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L'enquête qui se trouve à la base de cette étude a été entamée en septembre 2015. La présente étude est basée sur les données les plus récentes et doit être considérée comme la version finalisée de l'enquête menée par les auteurs.
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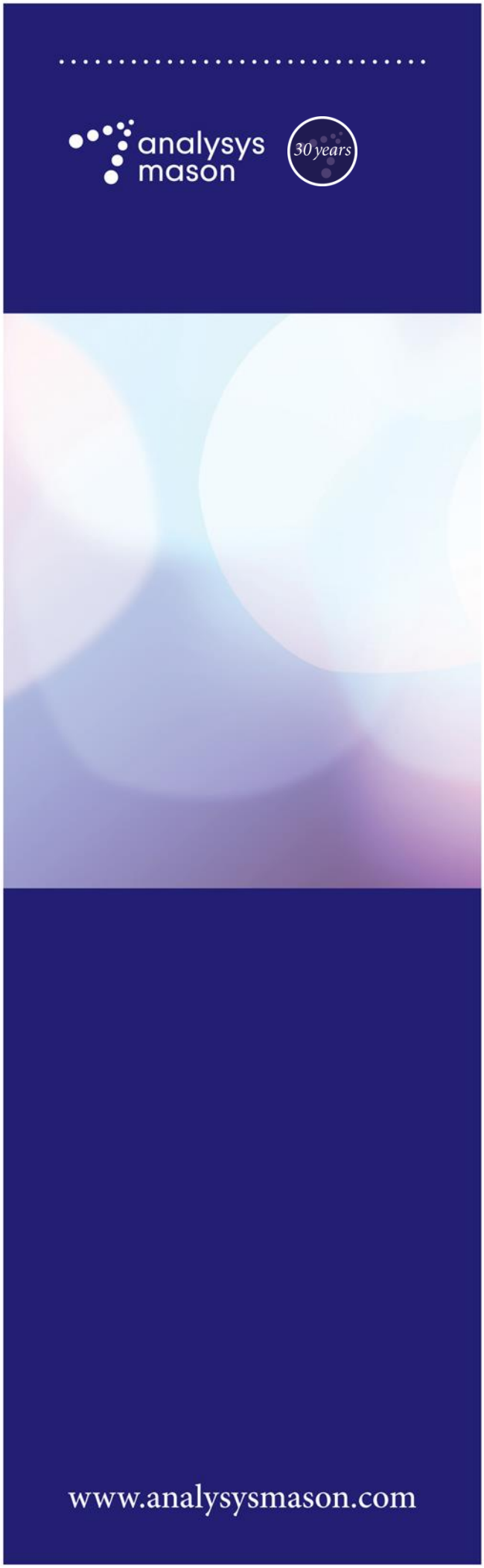

Report for BIPT

Study regarding the value of spectrum for public mobile systems

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Contents

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1 Executive summary

This document is the final report of a project carried out by Analysys Mason on behalf of BIPT to analyse the value of spectrum for the Belgian MNOs within different frequency bands, and to make recommendations on suitable price levels for these bands. We have structured our analysis around three interdependent themes which have an impact on the value of the spectrum:

- *The award mechanisms* that have been used by other national regulatory authorities (NRAs) throughout the world, with a focus on Western European markets.
- *The specific options for awarding spectrum* such as spectrum packaging, spectrum caps and related regulatory conditions imposed on licences such as coverage and quality-of-service obligations.
- *The value of each spectrum band* being considered, based on price benchmarks from European markets as well as our own economic analysis modelling.

We provide analysis and recommendations for *new spectrum bands* and for *existing bands* in Belgium. New bands are spectrum which is not currently allocated to mobile services, but might be so allocated in the future. This category includes mainly the 700MHz and 1400MHz bands, but also other potential bands such as the 2300MHz and 3500MHz. Existing bands are those that are already in use by mobile network operators (MNOs) and for which licences will expire in 2021. This category includes the 900MHz, 1800MHz and 2600MHz bands.

Our analysis takes into account our understanding of the characteristics of the Belgian market, the objectives of BIPT, the views of MNOs, international benchmarks and best practices, as well as our professional judgment based on our wide experience from previous similar studies.

Award mechanisms

The main mechanisms used to award spectrum are auctions, administrative assignment, hybrid assignment (usually a beauty contest followed by an auction), automatic renewal and first come first served. Auctions offer the benefits of transparency and simplicity, and typically result in an economically efficient use of the spectrum. Across Europe, auctions have been used in more than 60% of the spectrum awards in the last 10 years.

Almost all awards of *new spectrum* in Europe have been via auctions, which have the advantages of encouraging competition and economically efficient use of the spectrum, as well as being transparent and fair. The most common formats are simultaneous multi-round auction (SMRA) or combinatorial clock auction (CCA).

In the case of Belgium, we recommend, for the award of new bands the use of an SMRA format whether for auctioning just one band or several bands. This multi-round format facilitates price discovery, is simpler and more transparent than CCA, gives more flexibility to bidders and is already familiar to BIPT and the MNOs. This recommendation is also in line with European best practice.

The award mechanisms used for *existing bands* include auctions and non-full-auction-based methods (automatic renewal, administrative re-assignment and hybrid re-assignment). Each type of award serves different regulatory objectives, which can be grouped into five categories: competition and efficiency of assignment; investment incentives and service continuity; transparency and fairness; manageability; and revenue generation. Since 2005, most of awards of existing spectrum in the benchmark countries have been undertaken through non-auction mechanisms.

Based on the specificity of the Belgian market, and our analysis of the different objectives and potential outcomes, we recommend awarding existing bands through the use of a hybrid re-assignment mechanism. Incumbents would have the option to keep a minimum amount of spectrum through an administrative re-assignment, while the remaining spectrum would be awarded through an auction bidding process in which incumbents would be allowed to bid.

Options for spectrum award and regulatory conditions

We have examined the specific options that European NRAs have used when awarding spectrum, such as the duration of licences, how the spectrum is packaged, and caps on the amount assigned. We have also considered regulatory conditions that NRAs have attached to licences, such as coverage obligations, quality-of-service targets and requirements to share networks with competitors. Based on this analysis, we have made the following recommendations for Belgium, as summarised in Figure 1.1 (for new bands) and Figure 1.2 (for existing bands).

Figure 1.1: New bands: recommendations for award options and regulatory conditions [Source: Analysys Mason, 2015]

Obligation	700MHz only	1400MHz only	700MHz and 1400MHz
Licence duration	20 years	20 years	20 years
Spectrum packaging	Option 1: 3 blocks of 2×10MHz Option 2: 6 blocks of 2×5MHz	8 blocks of 5MHz	Option 1: 3 blocks of 2×10MHz for the 700MHz band, 8 blocks of 5MHz for the 1400MHz band Option 2: 6 blocks of 2×5MHz for the 700MHz band, 8 blocks of 5MHz for the 1400MHz band
Spectrum cap	Option 1: 2×10MHz Option 2: 2×15MHz	20MHz	Option 1: 2×10MHz for 700MHz band, 20MHz for 1400MHz band Option 2: 2×15MHz for 700MHz band, 20MHz for 1400MHz band
Coverage	No new or additional obligations	No new or additional obligations	No new or additional obligations
Quality of service	Minimum download speed of 6Mbit/s for 2×10MHz Minimum download speed of 5Mbit/s for 2×5MHz	None	Minimum download speed of 6Mbit/s for 2×10MHz Minimum download speed of 5Mbit/s for 2×5MHz

Obligation	700MHz only	1400MHz only	700MHz and 1400MHz
National roaming and network sharing	None[1]	None	None
Access and MVNO obligations	None	None	None
Service- and technology-neutrality	Service- and technology-neutral	Service- and technology-neutral	Service- and technology-neutral
Spectrum trading	Fully tradable	Fully tradable	Fully tradable
Reserved spectrum for new entrants	None	None	None
Payment terms	Whole amount upfront	Whole amount upfront	Whole amount upfront

Figure 1.2: Existing bands: recommendations for award options and regulatory conditions [Source: Analysys Mason, 2015]

Obligation	900MHz	1800MHz	2100MHz
Licence duration	20 years	20 years	20 years
Spectrum packaging	6 blocks of 2×5MHz 5 blocks of 2×1MHz	2×5MHz	2×5MHz
Reserved spectrum for existing MNOs	1 block of 2×5MHz	4 blocks of 2x5MHz	2 blocks of 2x5MHz
Spectrum cap	Option 1: 2×12MHz Option 2: 2×15MHz	2×35MHz	2×30MHz
Coverage	No new or additional obligations	No new or additional obligations	No new or additional obligations
Quality of service	No new or additional obligations	No new or additional obligations	No new or additional obligations
National roaming and network sharing	None	None	None
Access and MVNO obligations	None	None	None
Service- and technology-neutrality	Service- and technology-neutral	Service- and technology-neutral	Service- and technology-neutral
Spectrum trading	Fully tradable	Fully tradable	Fully tradable
Reserved spectrum for new entrants	None	None	None
Payment terms	Whole amount upfront	Whole amount upfront	Whole amount upfront

[1] National roaming may be mandated in the future for security reasons (i.e. PPDR).

Prices for the different bands

We have carried out our own valuation modelling based on a bottom-up discounted cash flow model, which calculates the value of each of the bands for each of the Belgian MNOs. We have also analysed the prices paid for each of the bands in other European markets, as well as the reserve prices set by the NRAs. Our recommendations for the reserve price of each band are presented in Figure 1.3 below.

Figure 1.3: Recommended prices [Source: Analysys Mason, 2015]

Band	Lot size (MHz)	Reserve price per lot (EUR million)	Reserve price (EUR/MHz/pop)*	Total price based on reserve price (EUR million)
New bands				
700MHz	2×5	40	0.35	240
1400MHz	5	3	0.05	24
Existing bands				
900MHz	2×5	28	0.25	196
1800MHz	2×5	9	0.08	135
2100MHz	2×5	9	0.08	108

* For ease of comparison, this column shows the price of each MHz of the spectrum divided by the population estimated in 2018. This measure (EUR/MHz/pop) is commonly used in the industry.

In order to compare our recommended reserve prices with the benchmark data, Figure 1.4 presents the *prices paid* in Europe, showing the highest price, average price and median price as well as the price paid for the 800MHz band in Belgium recently.

Figure 1.4: Average price paid by band across all benchmarks [Source: Analysys Mason, 2015]

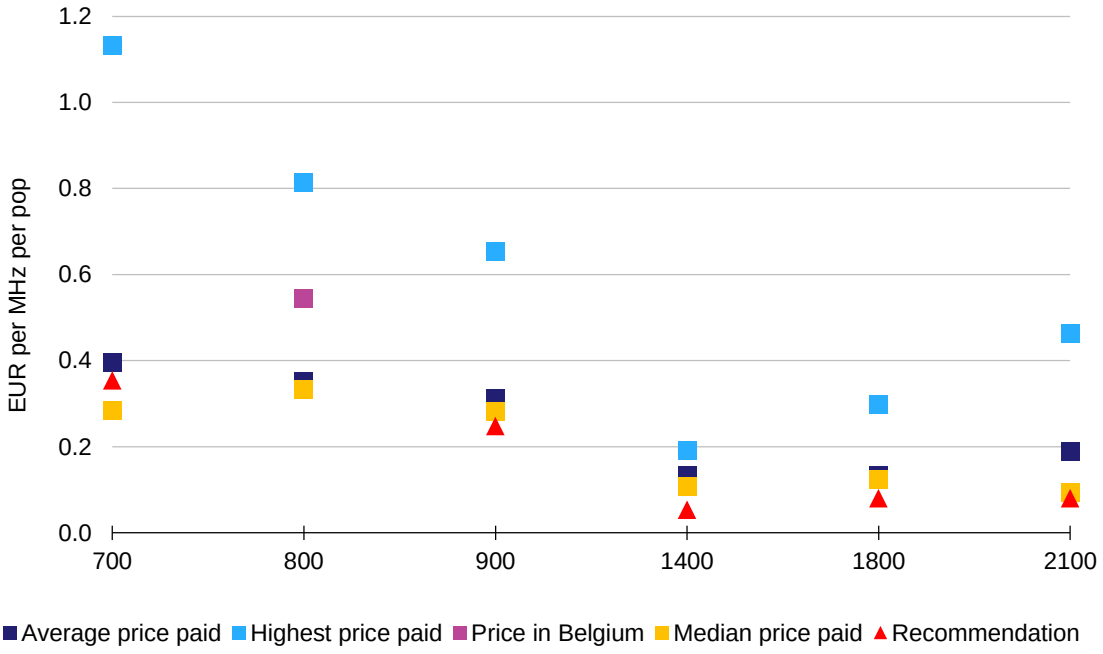
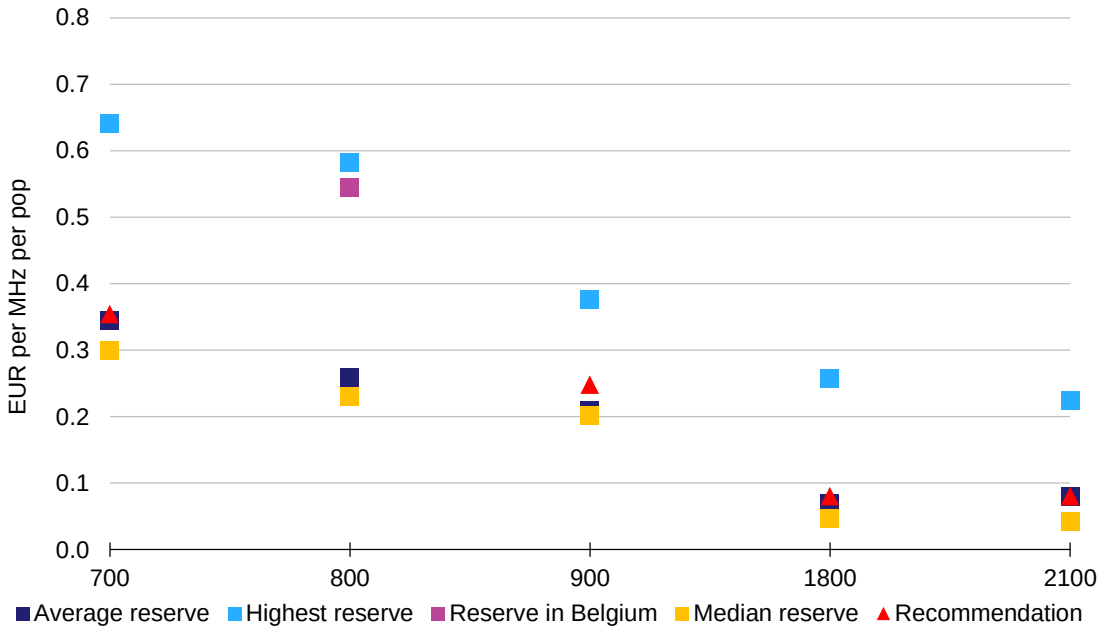


Figure 1.5 below presents a similar summary of the *reserve price* set by European NRAs for the different bands.

Figure 1.5: Average reserve price by band across all benchmarks [Source: Analysys Mason, 2015]

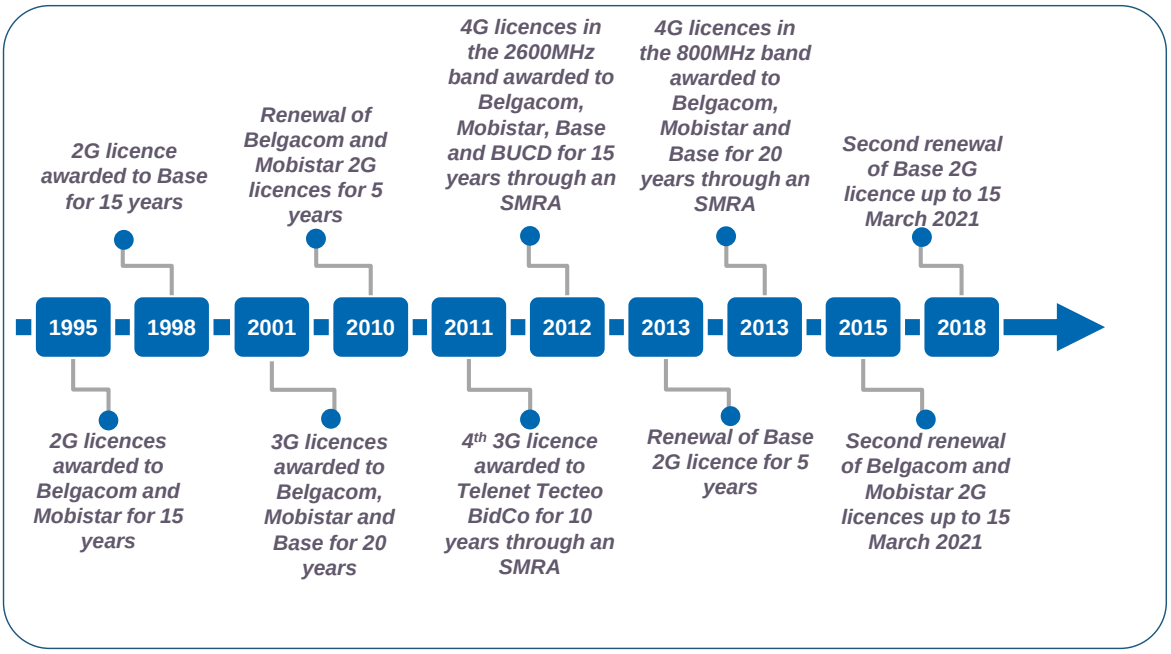


2 Introduction

The Belgian Institute for Postal services and Telecommunications (BIPT) launched a consultation in November 2014 on spectrum for mobile services, to help in determining its spectrum strategy for the short and medium term. The consultation covered several subjects including existing spectrum bands used by mobile network operators (MNOs) in Belgium, and potential new spectrum bands that may be awarded for mobile telecoms use in the future.

Several awards of new and existing spectrum bands have happened since 2010 in Belgium, as illustrated in Figure 2.1. It should be noted that the second renewal of 2G licences will be in 2015 and 2018, and has already been decided on by the BIPT.

Figure 2.1: Award of mobile licences in Belgium[2] [Source: Analysys Mason, 2015]



In this context, BIPT has commissioned Analysys Mason to undertake a study focusing on the value of spectrum for mobile operators within different frequency bands and to make recommendations on suitable price levels for these bands. We have structured our analyses and recommendations around three interdependent themes which have an impact on the value of the spectrum:

- An analysis of the *award mechanisms* that have been used by other national regulatory authorities (NRAs) throughout the world, with a focus on Western European markets.

[2] It should be noted that the current licences are technology-neutral. The fourth 3G licence awarded to Telenet Tecteo Bidco in 2011 was withdrawn in 2014.

- An analysis of the different *specific options for awarding spectrum*, such as spectrum packaging, spectrum caps and related regulatory conditions imposed on licences such as coverage and quality-of-service (QoS) obligations.
- An analysis of the *value of each spectrum band* being considered, including benchmarks from European markets and our own spectrum valuation modelling based on a bottom-up discounted cash flow (DCF) model.

Our analyses and recommendations are related to two categories of spectrum:

- *New spectrum* – spectrum which is not already allocated to mobile services but that might be allocated to mobile use and assigned in the future. This category includes mainly the 700MHz and the 1400MHz bands, but also other potential bands such as the 2300MHz and 3500MHz (which we do not examine in this report).
- *Existing spectrum* – spectrum which is already in use by MNOs and for which licences are coming to an end in 2021. This category includes the 900MHz, 1800MHz and 2100MHz bands.

Our analysis take into account our understanding of the characteristics of the Belgium market, the objectives of BIPT, operators' views, international benchmarks and best practices, as well as our professional judgment based on our wide experience from previous similar studies.

It should be noted that our recommendations are based on technical and economic analyses and that we have not considered any specific legal issues.

The remainder of this report is laid out as follows:

- Section 3 discusses the different award mechanisms and presents our recommendations.
- Section 4 considers the general award options and licence conditions available, and presents our recommendations.
- Section 5 analyses the economic value of the different spectrum bands considered, and presents our recommendation for spectrum prices for future awards.

3 Award mechanisms

In this section we discuss the award mechanisms that have been used by NRAs to award new and existing spectrum. We first summarise the different type of awards that have been used worldwide, then present the approaches used particularly by European NRAs. We then focus separately on the mechanisms used for *new bands* (700MHz and 1400MHz) and for *existing bands* (900MHz, 1800MHz and 2100MHz). Finally, we provide our recommendations of the type of award mechanisms that could be used in Belgium.

3.1 The main types of spectrum award mechanisms and their use in Europe

The main mechanisms used to award spectrum are auctions, administrative assignment, hybrid assignment (usually a beauty contest followed by an auction), automatic renewal and first come first served. Auctions offer the benefits of transparency and simplicity, and typically result in an economically efficient use of the spectrum. Across Europe, auctions have been used in more than 60% of the spectrum awards in the last 10 years.

In this subsection, we first present the main mechanisms used to award spectrum and summarise their advantages and disadvantages. We then present the approaches used by European NRAs.

3.1.1 The main types of award that can be used

There are a number of potential methods that may be used to award spectrum. The main mechanisms are presented below.

Auction

In an auction, the NRA assigns a spectrum licence to the operator who bids the highest price. There are a number of auction mechanisms that have been commonly used to assign spectrum, ranging from simple, single-round auctions to more complicated multiple-round auctions. Auctions are generally considered as economically efficient since a well-designed auction can capture policy objectives and incentivises bidders to bid according to their true valuation; auctions also tend to be simpler to administer and more transparent than alternative options. Additionally, auctions tend to be less open to post-award dispute than other award mechanisms.

The main concerns regarding an auction are the potential for collusion between market players, and the implications of allowing the market to determine the structure of the industry without regulatory intervention, as is done in auctions.

Administrative assignment

In administrative assignment, spectrum licences are assigned to the applicants that commit to best fulfil specific criteria laid down by the regulator in advance (through a beauty contest). MNOs are typically judged against generic indicators such as proposed services, coverage levels and QoS.

This approach tends to trade economic value for public policy objectives. MNOs may be tempted to overestimate their commitments in order to gain a licence, and an administrative assignment can lead to inappropriate spectrum valuations – either undervaluing (and therefore reducing government income) or overvaluing (and therefore hindering operator development). An administrative assignment is also somewhat subjective, which raises the risk of potential disputes.

Hybrid assignment

A hybrid approach merges certain elements of an auction with those of an administrative assignment, combining commitments to meet certain obligations with a bidding process. A beauty contest followed by an auction is one of the main hybrid mechanisms used. Hybrid assignments can also include the re-auction of the spectrum deemed to be "non-essential", while retaining some "essential" spectrum for incumbents. The same approach could also lead to a situation where all spectrum is auctioned but the original holder retains the right of first refusal on some of its previous holdings.

Whilst this does allow additional obligations to be imposed on the winning MNOs, it can prove difficult in practice to subjectively weight the importance of various commitments and is therefore more difficult to administer and can be open to disputes.

Automatic renewal

This is a commonly taken approach to renewing licences when the original licence period expires. Giving sufficient prior notice of automatic renewal to MNOs can provide the certainty they require to incentivise continued network investment. It may also be more efficient as the current holder of a band already has a network designed to utilise that particular frequency, reducing disruption and civil costs. However, it is difficult to ensure transparency and this approach may lead to disputes where competition for spectrum is high. Revocation of licences is possible, although MNOs should be given generous notification.

First come, first served

Under this approach, spectrum is assigned to the first applicants. Successful parties are those who submit their application the quickest once a licence is made available. This process is mainly suitable for bands where it is not expected to have scarcity of spectrum. However, it should be noted that this mechanism is very rarely used.

The main advantages and disadvantages of each approach are summarised in Figure 3.1 below.

Figure 3.1: Pros and cons of licence award mechanisms [Source: Analysys Mason, 2015]

Mechanism	Advantages	Disadvantages
Auction	• Transparent • Simple • Economically efficient	• Collusion is a major concern • Letting the market determine industry structure may create competition or pre-emption issues
Administrative assignment	• Regulators define the characteristics of the process • Beauty contests generally trade economic value for public policy objectives	• Consistency between different beauty contests is difficult to achieve • MNOs might be tempted to overestimate their commitments regarding the key criteria of the beauty contest • Can easily lead to inappropriate valuation of spectrum (and therefore reduce the income for the government if the price is too low, or hinder MNOs in their network development if it is too high)
Hybrid assignment	• Typically combines flexibility for the regulator (in the design of the award) and economy efficiency	• Longer process • High administrative costs
Automatic renewal	• Simple process • Low administrative costs • Maximises predictability for existing MNOs, leading to stimulation of investment	• Licences can only be revoked or otherwise modified when licence conditions are violated, and this involves lengthy notification periods
First come, first served	• Simple process • Low administrative costs	• No guarantee that assignments are made to those parties with the best skills and capabilities to efficiently use the spectrum resources

It should be noted that there is no "one size fits all" award as setting up awards should take into account the specific objectives in each case. These include for example:

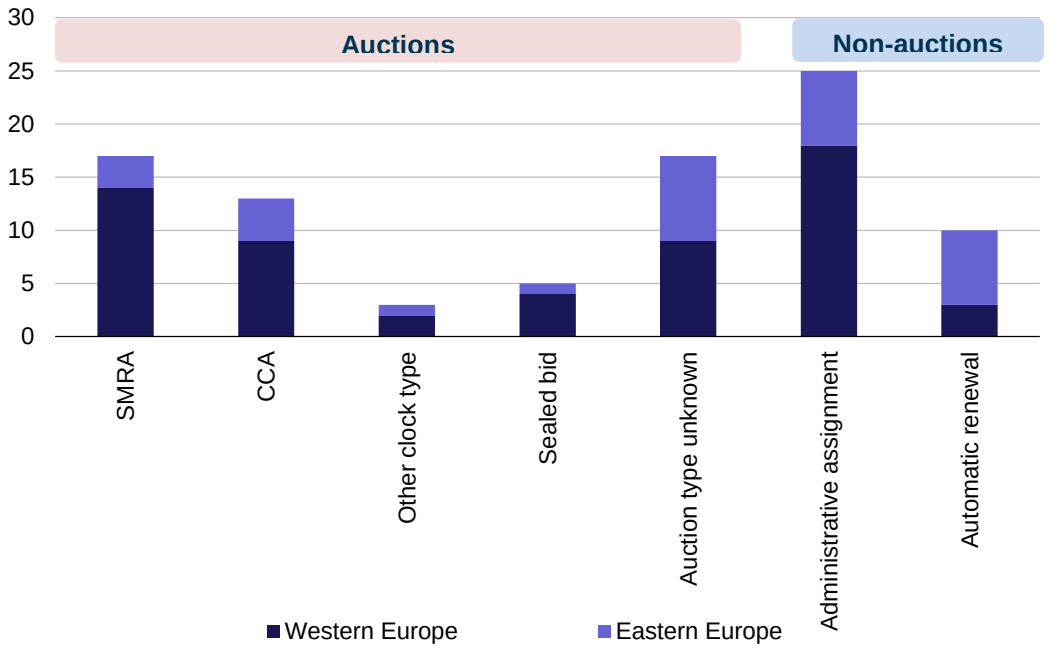
- competitiveness of the telecoms market (e.g. low barriers to entry)
- efficiency of assignment (price of spectrum correctly reflects spectrum scarcity)
- investment incentives and service continuity
- transparency and fairness (all potential parties have equal opportunity to acquire spectrum)
- manageability (NRA has ample discretion to change the assignment of spectrum at short notice)
- efficient use of spectrum
- complexity and cost of mechanism
- maximisation of revenues for the state
- universal service considerations.

