed as a solution to this problem, as it allows bidders to express a price for any permitted package of blocks. However, the rules required to implement the CCA are significantly more complex than the SMRA or standard clock.

8.3.2 Use of package bidding

In awards where bidders are seeking to acquire multiple lots, bidders may be exposed to aggregation risk. This issue arises in auctions, such as an SMRA, where bidders are making multiple bids on individual lots in each round, and the lots they are bidding on are complementary, such that the value of a package of lots is greater than standalone values of the component lots. Our valuation work illustrates that this issue is potentially relevant to the 800MHz band, as the value of acquiring 2×10MHz spectrum may be more than twice the standalone value of acquiring 2×5MHz for some bidders. Package bidding, which involves bidders making bids for a package of lots, that is either accepted or rejected in its entirety, provides an auction mechanism for eliminating aggregation risk.

Aggregation risk can be addressed either through auction design or through the packaging option. The simpler approach is to use packaging which is practical if there is a reasonable case for aggregating the lots in a preferred configuration in the first place. For example, for this award, there is a strong argument for

having 2×10MHz lots, which eliminates the risk that a bidder could only win 2×5MHz. The more complex approach of using package bidding to solve the aggregation risk is appropriate if there is genuine uncertainty about what bidders may want and/or there are strong differences in the positioning of bidders (e.g. entrants and incumbents with different business models).

Across Europe, a number of regulators have opted to use the CCA, a multi-round package format, for the award of the 800MHz band. These include Denmark, Ireland, Netherlands and Switzerland. A similar number of countries have chosen to use variants of the SMRA format with no package bidding. These include Germany, Italy, Spain and Sweden. Amongst those countries that opted to sell 800MHz in a standalone auction, Denmark opted for a CCA and Sweden opted for an SMRA variant. However, we note that the Danish auction featured special coverage obligation lots which are not relevant to the Belgian situation.

The main downside of using package bidding is the added complexity of the auction, both from an implementation and bidder perspective. These complexity costs must be weighed against the potential upside of a more efficient outcome if bidders are able to bid without concern about aggregation risk.

For Belgium, we think the case for using a package bid format, such as the CCA, is weak, for the following reasons:

- Package bidding is only relevant if for a decision was made to use 2×5MHz lots. Under the 2×10MHz (Option 1) packaging approach, there are no aggregation risks, so a CCA would offer no benefit over a standard multi-round auction format.
- Even with 2×5MHz lots, the lot structure is quite simple and bidders should be well placed to anticipate and manage aggregation risks. Thus, the case for package bidding in this auction is much weaker than for many other European auctions, which involved either complex multi-band structures or special coverage lots, where complementarities were less predictable and more likely to vary across bidders.
- There should be a preference for using a multi-round approach with which both the bidders and BIPT are familiar unless there is a clear case for a change in format. The case for package bidding is too weak to pass this test.

In conclusion, we recommend for this auction in Belgium to stick with a standard multi-round format and not permit package bidding.

8.3.3 Generic or specific lots

It is increasingly common to sell lots within the same frequency band on a generic basis, provided they have similar value. With generic lots, bidders simply bid on a number of lots within a category, and the specific frequency lot that they receive if they win is determined in a follow-up process. This approach works particularly well in a clock auction context.

A key advantage of the generic approach is that it is possible to guarantee that bidders winning multiple lots will receive contiguous spectrum, which ensures an efficiently ordered band plan and eliminates a potential source of aggregation risk. It is almost certainly for this reason that the majority of European regulators – including Denmark, Germany, Ireland, Italy, Netherlands, Spain, Switzerland and the United Kingdom – all opted for generic lots in the 800MHz band.

Of course, generic lots should only be used where frequency lots have similar values. If there were large value differences between lots, then this would cause uncertainty for bidders as to what to bid, which might lead to an inefficient auction outcome. Accordingly, in countries where the lowest 800MHz lot is subject to major constraints due to significant concerns about interference (e.g. Denmark, Italy, Spain) or where coverage obligations have been associated with only one 800MHz lot (e.g. the United Kingdom), these lots have been isolated as separate categories in the bidding process.

In our view, whether or not it is appropriate to use generic lots in Belgium depends on the packaging structure adopted. Under Option 1 (2×10MHz lots) combined with a 2×10MHz cap, the use of generic lots is redundant because there is no contiguity concern. In this case, we would propose that lots are simply sold on a defined frequency basis. Under any of the other approaches, as there is a possibility that a single operator could acquire two 2×5MHz lots, we would recommend using generic lots, so that contiguity of assignment is guaranteed.

If generic lots are used, then some form of follow-up process is required to assign specific lots to winning bidders. There are three main options:

- **Industry negotiation.** Under this approach, used in Germany and Spain, winning bidders are given a deadline to reach agreement on assignment. If no agreement, there is provision for administrative decision or assignment by random selection.

- **Ranking.** Under this approach, used in Italy, winning bidders are placed in rank order. For example, a potential set of criteria in Belgium might be to: award top rank to winner of additional coverage obligation; then bidders winning only 2×5MHz (if relevant); then bidders paying the highest price. If some bidders still cannot be ranked apart, their ranking order is decided by random selection. Bidders then select their preferred placements in rank order, subject to the condition that all bidders will get contiguous spectrum.

- **Sealed bid auction.** Under this approach, adopted in Denmark, Netherlands, Ireland, Switzerland and the United Kingdom, bidders are presented with an exhaustive list of frequency positions within the available spectrum, conditional on all winning bidders getting contiguous spectrum. Each bidder submits a bid for every option, but bids of zero are allowed. The set of compatible bids with collective highest value are selected.

We recommend the sealed bid auction approach. It avoids the need for any arbitrary administrative decisions (as may be required with either ranking or industry negotiation) and is guaranteed to produce an outcome acceptable to all parties. A sealed bid may also bring in some extra revenue, reflective of value differences (if any) between lot placement. Although other countries running sealed bid assignment rounds have used a second price rule, this was in the context of a CCA format, where software for calculating second prices had already been developed for the main auction. Given our finding that valuation differences between lots are likely to be very small and the stated preference to avoid implementation complexity, we would recommend applying a simple pay-your-bid rule.

8.3.4 Additional coverage obligation lot

One of the available options for Belgium is to impose an additional coverage obligation on one of the available lots. If this approach is adopted, then this lot must be sold separately from the other 800MHz lots. This raises the issue of lot placement. Our recommendation depends on other auction rules:

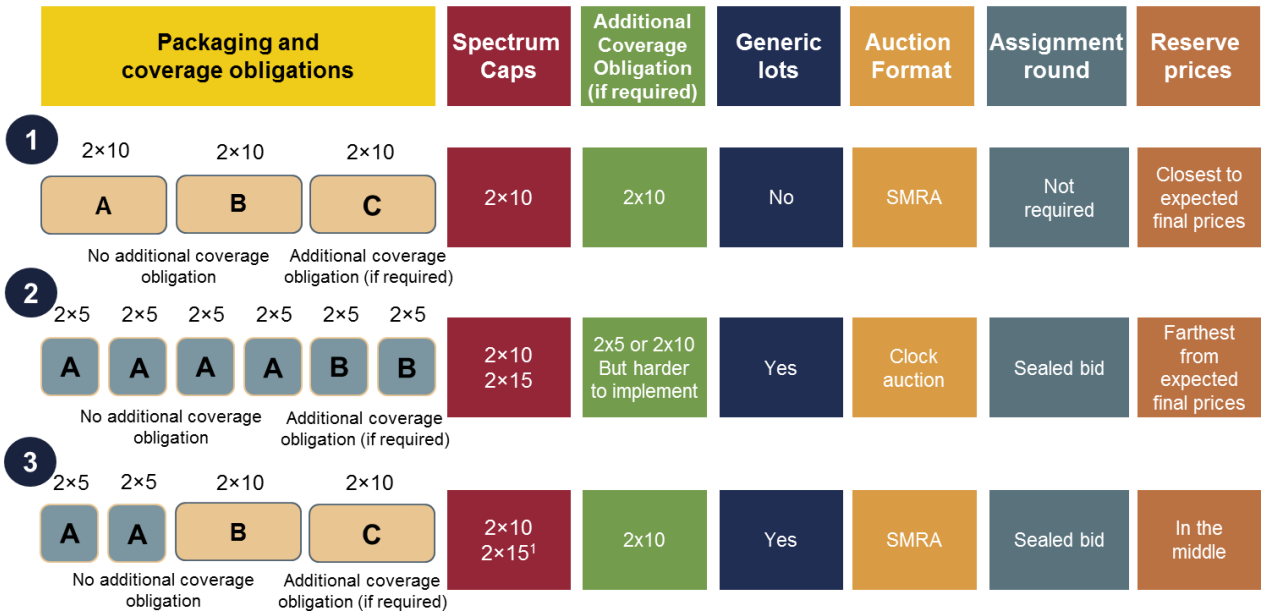
- If a specific lot approach is used, we recommend placing this lot at the top of the band, as this is the furthest position away from potential DTT interference.
- If a generic lot approach is used, the decision could be left to the market or the lot could be pre-assigned to the top slot. On balance, we lean towards pre-assignment, as this will simplify the assignment process.
- If the auction rules allow a bidder to purchase multiple lots, one of which might be the additional coverage lot, then the rules must still guarantee contiguity.