3.1.2 The approaches used by European NRAs

During the last ten years, European NRAs have been using a mix of approaches for awarding spectrum, as shown in Figure 3.2 below. The data presented includes all spectrum awards since 2005 in the following countries:

- in Western Europe: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK
- in Eastern Europe: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Slovakia and Slovenia.

Figure 3.2: Approaches adopted by European regulators since 2005 to award spectrum [Source: Analysys Mason, 2015]*



* The category "auction type unknown" relates to auctions. However, the auction type (e.g. SMRA, CCA, clock, sealed bid, etc.) is not known.

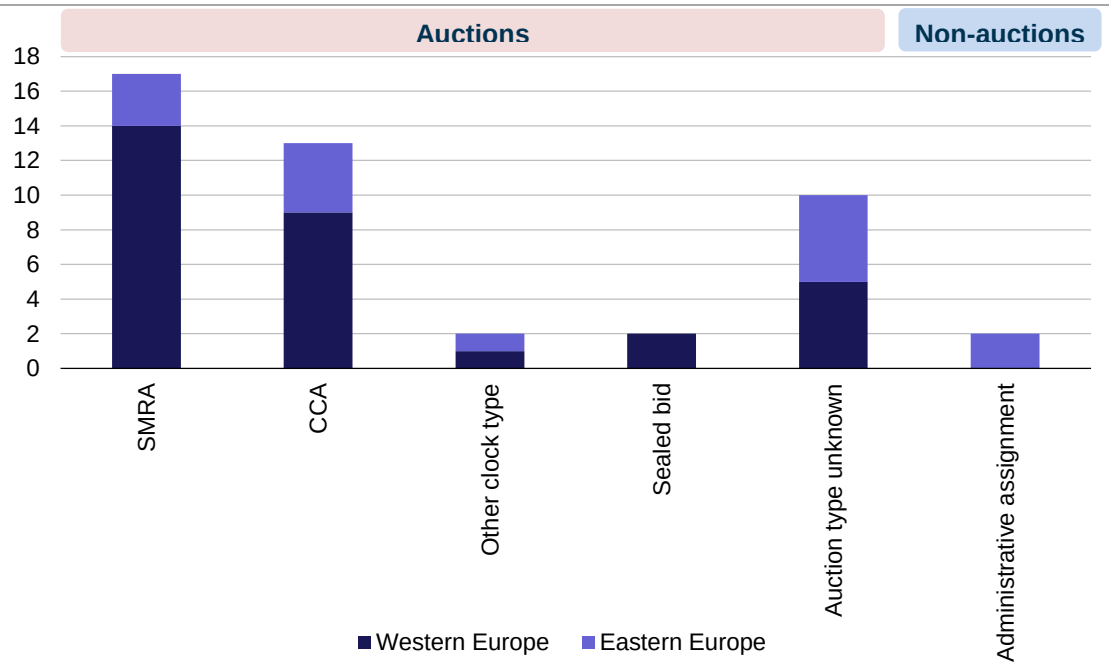
Across Europe as a whole, auctions have been used in more than 60% of the instances we have analysed, while non-auction approaches have been used in the remaining instances. In Eastern Europe the use of auctions has been lower (around 55%) compared to Western Europe (around 65%).

3.2 Award mechanisms used for new bands

Almost all awards of new spectrum in Europe have been via auctions, which have the advantages of encouraging competition and economically efficient use of the spectrum, as well as being transparent and fair. The most common formats are simultaneous multi-round auction (SMRA) or combinatorial clock auction (CCA). In the case of Belgium we recommend the use of an SMRA: the multi-round format facilitates price discovery; SMRA is simpler and more transparent than CCA; it gives more flexibility to bidders; and it is already familiar to BIPT and the MNOs.

As mentioned in the previous section, NRAs in Europe have generally favoured an auction mechanism when awarding spectrum. This is even more pronounced when awarding *new* spectrum bands, as shown in Figure 3.3 below: in all but two instances (96% of awards) new spectrum was awarded via an auction, primarily through simultaneous multi-round auctions (SMRAs) or combinatorial clock auctions (CCAs).

Figure 3.3: Approaches adopted by European regulators from 2005 when awarding new spectrum bands[3]
[Source: Analysys Mason, 2015]



In the following, we analyse the characteristics of the main auctions that have been used to award new bands. Based on that analysis, we then present our recommendations for the award of new bands in Belgium.

[3] The category "auction type unknown" relates to auctions. However, the auction type (e.g. SMRA, CCA, clock, sealed bid, etc.) is not known.

The design of auctions can have the characteristics described below.

► *Ascending versus final bid auctions*

In an *ascending* auction, the various bidding parties compete across a number of bidding rounds for the spectrum licence(s) available. At the end of each bidding round a highest bidder will emerge, and a new round commences. This process continues until no new bids are submitted. Ascending auctions utilise increasing monetary bids, and enable a flow of information to be shared between players.

In a *final bid* auction, the bidders submit only one single, binding bid for the spectrum licence. As with an ascending auction, the spectrum licence is then awarded to the party that has made the highest bid. Final bid auctions involve only one bid per bidder; they can only be won by bidding high, and as a result can result in 'winner's curse' – i.e. the overestimation of the licence's value.

► *Open versus closed bidding*

In an *open* auction, all bidders are provided with most of the information concerning the bids made within an auction, whereas in a *closed* auction bidders are provided with a limited amount of information. Closed bidding can also be used in conjunction with an ascending auction such that only a limited amount of information is passed between bidding parties, thereby reducing the possibility of collusion.

► *Simultaneous versus sequential auctions*

In a *simultaneous* auction, all assets are auctioned concurrently. As such, all auctions start and finish at the same time. Simultaneous auctions limit how bidders can respond to other parties' bids, and are more likely to lead MNOs to bid prices which represent the true value for them. In a *sequential* auction, each asset is auctioned one at a time, and each new auction commences at the end of the previous auction. Sequential auctioning is not widely used.

► *Individual versus package bidding*

With *individual* bidding, bidders are allowed to bid for individual licences only, whereas with *package* bidding, a bidder can place single 'all or nothing' bids for a combination of individual licences. Where package bids are allowed, the winning bids are the set of consistent bids that maximise total revenues. Package bidding is appropriate where the spectrum blocks on offer are complementary.

► *First-price versus second-price rule*

Under both first-price and second-price rules the licence is assigned to the highest bidder; however, under the first-price rule, the highest bidder pays the *highest* bid (its own bid), whereas under the second-price rule, the highest bidder pays the *second-highest* bid. A second-price rule reduces the risk of an inefficient outcome, and the outcome is still fair in the sense that each bidder

is paying as much as necessary to ensure that no other bidder or group of bidders would be happy to pay more.

► *Generic versus specific lots*

Multiple lots can be sold either on a specific or generic basis. With *specific* lots, bidders place bids for lots at specific frequencies. By contrast, with *generic* lots, bidders simply specify the number of lots that they want at a given price per lot, without the lots being associated with particular frequencies. The translation of lots won into actual frequency blocks then takes place in a follow-up process. The use of generic lots is appropriate if, within a given category of lot, the variation in value between lots for bidders is likely to be modest: bidders are likely to be interested in packages of more than one lot, and the value of a package has more to do with the characteristics of the package as a whole, rather than the specific frequencies within this package.

Based on these characteristics, three main types of auctions are distinguished: simultaneous multi-round auctions (SMRAs), combinatorial clock auctions (CCAs) and sealed bid auctions. These types are discussed below; their characteristics are summarised in Figure 3.4.

Figure 3.4: Main auction types and their characteristics [Source: Analysys Mason, 2015]*

Characteristics	SMRA	CCA	Sealed bid
Ascending	✓	✓	
Final			✓
Open	✓	✓	
Closed		✓	✓
Simultaneous	✓	✓	✓
Sequential			
Individual	✓		✓
Package		✓	
First price	✓*		✓
Second price		✓*	✓
Generic lots		✓	✓
Specific lots	✓		✓

* The table identifies the most common characteristics for each auction type, but some types may have different characteristics: e.g. an SMRA can have a second price rule and a CCA can have a first price rule.

SMRA

Bidders submit multiple bids in each round for individual lots and are able to shift their demand between rounds subject to certain activity rules. At the end of each round a standing highest bid is determined for each lot that has received any bids – any subsequent bids must be for an amount higher than this. Bids are assessed on a standalone basis – so an individual bidder may be the highest bidder on some but not the entire spectrum they bid on.

SMRAs typically have an activity rule to ensure that MNOs do not remain dormant until late on in the auction, and bidding remains open for all lots until

the end of the auction, allowing bidders to switch between lots at any time in response to price differentials. The auction typically ends when no more bids are received in a round, with the current highest bids being the price paid.

There are a number of risks with the SMRA format. A bidder may win an unwanted subset of lots (in particular, not winning complementary spectrum) or may win too many blocks that are substitutes for one another. Additionally, the format can be open to gaming from bidders, either concealing their intentions until late rounds or raising the prices for competitors through their own bidding behaviour.

CCA

In a CCA, MNOs bid on packages of usually generic lots over multiple rounds rather than submitting complementary bids for individual lots. A CCA is structured in two stages; the *open clock* stage and a secondary *sealed bid* round. In the open clock stage, a price is stated for each lot and bidders specify their demand at that price. The price is increased on those lots with excess demand for the next round until no excess demand exists. The sealed bid round invites bidders to submit a full list of alternative package bids. The overall winning bids are calculated as the combination which maximises revenue across the two stages.

This format mitigates the risk of an operator either winning an unwanted subset of spectrum, or winning too many substitutable blocks, as they either win the entire spectrum within a package, or none of it. It is also less susceptible to gaming behaviour. However, CCAs are relatively complex, both to administer and to bid as part of, and the format is somewhat counter-intuitive in that the highest bidder after the primary stage will not necessarily win the licence for that package.

Sealed bid

In a sealed bid, bidders submit one final bid and are not able to shift their demand. Sealed-bid auctions reduce the flow of information. Limiting the information flow reduces the risk of collusion but increases the likelihood that the value of the spectrum is either under- or over-valued. A bidder can only guarantee success by bidding high. This is in sharp contrast to an open auction where bidding behaviour generally leads the winner to obtain the asset at slightly above the value set by the second-highest bidder.

Of the auction mechanisms chosen by European regulators (see Section 3.1.2 above), SMRAs and CCAs have proved the most popular. Administrative assignment was only used in specific circumstances where auctions were supposed to be used but had failed. We have identified two instances when this happened:

- In Croatia, three blocks of 2×10MHz of 800MHz spectrum were made available in October 2012. However, only two MNOs expressed interest in the spectrum. As the spectrum cap was

of 2×10MHz, the auction process would therefore have been uncompetitive as the supply was higher than the demand. Given this, the NRA decided to assign the spectrum for a set fee.

- In Bulgaria, the NRA's initial auction in 2011 of three blocks of unused 1800MHz spectrum failed to attract any bids. This auction was intended to attract a new entrant but high market penetration and high reserve price deterred interested parties from taking part in the auction. Therefore, the NRA decided to share the three blocks amongst the existing three MNOs via an administrative assignment process.

3.3 Recommendations for awarding new bands in Belgium

We recommend the use of an auction for all new frequency bands (700MHz, 1400MHz, 2300MHz, 3500MHz), in line with European best practice. The use of an auction has several benefits, of which two can be highlighted as important in this context:

- *Encourages competition and ensures economically efficient use of the spectrum* – an auction will enable BIPT to allocate the new spectrum to bidders who will make the best use of it. In addition, the use of an auction may enable new participants to enter the market (though it must be said that this is highly unlikely within the context of the current Belgian telecoms market).

- *Transparent and fair* – an auction is a more transparent mechanism than other award methods, and is fair because the rules apply to any participant in the auction.

In terms of the specific type of auction to use, we recommend the SMRA format whether auctioning just one band or several bands. We believe that an SMRA would be the most appropriate format for the following reasons:

- SMRA includes multiple rounds. Multi-round auctions facilitate price discovery, which is usually desired by MNOs.
- SMRA is simpler and more transparent when compared, for example, to CCA.
- SMRA allows flexibility as bidders are able to switch bids in response to differences in prices among lots due to information released during the auction rounds.
- BIPT and the Belgian MNOs are already familiar with the SMRA type as it has been used in previous awards such as the 2100MHz, 2600MHz and 800MHz auctions.

3.4 Award mechanisms used for existing bands

The award mechanisms used for existing bands include auctions and non-full-auction-based methods (automatic renewal, administrative re-assignment and hybrid re-assignment). Each type of award has a different impact on the regulatory objectives, which can be grouped into five categories: competition and efficiency of assignment; investment incentives and service continuity; transparency and fairness; manageability; and revenue generation. Approximately 60%[4] of all awards of existing spectrum in the benchmark countries[5] since 2005 have been undertaken through non-full-auction-based mechanisms.

In this subsection, we first present the general regulatory objectives when awarding existing bands. We then present the different approaches to licence renewal followed in other countries. We also summarise the pros and cons of auctions and non-auction mechanisms to re-assign existing bands. Finally, we present our recommendations on the mechanism to be used for the awards of existing bands in Belgium.

3.4.1 Regulatory objectives when awarding existing bands

There are several potential regulatory objectives that an NRA considers when selecting an approach to licence renewals. These can be grouped into five categories as outlined below.

Competition and efficiency of assignment	The licensing approach needs to encourage a distribution of spectrum which is conducive to a competitive telecoms market. In particular, it should ensure an equal opportunity for all interested parties to acquire spectrum, and aim to minimise barriers to entry. It is also important that spectrum prices accurately reflect spectrum scarcity, so that spectrum is only held by MNOs that can use it profitably, and inefficient MNOs cede spectrum to more efficient players.
Investment incentives and service continuity	The approach taken should encourage MNOs to invest in high quality services with increasing coverage using the most recent technologies. Additionally, it is preferable to minimise any potential service disruption for consumers.
Transparency and fairness	The approach should be transparent to bidders such that where possible, it should set rules or criteria to give a quantifiable outcome. All potential licensees should have an equal opportunity to acquire spectrum and the NRA should act without bias to ensure the process is as fair as possible.
Manageability	It is preferable to allow the NRA to change the assignment of spectrum at relatively short notice if doing so is in the public interest or licence conditions

4 This includes the re-assignment of existing bands for licences with a duration of over 10 years (i.e. excluding licences with a shorter duration as these could be considered as licence harmonisation prior to a "real" award). This percentage increases to 65% if we include the licences with shorter duration than 10 years.

5 The list of countries is provided in Section 3.4.3.

and obligations have not been met by the existing licence holder. Such a change can include the redistribution of spectrum to enable new entrants to enter the market, or the re-allocation of spectrum for use by another technology.

Revenue generation Although it may typically involve a trade-off against other objectives (particularly increasing coverage or improving quality of service), revenue generation for the government can be an important objective. In order to maximise revenue, it is preferable to minimise the ability of bidders to engage in gaming or collusion, which may artificially depress prices.

3.4.2 The main approaches to licence renewal

We have identified seven main approaches to licence renewal, which fall under four broad categories, as shown in Figure 3.5 below.

Figure 3.5: Main approaches to spectrum licence renewal [Source: Analysys Mason, 2015]

Approach		Description
Automatic renewal		
1	High expectation of renewal	Licence renewal conditions are precisely formulated, and renewal can be expected if these conditions have been met
2	Indefinite licence period	A licence is given with an indefinite expiry date. Revocation may only be justified on public welfare grounds, with a generous notification period given
Administrative re-assignment		
3	Assignment with full regulatory discretion via beauty contest	Assignment and pricing is at the NRA's discretion. Re-distribution is made depending on an MNO's commitment towards certain criteria such as investment, coverage and QoS
Hybrid re-assignment		
4	Partial auction	The NRA reclaims and re-auctions spectrum deemed to be "non-essential", generally to be allocated to a new owner
5	Auction with preferential spectrum access for incumbents	All spectrum is auctioned but the original holder retains the right of first refusal on some or all of their previous holding
Auction-based re-assignment		
6	Full auction with prior harmonisation of licence dates	Licence expiry dates are harmonised in order that multiple bands can be renewed simultaneously at a later stage, typically through an auction process
7	Full auction	All expiring licenses are auctioned to all interested parties. Usually, the start dates of the new licences are staggered to accommodate the sequential expiry of the existing licences, in cases where multiple bands are auctioned

In the following subsections, we consider the impact of these approaches to licence renewal, and assess their ability to meet regulatory objectives.

Approach 1: Automatic renewal with high expectation of renewal

Figure 3.6: Impact of automatic renewal with a high expectation of renewal [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	This regime supports on-going competition between fair MNOs and can be considered pro-competitive in the long run (when implemented in combination with other tools). However, in practice, there may be no additional competition as MNOs are likely to hold on to high-demand frequencies. Furthermore, terminating licences for competition reasons would undermine this system's defining characteristic – a high expectation of renewal	
Investment incentives and service continuity	This approach aims to maximise the predictability of licence renewals via explicit conditionality. New Zealand's NRA, for example, adopted this approach in 2009 in order to "[minimise] the risk of stranded investment" and to "[maximise] the opportunity for new investment"	
Transparency and fairness	Automatic renewal is likely to reduce the transparency and fairness of the spectrum distribution as band valuations change. For instance, UK MNOs without 900MHz access have so far been unable to acquire any of this spectrum despite their best efforts, and they have argued that this puts them at a material disadvantage. This draws attention to the lack of neutrality and inclusiveness in the renewal of existing licences under automatic renewal	
Manageability	Manageability is low because licences can only be revoked or otherwise modified when licence conditions are violated (e.g. non-utilisation of spectrum). Renewal is deliberately legalistic to foster predictability and a high expectation of renewal for MNOs; if an unexpected licence revocation were to happen, it would compromise the objective of this renewal type. Hence, in countries such as the USA renewal is virtually certain if the operator meets the NRA's service conditions	
Revenue generation	Revenue generation is limited by the non-economic conditions that are generally considered alongside an automatic renewal. There is an underlying assumption that the incumbent will best use the spectrum, and therefore it may serve to undermine the objective of best use of the spectrum if excessive prices are charged. Additionally, future automatic renewals will be less likely if high prices are charged, which would increase uncertainty in the market and potentially reduce operator investment	

Automatic renewal with a high expectation of renewal offers high investment incentives is one of the most popular methods of spectrum reattribution around the world, having been used 20 times (25%) across our benchmark set. Countries that have used this approach include: Bangladesh, Brazil, Bulgaria, Canada, Czech Republic, Estonia, Hong Kong, Latvia, Lithuania, New Zealand, Norway, Pakistan, Poland, Slovenia, South Africa and the USA.

Approach 2: Automatic renewal with indefinite licence period

Figure 3.7: Impact of automatic renewal with indefinite licence period [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	As for automatic renewal with a high expectation of renewal, this regime supports on-going competition between fair MNOs in a market place and can be considered pro-competitive in the long run when combined with incentive pricing (e.g. Canada), incentive auctions (e.g. USA), or spectrum trading (e.g. Australia). However, incentive pricing is often imprecise, incentive auctions require co-operation, and spectrum trading is sometimes restricted. Still, since the value of indefinite licences does not drop as they mature, they support competition by encouraging trading. However, in practice, MNOs are likely to hold on to high-demand frequencies	
Investment incentives and service continuity	This should be effective at stimulating investment because the NRA has come as close as possible to granting permanent spectrum ownership to MNOs, thus minimising the risk of stranded investment. Naturally, automatic renewals also allow for full service continuity, minimising disruption to customers and MNOs	
Transparency and fairness	This approach maintains a distribution's transparency and fairness given unchanged values of the spectrum. Valuations will however change if shifts in spectrum demand (e.g. increased data demand) or supply (e.g. the digital dividend) occur. Spectrum trading allows for a legitimate transfer of ownership to accommodate such demand and supply shifts. However, as spectrum trading is generally imperfect, automatic licence renewal will erode a spectrum distribution's fairness over time as more of these shifts occur	
Manageability	Manageability is low because any licence modifications involve lengthy notification periods. Generally, automatic renewal with indefinite licences forms part of an 'arm's-length' approach to spectrum management where practised	
Revenue generation	With an indefinite licence period, annual fees are generally charged, which limits the ability to raise a lump sum. Additionally, it is difficult to accurately forecast the value of spectrum and it is likely that, in order to incentivise continued investment, annual fees will remain relatively low	

Automatic renewal with indefinite licences has a similarly positive effect on investment to automatic renewal with a high expectation of renewal. However, manageability is very low, and this approach has not been adopted by many NRAs worldwide: it has been used only once (1%) within our benchmark countries (by the UK).

Approach 3: Administrative re-assignment

Figure 3.8: Impact of administrative re-assignment [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	This approach may be pro-competitive but relies on the NRA to interpret what distribution of spectrum will be pro-competitive and is therefore prone to regulatory failure. Furthermore, spectrum prices are not market-discovered and are likely to be conservative, so as not to compromise the viability of spectrum holders	
Investment incentives and service continuity	Although NRAs are unlikely to deprive an incumbent of a critical amount of spectrum since this would result in a discontinuity of service, investment incentives may be reduced to some extent	
Transparency and fairness	This approach has the lowest transparency. By definition, it eliminates neutrality and it may also lack inclusiveness. For example, the Japanese administrative re-assignment approach has been frequently criticised as non-transparent with regard to licence fees: these are officially only supposed to cover the costs incurred by creating the public good of spectrum management, but many consider that the fees exceed what would be strictly necessary for this purpose	
Manageability	The determination of licence ownership and fees is fully at the discretion of the NRA. This has allowed NRAs such as ARCEP in France to fine-tune existing licences to accommodate refarming and new market entrants. In South Korea, this approach has enabled the pursuit of a long-term industrial policy aimed at rapidly increasing mobile broadband capacity to cope with sky-rocketing demand for data traffic	
Revenue generation	Administrative re-assignments tend to also have a number of public policy objectives which generally serve to reduce prices	

Administrative re-assignment offers NRAs the benefits of high manageability, allowing them to promote competition and investment. For this reason, this approach is the method of choice for many NRAs, and is used in 25 (32%) of our benchmark countries, including: Denmark, Finland, France, Germany, Hungary, Iceland, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, South Korea, Spain and Switzerland.

Approach 4: Hybrid re-assignment with partial auction

Figure 3.9: Impact of partial auction approach [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	Partial auctions serve to introduce new entrants. As an example, Denmark's NITA barred TDC, Telenor and TeliaSonera from bidding in its 2010 partial auction to allow Hi3G Denmark to enter the market. However, NITA only auctioned 2×5MHz of 900MHz and 2×10MHz of 1800MHz spectrum, thus limiting the auction's pro-competitive effect	
Investment incentives and service continuity	This approach should have a similar effect on investment to administrative re-assignment because an element of decision-making is taken out of the MNOs' hands in the same way. However, unlike with a full auction, some element of predictability remains	
Transparency and fairness	This approach does not completely rely on auctions: not all expiring licences are put to auction. As in the case of Spain, it is also often not fully inclusive: not all interested parties are permitted to bid. As a result, the effect of this approach can be ambiguous in terms of transparency and fairness	
Manageability	The NRA has little impact on the ownership or price of the auctioned spectrum, and auctioned licences are hard to modify. However, because the NRA determines the scope of the spectrum to be auctioned and the remainder is assigned by administrative means, this regime can still have a positive impact on manageability	
Revenue generation	By releasing some spectrum to the market the ability to raise revenues is increased, as competition is encouraged and the spectrum is more likely to be sold at its true value. However, the fact that some spectrum is not assigned by auction limits the overall ability to generate revenues	

Partial auctions appear to be a reasonably popular method of achieving the competitive benefits of auctions whilst maintaining investment incentives and service continuity. They have been used in five (6%) of our benchmark countries: Denmark, Indonesia, Italy, Spain and Sweden.

Approach 5: Hybrid re-assignment with auction and preferential spectrum access for incumbents

Figure 3.10: Impact of auction with preferential access for incumbents [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	Incumbents are encouraged to vacate non-essential spectrum, but can retain their existing spectrum and may choose to do so to prevent competitors from acquiring it. Hong Kong's OFCA cites a desire to accommodate potential market entrants as the key motivation for following this approach for licences expiring in 2013–2016	
Investment incentives and service continuity	Despite auction-based spectrum pricing, uncertainty is minimal for incumbents because of their right of first purchase. Hong Kong and Singapore embraced this hybrid approach specifically to deal with excess spectrum demand without denting incumbents' network investment incentives. In practice, given that the approach favours incumbents, it is likely that service disruption will be minimal	
Transparency and fairness	The approach favours incumbent MNOs, thus compromising inclusiveness. Nonetheless, transparency, neutrality and completeness can remain intact and therefore this approach can still serve to enhance fairness. OFCA in Hong Kong has previously chosen this approach to address excess demand for expiring licences	
Manageability	As this is an auction-based strategy that affects all licensed spectrum, the NRA has little impact on price, ownership and post-auction licensing. Indeed, NRAs in Hong Kong and Singapore have deliberately conferred manageability to incumbents via first right of purchase arrangements to increase investment confidence.	
Revenue generation	As with the partial auction, revenues may be increased versus an administrative re-assignment or automatic renewal but the right of first refusal generally serves to depress prices where the price set for the incumbent is below market value	

Auctions with first right of purchase offer both competition and investment benefits; however, they have not proved to be particularly popular and there are only two (3%) instances of their use in our benchmark countries, in Singapore and Hong Kong. However, both Australia and New Zealand's have adopted an approach of automatic renewal with high expectation of renewal which includes a condition that if the incumbent spectrum holders do not renew their holdings, they will be auctioned – effectively, a first right of refusal.

Approaches 6 and 7: Auction-based re-assignment

In Figure 3.5 above we distinguished two types of auction-based re-assignment: full auction *with* prior harmonisation of licence dates, and auction *without* such harmonisation. Both these approaches have similar pros and cons, and we here consider them together.

Figure 3.11: Impact of full auction with or without prior licence harmonisation [Source: Analysys Mason, 2015]

Regulatory objective	Impact	Summary
Competition and efficiency of assignment	A full auction can encourage the entry of new players to the market; should redistribute the spectrum in a fairer manner between existing players; and may lead to higher prices. In practice, however, we have not seen new players acquiring renewed spectrum as their business case would be much more difficult compared to existing players. Furthermore, the distribution of spectrum between existing players has usually not been modified; when this has occurred, it has been through the increase of spectrum supply for smaller players (which in turn positively impacts market competitiveness). Finally, spectrum prices are market-discovered and therefore MNOs are willing to pay their valuation (or in general, higher prices than for other assignment methods)	
Investment incentives and service continuity	This approach has less predictability for existing MNOs, as there is a risk (even if objectively extremely small) that they could lose the whole of the auctioned spectrum. Investment incentives may be reduced or pushed in time, especially until the auction outcome, and there is an important risk of service discontinuity if the operator fails to acquire the spectrum it needs	
Transparency and fairness	An auction is usually transparent to all market players (excluding some subtleties arising from specific types of auctions such as CCA which may makes it less transparent to some players) as the rules are known in advance. Therefore, this approach tries to be as fair as possible to all market players given the potential limitations	
Manageability	Auctions that affect all licensed spectrum make it difficult to manage, as the NRA has little impact on price, ownership and post-auction licensing. Furthermore, this method of assignment can be very complex to organise in practice	
Revenue generation	Full auctions represent the best opportunity to realise the full value of spectrum, as all interested parties have an opportunity to bid, thereby increasing competition. Additionally, the price is set by the market rather than the NRA, and this generally results in higher prices	

Full auctions offer competition benefits, even though manageability is very low, and auction-based re-assignment is the method of choice for many regulators, being used in 28 (35%) of our benchmark countries, including: Austria, France, Germany, Greece, Hungary, India, Ireland, Italy, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia Spain, Sweden and Switzerland.