8.4 Candidate approaches

We have identified four viable packaging formats. In all cases, we recommend these be awarded using a simple multi-round auction format, either an SMRA or clock. We recommend a specific lot approach if a 2×10MHz packaging structure is adopted, or otherwise a generic lot approach. On the basis of these conclusions, we have identified three candidate approaches, which we illustrate in Figure 8-6.

- **Approach 1: SMRA with 2×10MHz lots.** We propose a simple SMRA format under this approach, similar to that used for previous Belgian auctions. The simple packaging structure negates any need for generic lots or an assignment round.
- **Approach 2: Clock auction with 2×5MHz lots.** We propose that lots be sold on a generic basis and a clock auction be used. The clock auction format provides a simpler and faster mechanism for identifying market prices than an SMRA, and reduces scope for strategic bidding behaviour. As bidders may be pursuing multiple lots, some additional activity rules are required to ensure that the number of lots sold is never less than the level of demand at the start of the auction. An assignment process is required to assign specific frequencies to winning bidders.
- **Approach 3: SMRA with mix of 2×5 and 2×10MHz lots.** We propose that lots be sold on a generic basis. An SMRA or clock format could be used, but we recommend an SMRA, in accordance with BIPT's preference for implementation simplicity (the activity rules required to make a clock work are more complex than under Approach 2). An assignment process is required to assign specific frequencies to winning bidders. (Note: in Figure 8-6, we have only illustrated the Option 3 packaging approach but this could be substituted with the Option 4 approach).

Figure 8-6: Candidate approaches for the award format



We think any of these approaches could deliver an effective process for award of the 800MHz band. However, on balance, we recommend Approach 1 (SMRA with 2×10MHz lots) for the following reasons:

- Option 1 ensures a symmetric allocation of 800MHz spectrum with three operators, which may be considered an attractive outcome for downstream competition. The other approaches, although they allow the market a greater role in allocation, could result in asymmetric access to LTE spectrum across operators, with uncertain implications for the downstream competition.
- The likelihood that switching from 2×10MHz lots to 2×5MHz lots would encourage additional competition in the auction appears small.
- Option 1 offers the simplest award mechanism. An SMRA format, similar to those used for previous Belgian auctions, can be used, and an assignment round is not required.
- We also noted that in their responses to BIPT's consultation document, Belgacom and KPN GB indicated that they did not object to the use of an SMRA for the 800MHz award, whilst Mobistar indicated that an SMRA should be used provided it leads to an efficient outcome – though other auction formats should also be considered.

Under any approach, BIPT should be aware of the high risk that spectrum sells at reserve price owing to low competition in the auction. This is particularly true under Approach 1, given the obvious scope for spectrum to be split evenly amongst the three leading operators. This implies a strong case for attempting to set reserve prices at close to the anticipated market price under any approach and especially under Approach 1. We explore this issue further in Section 9.

8.5 Impact of including remaining 2.6GHz spectrum

BIPT has also asked us to consider the possibility of integrating the remaining 2×15MHz of 2.6GHz auction into the 800MHz award. We have considered three options:

- **Option I: Combined auction of 800MHz & 2.6GHz.** Both lots of 2.6GHz and lots of 800MHz would be available to bidders in single auction process.

- **Option II: Sequential auction.** The two bands would be sold in sequential auctions. The 800MHz lots would be sold first, followed by the 2.6GHz process. In this case, the second auction could either take place immediately, as part of a combined award, or after a period of delay (e.g. 6 months).

- **Option III: Allocate preferentially to new entrants.** A right of first refusal to 2.6GHz blocks could be provided to any bidder that wins 800MHz spectrum that does not already have 2.6GHz paired spectrum. This option could be combined with Option II.

We recommend that Options II and III are adopted in combination. Specifically, if there is a winner of 800MHz spectrum that does not already have 2.6GHz spectrum, it should be given first right of refusal on the 2.6GHz spectrum. There also needs to be a provision in the rules in case there are multiple winners of 800MHz spectrum that do not have 2.6GHz spectrum. A simple approach, which we describe below, is to give priority to bidders according to the 800MHz block that they acquire. Any 2.6GHz spectrum not sold to such bidders could then be made available in a separate auction to all interested parties, including Belgacom, Mobistar and KPN GB.

The rationale for this approach is as follows:

- Unsold 2.6GHz paired spectrum is likely not a good substitute for 800MHz. There is therefore no obvious benefit of having a single auction format in which bidders could switch demand between the two bands in response to changing prices.

- 2.6GHz paired spectrum, however, can be a complement to an operator's existing spectrum portfolio or to new portfolios including 800MHz, especially if the operator has few or no spectrum holdings in other bands suitable for mobile broadband. Such one way complementarity is best addressed through either allowing package bidding or through a sequential process in which 800MHz allocation is resolved before 2.6GHz allocation.

- Including 2.6GHz spectrum in the same auction as 800MHz would offer more complications than benefits. Firstly, it would suggest a case for package bidding, but this would greatly increase implementation complexity. Secondly, it may raise concerns about strategic bidding behaviour across the two bands; while this might be addressed through appropriate activity rules, this seems an undesirable step simply to include spectrum that has already gone unsold once before.

- Granting a first right of refusal to bidders that do not already have 2.6GHz spectrum offers two related advantages: (1) it may enhance the business case for such bidders to participate in the award; and (2) if one such bidder does acquire 800MHz, its chance of success in the downstream market may be enhanced by also acquiring 2.6GHz spectrum. Furthermore, it is a logical progression given that two of the three incumbents operators already have 2×20MHz of spectrum at 2.6GHz, which was the maximum permitted under the regulations for the original 2.6GHz auction.

There is a total of 2×15MHz of 2.6GHz spectrum available. A bidder with no existing 2.6GHz spectrum may decide it only requires a smaller amount, for example 2×10MHz. Meanwhile, Belgacom, Mobistar and KPN GB, who each already have either 2×15MHz or 2×20MHz, may want as little as 2×5MHz. Accordingly, we propose that the spectrum be packaged into 2×5MHz lots.

We note that in order to allow Belgacom, Mobistar and KPN GB flexibility to bid for additional 2.6GHz spectrum, the cap of 2×20MHz imposed in the previous auction would need to be relaxed. The simplest approach would be to raise the cap to 2×35MHz, which would maximise scope for competition amongst incumbents for the extra spectrum. This approach seems reasonable, given that (a) other bidders would have already had two opportunities to acquire this spectrum; and (b) we have not identified any evidence to suggest that one bidder acquiring extra 2.6GHz could gain an unfair advantage in the downstream market. However, we understand that a change in the spectrum cap would require an amendment to the Royal Decree relating to the award of the 2.6GHz band. Accordingly, this suggests a good case for scheduling a time gap between the 800MHz auction and a 2.6GHz auction (if required), so that changes to legislation are not initiated unnecessarily.

Lot placement may not be straightforward, given that there is a pre-existing band plan. An entrant should be granted contiguous spectrum. Ideally, an existing holder of 2.6GHz paired spectrum should be granted additional spectrum adjacent to its existing holdings. However, under the existing band plan, this would only be possible for KPN GB and/or Belgacom, whose allocations are adjacent to the unsold lots, and impossible for Mobistar. One solution could be to establish new regulations that require bidders to move holdings to ensure contiguity and/or make willingness to move a condition of entry into the 800MHz auction. As, in practice, only KPN GB might be required to move, the proportionality of this move would depend on whether or not this might impose significant costs on KPN GB.

Whatever approach is adopted, we suggest that any bidder acquiring at least two extra lots is guaranteed contiguity. In the first stage where a bidder is given a right of refusal to acquire 2.6GHz spectrum, this may be achieved simply by limiting their frequency selection options available, such that the lots they acquire must be contiguous and/or any remaining unsold lots must be contiguous. If the process proceeds to auction, the lots could be sold on a generic basis. In this case, if there were multiple winners of 2.6GHz lots, their placement could be resolved through a sealed bid assignment round in which any bidder acquiring two lots is guaranteed contiguity and all bidders pay the amount of their bids. However, a simpler alternative might be to guarantee contiguity to existing holders of 2.6GHz paired spectrum (where possible) and then assign any entrants the remaining contiguous spectrum.

The full process would proceed as follows:

- In the event that 800MHz spectrum is won by a bidder (or bidders) that does not have 2.6GHz paired spectrum, the 2×15MHz contiguous unsold 2.6GHz spectrum should be offered to that bidder (or bidders), using the following three-step process:
  - In the first step, any such bidder that acquires the lowest frequency 800MHz block should be offered a first right of refusal to acquire 1, 2 or 3 blocks of contiguous 2×5MHz spectrum in the 2.6GHz band.
  - In the second step, any such bidder that acquires the middle frequency 800MHz block should be offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum in the 2.6GHz band.
  - In the third step, any such bidder that acquires the highest frequency 800MHz block should be offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum in the 2.6GHz band.

If, after the conclusion of this process, there is still unsold spectrum in the 2.6GHz band, then this spectrum should be made available in a subsequent auction. A delay of around 6 months between the two auctions could allow time for changes to the Royal Decree to ensure that any interested parties, including incumbent operators within existing 2.6GHz holdings could participate in the second auction.