Summary of different approaches to licence renewal

Figure 3.12: Assessment of approaches to licence renewal [Source: Analysys Mason, 2015]

Regulatory objective	Best approach	Comments
Competition and efficiency of assignment	Full auction	In order to maximise competition and the efficiency of assignment, a full auction is the best approach. A full auction can encourage new entrants and may therefore redistribute spectrum in a fair and more efficient manner. It also gives all interested parties an equal opportunity to obtain spectrum, potentially leading to higher levels of competition.
Investment incentives and service continuity	Automatic renewal	Automatic renewals provide the best means of increasing investment incentives and maintaining service continuity. The approach minimises the risk of stranded investment on the part of the operator, and therefore incentivises continued investment. An automatic renewal also naturally allows for full service continuity.
Transparency and fairness	Auction	Renewing spectrum through an auction is the most transparent and fair processes as the rules are known well in advance and the outcome is quantifiable.
Manageability	Administrative re-assignment	Administrative re-assignments offer the most manageable option as the determination of the licence ownership and fees are fully at the discretion of the NRA.
Revenue generation	Auction	Revenue generation is most easily achieved through a well-designed auction because the prices are set by the market, and therefore MNOs are willing to pay their true valuation.

3.4.3 Approaches to licence renewal used by NRAs

We have undertaken a benchmark reviewing awards of existing bands since 2005 in the following countries:

- in Western Europe: Austria, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the UK
- in Eastern Europe: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia
- in other parts of the world: Bangladesh, Brazil, Canada, Hong Kong, India, Indonesia, New Zealand, Pakistan, Singapore, South Africa, South Korea and the USA.

NRAs have tended towards non-auction approaches when renewing existing licences, as evidenced in Figure 3.13. Approximately 65% of all awards of existing spectrum in the benchmark countries since 2005 have been undertaken through non-full-auction mechanisms.

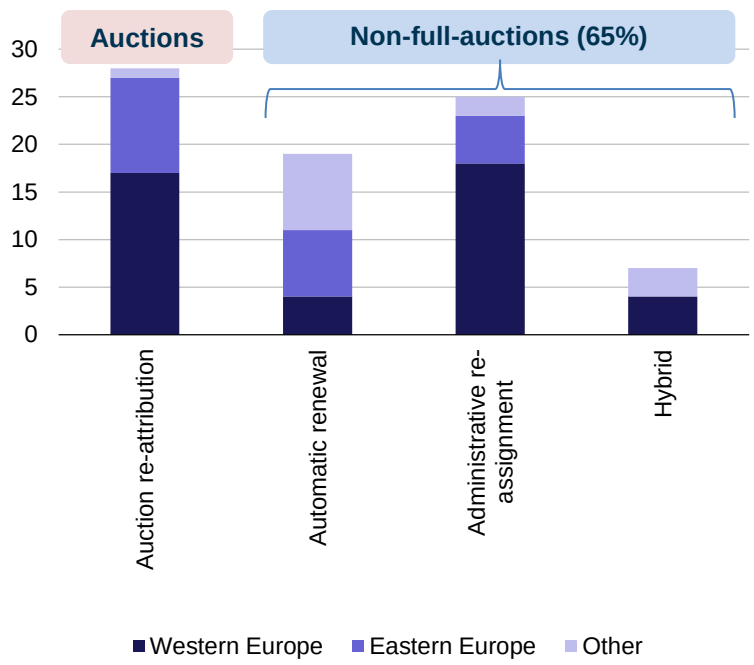


Figure 3.13: Approaches adopted by NRAs for renewals of existing bands since 2005 split by type [Source: Analysys Mason, 2015]

This proportion is different between regions, as shown in Figure 3.14, standing at around 60% in Western Europe and above 90% in non-European countries.

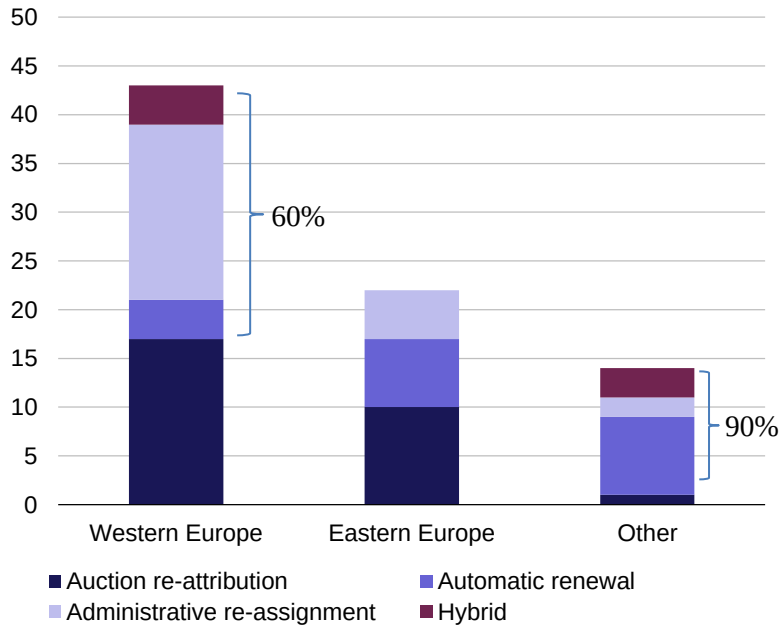


Figure 3.14: Approaches adopted by NRAs for renewals of existing bands since 2005 split by region [Source: Analysys Mason, 2015]

The results are broadly similar if we focus on the re-assignment of existing bands for licences with a duration of over 10 years (i.e. excluding licences for shorter duration as these could be considered as licence harmonisation prior to a "real" award). In this case (see Figure 3.15) approximately 60% of all awards of existing spectrum since 2005 have been undertaken through non-full-auction mechanisms.

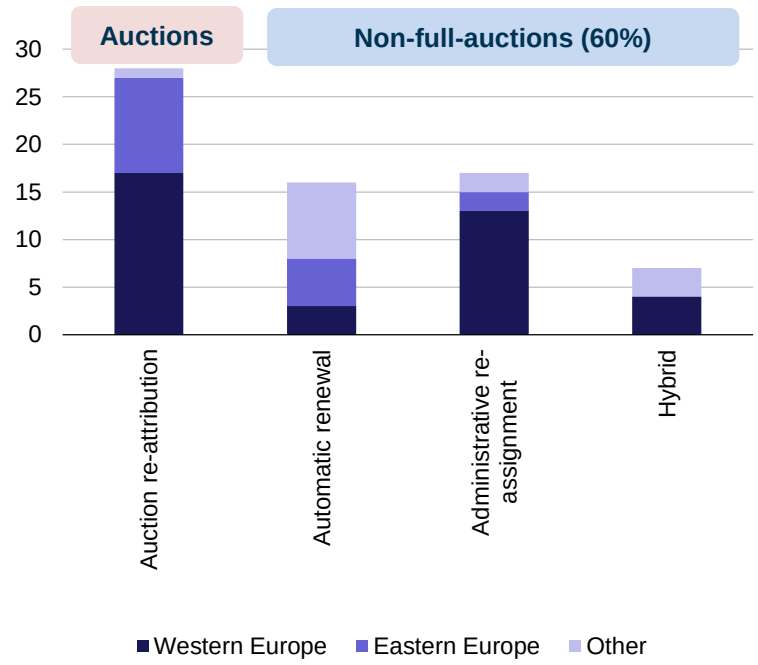


Figure 3.15: Approaches adopted by NRAs for renewals of existing bands since 2005 split by type excluding licence duration below 10 years [Source: Analysys Mason, 2015]

The proportion is different between regions (see Figure 3.16), standing around 55% in Western Europe and around 90% in non-European countries.

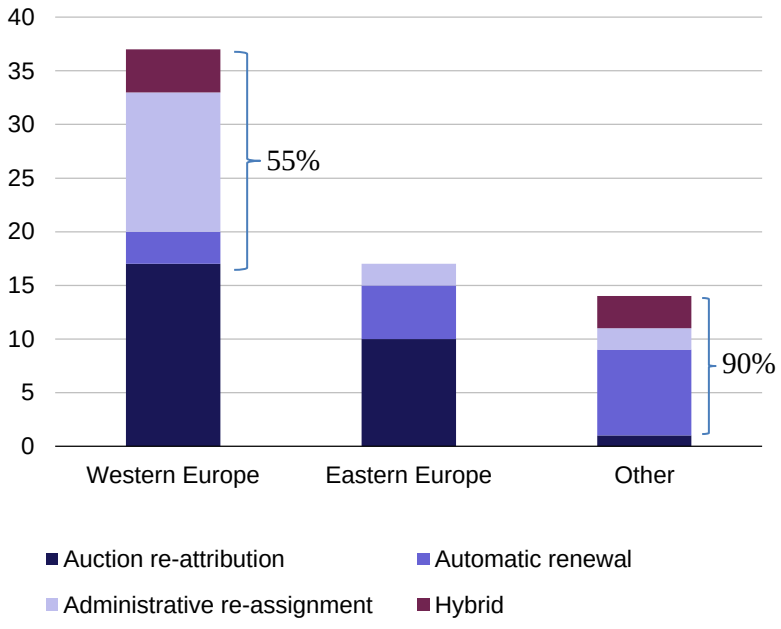


Figure 3.16: Approaches adopted by NRAs for renewals of existing bands since 2005 split by region excluding licence duration below 10 years [Source: Analysys Mason, 2015]

The results remain similar if we undertake this analysis by counting individual *bands* that were renewed (and not *awards*): for example, the auction or automatic renewal of both 900MHz and 1800MHz bands simultaneously would be considered as two 'renewals'. Here analysis shows that 60–65% of the bands are renewed through a non-full-auction mechanism.

The distribution of specific renewal strategies is shown in Figure 3.17, which illustrates a preference for automatic renewals (with a high expectation of renewal), administrative

re-assignments and auction-based re-assignments. Each of these approaches has certain benefits and drawbacks, as discussed earlier; the ability of each approach to meet regulatory objectives is summarised in Figure 3.17 below.

Figure 3.17: Impact on regulatory objectives of licence renewal approaches [Source: Analysys Mason, 2015]

Approach	Times used (percentage)	Competition / efficiency of assignment	Investment incentives / service continuity	Trans-parency / fairness	Manage-ability	Revenue generation
Automatic renewal: High expectation of renewal	20 (25%)					
Automatic renewal: Indefinite licence period	1 (1%)					
Administrative re-assignment	25 (32%)					
Hybrid re-assignment: Partial auction	5 (6%)					
Hybrid re-assignment: Auction with preferential access	2 (3%)					
Auction based re-assignment: Full auction	28 (35%)					

3.4.4 Benefits of using auction mechanisms to award existing bands

As already highlighted in previous sections, the use of auctions to award spectrum has several benefits, which are summarised below.

Efficiency — Auctions are the most economically efficient means of allocating spectrum to those who will make the best use of it and place the most value upon it. Additionally, auctions provide the best opportunity for new participants to enter the market.

Pricing — The market theoretically holds the most complete information on the commercial and technical landscape surrounding an assignment. In an auction, the price is decided by the market and so this should represent the most efficient pricing mechanism, and offers the best opportunity for governments to raise revenues.

Flexibility The NRA may account for both economic and other public policy objectives when designing an auction, including applying obligations such as coverage obligations or competitive conditions on the winning bidder.

Transparency Auctions are more transparent as a form of spectrum award process compared to non-auction based approaches.

Fairness An auction is generally less subject to post-award disputes arising from a perceived lack of transparency or fairness, since every participant operates within the same set of rules, which are set in advance.

3.4.5 Benefits of using non-auction mechanisms to award existing bands

Renewing spectrum through means other than auctions also has its benefits. A number of NRAs have commented on their specific rationale for re-assigning spectrum through non-auction formats, referring mainly to the low level of investment uncertainties, and lower risk of service disruption.

- **IDA (Singapore):** "*to avoid unnecessary spectrum churn and more importantly, service disruption to end-users. This is especially when there are still a substantial number of mobile customers on 2G networks. IDA has thus decided to incorporate an element of "first rights of refusal" for existing holders of 2G Spectrum Rights, as part of the allocation process*."
- **Minister of broadband, Communication and the Digital Economy (Australia)**: "*reissue of licenses will provide certainty about the continuity and operation of mobile and wireless communication networks … This decision has involved a careful evaluation of how the public interest is served by allowing renewal of current licenses*."
- **FCC (USA)**: "*it will award a renewal expectancy if the licensee has provided 'substantial' performance, which is defined as 'sound', favourable and substantially above a level of mediocre service just minimally justifying renewal*."
- **Industry Canada (Canada)** argued for this change in policy by pointing out that it would reduce uncertainty among MNOs and, thus increase investment in new technologies, QoS and coverage. It also highlighted that a high expectation of renewal would facilitate spectrum trading because licences would maintain value better as they matured.
- **Ofcom (UK)**: "*licences with an indefinite term are likely to promote optimal use of the radio spectrum and other relevant objectives, including the promotion of competition" and "the award of licences with an indefinite duration reduces the need for regulatory intervention to reassign spectrum at the end of the licence term". Moreover "reassignment by the regulator typically takes significant time and resource. The spectrum may also lie idle for a period as the regulator prepares for reassignment*."

The advantages of non-auction approaches are summarised below.

Predictability Non-auction approaches are less transparent but tend to have a more certain

outcome. They also limit the exposure of MNOs to stranded investment, and are most likely to incentivise continued investment without significant delays. Automatic renewals naturally lead to service continuity, minimising disruption to consumers over the renewal period and reducing the risk of a poorly-prepared new entrant under-utilising spectrum.

Limits high spectrum prices

There is a risk that high prices in a highly competitive auction could lead to costs being passed on to consumers, reduce investment in network development and new services, or even cause an MNO to exit the market altogether. Additionally, a focus on pure revenue maximisation can result in spectrum concentration and therefore a decrease in competition.

Manageability

NRAs maintain greater control of the renewal and are therefore better able to respond to market developments such as newly-interested parties or technological developments. Public policy objectives may also be pursued to a greater degree as part of a non-auction award.

Simplicity

Auctions can be difficult to administer and extremely lengthy, whereas certain non-auction methodologies can be planned in advance and carried out over a short period of time. Non-auction assignments also tend to be less open to complex gaming or signalling behaviour which may result in artificially depressed prices.

3.5 Recommendations for awarding existing bands in Belgium

As highlighted in the previous section, there is no single award mechanism that fulfils all regulatory objectives. Each award mechanism includes advantages and disadvantages, and the choice of a mechanism for Belgium should be considered in relation to the priorities of the BIPT and the government. We have therefore identified relevant options that could be adopted for future awards depending on the priorities set by BIPT and the government. **There are three main options that could be relevant for the re-award of existing bands (900MHz, 1800MHz and 2100MHz); these are summarised in Figure 3.18 below**.

Figure 3.18: Selected options for the award of existing bands in Belgium [Source: Analysys Mason, 2015]

Option	Advantages	Disadvantages	Comments
Automatic renewal (high expectation of renewal)	Provides investment incentives and service continuity, as it maximises the predictability of licence renewals.	Manageability is low because licences can only be revoked or otherwise modified when licence conditions are violated. This approach would automatically preclude potential new entrants in the market.	This approach is the preferred option for MNOs, who are also in favour of an indefinite licence period. We are not in favour of an indefinite licence period, as manageability from BIPT's perspective is even harder and we believe that BIPT should still have some flexibility to cope with changes in the market or technology in the long term
Auction based re-assignment (full auction)	Competition and efficiency of assignment (rationale similar to the award of new bands). Transparency and fairness (rationale similar to the award of new bands).	Does not provide investment incentives and service continuity. Has the least predictability for existing MNOs, as there is a risk of losing part of their spectrum (though this risk is extremely small). Manageability is low as the NRA has little control over price, ownership or post-auction licensing.	This approach would be potentially relevant if coupled with the award of new bands: • it would give existing MNOs overall visibility of several spectrum bands • it would make possible a single award process, which is thought to be more efficient for BIPT and the MNOs.
Hybrid re-assignment (partial auction)	Allows the achievement of the competitive benefits of auctions whilst maintaining investment incentives (which is an advantage of automatic renewal).	Some element of unpredictability as an element of decision-making is taken out of the MNOs' hands.	This approach would consist of auctioning of a certain amount of spectrum within each band, which incumbents would be allowed to bid for. They would keep the rest of the spectrum that was not auctioned and which is necessary for service continuity. This approach could be interesting in particular for the 900MHz band, where there is a limited amount of spectrum available and where MNOs have different amounts.

There are two additional points that should be considered when awarding the existing bands:

- Timing: The existing licences expire in March 2021, and we recommend that the award process should take place at least three years before this date in order to provide visibility to MNOs.

- Coupling of different awards: The award of existing bands could be coupled with the award of new bands even if the availability dates of the different bands are not the same. However, as mentioned previously, the timing of the award of the existing bands should not be postponed because of delays in awarding new bands. However, the award of the new bands should not happen too early from the date when these bands would become available for use, as this could impact negatively BIPT and MNOs (i.e. MNOs may have difficulty in having a strategy in place for the use of new bands that will become available in more than two or three years' time, and this would make it difficult for them to set a true value for the spectrum). Taking into account these considerations, a recommended date for the award of both existing and new bands would be late 2017 to early 2018.

We understand that BIPT's main objectives for awarding the existing bands are:

- Competition – to ensure that the mobile market is competitive and does not preclude any potential new entrants
- Predictability – to encourage investments and innovation and to ensure service continuity to consumers
- Efficiency of assignment – to encourage a distribution of the spectrum so that inefficient MNOs will cede spectrum to more efficient competitors
- Revenues – to ensure that the government maximises revenues.

Figure 3.19 maps the three award options we have identified to our understanding of BIPT's main objectives.

Figure 3.19: Award options for existing bands: mapping of our recommendations to BIPT's main regulatory objectives [Source: Analysys Mason, 2015]

	Competition	Predictability	Efficiency of assignment	Revenues
Automatic renewal (high expectation of renewal)	✖	✓✓	✖	✓
Auction based re-assignment (full auction)	✓✓	✖	✓✓	✓✓
Hybrid re-assignment (partial auction)	✓	✓	✓	✓✓

In conclusion, based on this analysis of the different objectives and potential outcomes, **we recommend awarding existing bands through the use of a *hybrid re-assignment mechanism***. This option allows fulfilling BIPT's main objectives in terms of competition, predictability, efficiency of assignment and revenues whereas an automatic renewal will not allow fulfilling "competition" and "efficiency of assignment" objectives and a pure auction will not allow fulfilling "predictability" objectives.

4 Options for spectrum award and regulatory conditions

In this section we discuss the specific options that European NRAs have used when awarding spectrum as well as the regulatory conditions that they have attached to licences. We focus separately on options and conditions for *new* bands and then for *existing* bands. In each case, we use our analysis to derive recommendations for the Belgian market.

4.1 Options and conditions for the award of new bands

European NRAs have applied a number of options when awarding spectrum, such as the duration of the licences, how the spectrum is packaged, and caps on the amount assigned. They have also attached a number of conditions to licences, such as coverage obligations, quality-of-service targets and requirements to share networks with competitors.

Based on our analysis, we recommend the following options and conditions for the award of new bands in Belgium:

- a licence duration of 20 years
- packaging the 700MHz spectrum in three blocks of 2×10MHz (option 1) or six blocks of 2×5MHz (option 2), and the 1400MHz spectrum in eight blocks of 5MHz
- imposing an individual spectrum caps of 2×10MHz (option 1) or 2×15MHz (option 2) for the 700MHz band, and 20MHz for the 1400MHz band
- increasing the minimum download speed for 800MHz from 3Mbit/s to 5 or 6Mbit/s depending on the amount of 700MHz acquired
- winners of spectrum should pay the whole amount upfront.

In certain aspects we recommend that no obligations should be imposed:

- no coverage obligations
- no national roaming or network-sharing obligations
- no wholesale access or MVNO obligations
- service- and technology-neutral
- fully tradable
- no spectrum reserved for new entrants.

We have focused our analysis on the two main bands, 700MHz and 1400MHz, which could be made available relatively soon for allocation to mobile services in Belgium, following the WRC 2015 decisions. There are other potential candidate bands for mobile services such as 2300MHz and 3500MHz, but we have not considered these bands in our analyses for two reasons. First, in Belgium these two bands are being used by other services (aeronautical and military use for the 2300MHz band; fixed wireless and mobile broadband regional use for the 3500MHz band). Second, there is no real need in Belgium for the use of high-frequency bands for mobile telecoms

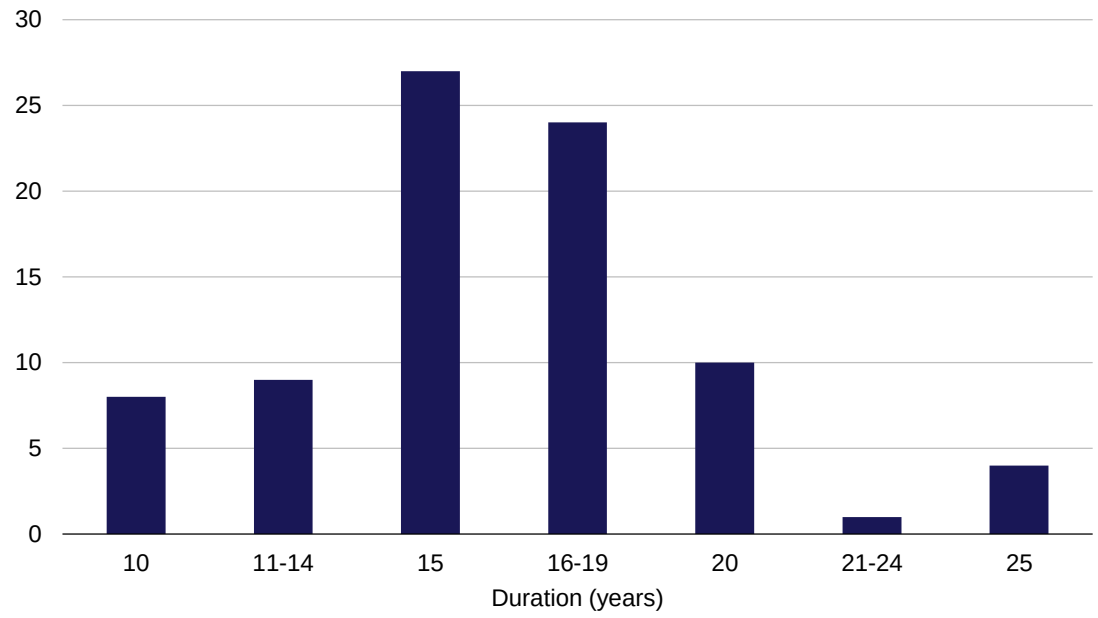
in the short to medium term; this is validated by our valuation modelling and by the fact that Belgian MNOs are not yet using their existing spectrum in the 2600MHz band, which they acquired in 2012.

4.1.1 Duration of licences

Options available

European NRAs have opted for a variety of licence durations when assigning spectrum over the past ten years. However, the most popular approach has been generally a licence duration of between 15 and 20 years, which accounts for more than 70% of all licences that have been awarded during that period (see Figure 4.1 below).

Figure 4.1: Distribution of licence durations in spectrum awards in Europe since 2005 [Source: Analysys Mason, 2015]



Generally, within any given country the licence period does not tend to differ between bands (see Figure 4.2). Instead, it appears that once an NRA decides on a suitable duration, this is applied to most bands in that country.

Figure 4.2: Overview of licence durations in spectrum awards in Europe since 2005 [Source: Analysys Mason, 2015]

Duration (years)	Country (band)
10	Belgium (2100), Bulgaria (1800), Estonia (2100), Greece (3500), Latvia (900), Macedonia (1800), Slovakia (900, 1800)
11–14	Croatia (800), Greece (900), Iceland (900), Lithuania (900, 1800), Netherlands (2100), Norway (900), Poland (1800), Switzerland (2100)
15	Austria (2600), Belgium (2600), France (900), Germany (800, 1800, 2100, 2600), Greece (1800), Latvia (2600),Norway (2100, 2600), Poland (900), Portugal (800, 900,

Duration (years)	Country (band)
	1800, 2600), Romania (800, 900, 1800, 2100, 2600), Slovenia (800, 900, 1800, 2600), Sweden (2600), Switzerland (900)
16–19	Austria (800, 900, 1800, 2600), Ireland (800, 900, 1800), Italy (800, 2600), Latvia (800), Netherlands (800, 900, 1800, 2600), Spain (800, 900, 1800, 2600), Sweden (900), Switzerland (800, 1800, 2100, 2600)
20	Belgium (800), Denmark (2600), Finland (800, 2600), France (700, 800, 2100, 2600), UK (800, 2600)
21–24	Denmark (800)
25	Denmark (900, 1800), Sweden (800, 1800)

It should be also noted that the longer-duration licences have been more of a recent phenomenon: all licences of 20 years or more have been issued after 2010 except for of the Finnish 2600MHz award in November 2009.

Ofcom in the UK has decided to renew the 900MHz and 1800MHz licences with indefinite terms. The advantages and disadvantages of an indefinite terms licence versus a fixed duration licence is summarised in Figure 4.3 below.

Figure 4.3: Advantages and disadvantages of indefinite licences [Source: Analysys Mason, 2015]

Advantages	Disadvantages
• Provides more visibility to MNOs resulting in stimulating investments • Promotes competition between existing MNOs • Allows full service continuity without any risk of service disruption • Reduces the need for regulatory intervention to reassign spectrum at the end of the licence term	• Spectrum distribution in the future may not be very efficient if market dynamics (demand and supply) change, as there is no flexibility to cope with changes in the market or technology in the long term • Much harder to reassign spectrum to another use in the future • Potential negative impact on the government or regulator revenues (e.g. a potential auction in 15 years may allow more money to be raised) • Difficult and lengthy process for an NRA to change licence conditions (if required)

Recommendation for Belgium

We recommend a licence duration of 20 years for the future award of the 700MHz and 1400MHz bands in Belgium as we believe that this duration is sufficiently long to ensure an adequate return on the investment undertaken by MNOs. Furthermore, 20 years would be the same as the duration of the 800MHz licence that was awarded in 2013.

Another option would be to have multiple licences that expire at the same time if several awards are coupled (existing bands: 900MHz, 1800MHz and 2100MHz and new bands: 800MHz and 1400MHz). In this case the licence duration should end in 2041, as we are recommending a 20-year licence for existing bands that will be renewed in 2021 (see Section 4.2.1). The main

advantage of having all licences ending at the same date is to give visibility and flexibility to MNOs to decide on their spectrum strategy and choose from a wide range of frequencies. On the other hand, the main disadvantages would include the risk of losing a significant share of frequencies (if licences are not automatically renewed) and the need for operators to have significant funding to acquire all their spectrum at the same time.

4.1.2 Spectrum packaging

700MHz band

Given that the 700MHz band will be used for 4G/LTE services (and presumably for 5G in the future), it is logical to package the band in a multiple of 5MHz blocks (i.e. 2×5MHz; 2×10MHz and 2×15MHz). Considering that there will be at least three bidders interested in this band (i.e. the existing MNOs) and that the band consists of a total 2×30MHz, we can rule out blocks of 2×15MHz as this would constraint the possible range of outcomes without offering any particular benefits.

It is interesting to look at the packaging considered by other NRAs for similar bands, i.e. low-frequency bands involving a small amount of spectrum, including the 700MHz, 800MHz and 900MHz bands. Spectrum packages of 2×5MHz are by far the most commonly used across Europe: of the 21 awards we reviewed, all offered at least one block of 2×5MHz. However, some NRAs also created alternative packages:

- France, 800MHz: packages of 2×5MHz, 2×10MHz and 2×15MHz
- Denmark, 800MHz: packages of 2×5MHz and 2×10MHz
- UK, 800MHz: packages of 2×5MHz and 2×10MHz.

We suggest retaining two options for the packaging of the 700MHz band:

- Option 1: three blocks of 2×10MHz
- Option 2: six blocks of 2×5MHz.

The advantage of having only three blocks available, coupled with an adequate spectrum cap, will ensure that each MNO acquires 2×10MHz of spectrum in the 700MHz band. However, the disadvantage of this option is that it would not allow a MNO who may be willing to acquire a different amount than 2×10MHz (e.g. 2×5MHz or 2×15MHz) to show his preferences.

Therefore, if the 700MHz band is awarded simultaneously with another band, and/or spectrum caps are applied to joint bands (see Section 4.1.3), packaging the band in blocks of 2×5MHz would allow more flexibility.

1400MHz band

Given that this band will be used for 4G/LTE services (and presumably for 5G in the future), it is logical to package the band in a multiple of 5MHz blocks. Considering that this band consists of a total 40MHz and that it will be used as a supplemental downlink (SDL) which would be

aggregated with another band, it would be interesting to look at the packaging considered by other NRAs for time division duplex (TDD) bands such as the 2600MHz TDD. Amongst the assignments of 2600MHz TDD spectrum, packages of 5MHz have generally been preferred: five of the eight instances in Europe have offered this size. The other three NRAs chose blocks of 15MHz (Switzerland), 25MHz (Portugal) and 50MHz (Sweden).

If the 1400MHz band is awarded simultaneously with another band, and/or spectrum caps are applied, packaging the band in blocks of 5MHz would allow more flexibility. **Therefore, we recommend packaging the 1400MHz band in eight blocks of 5MHz**.

4.1.3 Spectrum caps

Options available

Spectrum caps are usually used by NRAs to limit the risk that one or more MNOs will acquire a large amount of spectrum in order to gain a significant competitive advantage in the mobile market, as spectrum is a limited resource. There are three main approaches to spectrum caps:

- *individual cap* – a cap on the maximum amount of spectrum that can be held is applied to a single specific band
- *joint cap* – a cap is applied across multiple bands, for instance all sub-1GHz spectrum
- *total cap* – a cap is applied over all available spectrum bands.

Figure 4.4 below gives an overview of the approaches to spectrum caps taken by NRAs in Europe.

Figure 4.4: Spectrum caps approaches used by European NRAs[6] [Source: Analysys Mason, 2015]

Country	No cap	Individual cap	Joint cap	Total cap
Austria		✓		
Belgium		✓		
Croatia		✓		
Czech Republic		✓		
Denmark		✓	✓	
Finland		✓		
France		✓	✓	
Germany	✓	✓		
Greece		✓		
Hungary		✓		
Ireland		✓		✓
Italy			✓	
Netherlands		✓		
Norway		✓	✓	

6 Several awards have occurred in some countries sometimes following different approaches: e.g. in one award in Germany there was no cap used while in another award an individual cap was used.

Country	No cap	Individual cap	Joint cap	Total cap
Portugal	✓	✓	✓	
Romania		✓	✓	✓
Slovenia		✓	✓	✓
Spain			✓	
Sweden	✓	✓		
Switzerland	✓	✓	✓	✓
UK			✓	✓

This shows that there is a general preference for using individual caps, often in combination with joint or total caps. Spectrum caps have been used more frequently for low frequency bands (i.e. below 1GHz). We list in Figure 4.5 the caps that have been used by European NRAs for the 700MHz, 800MHz and 900MHz bands.

Figure 4.5: Spectrum caps used by European NRAs for sub-1GHz bands [Source: Analysys Mason, 2015]

Country	Band(s)	Cap
Croatia	800MHz	2×10MHz
Czech Republic	800MHz	2×10MHz
Denmark	800MHz	2×20MHz
France	700MHz	2×15MHz
France	800MHz	2×15MHz
France	Sub-1GHz	2×30MHz across 700MHz, 800MHz and 900MHz bands
Germany	800MHz	2×15MHz for T-Mobile, 2×10MHz for Vodafone and O2, no cap for E-Plus
Germany	800MHz, 900MHz	2×20MHz across both bands
Greece	900MHz	2×15MHz, reduced to 2×12.5MHz if more than three bidders
Hungary	900MHz	2×7.8MHz
Ireland	Sub-1GHz	2×20MHz
Ireland	All	2×50MHz
Italy	Sub-1GHz	2×20MHz
Netherlands	800MHz	2×10MHz, applicable to new entrants only
Norway	900MHz	2×10MHz, applicable to incumbent GSM MNOs only
Norway	900MHz, 1800MHz	37.6MHz across both bands
Portugal	800MHz	2×10MHz
Portugal	900MHz	2×5MHz, 2×10MHz cap for new entrants
Romania	800MHz	2×15MHz
Romania	800MHz, 900MHz	2×20MHz
Slovenia	900MHz	2×15MHz
Slovenia	800MHz, 900MHz	2×30MHz with a total cap of 2×105MHz
Spain	Sub-1GHz	2×20MHz
Sweden	800MHz	2×10MHz

Country	Band(s)	Cap
Switzerland	900MHz	2×20MHz
Switzerland	800MHz, 900MHz	2×25MHz with a total cap of 2×135MHz
UK	Sub-1GHz	2×27.5MHz with a total cap of 2×105MHz

NRAs have tended to apply caps of between 2×10MHz and 2×20MHz on low-frequency bands, with some of them also adding a further cap to all sub-1GHz spectrum. However, the majority have applied a spectrum cap of 2×15MHz on these low bands.

It should be noted that the 1400MHz band can be considered as a low band to some extent, as it is used for downlink only and is intended to be aggregated with another band – it could be aggregated with the 800MHz for instance without a major impact on coverage as it is not limited by the uplink: it will only be used for downlink and would benefit from the 800MHz uplink in this instance.

Recommendations for Belgium

We recommend the use of individual spectrum caps for the award of the 700MHz and 1400MHz bands; the size of the cap we recommend depends on the award scenario, as presented in Figure 4.6 below.

Figure 4.6: Spectrum cap recommendations for different award scenarios [Source: Analysys Mason, 2015]

Award scenario	Spectrum cap	Rationale and comments
700MHz band awarded alone	Option 1: 2×10MHz	If the packaging includes three blocks of 2×10MHz, then we recommend a spectrum cap of 2×10MHz to allow the possibility of three bidders acquiring spectrum in this band.
	Option 2: 2×15MHz	However, if the packaging includes six blocks of 2×5MHz, then we recommend a spectrum cap of 2×15MHz. The rationale of having a higher spectrum cap is that all Belgian MNOs have a low-frequency band that is used for 4G (i.e. 800MHz). In addition, each MNO may have a different preference for the amount of spectrum it holds in the 700MHz band as MNOs do not have the same technical strategy, number of subscribers and traffic. This cap would ensure that each bidder is able to satisfy its preference by bidding for 2×5MHz, 2×10MHz or 2×15MHz as appropriate. In addition, if there are only two bidders interested in acquiring spectrum in the 700MHz band, a cap of 2×15MHz would allow the whole band to be awarded (and not have a certain amount of the band not awarded)
1400MHz awarded alone	20MHz	In the three European countries that have recently awarded the 1400MHz band, in each case two bidders were successful in obtaining 20MHz of spectrum. As this spectrum will be used as a SDL to cope with data traffic growth, and as it has to be aggregated with another existing band (e.g. 800MHz or 1800MHz), it is not crucial that all MNOs acquire this band. Therefore, imposing a cap of 20MHz would ensure that at least two MNOs can acquire significant amount of spectrum in this band

Award scenario	Spectrum cap	Rationale and comments
700MHz and 1400MHz awarded jointly	Option 1: 2×10MHz for 700MHz Option 2: 2×15MHz for 700MHz 20MHz for 1400MHz	If the two bands are awarded simultaneously, this approach would allow participants to satisfy their preferences for one or other of the bands

We also suggest retaining some flexibility on these caps, so that they can be changed if fewer-than-expected bidders express interest in the spectrum. If there are only two interested bidders, the cap for the 700MHz band under option 1 must be increased to 2×15MHz. For option 2, the caps that are suggested allow the award of the bands in their entirety if there are only two interested bidders. Therefore, we do not believe that there is a need to further increase these caps under option 2 as we would expect to have at least two bidders interested in the award of each band.

4.1.4 Coverage obligations

Options

A coverage obligation is commonly used by NRAs regardless of the assignment mechanism. Coverage obligations are generally more extensive for low-frequency bands because of their inherent physical properties. Figure 4.7 gives an overview of coverage obligations imposed by European NRAs on low-frequency bands.

Figure 4.7: Summary of coverage obligations applied to low-frequency bands in Europe [Source: Analysys Mason, 2015]

Country	Band	National coverage	Specific coverage	Comments
Austria	900MHz	25% coverage within 2 years, 50% coverage within 4 years	None	–
Belgium	800MHz	30% population coverage within 3 years, 70% within 6 years and 98% within 9 years	98% population coverage in municipalities with unsatisfactory 3G coverage within three years	Specific coverage obligations applied only for one awarded lot
Croatia	800MHz	50% area coverage within 5 years	None	–
Denmark	800MHz	None	99.8% coverage of households, 98% geographic area coverage in priority zones (with low broadband availability) within 3 years	Obligation may be met using any other band

Country	Band	National coverage	Specific coverage	Comments
France	700MHz	98% coverage within 12 years; 99.6% coverage within 15 years	Coverage of priority zones; 50% within 7 years, 92% within 12 years and 97.7% within 15 years. Additional coverage obligations within departments; 90% within 12 years, 95% within 15 years	Additional specific obligations related to highways, roads and train tracks were also imposed
France	800MHz	98% coverage within 12 years, 99.6% within 15 years	40% of priority zones (areas with poor 3G coverage) within 5 years, 90% within 10 years	Use of 800MHz band mandatory
Finland	800MHz	95% coverage within 3 years, 97% within 5 years	None	–
Georgia	800MHz	None	4G coverage to 30% of settlements with a population of less than 5000 by 2016, rising to 50% by 2017, 70% by 2018 and 90% 2020	–
Germany	700MHz	98% population coverage	None	–
Germany	800MHz	50% population coverage within 5 years	90% population coverage in priority zones (areas with low broadband availability)	Initial roll-out restricted to pre-defined rural zones. The most rural zones must be 90% covered first before the next zone type may be covered. Obligation may be met using any other band
Ireland	800MHz	70% population coverage within 3 years. New operators: 35% population coverage within 3 years, 70% within 7 years	None	Coverage obligations are across all bands, 50% of which must be met with sub-1GHz spectrum
Ireland	900MHz	70% population coverage within 3 years	None	–
Italy	800MHz	None	30% of municipalities with fewer than 3000 people within 3 years, 75% within 5 years	Use of 800MHz band mandatory

Country	Band	National coverage	Specific coverage	Comments
Latvia	800MHz	None	Install at least one base station in each 200km^2 area by July 2018, with the exception of nine cities	–
Lithuania	800MHz	None	30% coverage of sub-districts within three years and 80% within five years	–
Netherlands	800MHz	308km^2 within 2 years (0.7% population coverage), 3080km^2 within 5 years (18% population coverage)	None	Use of 800MHz band mandatory
Netherlands	900MHz	256.7km^2 within 2 years, 2567km^2 within 5 years	None	–
Portugal	800MHz	None	50% coverage of priority zones within 6 months, 100% within a year	900MHz may also be used to meet the obligation
Romania	800MHz	60% population coverage within 7 years	90% coverage of priority zones within 3 years	-
Romania	900MHz	60% population coverage within 7 years	90% priority zones within 3 years	–
Slovenia	800MHz 900MHz	25% population within 1 year, 50% within 2 years, 75% within 3 years	None	–
Spain	800MHz	None	90% of priority zones (fewer than 5000 people) within 8 years	Use of 800MHz band mandatory
Sweden	800MHz	None	25% coverage of priority zones (areas lacking a basic broadband connection) within 1 year, 75% within 2 years, 100% within 3 years	Use of 800MHz band mandatory
Switzerland	800MHz	50% coverage within 6 years	None	–
Switzerland	900MHz	50% coverage within 8 years	None	–
UK	800MHz	98% indoor population coverage, 99.8% outdoor population coverage	Minimum of 95% coverage of each nation	Obligation may be met using any other band

As can be seen from this summary, NRAs have adopted different coverage obligations, with some preferring to impose national obligations alone and others targeting specific public policy objectives. The level of coverage required varies significantly by country, but more developed Western European countries appear to commonly have a national coverage obligation of around 98% to 99.8% of the population.

Recommendations for Belgium

We consider that there are three potential options for the award of the 700MHz band in Belgium:

1. Do not impose any coverage obligations.
2. Impose an obligation on 700MHz that is greater than the current one for 800MHz through the increase of current national coverage obligation from 98% of the population to 99% of the population.
3. Define specific coverage obligations in municipalities with unsatisfactory mobile or/and fixed broadband coverage.

It should be noted that if any coverage obligation is imposed, we recommend that it is not attached to any specific spectrum band but is treated as a technology-neutral obligation which can be achieved through the use of any spectrum band.

Our view is that Belgium has satisfactory fixed and mobile broadband coverage and that the current coverage obligations on 2G and 3G have been exceeded. **We therefore recommend that no new coverage obligations should be imposed for either the 700MHz or 1400MHz bands**.

4.1.5 Quality of service obligations

Options available

With the emergence of 4G, a QoS obligation has become as important as a coverage obligation. European NRAs have typically imposed either a minimum service download speed or a theoretical maximum download speed when assigning spectrum licences. An overview of European QoS obligations is given in Figure 4.8 below.

Figure 4.8: QoS obligations imposed by European NRAs [Source: Analysys Mason, 2015]

Country	Band(s)	Download speed obligations	Comments
Austria	2600MHz	Data transmission of at least 1MBit/s downlink, 256kbit/s uplink	–
Belgium	800MHz	Minimum download speed of 3Mbit/s	–
Belgium	2600MHz	None	–
Denmark	800MHz	Minimum downlink speed of 10Mbit/s	–

Country	Band(s)	Download speed obligations	Comments
France	800MHz	30Mbit/s (for a block of 2×5MHz) or 60Mbit/s (for a block of 2×10MHz)	Maximum theoretical download speed
France	2600MHz	60Mbit/s	Maximum theoretical download speed
Germany	800MHz, 2600MHz	Minimum speed of 1Mbit/s	MNOs are obliged to offer "broadband access" as defined by the NRA, therefore minimum speeds are subject to change
Ireland	All	None	Networks must not be offline for more than 35 minutes in a 6-month period
Netherlands	800MHz, 900MHz, 1800MHz, 2100MHz	Minimum downlink speed of 2Mbit/s	Speed must be available to 90% of the population covered
Portugal	800MHz	Speed equal to that of 75% of fixed broadband subscribers in the area	–
Slovenia	All	None	–
Spain	800MHz	Peak download speed of 30Mbit/s	–
Sweden	800MHz	1Mbit/s	Peak of 1Mbit/s, daily average must be 750kbit/s, 4-hour rolling average must be 500kbit/s
Switzerland	All	None	–
UK	800MHz	Average download speed of 1Mbit/s	–

Recommendations for Belgium

As Belgian MNOs will have the opportunity to acquire additional spectrum in low-frequency bands which would allow them to improve the QoS offered, **we recommend increasing the minimum download speed obligation for 800MHz**:

- from 3Mbit/s to 6Mbit/s if an MNO acquires at least 2×10MHz in the 700MHz band
- from 3Mbit/s to 5Mbit/s if an MNO acquires at least 2×5MHz in the 700MHz band.

We recommend that **MNOs be allowed to meet the QoS obligations with any spectrum band or combination of bands**. In addition, **we do not recommend attaching any QoS obligation to the 1400MHz band**.

4.1.6 National roaming and network sharing

Options available

Obligations related to national roaming and network sharing are two levers that have been used by some European NRAs, mainly to help new entrants to have a viable business case. However, many

NRAs have chosen not to impose any such obligations and have left these issues for commercial negotiation between parties. Where national roaming and network sharing obligations have been imposed, there appears to have been a focus on lower bands. The details of these obligations, where implemented, are shown in Figure 4.9.

Figure 4.9: National roaming and network-sharing obligations imposed by European NRAs [Source: Analysys Mason, 2015]

Country	Band(s)	National roaming obligations	Network sharing obligations
Belgium	800MHz	The three main MNOs must offer national roaming to MNOs that do not have 2G spectrum	None
Czech Republic	800MHz, 900MHz	Obligation to provide roaming to MNOs without 800MHz or 900MHz but who do hold 1800MHz or 2600MHz	None
Denmark	800MHz, 2100MHz, 2600MHz,3500MHz	None	None
France	800MHz	Mandatory for MNOs with 2×10MHz to accept MNOs who hold 2600MHz spectrum but no 800MHz (provided they cover 25% with the 2600MHz and participated in the 800MHz auction)	Compulsory where little 3G coverage. Pooling reserved for the bottom 20MHz of the band
Germany	All	None	None
Italy	800MHz	Must accept reasonable requests in areas where 800MHz spectrum is deemed under-utilised	None
Netherlands	All	None	None
Portugal	800MHz, 900MHz	Mandatory if 2×10MHz held	None
Spain	800MHz, 900MHz, 2600MHz	None	None
Sweden	800MHz, 1800MHz, 2600MHz	None	None
Switzerland	All	None	None
UK	All	None	None

It appears that network-sharing obligations are somewhat unusual: the only country implementing them is France, and only in specific areas of low coverage. Whilst national roaming obligations are more common, they often carry with them caveats (e.g. minimum spectrum holdings to be binding) or conditions relating to "reasonable requests", meaning that in practice each instance is reviewed on a case-by-case basis.

PPDR (Public Protection and Disaster Relief) services may use the 700MHz band in the future. There are several options that are still under consideration by the ECC group of the CEPT (European Conference of Postal and Telecommunications Administrations) such as the allocation

of a 2×3MHz or 2×5MHz of the 700MHz band for PPDR (outside the 2×30MHz that has been allocated for mobile services). However, other options exist. For example, in the UK, the Emergency Services are undertaking procurement for its wireless broadband network. The MNO who wins the contract will have to commit to certain coverage and capacity obligations for the Emergency Services contract alongside the 4G commercial services provided by the MNO using its own 700MHz spectrum. Depending on the option that will be chosen in the future in Belgium, national roaming may be relevant for PPDR and this aspect should be dealt with when further visibility is ensured. It may require the intervention of the BIPT to impose national roaming for security reasons and public benefit.

Recommendations for Belgium

Belgium is a relatively small and dense country, and we therefore believe that sharing obligations are not necessary. **We recommend that no specific national roaming or network-sharing obligations are imposed in Belgium**, and that the matter should be left for commercial negotiations.

4.1.7 Wholesale access and MVNO obligations

Options

NRAs have generally been reluctant to introduce mandatory MVNO obligations with spectrum licences. Figure 4.10 gives an overview of MVNO obligations in Europe.

Figure 4.10: MVNO obligations imposed by European NRAs [Source: Analysys Mason, 2015]

Country	Band(s)	MVNO obligations
France	800MHz, 2600MHz	MNOs who committed to give access to MVNOs received a 'bonus' during the award
Germany	All	None
Italy	800MHz	MNOs must meet reasonable requests for access in areas where the 800MHz spectrum is being under-utilised
Netherlands	All	None
Portugal	800MHz, 900MHz	Mandatory if 2×10MHz held
Romania	800MHz	Coverage and speed requirements relaxed if wholesale access is granted
Spain	800MHz, 900MHz, 2600MHz	None
Sweden	800MHz, 1800MHz, 2600MHz	None
Switzerland	All	None

As can be seen, there are only a limited number of instances of mandatory MVNO obligations – in France and Portugal. There are also two instances (in Italy and Romania) where MNOs offered or were incentivised to offer hosting to MVNOs, but were not obliged to do so.

Recommendations for Belgium

In Belgium, MVNOs are already playing an important role in the mobile market. In this context, **we recommend that no specific wholesale access or MVNO obligations should be imposed in Belgium**, but that the matter should be left for commercial negotiations.

4.1.8 Other considerations

Service- and technology-neutrality

We recommend that the licences for use of the 700MHz and 1400MHz bands in Belgium are service and technology neutral. This is in line with EU legislation, which requires such an approach to be adopted.

Spectrum trading

We recommend that the 700MHz and 1400MHz bands are fully tradable. This is in line with EU spectrum policy, which requires all mobile spectrum bands to be tradable, and also accords with the approach to previous bands awarded in Belgium.

Reserved spectrum for new entrants

In some specific cases, a few European NRAs have reserved certain spectrum in order to enable the entry of new MNOs into the market. The amount of spectrum reserved and some further commentary on the approach and outcome is detailed in Figure 4.11.

Figure 4.11: Spectrum reserved by European NRAs for new entrants [Source: Analysys Mason, 2015]

Country	Band(s)	Reserved spectrum	Comments
Bulgaria	1800MHz	–	2011 auction was reserved solely for new entrants
Denmark	900MHz, 1800MHz	–	Existing holders were excluded from the auction
France	800MHz	None	–
France	900MHz	–	Spectrum must be shared with a fourth MNO if interest is shown
Germany	All	None	–
Hungary	900MHz, 1800MHz, 2100MHz	2×5MHz reserved, plus option for 2×15MHz across 1800MHz and 2100MHz bands	–
Netherlands	800MHz	2×10MHz	Licence was won by the MVNO Tele2
Netherlands	900MHz	2×5MHz	No interest shown by new entrants
Netherlands	1800MHz	–	Incumbents barred from the “A” and “B” blocks
Netherlands	2600MHz	–	Spectrum cap is doubled for new entrants
Norway	900MHz	2×10MHz	–

Country	Band(s)	Reserved spectrum	Comments
Portugal	All	None	–
Spain	900MHz, 1800MHz	–	Movistar and Vodafone excluded from the auction
Sweden	All	None	–
Switzerland	All	None	–
UK	1800MHz	2×15MHz	Spectrum is reserved unless the new entrant wins more than 2×5MHz
UK	2100MHz	One block	–
UK	2600MHz	2×20MHz if no 800MHz won, 2×10 MHz if 2×10MHz 800MHz won, otherwise none	–

For the award of the 700MHz and the 1400MHz bands in Belgium, we do not recommend that any spectrum be reserved for potential new entrants, for the following reasons:

- The likelihood of new entry in the market is extremely low, and this is reinforced by the fact that previous attempts have failed (i.e. Bidco's fourth 3G licence).
- The mobile market in Belgium is saturated and competitive, reducing the likelihood of interest in the market from new entrants.
- Given that there are already three MNOs and another company (VOYACOM) with significant spectrum holdings, it is unlikely that a new entrant would be able to develop a profitable mobile business in the long term.
- The amount of the 700MHz and 1400MHz bands that will be awarded is limited and we believe that existing MNOs will all want to acquire a fair amount in these bands.
- Many spectrum reservations in other European countries did not lead to a positive outcome.

Payment terms

NRAs have generally required payment to be made shortly after finalising assignment of the spectrum, as detailed in Figure 4.12.

Figure 4.12: Payment terms imposed by European NRAs [Source: Analysys Mason, 2015]

Country	Band(s)	Payment terms
Denmark	800MHz	Payment either in full or 20% upfront, with the remaining 80% split over the next 8 years
France	800MHz	Immediate payment required
Germany	800MHz	Payment within 5 days required
Ireland	800MHz, 900MHz, 1800MHz	The winning bidders will pay EUR854.6 million for the spectrum rights – 481.7 million in up-front fees plus annual spectrum usage fees totalling EUR372.9 million, paid in instalments until July 2030
Italy	800MHz	Immediate payment required
Netherlands	800MHz	Payment within two weeks required

Country	Band(s)	Payment terms
Poland	1800MHz	Immediate payment required
Portugal	800MHz	Two-thirds of the total amount is due immediately. The remainder may be paid immediately or over 5 years at a rate of 6.08%
Sweden	800MHz	Payment within 30 days required

Based on the benchmark an **upfront payment within a reasonable period** (between 5 and 30 days following the assignment of the spectrum) can be considered as an alternative to existing payment practices in Belgium.

4.2 Options and conditions for the award of existing bands

Based on our analysis, we recommend the following options and conditions for the award of existing bands in Belgium:

- 20-year licence period
- packaging both the 1800MHz and the 2100MHz bands in blocks of 2×5MHz, and different spectrum packaging schemes for the 900MHz band depending on the award format used. If, as we recommend, the hybrid re-assignment award is used, the 900MHz band should be packaged in 6 blocks of 2×5MHz and 5 blocks of 2×1MHz
- reserving, in the case of a hybrid re-assignment, 1 block of 2×5MHz in the 900MHz band, 4 blocks of 2×5MHz in the 1800MHz band and 2 blocks of 2×5MHz in the 2100MHz band for each existing MNO at the reserve price
- applying a spectrum cap of 2×12MHz (option 1) or 2×15MHz (option 2) to the 900MHz band, 2×35MHz to the 1800MHz band and 2×30MHz to the 2100MHz band.

We have analysed the options and regulatory conditions for the re-award of the existing bands in Belgium (900MHz, 1800MHz and 2100MHz) when the licences come to an end in March 2021. In general, whenever existing spectrum has been re-awarded, regulatory conditions such as coverage and QoS obligations have not been changed. *Adding* new obligations or *increasing* the level of existing obligations is not usually necessary, and is not considered best-practice. Further, for most obligations, *removing* them does not usually have any impact, as MNOs should have already have met all their existing obligations during the previous licence period. Nevertheless, *smoothing* or *adapting* obligations may be useful under certain circumstances such as when there are competitive issues in the market, or when there is the expectation of new entrants.

In the following we discuss a number of award options and regulatory conditions that some NRAs have decided to change, namely licence duration, spectrum packaging and spectrum caps.

4.2.1 Duration of licences

Some NRAs have changed the licence period when re-awarding existing bands. Usually they have increased the licence duration (to more than 15 years) unless the re-award was undertaken with the

objective of harmonising different bands, in which case licence durations are usually between two and eight years.

We recommend a 20-year licence period for the existing bands, the same as for the new bands (see Section 4.1.1).

4.2.2 Spectrum packaging

Existing bands in Belgium are being used for different technologies and therefore the block sizes are different, as shown in Figure 4.13 below.

Band	Technology	Block size
900MHz	2G (GSM, GPRS, EDGE) 3G (UMTS, HSPA, HSPA+)	2×200kHz 2×5MHz
1800MHz	2G (GSM, GPRS, EDGE) 4G (LTE)	2×200kHz 2×5MHz
2100MHz	3G (UMTS, HSPA, HSPA+)	2×5MHz

Figure 4.13: Current technologies and block sizes used by Belgian MNOs [Source: Analysys Mason, 2015]

Most NRAs have changed the block size when re-awarding existing bands, mainly rearranging the 900MHz and 1800MHz bands in 2×5MHz blocks rather than the previous packaging of 2×200kHz blocks.