8.6 Recommendation

We recommend that BIPT adopt the following approach for the award of the 800MHz band and remaining 2.6GHz spectrum:

- The 800MHz band should be divided into three lots of 2×10MHz, each occupying pre-assigned frequencies within the band.
- If an additional coverage obligation is applied to one of the lots, this should be the lot at the upper end of the band.
- A 2×10MHz cap will be applied in the auction, meaning that no bidder can bid for more than one lot.
- The lots will be sold using a standard SMRA format, which will determine both the frequencies awarded to each bidder and the price that each bidder must pay.
- Any bidders that win 800MHz spectrum but do not already have 2.6GHz paired spectrum should be given the option to acquire 2.6GHz paired spectrum according to the following order of precedence:
  - Step 1: any such bidder that acquires the lowest frequency 800MHz block offered right of refusal to acquire 1, 2 or 3 blocks of contiguous 2×5MHz spectrum;
  - Step 2: any such bidder that acquires the middle frequency 800MHz block offered right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum; and
  - Step 3: any such bidder that acquires the highest frequency 800MHz block offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum.
- In case some 2.6GHz spectrum is unsold after the conclusion of the auction, this could be made available in a subsequent auction. A delay of around 6 months between the two auctions could allow time for changes to the Royal Decree to ensure that any interested parties, including incumbent operators within existing 2.6GHz holdings could participate in the second auction.

Given that the approach we are recommending for the 800MHz band is similar to that used in previous Belgian spectrum auctions, it may be possible to re-use previous rules from past awards. This may facilitate the drafting of official regulations for the award. It is beyond the scope of this project to draft a detailed set of auction rules for the award. However, in order to facilitate this process, we have conducted a preliminary view of the auction rules used for the 2010 Belgian 2.6GHz auction (which, we understand, were based on the rules for 2.1GHz award from 2001), with a view to identifying what rules might need to be adapted for this award. Our main observation is that the rules require some updating to bring them into line with latest thinking on best practice for conducting spectrum auctions using SMRAs; notably, the rules on bid increments and transparency are out of step with revisions to the format widely adopted by regulators in the last ten years.

We propose that the following changes to the rules for this award are considered:

- **Activity rules** – These will need to be adapted to the specific structure of the awards for 800MHz and (if required) remaining 2.6GHz spectrum. For 800MHz, if there are only three blocks and there is a cap of one block per bidder, the process is quite straightforward. If an SMRA was used for additional 2.6GHz spectrum, then a simple eligibility point rule with 1 point per 2×5MHz may be used. The present approach where standing high bidders cannot withdraw or switch away from a lot unless and until they are overbid should be maintained.

- **Bid amounts** – We recommend switching to a fixed bid increment rule with non-discretionary bid amounts, instead of allowing bidders flexibility to bid at any level between specified minimum and maximums. This is in line with best practice in spectrum auctions worldwide (and consistent with the approach used for all recent multi-round auctions in Europe). The discretionary bid amount rule, though popular auction design up to the early 2000s, is no longer widely used, owing to many examples of bidders abusing the flexibility this provides for strategic purposes that may be contrary to the integrity of the auction, for example using bid digits to send signals to rival bidders.

- **Bid increments** – The current regulations envisage a bid increment range of between 10% and 50% each round. We propose instead that the Auctioneer has discretion to set a fixed increment level within a specified range. Rules on bid increments should be finalised in conjunction with starting prices, level of competition and pace of the auction. Assuming that a substantial reserve price is set for the 800MHz band, a range of between 5% and 20% of current round prices may be appropriate.

- **Transparency** – The current rules feature full disclosure of bidder names and bids on a round-by-round basis. This approach is now rarely used in spectrum auctions, owing to concern that transparency may favour incumbents, who may have a common interest in blocking entry. If BIPT were to select a standalone 800MHz auction, we would recommend switching to a regime of restricted information disclosure in which only the level of demand and price by lot are revealed at the end of each bid round. However, as we recommend incorporating the option for a new entrant to acquire 2.6GHz spectrum in the 800MHz award, a transparent process disclosing the identity of current winning bidders for each lot at the end of each auction round would be beneficial to entrants in determining their prospects of securing first refusal on 2.6GHz spectrum.

- **Waivers** – The current rules envisage bidders having three waivers. In similar auctions, the use of waivers for strategic purposes (as opposed to their primary purpose as a protection against technical error) has been identified as a concern, and various adjustments to the waiver rule have been proposed as address this. One possible approach is to start bidders with two waivers but to include a provision allowing the Auctioneer to grant additional waivers to bidders in the event if the bidder can provide evidence that its use of a waiver was necessitated by conditions clearly outside its control (e.g. an internet blackout).