In Belgium, we understand that the 2100MHz band is already packaged in 2×5MHz blocks, and for the 1800MHz band there will be no impact on the market if that band is packaged in 2×5MHz blocks as MNOs currently hold contiguous spectrum and are already using blocks of 2×5MHz. Therefore, **we recommend packaging both the 1800MHz and the 2100MHz bands in blocks of 2×5MHz**.

Regarding the 900MHz band, the following points should be taken into account:

- The band is currently used for 2G and 3G services and therefore blocks of 2×200kHz (for 2G) and 2×5MHz (for 3G) are being used.
- Proximus and Mobistar do not have contiguous spectrum.
- The three MNOs have different amounts of 900MHz spectrum (namely 2×10.2MHz, 2×11.6MHz and 2×12.4MHz) which are not multiples of 2×5MHz.
- The MNOs prefer to retain the same channels (including preference channels for GSM) after the re-award of the band.
- Two of the MNOs have mentioned that they believe that the GSM network will still exist for a long time. They do not expect a shutdown of the GSM network in the short or medium term.

- One MNO mentioned that it is important to allow MNOs to acquire small amounts of spectrum in this band (and not only blocks of 2×5MHz) in order to offer, for example, machine-to-machine (M2M) services.

Taking into account the technologies and market specificities, **we recommend different spectrum packaging schemes for the 900MHz band depending on the award format used**, as summarised in Figure 4.14 below.

Figure 4.14: Recommended options for 900MHz packaging for different award formats [Source: Analysys Mason, 2015]

Award format	Spectrum packaging	Comments
Automatic renewal (high expectation of renewal)	Current packaging	Exact frequencies and current amount of spectrum to be re-awarded to each operator
Auction based re-assignment (full auction)	6 blocks of 2×5MHz 5 block of 2×1MHz	All spectrum to be auctioned, and spectrum caps must be enforced to ensure that all MNOs are able to acquire a fair amount of spectrum in this band
Hybrid re-assignment (partial auction)	6 blocks of 2×5MHz 5 blocks of 2×1MHz	Three blocks of 2×5MHz to be automatically re-awarded to MNOs (at reserve price) to ensure that all MNOs have spectrum in this band. In addition, three blocks of 2×5 MHz and five blocks of 2×1MHz should be auctioned. Spectrum caps should also be defined

If the hybrid re-assignment award format is used, we recommend reserving the following amount of spectrum for each existing MNO:

- 1 block of 2×5MHz in the 900MHz band
- 4 blocks of 2×5MHz in the 1800MHz band
- 2 blocks of 2×5MHz in the 2100MHz band.

The reserved spectrum for MNOs will be awarded at the reserve price.

4.2.3 Spectrum caps

In the case of re-awarding the spectrum through an auction, BIPT must ensure that MNOs are able to acquire a fair amount of the spectrum, in particular in low-frequency bands. However, **we recommend applying a spectrum cap to the 1800MHz and 2100MHz bands** to ensure that an MNO will not acquire more than half of the band. Therefore, we recommend applying a spectrum cap of 2×35MHz for the 1800MHz band and 2×30MHz for the 2100MHz band.

We suggest retaining two options for the application of a spectrum cap for the 900MHz band:

- Option 1: a spectrum cap of 2×12MHz
- Option 2: a spectrum cap of 2×15MHz.

On the one hand, having a spectrum cap of 2×12MHz is advantageous since it means that each MNO is able to acquire the equivalent amount of spectrum that it already has in the 900MHz band. On the other hand, the 2×15MHz option would provide more asymmetry in the assignment process by allowing MNOs to acquire additional frequencies but with the associated risk of one MNO acquiring only 2×5MHz (which would have an impact on the quality of its 2G and 3G services and would require additional network design and engineering).

4.3 Recommendations for award options and regulatory conditions in Belgium

A summary of the recommendations regarding the options for spectrum award and the regulatory conditions is provided below in Figure 4.15 (for new bands) and Figure 4.16 (for existing bands).

Figure 4.15: New bands: recommendations for award options and regulatory conditions [Source: Analysys Mason, 2015]

Obligation	700MHz only	1400MHz only	700MHz and 1400MHz
Licence duration	20 years	20 years	20 years
Spectrum packaging	Option 1: 3 blocks of 2×10MHz Option 2: 6 blocks of 2×5MHz	8 blocks of 5MHz	Option 1: 3 blocks of 2×10MHz for the 700MHz band, 8 blocks of 5MHz for the 1400MHz band Option 2: 6 blocks of 2×5MHz for the 700MHz band, 8 blocks of 5MHz for the 1400MHz band
Spectrum cap	Option 1: 2×10MHz Option 2: 2×15MHz	20MHz	Option 1: 2×10MHz for 700MHz band, 20MHz for 1400MHz band Option 2: 2×15MHz for 700MHz band, 20MHz for 1400MHz band
Coverage	No new or additional obligations	No new or additional obligations	No new or additional obligations
Quality of service	Minimum download speed of 6Mbit/s for 2×10MHz Minimum download speed of 5Mbit/s for 2×5MHz	None	Minimum download speed of 6Mbit/s for 2×10MHz Minimum download speed of 5Mbit/s for 2×5MHz
National roaming and network sharing	None[7]	None	None
Access and MVNO obligations	None	None	None
Service- and technology-neutrality	Service- and technology-neutral	Service- and technology-neutral	Service- and technology-neutral
Spectrum trading	Fully tradable	Fully tradable	Fully tradable

[7] National roaming may be mandated in the future for security reasons (i.e. PPDR).

Obligation	700MHz only	1400MHz only	700MHz and 1400MHz
Reserved spectrum for new entrants	None	None	None
Payment terms	Whole amount upfront	Whole amount upfront	Whole amount upfront

Figure 4.16: Existing bands: recommendations for award options and regulatory conditions [Source: Analysys Mason, 2015]

Obligation	900MHz	1800MHz	2100MHz
Licence duration	20 years	20 years	20 years
Spectrum packaging	6 blocks of 2×5MHz 5 blocks of 2×1MHz	2×5MHz	2×5MHz
Reserved spectrum for existing MNOs	1 block of 2×5MHz	4 blocks of 2x5MHz	2 blocks of 2x5MHz
Spectrum cap	Option 1: 2×12MHz Option 2: 2×15MHz	2×35MHz	2×30MHz
Coverage	No new or additional obligations	No new or additional obligations	No new or additional obligations
Quality of service	No new or additional obligations	No new or additional obligations	No new or additional obligations
National roaming and network sharing	None	None	None
Access and MVNO obligations	None	None	None
Service- and technology-neutrality	Service- and technology-neutral	Service- and technology-neutral	Service- and technology-neutral
Spectrum trading	Fully tradable	Fully tradable	Fully tradable
Reserved spectrum for new entrants	None	None	None
Payment terms	Whole amount upfront	Whole amount upfront	Whole amount upfront

5 Prices for the different bands

In this section we discuss the optimum pricing of the spectrum bands under consideration. We first analyse benchmarks derived from recent awards in other countries. We then present the results of our economic analysis of the value that the Belgian MNOs can be expected to assign to the various bands. Finally, we recommend a price for each of the bands. As before, we focus first on *new* bands and then on *existing* bands.

5.1 Prices for the new bands

We recommend the use of the minimum expected return approach when setting the price for the 700MHz and 1400MHz bands, as for the other bands.

Based on our economic analysis, we recommend that BIPT set a reserve price for the 700MHz band of EUR40 million per 2×5MHz lot, which translates into a price of 0.36 EUR/MHz/pop.

For the 1400MHz band we recommend a reserve price of EUR3 million per 5MHz lot, which translates into a price of 0.05 EUR/MHz/pop.

5.1.1 Price for the 700MHz band

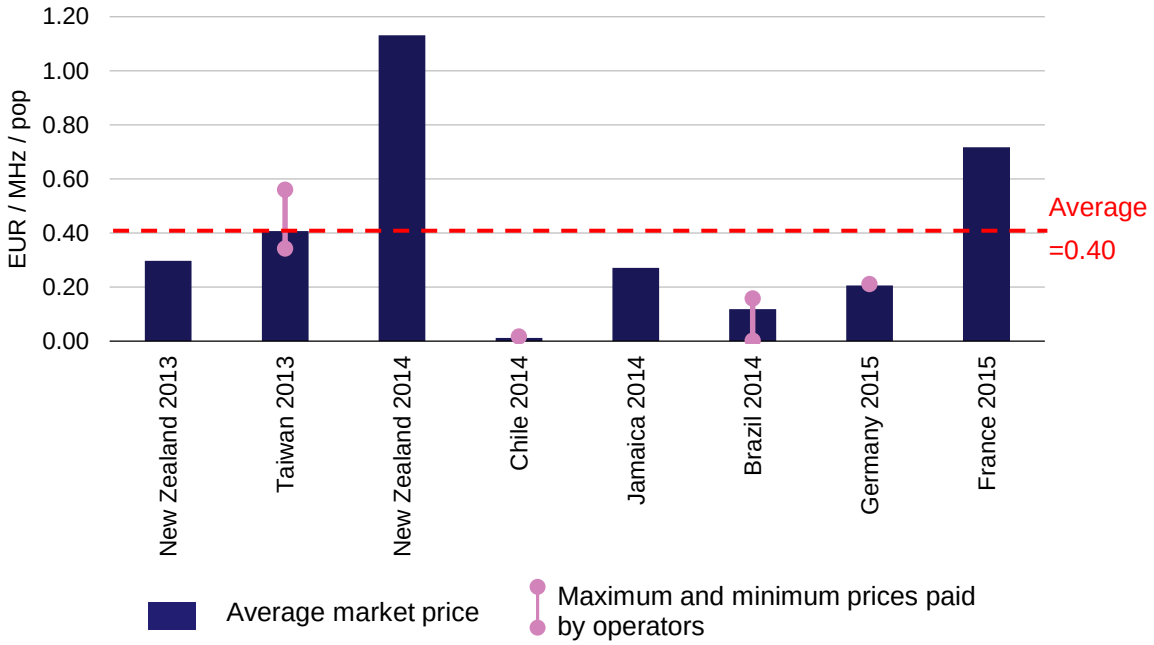
Regarding the 700MHz band, it is relevant to analyse previous awards both of this band and of the 800MHz band as their technical properties are very similar. We begin by analysing relevant benchmark prices (it should be noted that all our benchmarks have been normalised to show the price in EUR per MHz per population which ensures a better comparison between different markets).

Price benchmarks (700MHz band)

Figure 5.1 presents the prices paid for 700MHz spectrum internationally in recent awards. It should be noted that, apart from Germany and France, all other awards have been outside of Europe. In this context it should be noted that the '700MHz band' in non-European countries which are not within ITU Region 1[8] is different from the 700MHz band in Europe and includes a part of the European 800MHz band.

[8] Region 1 includes Europe, Africa and the Middle East.

Figure 5.1: Prices paid for 700MHz spectrum [Source: Analysys Mason, 2015]



With the exception of the 2014 award in New Zealand and the 2015 award in France, all benchmarks fall below 0.40 EUR/MHz/pop. The high price paid in New Zealand inflates the average price paid to 0.40 EUR/MHz/pop.

Figure 5.2 presents the reserve prices for the 700MHz spectrum awards.

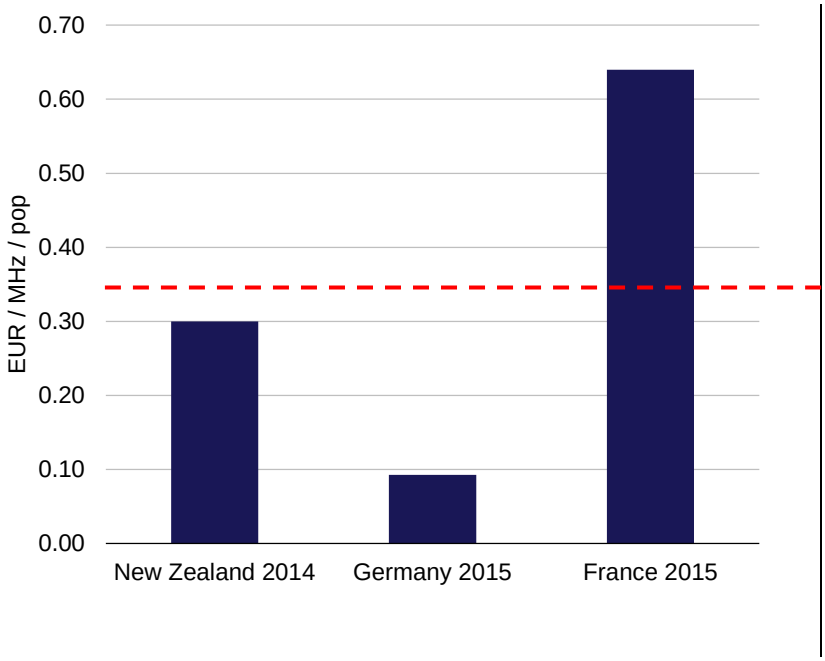


Figure 5.2: Reserve prices for 700MHz spectrum [Source: Analysys Mason, 2015]

In Europe, Germany and France are the only two countries that have already defined reserve prices for 700MHz spectrum. These are slightly higher than those for 800MHz. Germany has set a very

low reserve price of less than 0.10 EUR/MHz/pop (as it did for the 800MHz band), while France has set a high reserve price of more than 0.60 EUR/MHz/pop, with the objective of raising revenue that was already included in the government's 2016 budget. Figure 5.3 presents the reserve prices as a proportion of the prices paid for the 700MHz spectrum.

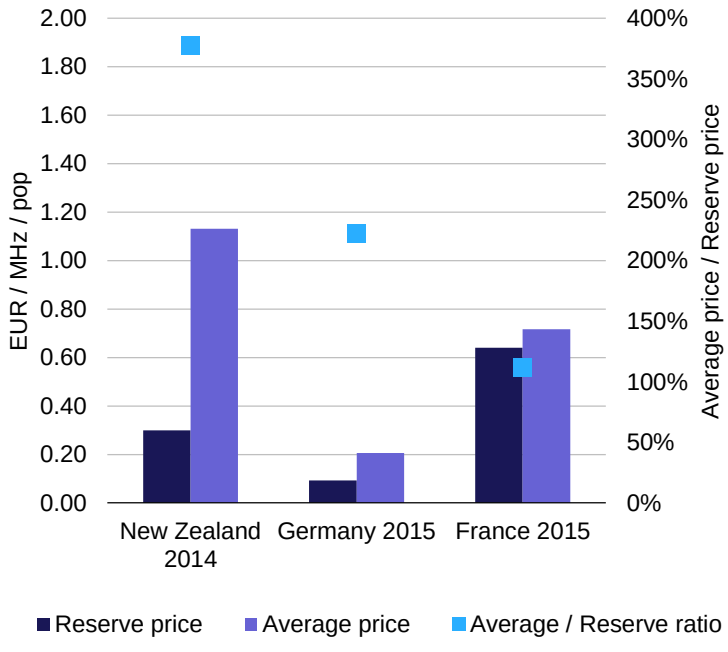


Figure 5.3: Reserve price as a proportion of price paid for 700MHz spectrum [Source: Analysys Mason, 2015]

This illustrates that in all cases the price paid was higher than the reserve price (even when reserve prices were high), although this was less marked in the recent French auction than other countries.

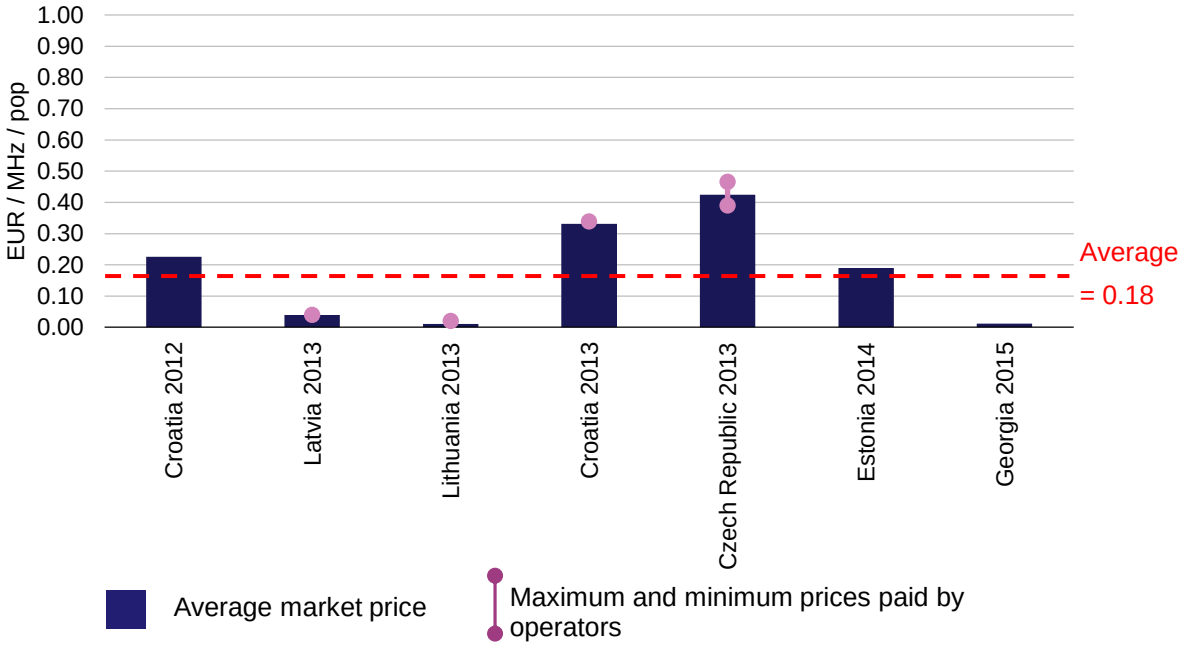
Price benchmarks (800MHz band)

Figure 5.4 below presents the prices paid for 800MHz spectrum in Western Europe in recent awards. The average price paid was 0.47 EUR/MHz/pop, with the majority of benchmarks lying between 0.30 and 0.70 EUR/MHz/pop. The high prices in Germany, Italy and France were the result of having four MNOs in the market bidding for just three spectrum lots. On the other hand, in Sweden and Denmark MNOs formed joint ventures ahead of the auction to avoid competition during the auction. The Greek auction in 2014 had the three incumbent MNOs bidding, leading to a low level of competition; given the very low reserve price, this resulted in a very low price paid.

Figure 5.4: Prices paid for 800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]

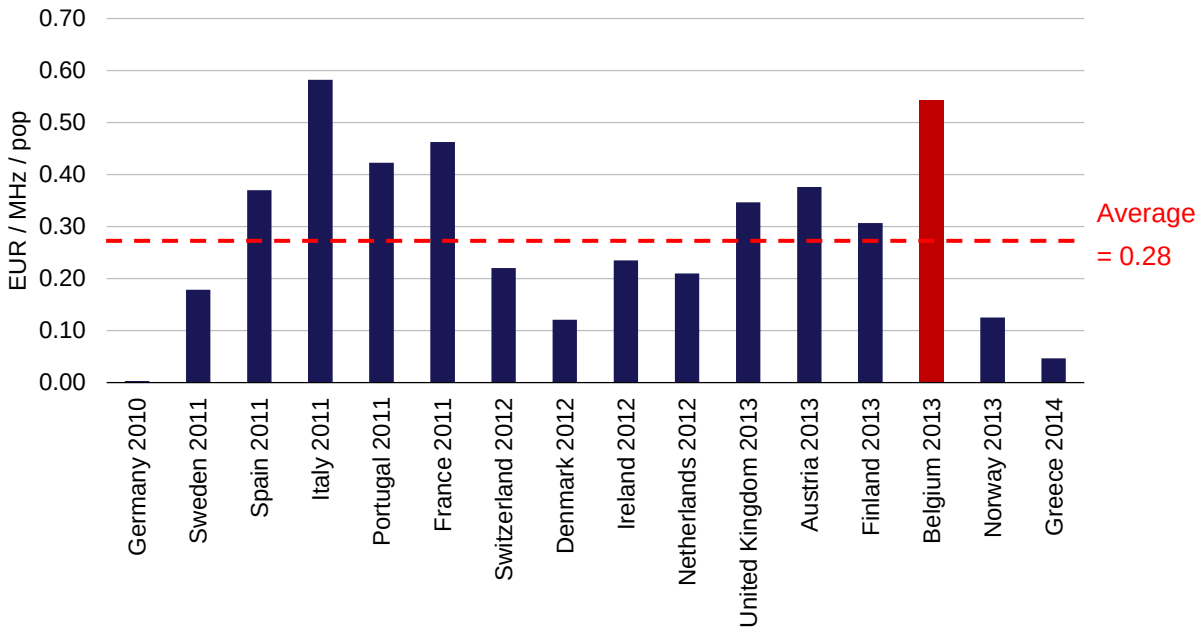
In Eastern Europe, the average price paid was 0.18 EUR/MHz/pop (see Figure 5.5 below), significantly lower than in Western Europe. It may be noted that mobile ARPU in these countries is usually significantly below Western European levels. The extremely low prices in Latvia and Lithuania can be explained by very low competition during the award process and low reserve prices.

Figure 5.5: Prices paid for 800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]



The reserve prices in Western Europe in most cases lie between 0.12 EUR/MHz/pop and 0.45 EUR/MHz/pop with an average price around 0.28 EUR/MHz/pop (see Figure 5.6 below). Germany once again set a very low reserve (as it did for the 700MHz band), and Greece similarly set a low reserve price. At the higher end, both Italy and Belgium set relatively high reserve prices.

Figure 5.6: Reserve prices for 800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]



As can be expected, reserve prices were lower in Eastern Europe (see Figure 5.7 below), though to a lesser extent than was the case for prices paid. The average reserve price of 0.19 EUR/MHz/pop is lowered by extremely low reserve prices in Latvia and Slovenia.

Figure 5.7: Reserve prices for 800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]

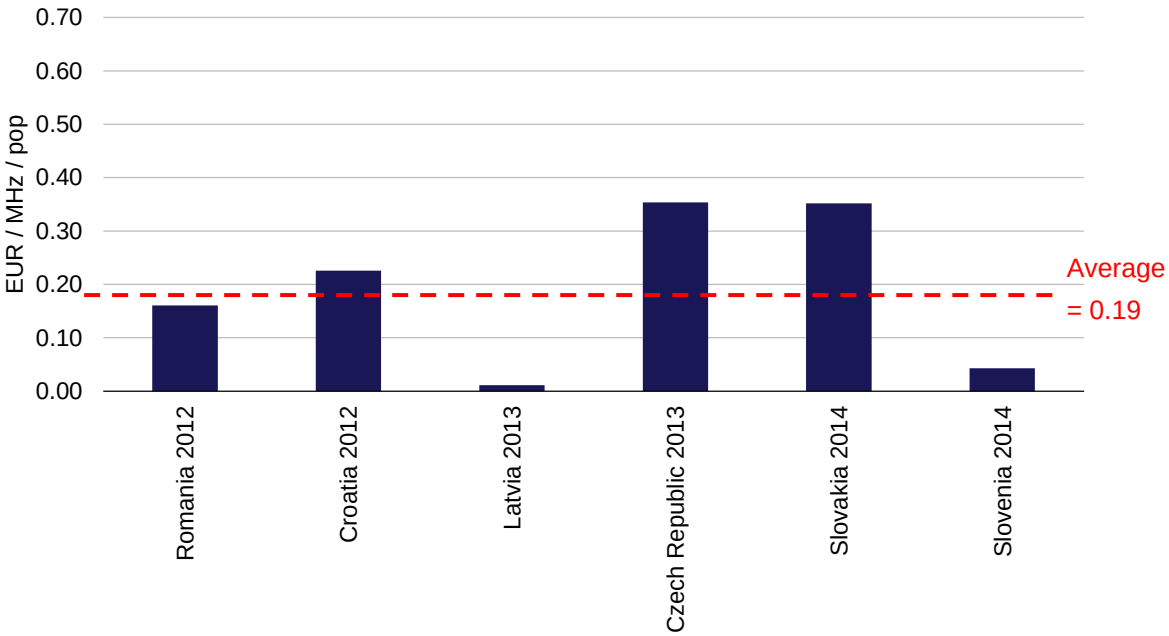


Figure 5.8 presents the reserve prices for 800MHz spectrum as a proportion of the prices paid in Western Europe. Most prices paid were between 100% and 150% of the reserve price, although both Sweden and Denmark were higher at between 200% and 250%. The price paid in Germany was 280 times higher than the reserve price, due to the extremely low reserve price set.

Figure 5.8: Reserve price as a proportion of price paid for 800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]

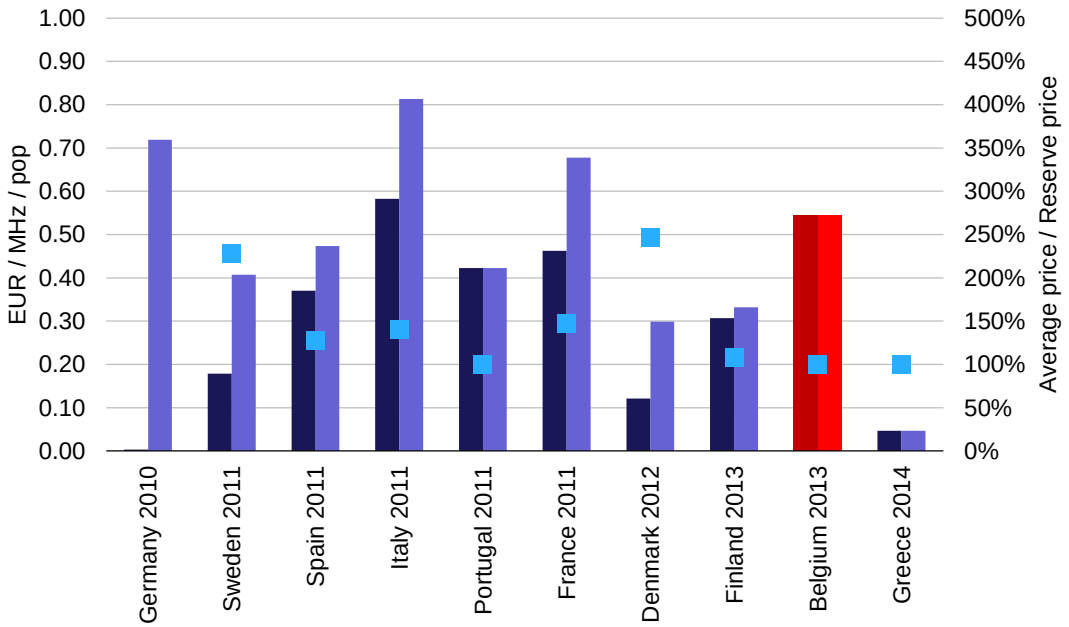


Figure 5.9 below shows the reserve prices as a proportion of the prices paid in Eastern Europe. In both Croatia and the Czech Republic spectrum was won at around the reserve price, whilst in Latvia it was significantly higher at around three times the reserve price due to the low reserve price set in this market.

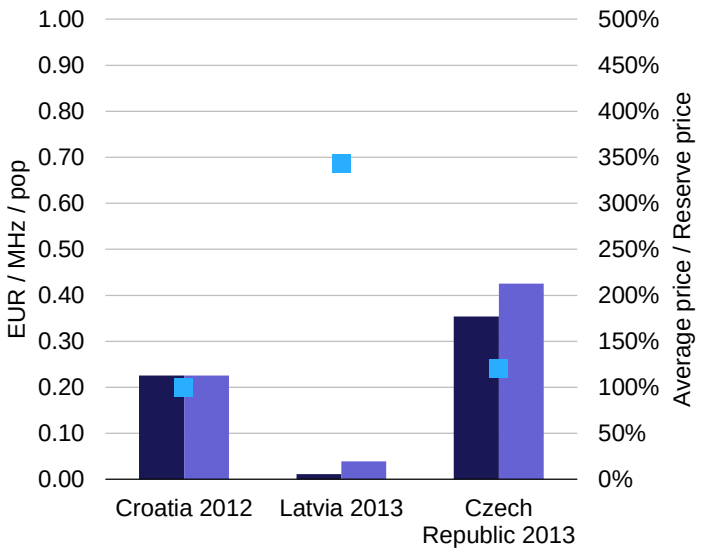


Figure 5.9: Reserve price as a proportion of price paid for 800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]

Economic analysis: methodology used

In our economic analysis we have modelled the value of the bands under consideration to each of the Belgian MNOs by developing a spectrum valuation model. As highlighted in Section 4.1.8, the likelihood of a new entrant in the market is extremely low and we have therefore focused our analysis on the three existing MNOs.

For the 900MHz, 1800MHz and 2100MHz spectrum (i.e. the existing bands), we have calculated the value by estimating the costs that an MNO will have to bear if it *loses* a particular band. These include the cost of replacing sites operating only in the band under consideration with sites using one or more other frequencies.

For the 700MHz and 1400MHz bands (i.e. the new bands) we have calculated the value of the spectrum by assessing the delta (incremental change) in cash flows generated by the mobile business as a consequence of having acquired additional blocks of that spectrum. We have done this by comparing the net present value of these different cash flows over the entire licence period using an appropriate discount rate. The value of the spectrum is the difference in valuation between the scenario where an MNO holds that frequency and the scenario where it does not.

There are three main categories that can provide a source of value for an MNO – technical, commercial and strategic:

- **Technical value**: the acquisition of spectrum can save network costs by providing additional coverage and capacity, rather than needing to build new base stations. In the context of the Belgian market, the roll-out of the 800MHz band is already addressing coverage requirements and therefore the 700MHz spectrum would be used mainly to increase network capacity, leading to cost savings.

- **Commercial value:** spectrum can affect the services than an MNO can offer, which in turn will affect subscriber numbers and revenues. In particular, the ability to offer high-speed services with certain spectrum can enable lower churn rates and increase competitiveness. Having additional spectrum at low frequencies, such as the 700MHz band, would lead to a better QoS and enable an MNO to provide higher data rates to subscribers in rural areas, in indoor locations and at the edge of higher-frequency cells in urban areas.

- **Strategic value:** by acquiring spectrum, an MNO may gain strategic benefits over its competitors. For instance, the spectrum can be used to improve the MNO's service offerings (e.g. double- and triple-play packages), increasing its competitiveness and raising the barriers to market entry. An MNO may also gain strategic advantage by preventing other MNOs from acquiring the spectrum (or at least, the amount that they want).

In our modelling for this study *we have considered only the technical value of the spectrum*. We have not analysed the commercial value of the spectrum as the bands will mainly be used to meet increasing traffic demands, and as the market is already relatively mature and competitive with the three main players offering similar LTE services and with a very strong fixed broadband market.

Neither have we considered the strategic value, as this would require detailed insight into the commercial strategies of the potential bidders, and could lead us to overestimate the demand for spectrum. Furthermore, as we have not had access to detailed commercial and technical inputs from MNOs, and in order to avoid overestimating the value of the spectrum, we have chosen conservative assumptions in our model.

Economic analysis of the 700MHz band

In modelling the value of the 700MHz band to Belgian MNOs we have considered cases where each of the three main players wins either (a) 2×5MHz, (b) 2×10MHz, or (c) 2×15MHz. We have also taken into account a number of factors which may have an impact on the results, such as:

- the availability of terminals and the current and future ecosystem in terms of network roll-out
- a potential date of 2018 for the availability of the 700MHz band
- the possibility of using terminals that include the new bands with existing bands
- the possibility of carrier aggregation with different existing bands or with bands that would be granted in the future
- the technical characteristic of the band in terms of potential coverage and bandwidth/capacity.

It is also worth highlighting that some parts of 700MHz band (in addition to the 2×30MHz that will be allocated for mobile services) may be allocated in the future for other services such as M2M and SDL (Supplementary Down Link). We believe that it is too early to define any prices for such services for the following reasons:

- M2M: We do not see any spectrum scarcity in Belgium for the development of M2M services in the short to medium term. The low data rates typical of the majority of emerging M2M applications mean that they can be supported within the existing spectrum. However, it is clear that the spectrum requirements in the long term are uncertain as the market is currently immature and future applications might require increased demand for spectrum. Therefore, it is important to monitor the development of M2M worldwide and in Belgium in particular to anticipate for any significant change in the spectrum demand for such applications.

- SDL (Supplementary Down Link): There is currently no ecosystem for SDL in the 700MHz band as there are some technical issues with handsets supporting 700MHz SDL (in particular when combined with 700MHz FDD in the adjacent paired bands). Therefore, it would be reasonable to wait and follow the progress on this band before taking any decision.

We have considered two main scenarios:

- *Base case* – this reflects the current situation of the mobile market and its expected evolution
- *Consolidation case* – this reflects the potential acquisition of Base Company by Telenet, under which scenario Telenet's MVNO subscribers would be migrated from Mobistar's network to Base Company's network between 2017 and 2019.

Approaches to setting spectrum prices

There are three main approaches taken by NRAs when setting spectrum prices for awards, which are summarised in Figure 5.10 below.

Figure 5.10: Main approaches for setting spectrum prices [Source: Analysys Mason, 2015]

Approach	Objectives	Details	Comments
Low but not insignificant price	Efficiency of outcome	Prices are set at a modest level considered sufficient only to deter frivolous participation Prices are set with no consideration of the expected value of the frequencies being awarded	Appropriate if the regulator's core objective is efficiency of outcome and it does not aim to raise revenues This approach is very popular with bidders, as under low-competition scenarios, they may acquire licences at a very low price relative to the expected return
Revenue maximisation	Raising significant revenues	Prices are set at – or very close to – the estimated value of the licence to the marginal winning bidder (the bidder who assigns the lowest value to the spectrum)	Pricing at this level incurs a significant risk that spectrum lots may be priced too high and therefore remain unsold
Minimum expected return	Efficiency of outcome. Raising revenues even when there is no excess demand	Prices are set with a discount on the estimated value of the licence to the marginal winning bidder, but at a level that will still ensure a significant revenue return	Approach widely used in spectrum auctions. This approach will suit the leading MNO in the market, which will assign a much higher value to the spectrum

In the case of Belgium, for all the bands under consideration, **we recommend the use of the minimum expected return** when setting the prices. This approach should ensure that BIPT's two main objectives are met, namely making sure that all the available spectrum is sold and used in the most economically efficient manner, and ensuring that the government receives adequate revenues from the spectrum.[9]

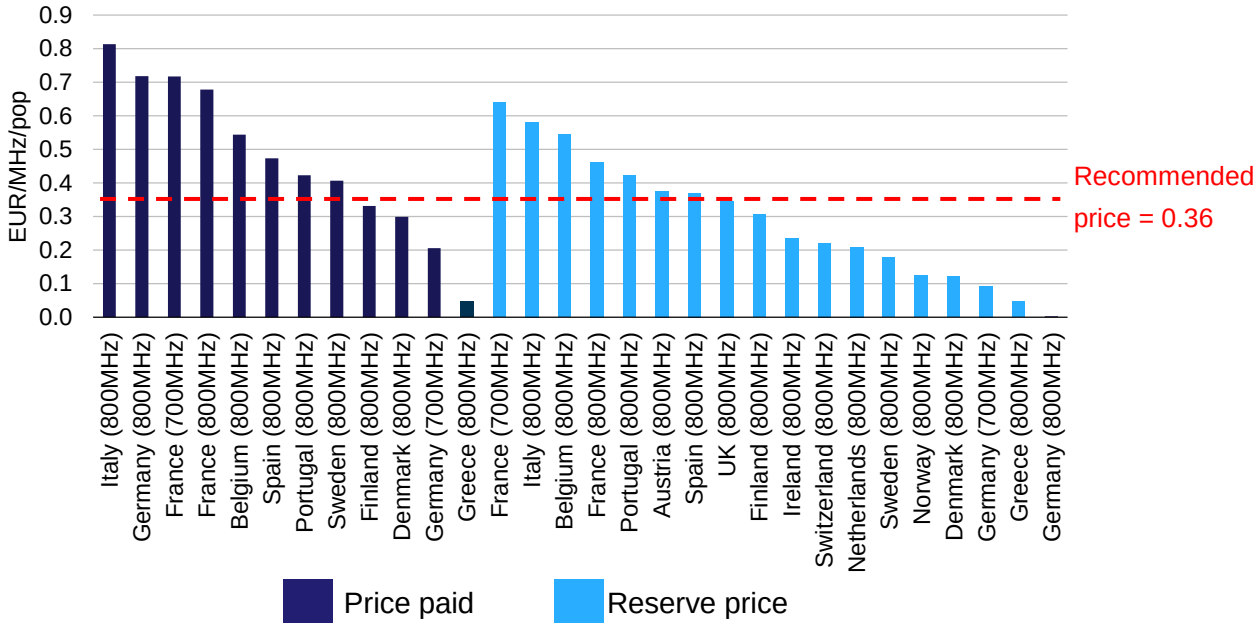
Recommendations for Belgium

Based on our economic analysis, **we recommend that BIPT set a reserve price for the 700MHz band of EUR40 million per 2×5MHz lot, which translates into a price of 0.36 EUR/MHz/pop**. This is in line with the prices paid for 800MHz in Denmark, Finland, Portugal and Sweden, and is below the average price of 0.47 EUR/MHz/pop in Western Europe. It is also in line with the reserve prices set for 800MHz in Austria, Spain and the UK. Furthermore, the price is lower than the reserve price set in France for 700MHz as well as the price paid in Belgium for 800MHz.

[9] Note that since our recommendations are based on the minimum expected return approach, in our valuation model we significantly discount the estimated value of the spectrum to a marginal winning bidder.

The recommended price is compared with benchmarks from Western Europe in Figure 5.11 below.

Figure 5.11: Recommended price for the 700MHz band in Belgium compared to Western European benchmarks [Source: Analysys Mason, 2015]



5.1.2 Price for the 1400MHz band

Price benchmarks

1400MHz spectrum has typically not been available for mobile use in most countries, having been used instead for broadcasting. It is now being released for use as supplementary downlink (SDL) spectrum alongside other bands, to increase network capacity. Therefore, it is difficult to compare this band with other frequencies that were allocated to mobile, and it is only relevant to consider other assignments of 1400MHz when benchmarking this band.

Figure 5.1 presents benchmarks of the prices paid for 1400MHz spectrum in recent awards in Western Europe. Only three awards have occurred so far, in Germany, Italy and the UK. In each case, 40MHz of spectrum was awarded and shared equally between two MNOs. The spectrum in the UK was privately sold by Qualcomm and therefore did not have a reserve price; in Germany the reserve price was set at EUR150 million, or 0.05EUR/MHz/pop.

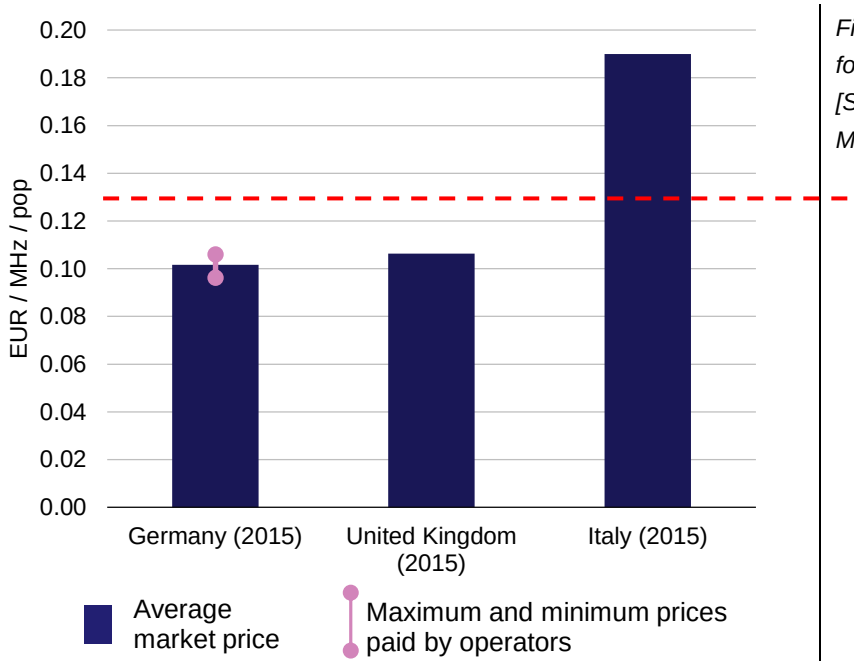


Figure 5.12: Prices paid for 1400MHz spectrum [Source: Analysys Mason, 2015]

Economic analysis

In our valuation modelling of the 1400MHz band we have considered two scenarios. The first scenario assumes that the 700MHz band is not awarded, and therefore calculates a valuation of the 1400MHz band alone. We have considered three cases, where either (a) 10MHz, (b) 15MHz or (c) 20MHz of the 1400MHz band are auctioned. However, we believe that in practice this first scenario is not very relevant as the priority of BIPT and the MNOs is the 700MHz band, and therefore the 1400MHz band would be awarded either along with the 700MHz band, or following the award of the 700MHz band.

The second scenario determines the value the 1400MHz band as *incremental* to the 700MHz band. This means that when valuing this band, we assume that MNOs would have already acquired 700MHz spectrum. The cases that we have considered are:

- 2×5MHz of 700MHz and 10MHz of 1400MHz
- 2×10MHz of 700MHz and 10MHz of 1400MHz
- 2×15MHz of 700MHz and 10MHz of 1400MHz.

We have also taken into account the factors mentioned previously in the subsection on *Economic analysis of the 700MHz band* (page 61), such as the availability of terminals; a potential date of 2018 for the availability of the band; and the technical characteristic of 1400MHz in terms of potential coverage and bandwidth/capacity. As in our valuation of the 700MHz band we have modelled a *base case* in which the market continues evolving as expected, and a *consolidation case* in which Telenet acquires Base Company.

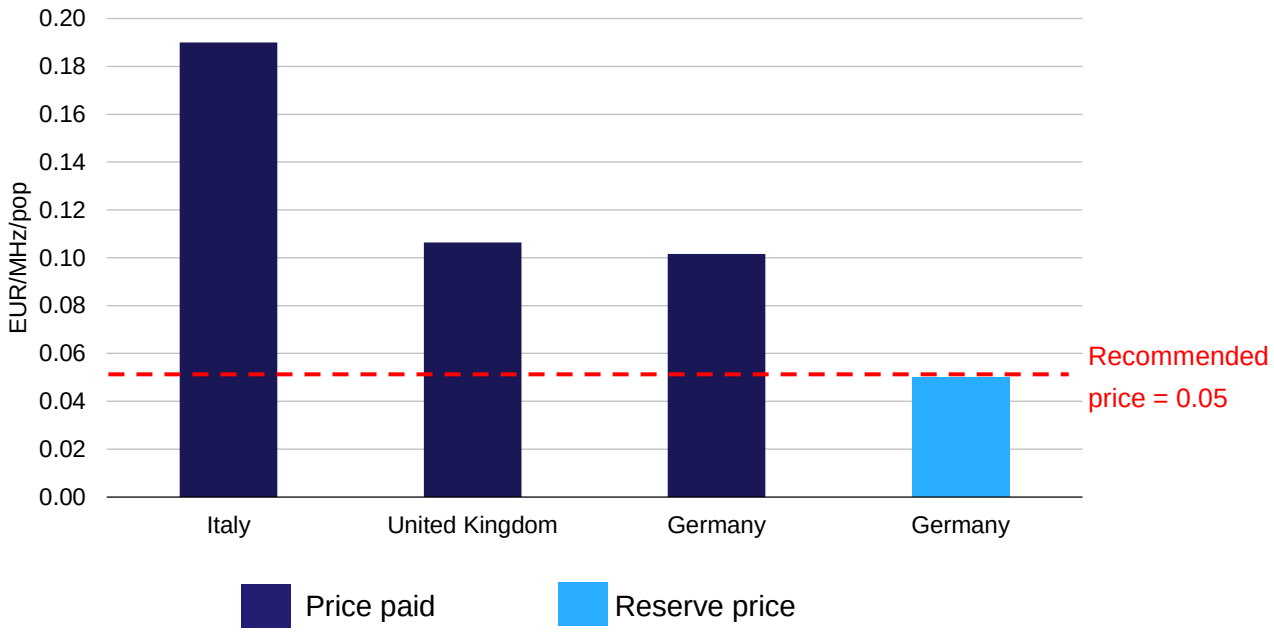
Recommendations for Belgium

As discussed in the subsection on *Approaches to setting spectrum prices* (page 62) we recommend the use of the minimum expected return approach when setting the price for the 1400MHz band, as for the other bands.

We recommend that BIPT set a reserve price of EUR3 million per 5MHz lot, which translates into a price of 0.05 EUR/MHz/pop. This is in line with the reserve price recently set in Germany for the 1400MHz band. This price assumes that the Belgian MNOs have also acquired 2×10MHz in the 700MHz band and that the 1400MHz is incremental to their existing spectrum (i.e. 700MHz and 800MHz). This strengthens the fact that there is no important need for additional spectrum in Belgium in the short to medium term (i.e. acquiring an additional band seems to be enough to cope with capacity needs). This has also been highlighted by the MNOs in discussions.

The price recommended is compared with benchmarks from Western Europe in Figure 5.13.

Figure 5.13: Recommended price for the 1400MHz band in Belgium compared to benchmarks [Source: Analysys Mason, 2015]



5.2 Prices for the existing bands

As for the new bands, we recommend the use of the minimum expected return approach when setting the price for the 900MHz, 1800MHz and 2100MHz bands.

Based on our economic assessment, we recommend that BIPT set the following reserve prices:

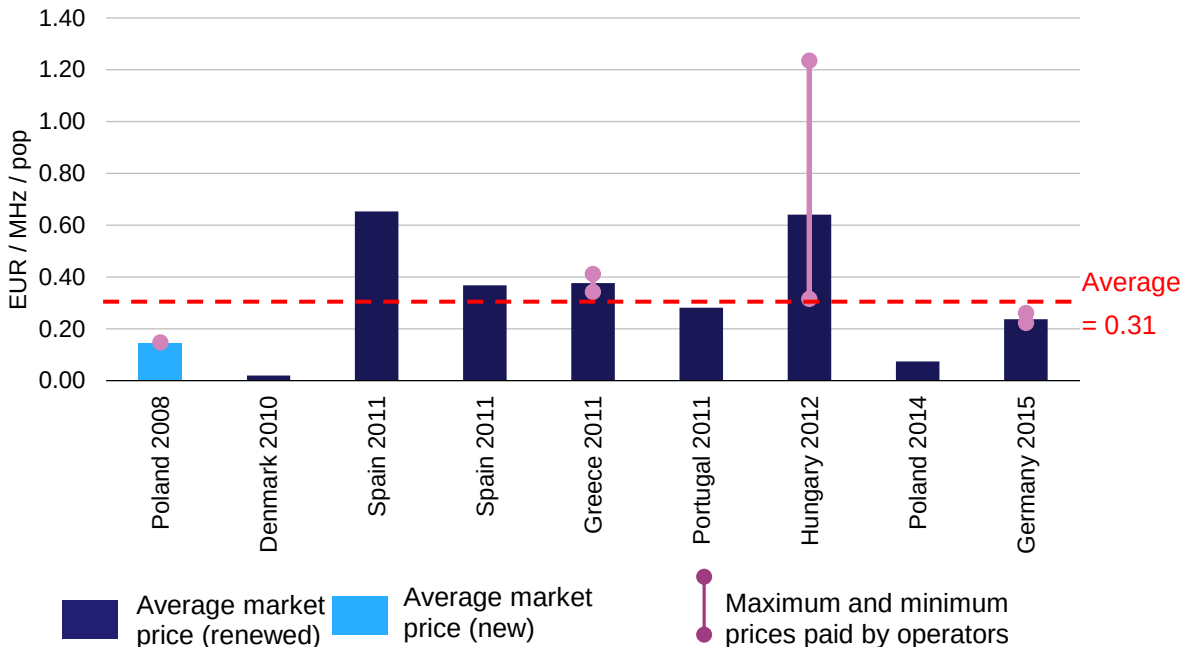
- 900MHz band – EUR28 million per 2×5MHz lot (0.25 EUR/MHz/pop)
- 1800MHz – EUR9 million per 2×5MHz lot (0.08 EUR/MHz/pop)
- 2100MHz – EUR9 million per 2×5MHz lot (0.08 EUR/MHz/pop).

5.2.1 Price for the 900MHz band

Price benchmarks

900MHz awards that have taken place in Europe during the last ten years have mainly related to the renewal of existing licences, with the exception of one award in 2008 in Poland where 900MHz spectrum was newly awarded. Figure 5.14 presents the prices paid for 900MHz spectrum in Europe during the last ten years. As can be seen, prices have been between 0.20 and 0.40 EUR/MHz/pop, with an average price of 0.31 EUR/MHz/pop.

Figure 5.14: Prices paid for 900MHz spectrum in Europe [Source: Analysys Mason, 2015]



Reserve prices for 900MHz have also mainly been set between 0.20 and 0.40 EUR/MHz/pop by most Western European regulators since 2011, with an average price of 0.21 EUR/MHz/pop (see Figure 5.15 below).

Figure 5.15: Reserve prices for 900MHz spectrum in Europe [Source: Analysys Mason, 2015]

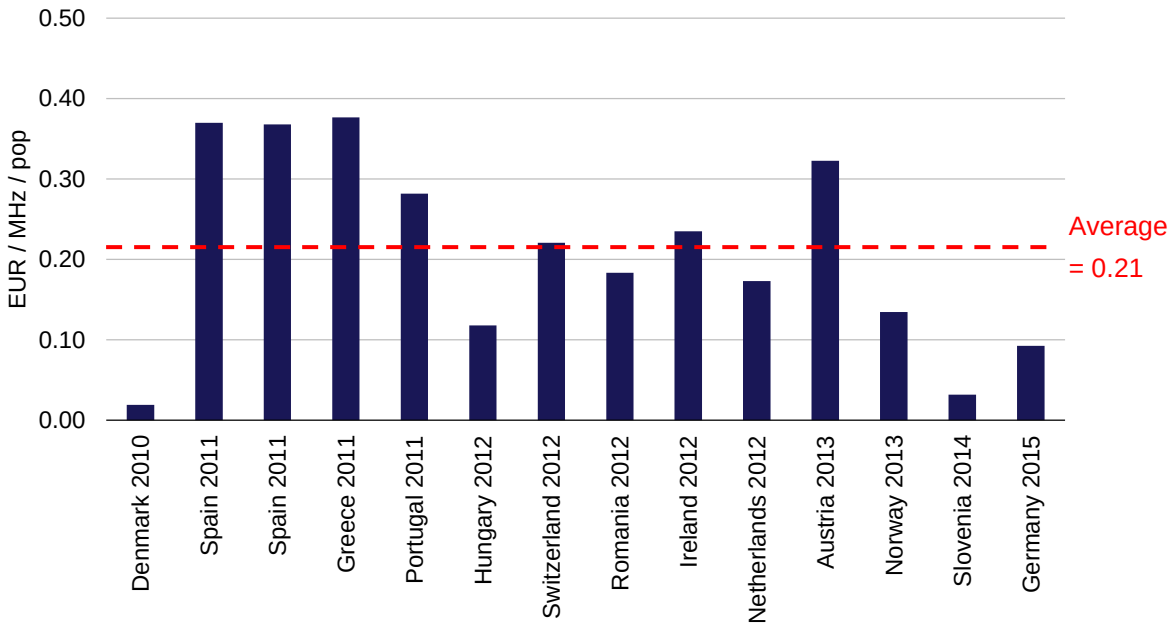
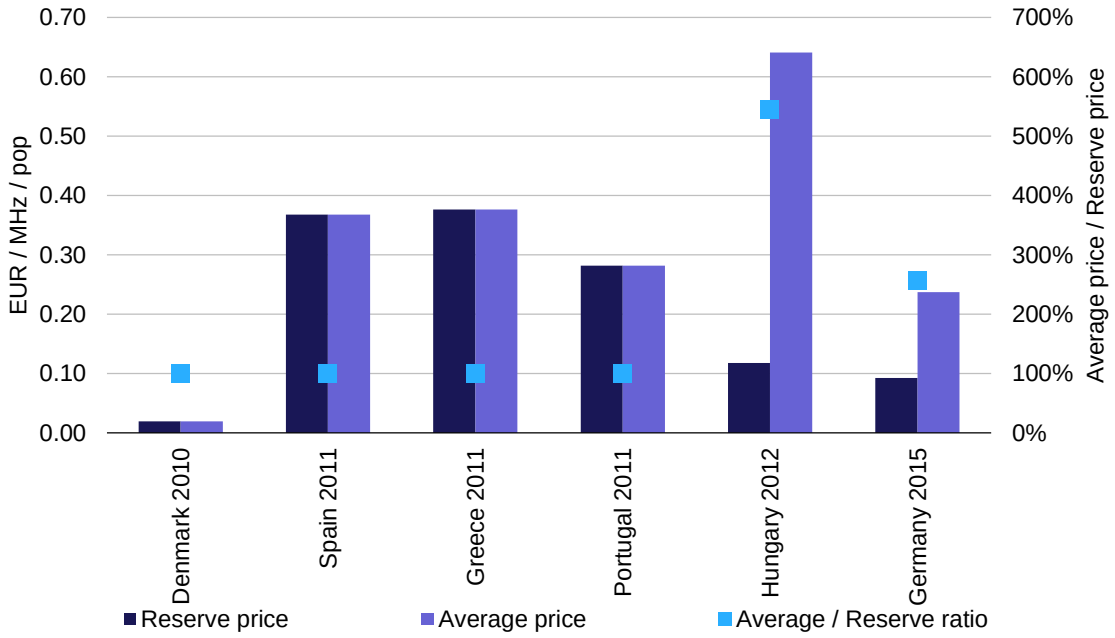


Figure 5.16 presents the reserve prices as a proportion of the prices paid for the 900MHz spectrum. In most of the cases, the prices paid by MNOs were similar to the reserve prices; in some cases this was the consequence of the renewal method (i.e. the use of a non-auction-based method).

Figure 5.16: Reserve price as a proportion of price paid for 900MHz spectrum in Europe [Source: Analysys Mason, 2015]



Economic analysis

The 900MHz band is used by the three MNOs in Belgium to provide 2G and 3G services. In general, the band is used to provide coverage and capacity for 2G networks, and mainly coverage for 3G networks in rural areas. In estimating the value of this band we have assumed that it will not be used for 4G services in the short to medium term. We have also assumed that 2G and 3G networks will not be shut down in the short to medium term; this assumption was also confirmed by two MNOs in discussions. Finally, we have considered that the 2G network will still be required for M2M services and low-value, voice-only customers.