- **Round scheduling** – The rules as drafted give great flexibility to the Auctioneer and are appropriate for regulations. However, given the high value of the award, BIPT should be prepared to give greater guidance to bidders on the actual auction schedule, so bidders can confidently predict how prices might evolve on a day-to-day basis. Notably, we recommend that BIPT publish a provisional schedule of bidding rounds for each day and commit not to run more rounds in a day than specified in the schedule.

- **Deposits** – Compared to the 2.6GHz award, the deposit level should be increased substantially in line with the higher value of the 800MHz band. An approach equivalent to many other regulators would to require a bank guarantee to cover 50% of the value of a 2×10MHz lot, with provision to suspend the auction and require top-up deposits in (the unlikely) case bid levels climbed to levels where the original deposit was deemed to be an insufficient deterrent to default. However, any revision to deposit rules would need to be reconciled with provisions for payment by annual instalment.

Our view is that these proposed changes are modest and prudent, and should not require extensive work. The auction offers an opportunity for BIPT to take advantage of recent innovation in auction design and integrate current best practices into its familiar SMRA design.

9 Reserve price for 800MHz spectrum

In Section 4, we established that Belgacom, Mobistar and KPN GB are likely to express demand of 2×30MHz of 800MHz spectrum but that it was not clear whether there would be demand in excess of this from existing operators (which would be prohibited if a 2×10MHz cap is used), Bidco, BUCD or new market entrants.

In this section, we first explore the trade-offs which regulators need to consider when setting reserve prices (Section 9.1). We then look at the benchmarks from other European auctions (Section 9.2). Finally we conclude with a recommendation on the level of reserve price which we consider appropriate for BIPT to set in the context of the Belgian market (Section 9.3).

9.1 Rationale for reserve price setting

Broadly speaking, there are three main approaches to setting reserve prices for a spectrum auction:

- Low but non-trivial – Under this approach, which has been used for a number of UK and Dutch spectrum auctions, reserve prices are set at a modest level considered sufficient only to deter frivolous participation. The reserve prices are set with no consideration for the expected value of the frequencies being awarded. This approach is appropriate if the regulator's core objective is efficiency of outcome and it has no secondary objectives to raise revenues. This approach is typically very popular with bidders, as under low competition scenarios, they may acquire licences at very low price relative to expected return.

- Minimum expected return – Under this approach, which has been widely used in spectrum auctions around the world, reserve price levels are set at a significant discount to the estimated value of a licence to a marginal winning bidder[45], but at a level that will still ensure a significant revenue return for taxpayers if all licences are sold. This approach should normally achieve an efficient outcome while realising substantial revenues even when there is no excess demand. There is no standard approach for the level of discount relative to expected value, but smaller discounts imply a heightened risk of lots going unsold because prices are accidentally set too high.

- Revenue maximisation – Under this approach, used occasionally in spectrum auctions, revenues are priced at or very close to the estimated value of a licence to the expected marginal winning bidder. If all licences are sold, this ensures that revenues are close to the maximum level even if there is no excess demand. However, pricing at this level carries with it a significant risk that lots are accidentally priced too high, and lots go unsold. Such an outcome would be inefficient and may result in lower revenues than could have been achieved had all lots been sold at a more conservative price level.

Typically, the low but non-trivial approach is only used for bands of modest and uncertain value. For high profile awards, such as this one, there is generally an expectation on regulators to realise a return commensurate with a substantial proportion of the scarcity value of the spectrum. For this reason, we do not recommend this approach for the Belgium 800MHz award.

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45 The term marginal winning bidder is used to refer to the winning bidder that has the lowest value. For this award, with three blocks and a cap of one block per bidder, the marginal winning bidder would be the third strongest bidder.

Belgium therefore faces a choice between the second and third approaches. Our view is that the minimum expected return approach would be a good fit with the stated objectives for this award (see Section 3). In particular, it should strike a good balance between efficiency of outcome, avoiding unsold lots and obtaining adequate revenues. Identifying the exact level for the reserve price under this approach is more an art than a science. If, as in the case of Belgium, many other countries have already sold equivalent spectrum, international benchmarks on a pop per MHz basis, typically provide a good guide on plausible reserve price levels. Benchmark results may then be compared against the results of Belgium-specific valuation models to check that these reserve prices are achievable.