We have calculated the value of the 900MHz band by estimating the costs that an MNO will have to bear if it *loses* this band. This is modelled by calculating the relevant cost for replacing 2G 900MHz-only sites with sites using 1800MHz, and 3G 900MHz-only sites with sites using 2100MHz.

With the replacement of 900MHz with higher frequencies, we would expect a decrease in QoS, mainly in rural areas and indoors, which would result in a fall in subscribers and therefore a loss in commercial value. However, as discussed in the subsection *Economic analysis of the 700MHz band* (page 61), we have chosen not to include any commercial value in our assessment, in order not to overestimate the value of the spectrum.

Recommendations for Belgium

As discussed in the subsection on *Approaches to setting spectrum prices* (page 62) we recommend the use of the minimum expected return approach when setting the price for the 900MHz band, as for the other bands. Therefore, we discount significantly the estimated value to a marginal winning bidder in our valuation model.

Based on our economic assessment, **we recommend that BIPT set a reserve price of EUR28 million per 2×5MHz lot which translates into a price of 0.25 EUR/MHz/pop**. This is in line with prices paid for the renewal of the 900MHz band in Portugal and Germany and is below the average paid price of 0.31 EUR/MHz/pop in Europe.

It is also in line with the reserve prices set for the 900MHz band in Switzerland, Ireland and Portugal.

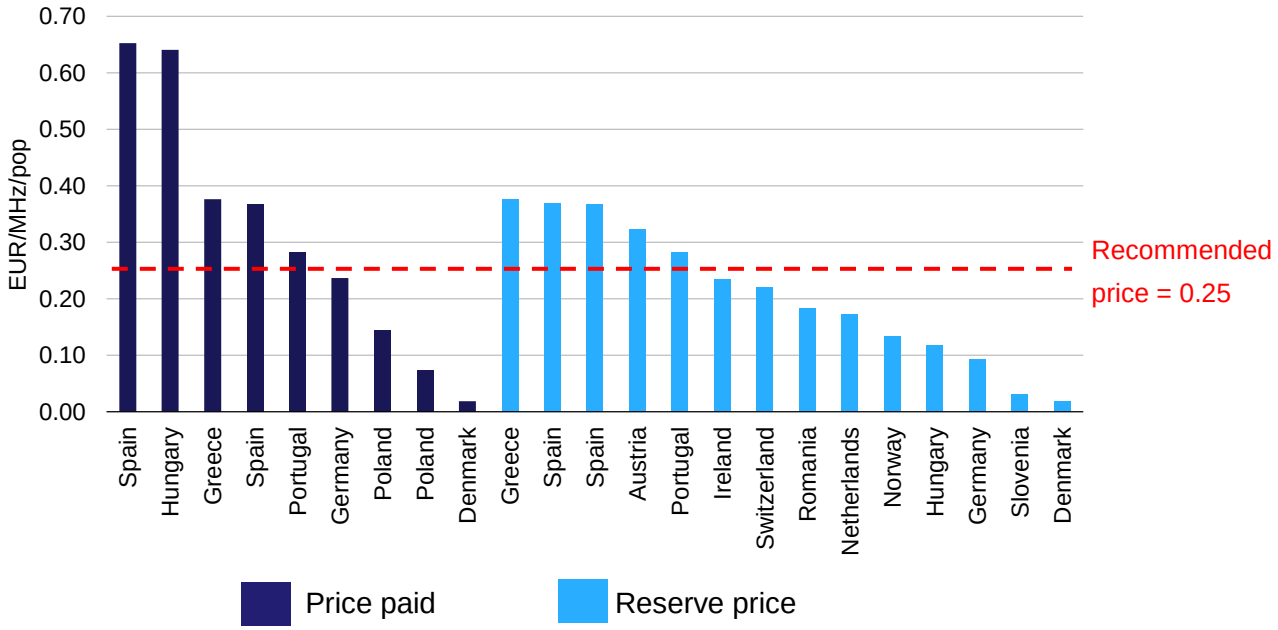
We note that if the 900MHz licences have an indefinite period[10] (rather than a duration of 20 years as we recommend), the value of the spectrum may increase by around 20% as for the 900MHz band, on the basis of an 8.42% discount factor[11] set by BIPT.

The price recommended is compared with benchmarks in Figure 5.17.

10 We have assumed that a licence of 40 to 50 years can be considered as an indefinite licence.

11 The WACC set in Belgium for MNOs is 8.42%.

Figure 5.17: Recommended price for the 900MHz band in Belgium compared to benchmarks [Source: Analysys Mason, 2015]

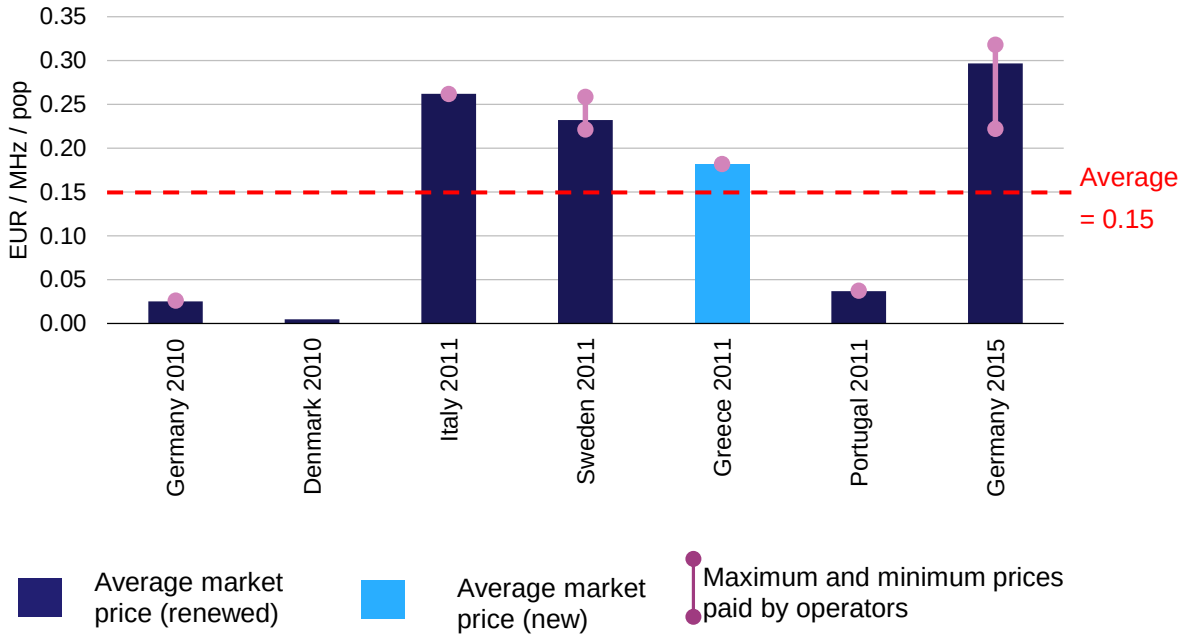


5.2.2 Price for the 1800MHz band

Price benchmarks

1800MHz awards that have taken place in Western Europe during the last ten years have mainly related to the renewal of existing licences, with the exception of one award in 2011 in Greece where 1800MHz spectrum was newly assigned. Figure 5.18 shows the prices paid in Western Europe during this period. The prices paid have been between 0.20 and 0.30 EUR/MHz/pop in some countries (Germany, Italy and Sweden) and extremely low in other countries at below 0.05 EUR/MHz/pop. The average price paid was 0.15 EUR/MHz/pop. Note that in some countries the prices paid by different MNOs were the same due to the renewal method that was used (i.e. non-auction-based).

Figure 5.18: Prices paid for 1800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]



In Eastern Europe over the same period, the prices paid for the renewal of 1800MHz spectrum were much lower than in Western Europe, lying between 0.05 and 0.13 EUR/MHz/pop, with an average price of 0.10 EUR/MHz/pop (see Figure 5.19).

Figure 5.19: Prices paid for 1800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]

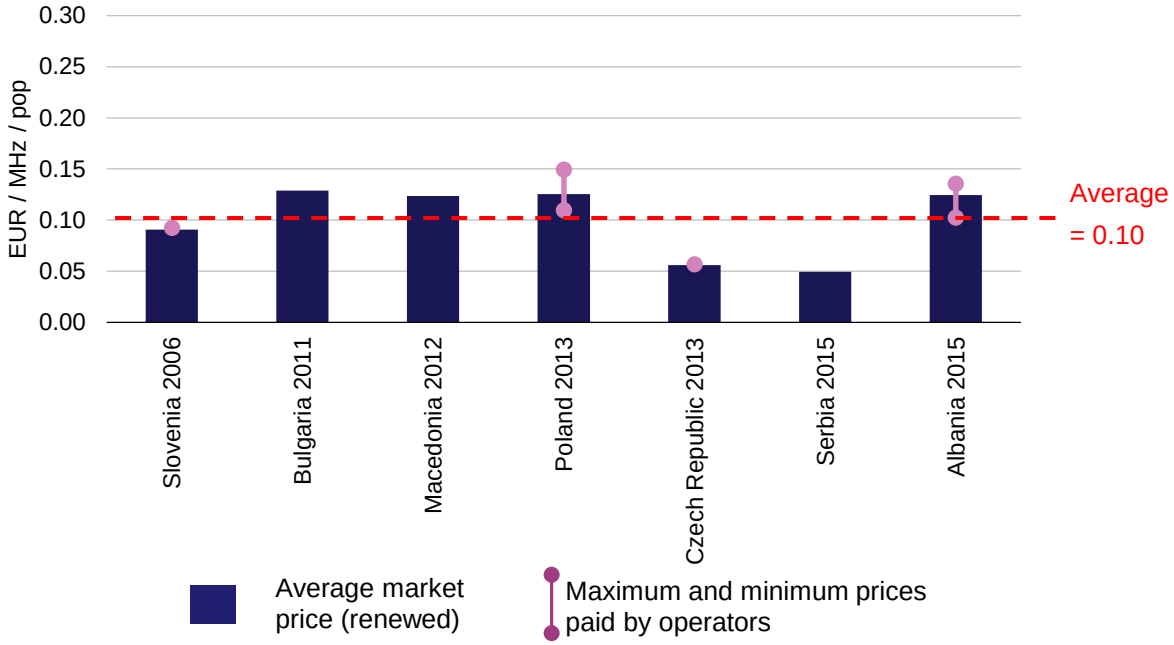
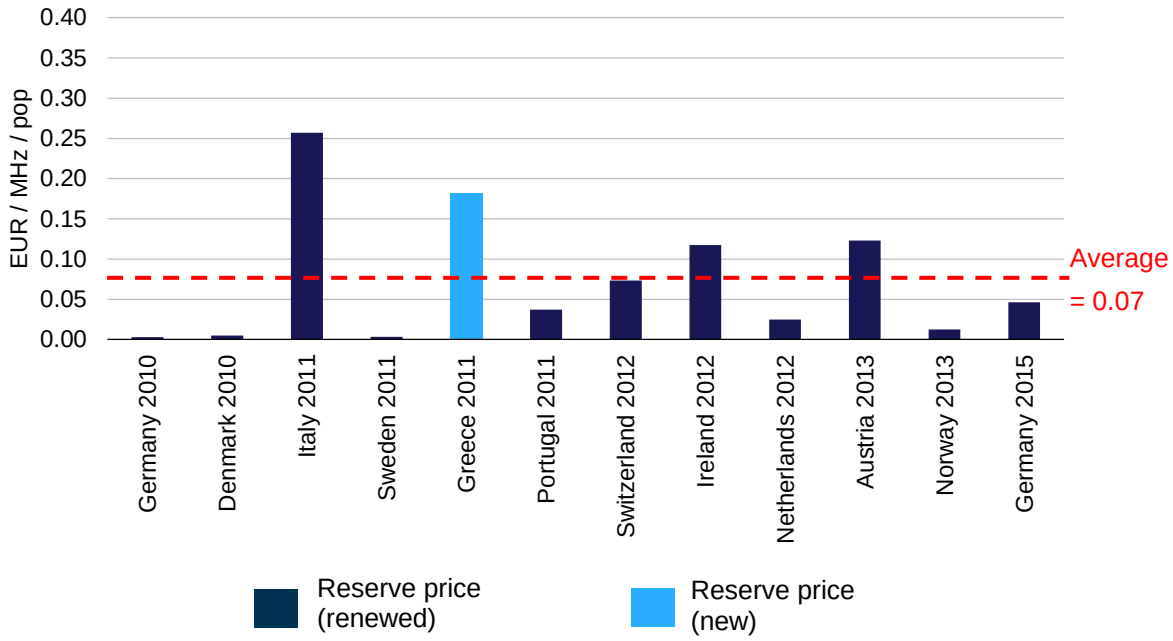


Figure 5.20 shows the reserve price for 1800MHz spectrum in Western Europe during the last ten years. With the exception of Italy, which had a high reserve price, all countries have set a reserve

price for the renewal of 1800MHz at less than 0.13 EUR/MHz/pop, with an average price of 0.07 EUR/MHz/pop.

Figure 5.20: Reserve prices for 1800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]



In Eastern Europe, the reserve prices for the renewal of 1800MHz were also low at below 0.10 EUR/MHz/pop, with an average price of 0.06 EUR/MHz/pop (see Figure 5.21). Most countries set a reserve price below 0.05 EUR/MHz/pop.

Figure 5.21: Reserve prices for 1800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]

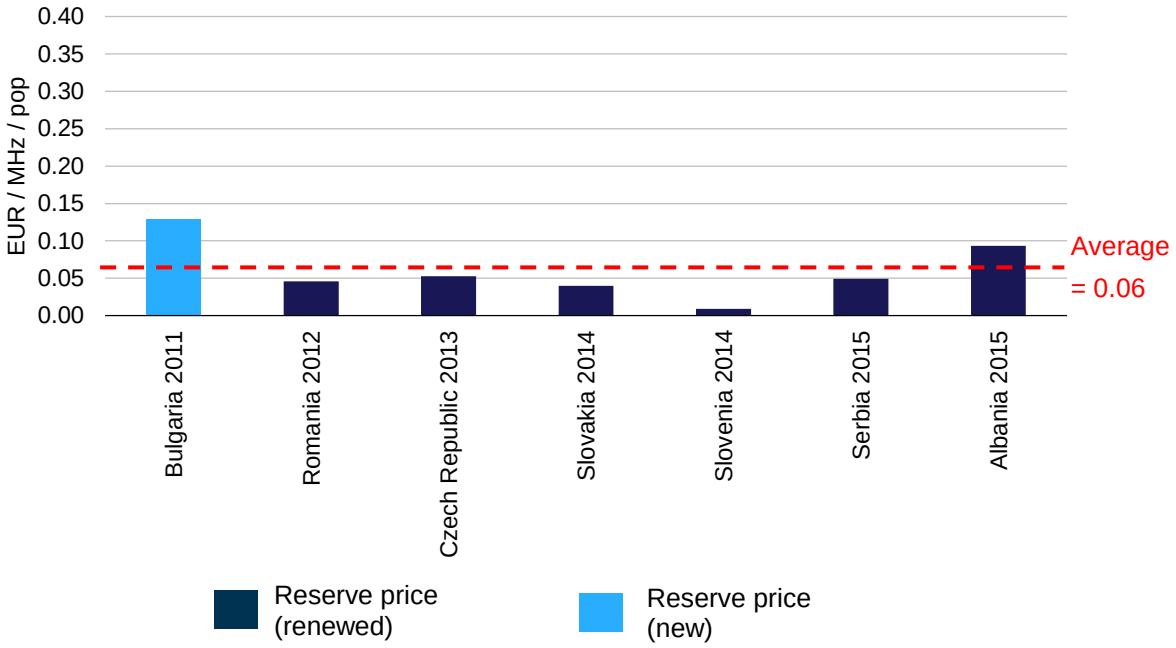
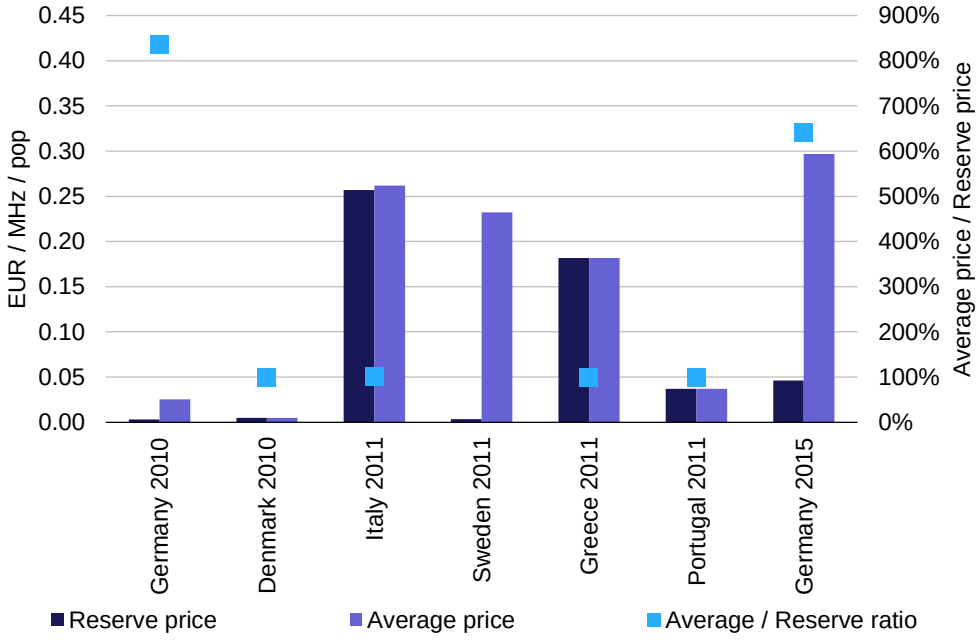


Figure 5.22 presents the reserve prices in Western Europe as a proportion of the prices paid. In many instances the spectrum was sold at the reserve price (often as a consequence of the renewal method), although in Germany in 2015 it was sold for six times the reserve price and in 2010 for eight times the reserve – probably due to the relatively low reserve prices. The price paid in Sweden was 68 times higher than the reserve due to an extremely low reserve price being set.

Figure 5.22: Reserve price as a proportion of price paid for 1800MHz spectrum in Western Europe [Source: Analysys Mason, 2015]



In Eastern Europe, too, the prices paid by MNOs were similar to the reserve prices (often as a consequence of the renewal method). This is shown in Figure 5.23 below.

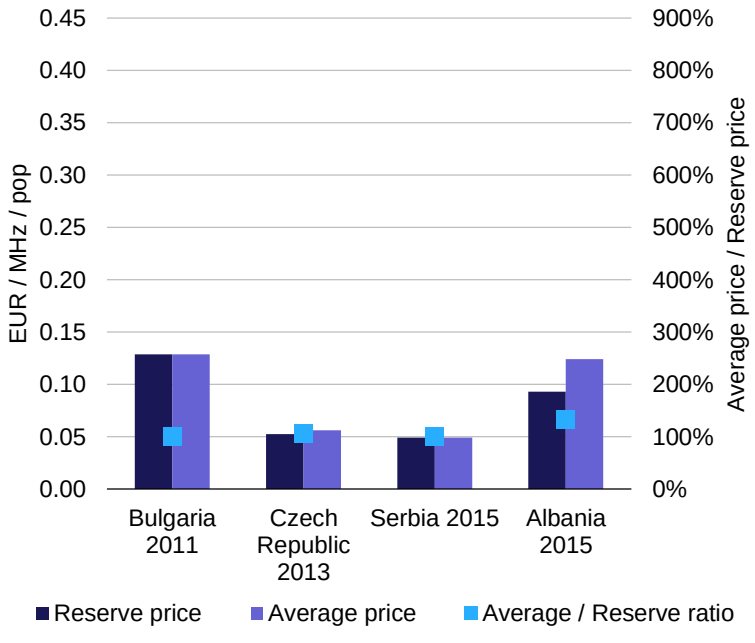


Figure 5.23: Reserve price as a proportion of price paid for 1800MHz spectrum in Eastern Europe [Source: Analysys Mason, 2015]

Economic analysis

The 1800MHz band is used by the three MNOs in Belgium to provide 2G and 4G services. In general, the band is used to provide capacity for the 2G and 4G networks, allowing MNOs to provide higher peak rates than they could provide using 800MHz spectrum.

We have assumed that the 1800MHz band will be increasingly used for 4G services. We also assume that this band is mainly used for 2G in areas where there is a need for capacity.

We have modelled the value of the 1800MHz band by estimating the costs that an MNO will have to bear if it loses this band. This is modelled by calculating the relevant cost for replacing 2G 1800MHz only sites using the 900MHz band and 4G 1800 only sites using the 2600MHz.

We could envisage a decrease in QoS due to replacing 1800MHz with higher frequencies for 4G, which would result in a fall in subscribers and therefore a loss in commercial value. However, as discussed above, we have chosen not to include any commercial value in our assessment, in order not to overestimate the value of the spectrum.

Recommendations for Belgium

As discussed in the subsection on *Approaches to setting spectrum prices* (page 62) we recommend the use of the minimum expected return approach when setting the price for the 1800MHz band, as for the other bands.

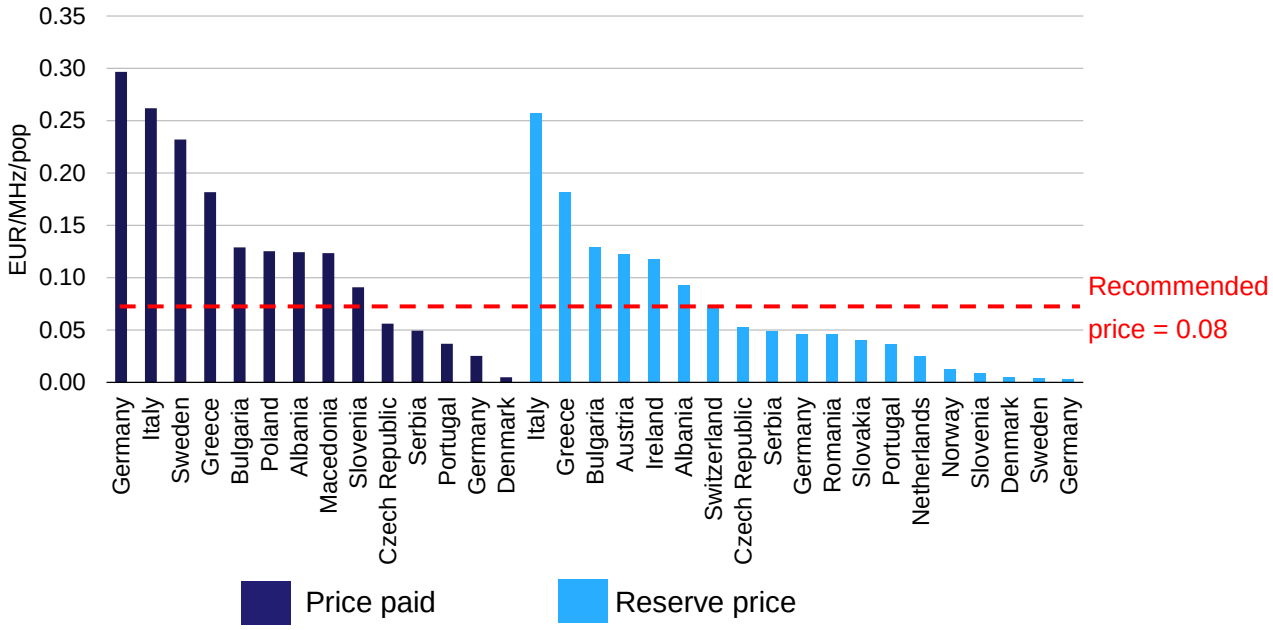
Based on our valuation modelling **we recommend that BIPT set a reserve price of EUR9 million per 2×5MHz lot which translates into a price of 0.08 EUR/MHz/pop**. This is in line with the prices paid for the renewal of the 1800MHz band in most Eastern European countries, and very close to the average price of 0.10 EUR/MHz/pop for these countries, but is lower than most of the prices paid in Western European countries, with the exception of Denmark, Germany (2010) and Portugal.

This recommended price is in line with most of the reserve prices set for the renewal of this band in both Western and Eastern European countries, in particular Albania, Austria, Ireland and Switzerland.

We note that if the 1800MHz licences have an indefinite period (rather than a duration of 20 years as we recommend), the value of the spectrum may increase by around 20%, as for the 900MHz band.

The price recommended is compared with benchmarks in Figure 5.24.

Figure 5.24: Recommended price for the 1800MHz band in Belgium compared to benchmarks [Source: Analysys Mason, 2015]



5.2.3 Price for the 2100MHz band

Price benchmarks

The prices paid for 2100MHz spectrum in awards in Europe during the last ten years are shown in Figure 5.25. These prices are significantly below the levels seen in the late 1990s and early 2000s. The prices vary a lot between markets, mainly ranging between 0.05 and 0.40 EUR/MHz/pop, with an average price of 0.19 EUR/MHz/pop.

Figure 5.25: Prices paid for 2100MHz spectrum in Europe [Source: Analysys Mason, 2015]

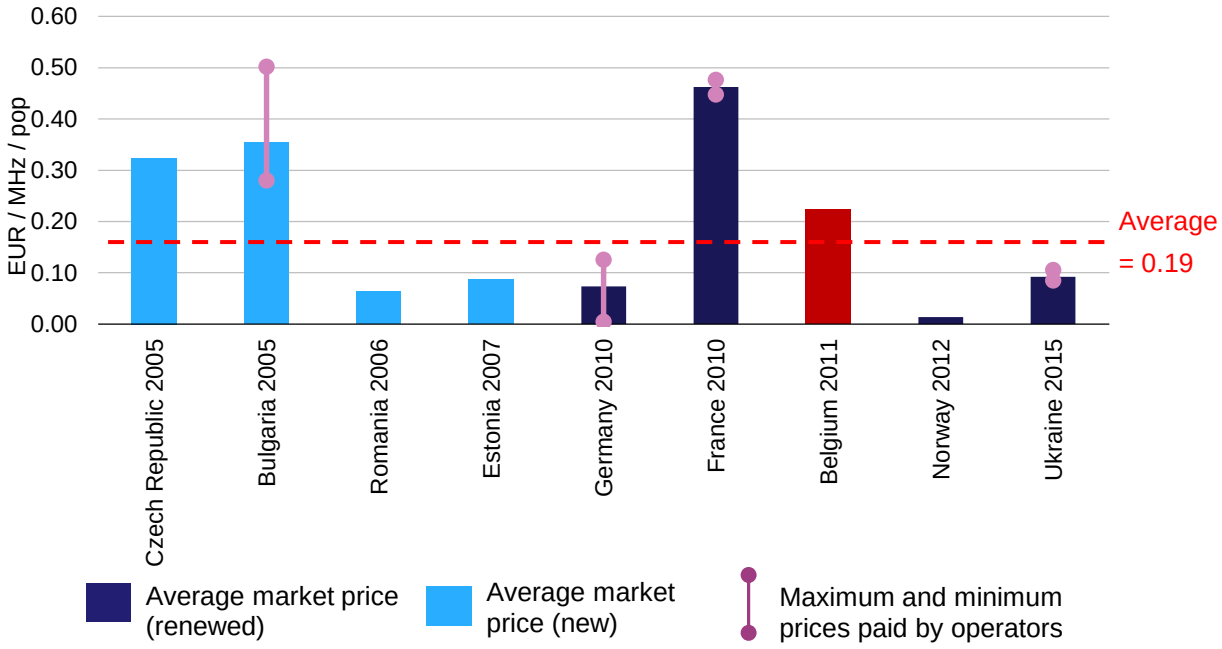


Figure 5.26 presents the reserve price for 2100MHz spectrum in Europe during the last ten years. With the exception of Belgium and France, reserve prices have been set very low at less than 0.05 EUR/MHz/pop, leading to an average of 0.08 EUR/MHz/pop.

Figure 5.26: Reserve prices for 2100MHz spectrum in Europe [Source: Analysys Mason, 2015]

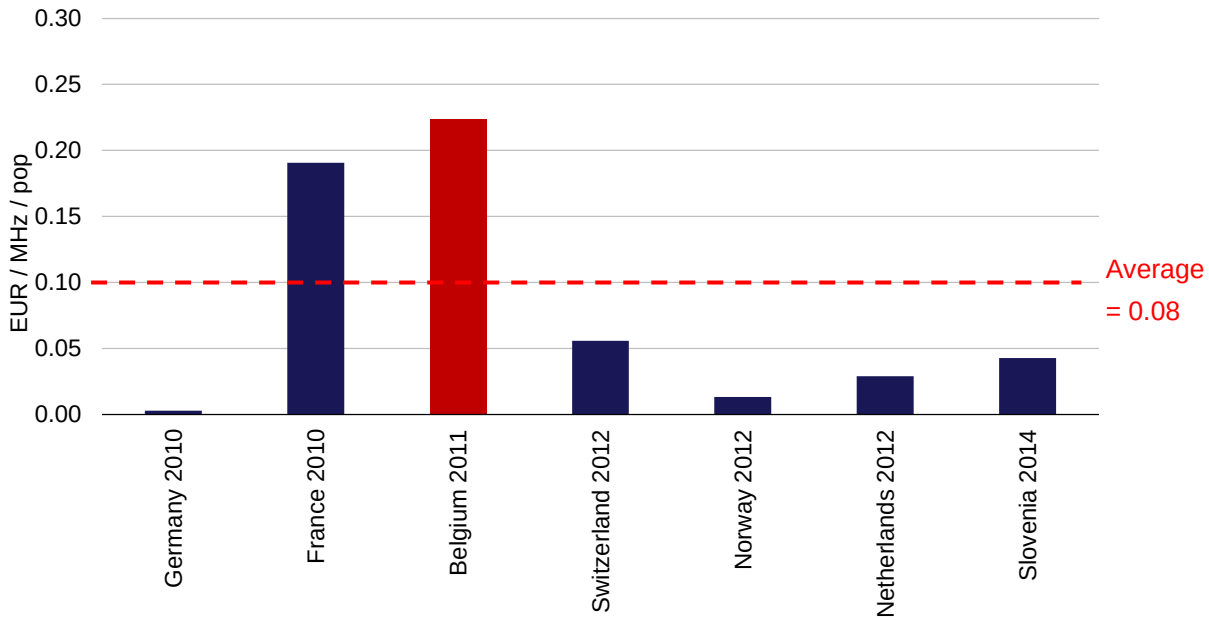


Figure 5.27 presents the reserve prices as a proportion of the prices paid. Spectrum was sold at close to the reserve price in Belgium and Norway, but significantly more in France (more than 2.5 times the reserve). In Germany, the price paid was 25 times higher than the reserve price due to the extremely low reserve set.

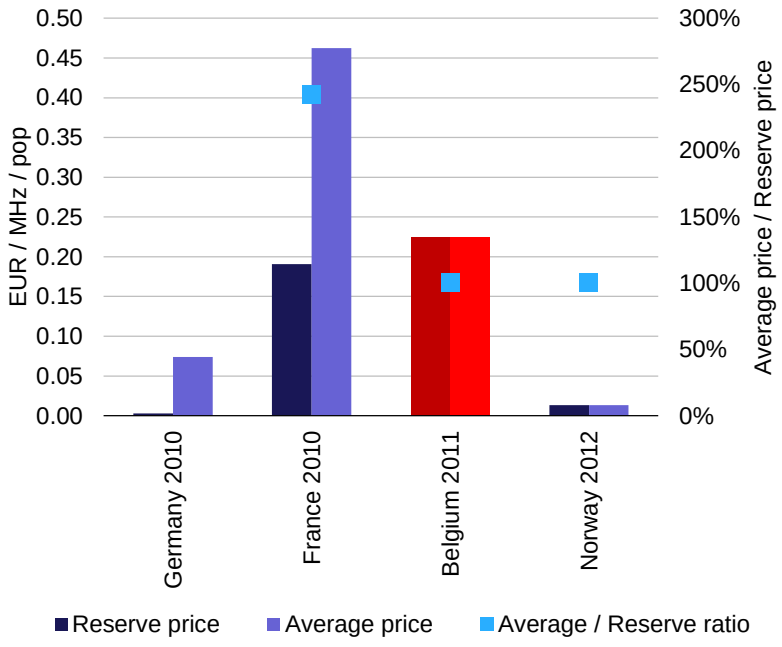


Figure 5.27: Reserve price as a proportion of price paid for 2100MHz spectrum in Europe [Source: Analysys Mason, 2015]

Economic analysis

The 2100MHz band is used by the three MNOs in Belgium to provide 3G services, in particular to provide capacity and coverage, mainly in urban and suburban areas.

We have assumed that 2100MHz will be very important in some areas where the use of 900MHz for 3G is not possible. We have also assumed that the 3G networks will not be shut down in the short to medium term, an assessment confirmed by all three MNOs in discussions. We consider that the 3G network will still be required in order to serve customers who are using data without 4G-enabled terminals.

We have modelled the value of the 2100MHz band by estimating the costs that an MNO will have to bear if it *loses* this band. This is modelled by calculating the relevant cost for replacing 3G 2100MHz-only sites using the 900MHz band.

As a result of the loss of 2100MHz, we could envisage a decrease in QoS due to potential congestion and interference on the 900MHz band due to increased usage of 2G and 3G on this band resulting in subscriber loss and therefore a decline in a commercial value. However, as discussed above, we have chosen not to include any commercial value in our assessment, in order not to overestimate the value of the spectrum.

Recommendations for Belgium

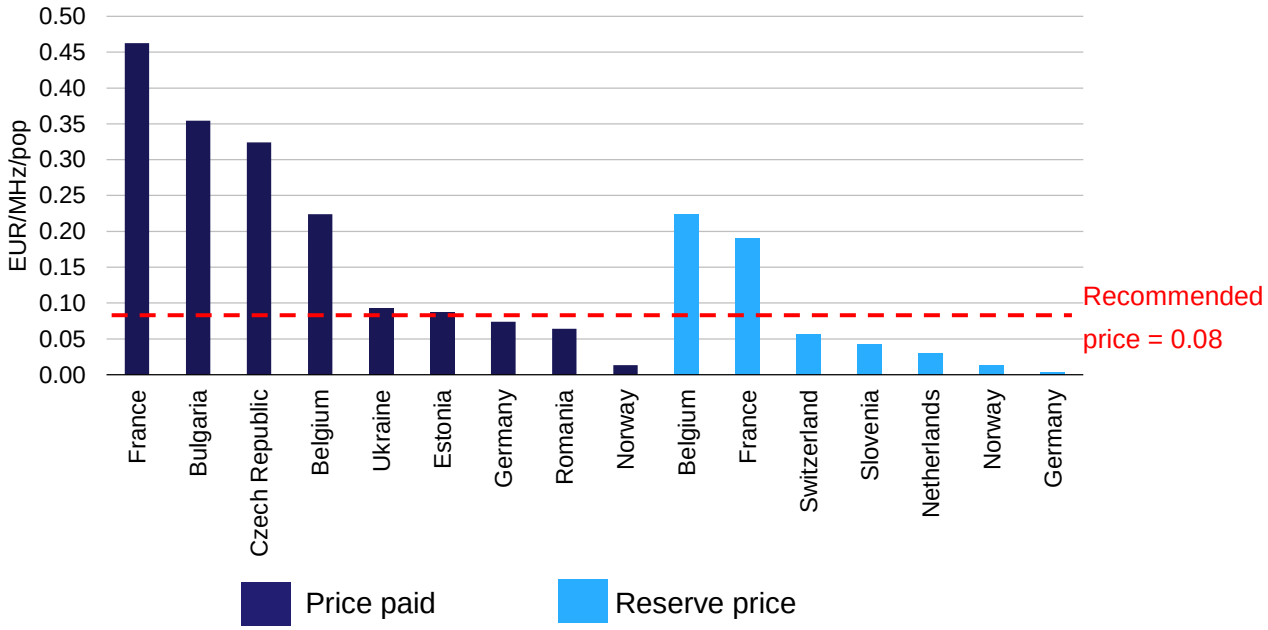
We recommend the use of the minimum expected return when setting the price for the 2100MHz band, as for the other bands. Therefore, in our valuation model we significantly discount the estimated value to a marginal winning bidder.

Based on our valuation modelling, **we recommend that BIPT set a reserve price of EUR9 million per 2×5MHz lot which translates into a price of 0.08 EUR/MHz/pop**. This is in line with the prices paid for the renewal of 2100MHz in Germany and Ukraine, and is below the average price of 0.19 EUR/MHz/pop across Europe. It is also in line with the average reserve prices for this band of 0.08 EUR/MHz/pop (in fact, it is higher than all reserve prices in Europe with the exception of France).

We note that if the 1800MHz licences have an indefinite period (rather than a duration of 20 years as we recommend), the value of the spectrum may increase by around 20%, as for the other existing bands.

The price recommended is compared to benchmarks in Figure 5.28.

Figure 5.28: Recommended price for the 2100MHz band in Belgium compared to benchmarks [Source: Analysys Mason, 2015]



5.3 Recommendations for spectrum prices in Belgium

Figure 5.29: Recommendations for spectrum reserve prices by band [Source: Analysys Mason, 2015]

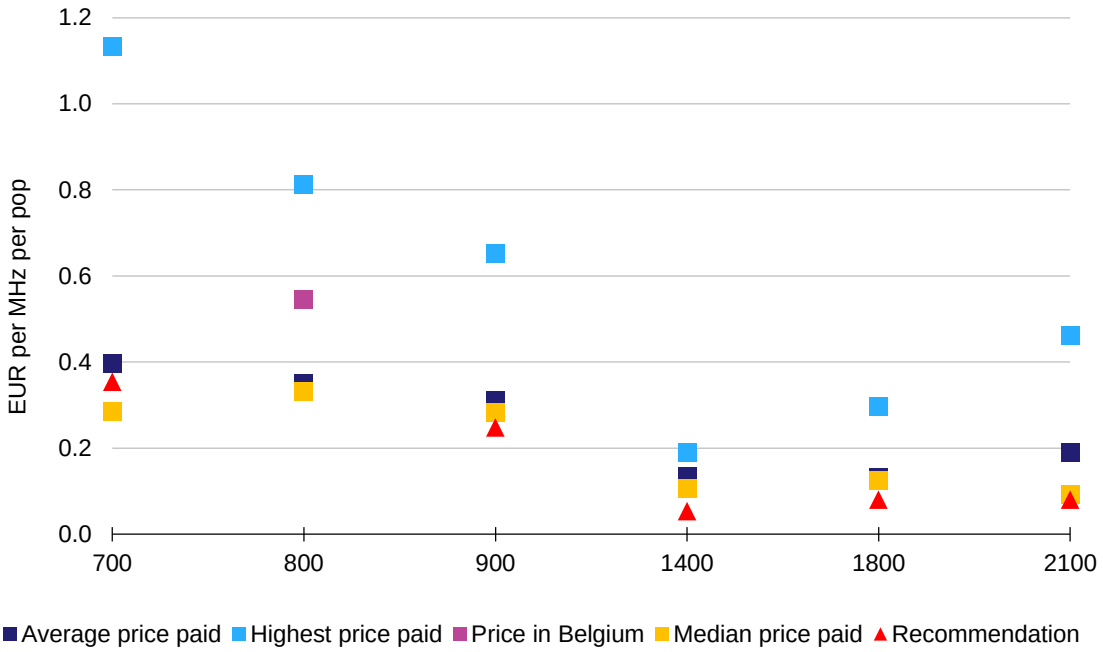
Band	Lot size (MHz)	Reserve price per lot (EUR million)	Reserve price (EUR/MHz/pop)*	Total price based on reserve price (EUR million)
New bands				
700MHz	2×5	40	0.36	240
1400MHz	5	3	0.05	24
Existing bands				
900MHz	2×5	28	0.25	196
1800MHz	2×5	9	0.08	135
2100MHz	2×5	9	0.08	108

* For ease of comparison, this column shows the price of each MHz of the spectrum divided by the population estimated in 2018. This measure (EUR/MHz/pop) is commonly used in the industry.

In order to compare these recommended reserve prices with our European benchmarks, in Figure 5.30 we indicate the highest price, average price and median price paid for each of the bands, as well as the price paid for the 800MHz band in Belgium recently. As can be seen, the price paid generally decreases when moving from the lowest-frequency band to the highest band

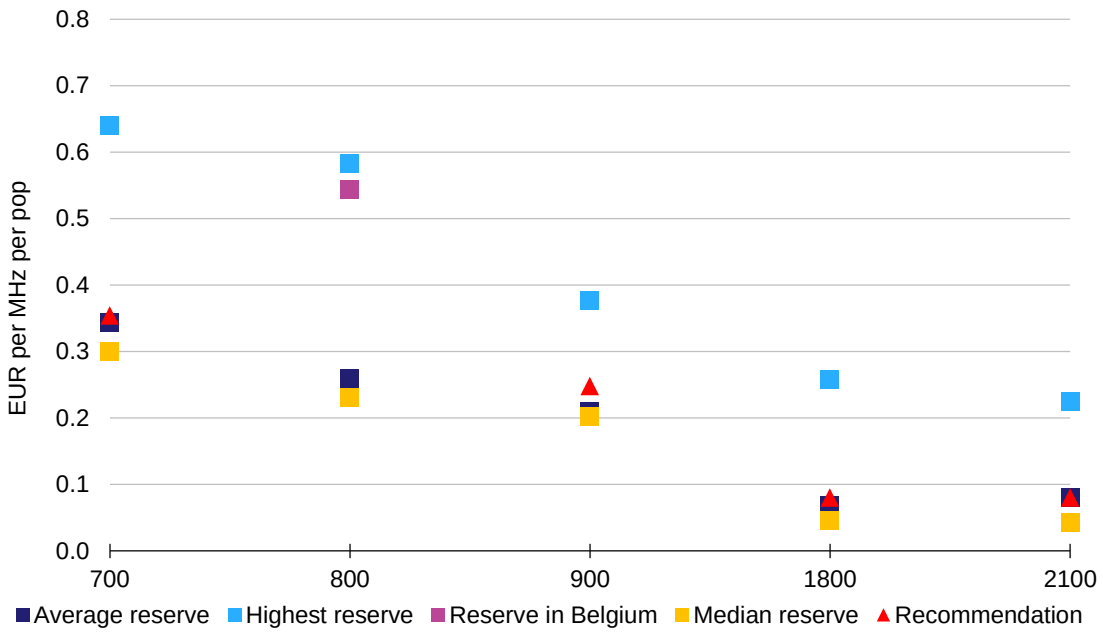
(the exception is the 2100MHz band, which has a higher average price than the 1400MHz and 1800MHz bands).

Figure 5.30: Average price paid by band across all benchmarks [Source: Analysys Mason, 2015]



A similar comparative analysis of the benchmark reserve prices and our recommendations is provided in Figure 5.31. Again the prices of the 2100MHz band are slightly above the prices for the 1800MHz band, though this is much less pronounced than for the prices paid.

Figure 5.31: Average reserve price by band across all benchmarks [Source: Analysys Mason, 2015]



5.4 Annual fees

Belgian MNOs are concerned that the annual fees they pay for spectrum may be too high and in particular that these fees will continue to increase. These fees cover the licences themselves as well as spectrum management costs incurred by BIPT.

Based on our review of annual spectrum fees in other European countries, the annual spectrum fees paid in Belgium are within the benchmarks.

Annual fees in European countries

Belgian MNOs – like most MNOs in Europe – have seen declining revenues in recent years as markets mature and competition increases. In parallel, annual fees for spectrum have increased as further bands have been released. Therefore, the MNOs feel that the annual fees are somewhat excessive and would like BIPT to review them.

In addition to the upfront fees for spectrum licences, the majority of NRAs also apply annual fees, either for the licences themselves (fees which are considered part of the overall charge for the licences), for spectrum management (covering some or all of the costs that the NRA incurs in administering the licences), or for both. We have reviewed the annual fees charged by 20 European NRAs, and found that 75% apply an annual licence fee, 70% charge spectrum management fees, and 55% apply both. The details are provided in Figure 5.32.

Figure 5.32: Annual fees applied by European NRAs [Source: Analysys Mason, 2015]

Country	Spectrum licence fees	Spectrum management fees
Western Europe		
Austria	✓	✓
Belgium	✓	✓
Finland	✓	✓
France	✓	✗
Germany	✗	✗
Greece	✗	✗
Ireland	✓	✓
Italy	✓	✓
Netherlands	✗	✓
Portugal	✓	✓
Spain	✓	✓
Sweden	✓	✓
Switzerland	✓	✓
UK	✓	✗
Eastern Europe		
Czech Republic	✓	✗

Country	Spectrum licence fees	Spectrum management fees
Hungary	✓	✓
Latvia	✗	✗
Poland	✓	✓
Slovakia	✓	✗
Slovenia	✗	✗

The structure of these fees varies widely between markets and depends on a number of factors including:

- frequency band (e.g. 900MHz, 1800MHz)
- bandwidth (i.e. amount of spectrum)
- coverage
- technology (e.g. 2G, 4G)
- revenue (i.e. share of revenue).

The method of calculating annual licence fees also varies, as shown in Figure 5.33.

Figure 5.33: Annual spectrum licence fee calculation methodologies in Europe [Source: Analysys Mason, 2015]*

Country	Freq-uency	Band-width	Cover-age	Tech-nology	Revenue	Comments
Western Europe						
Austria		✓				Applicable to all bands
Belgium	✓	✓				Applicable to all bands
Finland	✓	✓	✓			Applicable to all bands
France	✓	✓		✓	✓	Frequency-specific fee per MHz and a percentage of revenues applicable to all bands
Ireland		✓				Lump sum over licence duration
Italy	✓	✓				Prices subject to mark-ups or discounts in specific circumstances
Portugal		✓				Subject to 50% discount in first 3 years if no spectrum previously held in that band
Spain	✓	✓	✓	✓		Applicable to all bands
Sweden	✓	✓	✓			Applicable to all bands
Switzerland	✓	✓	✓			Applicable to 3500MHz only
UK	✓	✓				Proposed fee structure for 900MHz and 1800MHz

Country	Freq-uency	Band-width	Cover-age	Tech-nology	Revenue	Comments
Eastern Europe						
Czech Republic		✓				Applicable to all bands
Hungary	✓	✓				Applicable to 800MHz, 900MHz, 1800MHz and 2600MHz
Poland	✓		✓			Applicable to all bands
Slovakia	✓	✓				Also subject to base station fees

* It is our understanding that there are no annual spectrum licence fees in Germany, Greece, Latvia, Netherlands and Slovenia.

Other annual fees may also be applied in some markets, generally to cover the NRA's costs of licensing spectrum. The way these fees are calculated and implemented varies greatly between countries, as shown in Figure 5.34.

Figure 5.34: Annual spectrum management fee calculation methodologies in Europe [Source: Analysys Mason, 2015]

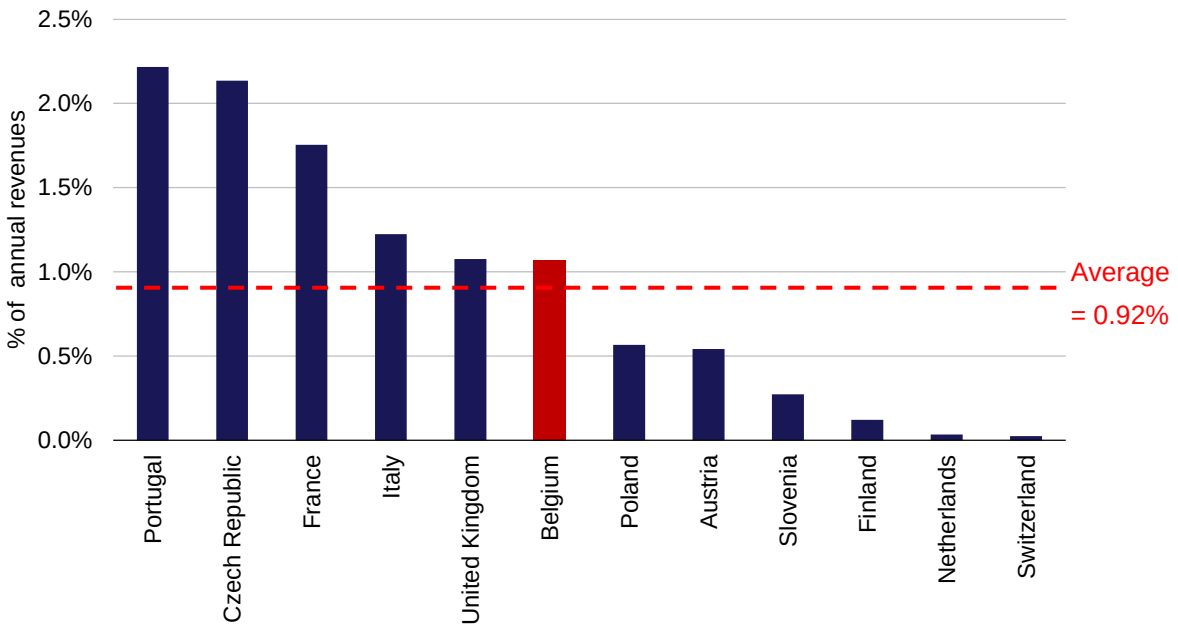
Country	Freq-uency	Band-width	Cover-age	Technology	Revenue	Comments
Western Europe						
Austria					✓	Contribution to NRA equal to ~0.1% of revenues
Belgium				✓		Management fees applicable to licences
Finland					✓	Management fees to meet NRA's costs, plus a tax of 0.12%
Ireland		✓				Flat fee for 1800MHz. Fees for 900MHz vary by operator (i.e. by amount of spectrum held)
Italy					✓	0.2% of revenues to fund NRA's undertakings
Netherlands		✓				Applicable to all bands
Portugal					✓	0.6% of revenues to fund NRA's undertakings
Spain					✓	Tax on public mobile MNOs owning equipment installed on public land
Sweden	✓	✓	✓			Fees payable as proportion (3%) of licence fees, as well as hourly charge (EUR74.63) for administration of spectrum licences

Country	Frequency	Bandwidth	Coverage	Technology	Revenue	Comments
Switzerland	✓	✓				Fee per base station for 3500MHz. Fee per MHz for 900MHz, 1800MHz and 2100MHz
Eastern Europe						
Hungary					✓	Flat fee adjusted with US CPI for 1800MHz. 3% of revenues for 2100MHz. All bands subject to market supervision fee
Poland						Fees payable on a case-by-case basis
Slovenia	✓	✓				Applicable to all bands

* It is our understanding that there are no management fees in Czech Republic, France, Greece, Latvia, Netherlands and UK.

In order to be able to compare at a high level the total annual fees charged in different countries, we have combined all annual fees together whenever possible. In order to do this, for each country we have summed the individual fees together and converted them to a proportion of average annual revenues in the mobile market as a whole for 2014. Short-term discounts (such as the 50% reduction possible in Portugal) have not been factored into these calculations. The results of this analysis are shown in Figure 5.35.

Figure 5.35: Total spectrum annual fees as a proportion of market revenues (2014) [Source: Analysys Mason, 2015]



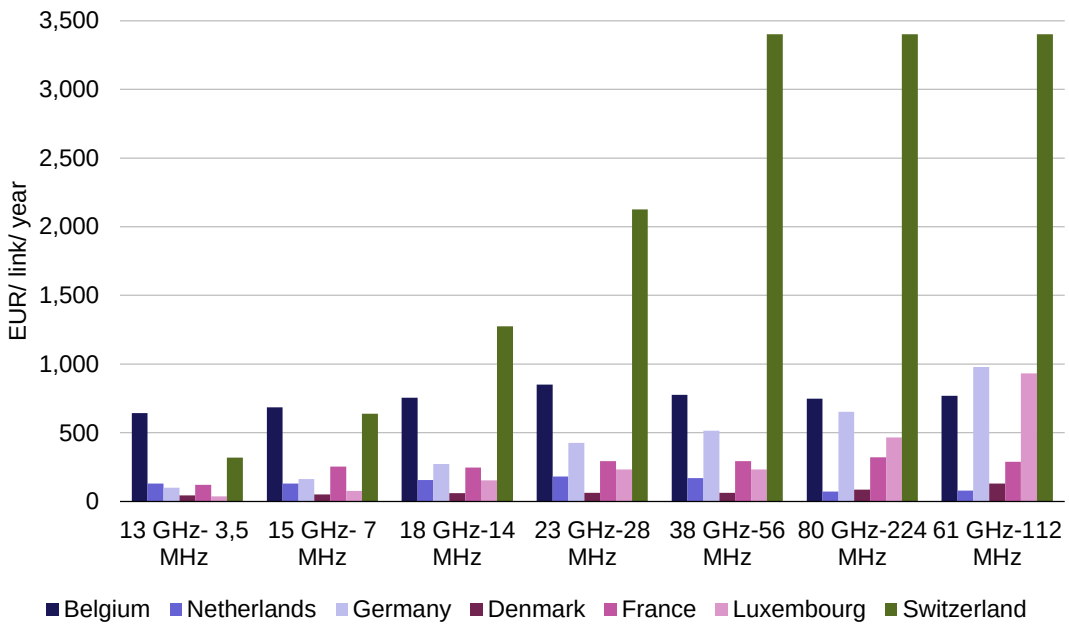
This shows that where fees are charged, they average 0.92% of mobile revenues. All markets have fees below 2.2% of revenues, although fee levels are fairly evenly distributed between close to zero and 2.2%. We note that the fees may increase in Switzerland and the UK if the current fee structure is imposed on future spectrum renewals. Similarly in France, fees for the use of 1800MHz for LTE are only temporary and therefore it is expected that the spectrum fees as a percentage of annual revenues will reduce after 2016.

5.5 Microwave fees

Microwave link prices in Belgium should be reduced by 20% to 50% to be more in line with European levels.

BIPT microwave tariff structure is in line with most European country tariff structure and is based on each link taking into account the frequency band and the bandwidth (amount of spectrum). In Figure 5.36, Belgian prices are compared to other European countries for standard frequency bands and bandwidths. As illustrated below, Belgian prices appear to be higher than the other benchmarked countries, except for prices in Switzerland.

Figure 5.36: Comparison of microwave links tariffs in European countries [Source: BIPT, 2015]



The microwave fees in Belgium appear to be expensive for frequencies below 40GHz, whereas prices for frequencies above 40GHz lie in the high end of the benchmarks.

We recommend the reduction of microwave link prices in Belgium by 20% to 50%. The comparison of the proposed new tariffs in Belgium with the tariffs in other European countries is presented in Figure 5.37.

Figure 5.37: Comparison of microwave links tariffs in European countries with recommendations [Source: Analysys Mason, BIPT, 2015]