9.2 International benchmarks

Nine auctions involving the award of the 800MHz band have been carried out to date in Europe. Broadly speaking, these auctions can be divided into two categories:

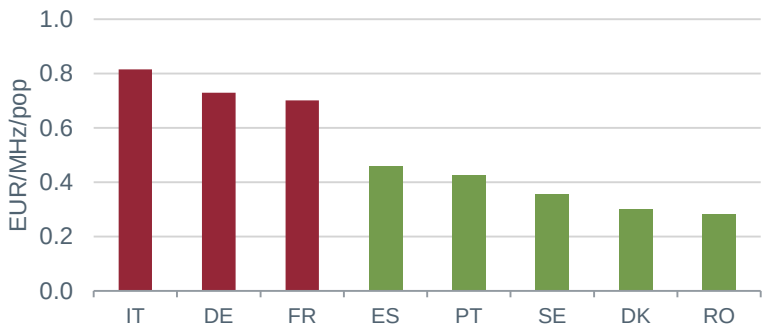
- Highly competitive auctions – these are auctions with prolonged bidding on 800MHz spectrum and prices significantly above reserve prices and at the upper end of the benchmarks. The setting of the reserve price was not of critical importance in these auctions.
- Less competitive auctions – these auctions did not have prolonged bidding on 800MHz spectrum and prices did not move significantly above reserve price or stayed in the middle range of the benchmarks.

The results of the auctions are summarised in Figure 9-1. For the purpose of this graph, we have normalised the auction results to show the price in Euro per Megahertz per capita (EUR/MHz/pop). This removes differences in auction results due to different market or lot sizes. We have not further attempted to normalise the results based on differences between markets in ARPU levels, mobile (data) penetration or economic indicators such as GDP as this might introduce an unwanted bias into our results and it is not clear that these factors are directly related to the auction results.

Figure 9-1:

Final auction prices in European 800MHz awards[46]

[Source: Aetha, 2012]



The results show that the auctions in Italy, Germany and France resulted in a significantly higher price than all other auctions, between EUR0.7-0.8/MHz/pop. These three auctions share a couple of common characteristics:

46 Prices for Switzerland cannot be deducted due to auction format. As there were only very few auction rounds in Romania and spectrum remained unsold, we estimate that prices have not increased above reserve. Our estimate for Romania also takes into account the non-trivial licence fees which are payable by operators over the course of the licence period

- there are four existing mobile network operators in all of these markets (or, as in the case of France, the impeding entry of a fourth mobile network operator)
- within the auction, these operators competed against each other. This is in contrast to, for example, the auction in Sweden or Denmark, where the existing mobile network operators formed joint ventures ahead of the auction.

From the results of these competitive auctions, it appears that the value for 800MHz spectrum for a fourth operator is around EUR0.7/MHz/pop. It is not clear whether such demand is for lots of 2×5MHz or 2×10MHz. However, for reasons outlined in Section 4, we are inclined to believe that demand is more likely to be for a total of 2×10MHz.

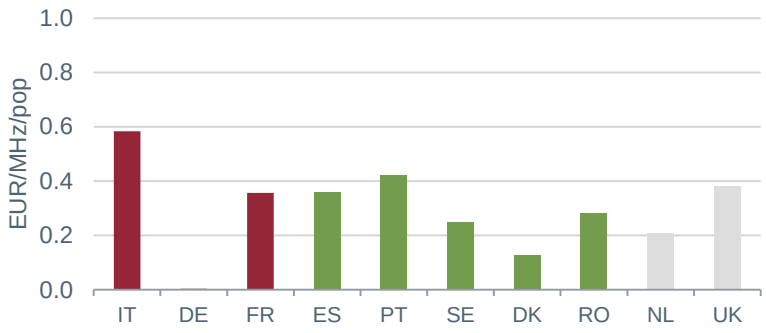
All other auctions resulted in prices between EUR0.25-0.45/MHz/pop. Within these auctions, there were typically three bidding entities which were content to acquire 2×10MHz. The exceptions are in Denmark, where TDC outbid Hi3G to acquire 2×20MHz and Romania, where Cosmote only acquired 2×5MHz with 2×5MHz remaining unsold.

Figure 9-2 provides an overview of the reserve prices asked by regulators in the respective countries. Again, we have normalised all reserve prices to be displayed in EUR/MHz/pop. We have also added the reserve prices announced for the Dutch and UK auctions which are scheduled to take place over the coming months.

Figure 9-2:

Reserve prices in European 800MHz awards

[Source: Aetha, 2012]



Regulators took a very different approach across the three competitive auctions with prices varying between EUR0.003/MHz/pop and EUR0.58/MHz pop. In face of high expected competition, it is worthwhile to note that the reserve price setting was not that critical, although it is not clear that all regulators could expect such competition ahead of the auction.

There is a much more consistent picture for the remainder of the auctions. In most of these auctions, the reserve price was set between EUR0.2-0.4/MHz/pop. With the exception of Romania – where mobile ARPU is significantly below Western European levels – this has led to all available spectrum being sold.

9.3 Recommendations

As discussed in Section 4, we strongly expect demand from Belgacom, Mobistar and KPN GB for 2×10MHz each meaning that it is highly likely that the available 2×30MHz of spectrum will be sold. At the same time, it is not clear whether there will be demand in excess of 2×30MHz:

- in their consultation responses, Belgacom, Mobistar and KPN GB appeared content with a spectrum cap of 2×10MHz
- within all auctions to date, operators have rarely acquired more than 2×10MHz (though during the auction they may have been for more than this (where allowed by the spectrum caps) at lower price levels)
- our business modelling indicates that there are credible scenarios where Bidco could generate value from 800MHz spectrum. This is supported by Bidco's response in the consultation asking for a spectrum reservation. However, at the same time, Bidco has publicly stated on various occasions that it has limited intentions to deploy its own mobile network infrastructure, so whilst there are positive indications of interest in 800MHz spectrum from Bidco, actual demand remains unclear
- demand from BUCD or a new entrant is highly uncertain.

It follows that we are uncertain about the level of competition which can be expected as part of the upcoming 800MHz awards. A likely market outcome could be for the existing operators to acquire 2×10MHz each.

In setting the reserve price, it will therefore be important for BIPT to consider the trade-offs between making sure that all available spectrum is sold and used in the most efficient manner but, at the same time, ensuring that the government receives adequate compensation in return for awarding this highly sought after spectrum.

We therefore recommend that BIPT set a reserve price at around EUR90million per 2×10MHz lot. This translates into a price of about EUR0.41/MHz/pop and is in line with the levels adopted in other countries, most notably France, UK and Portugal. It is likely that at such prices, all spectrum will be acquired. The results of our valuation modelling work also clearly indicate that there should be sufficient spectrum demand at such a reserve price level.

10 Summary of recommendations

In this section, we provide a tabular summary of our recommendations relating to the award of the 800MHz band and unassigned 2.6GHz spectrum.

10.1 800MHz band

Packaging of spectrum	Three lots of 2×10MHz each
General licence conditions	15 years licence from notification of granting and extendable by BIPT for an additional five years after expiry of the initial 15 year period Service and technology neutral Fully tradable – subject to limits set out in spectrum caps (see below) Annual usage fees of EUR174 850 per paired MHz apply Mandated national roaming for operators with existing 900MHz infrastructure to provide GSM (2G), UMTS/HSPA (3G) and 800MHz national roaming to operators who: • have acquired 800MHz spectrum • do not own any existing 900MHz mobile infrastructure • are meeting the coverage obligations associated with any of their mobile spectrum licences • have deployed services using the 800MHz band to at least 20% of population
Standard coverage obligation	Deploy and maintain a network providing average downlink user throughput outdoors of 3Mbit/s across an area which covers 98% of the population Timescale for implementation: • 33% of the population coverage target must be achieved within 2 years of spectrum award (3 years allowed for an operator without an existing 900MHz network grid) • 66% of the population coverage target must be achieved within 4 years of spectrum award (6 years without existing 900MHz network) • 100% of the population coverage target must be achieved within 6 years of spectrum award (9 years without existing 900MHz network) • Postcode areas identified by BIPT as being covered by GSM (2G) services but are not covered by UMTS/HSPA services must be covered within 2 years of spectrum award (within 6 years for an operator without an existing 900MHz grid) This coverage obligation can be achieved/met using any combination of the spectrum bands available to the licensee
Award process	Simultaneous Multiple Round Auction (SMRA) format, which will determine both the frequencies awarded to each bidder and the price that each bidder must pay Spectrum cap of 2×10MHz Reserve price of EUR90million per 2×10MHz lot Payment of full fee upfront or paying an equal amount on an annual basis throughout the licence duration, with an interest rate of equal to the market rate + 2%

10.2 Unassigned 2.6GHz spectrum

Packaging of spectrum	Three generic 2×5MHz lots
Licence conditions	Same licence conditions as for existing 2.6GHz assignments
Award process	Any bidders that win 800MHz spectrum but do not already have 2.6GHz paired spectrum should be given the option to acquire 2.6GHz paired spectrum according to the following order of precedence: • Step 1: any such bidder that acquires the lowest frequency 800MHz block offered right of refusal to acquire 1, 2 or 3 blocks of contiguous 2×5MHz spectrum; • Step 2: any such bidder that acquires the middle frequency 800MHz block offered right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum; and • Step 3: any such bidder that acquires the highest frequency 800MHz block offered the right of refusal to acquire any remaining blocks of contiguous 2×5MHz spectrum. In each step, bidders must select specific frequencies and these must be contiguous. Reserve price of EUR2.5million per 2×5MHz lot (no change) If all bidders that win 800MHz spectrum already have 2.6GHz paired spectrum or no 2.6GHz spectrum is assigned in the above steps, then the 2.6GHz spectrum should be sold in a separate auction.