Report for the Ministry of Economic Affairs

Economic and Social Limitations to Alternative Uses of 'Digital Dividend' Spectrum

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Contents

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1 Executive summary

Analysys Mason Limited ('Analysys Mason') has prepared this report for the Ministry of Economic Affairs of the Netherlands ('the Ministry'), in order to estimate the economic value and limitations associated with the potential use of all or part of the 'digital dividend' spectrum.

1.1 Background and objectives

In December 2006, the Netherlands switched off its analogue television broadcasts. This freed significant amounts of spectrum, which allowed the recently launched digital terrestrial television (DTT) platform to operate five multiplexes. Two broadcasters have been allocated the spectrum to operate these multiplexes until 2017: NOS, the national public service broadcaster, and Digitenne, now owned by KPN. Both broadcasters make use of the same network, operated by KPN Broadcast, which also operates a mobile TV service using the DVB-H standard.

At the time of the switchover to digital TV (DSO), only an estimated 30 000 households were solely dependent on terrestrial transmission to receive television,[1] with the vast majority of households connected to one of the cable networks accessible to virtually every household. One of the consequences of the switchover to digital TV has been to enable terrestrial television to compete in the multi-channel space, where previously, cable and satellite were the only options. Terrestrial viewers now have access to a total of 25 channels, compared to 3 national channels formerly available on analogue TV. Although this falls short of the 60+ channels available on cable and satellite, it does provide a viable alternative to a fair proportion of households, as demonstrated by the fact that there are now over 500 000 TV sets connected to the DTT networks.

In parallel to the DSO, the government of the Netherlands finalised bilateral agreements with neighbouring countries during the Regional Radiocommunication Conference held in Geneva in 2006 (RRC-06). This agreement will also enable additional spectrum to be used in the Netherlands in 2012, after neighbouring countries have switched off their analogue signals. This will provide enough spectrum to create two multiplexes for digital terrestrial broadcasting, or to make a sub-band available for telecoms services, in particular, wireless broadband access.

The term 'digital dividend' remains subject to interpretation, but the common definition, suggested by the European Commission is "the spectrum over and above the frequencies required to support existing broadcasting services in a fully digital environment, including current public service obligations".[2]

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1 At the point of DSO, in December 2006, the Ministry estimates that a total of 128 000 households were receiving analogue TV, of which about 30 000 were solely dependent on this platform.

2 *Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover*, Commission of the European Communities, COM(2007) 700 final, 13 November 2007.

In the context of the Netherlands, the digital dividend would therefore be the spectrum released by switching the three national public service broadcasting (PSB) channels, as well as existing regional broadcast channels, over to digital. This requires one multiplex. Consequently, the digital dividend would consist of the spectrum associated with the equivalent of four multiplexes from 2008 to 2012, then the equivalent of six multiplexes from 2012 onwards.

The Ministry of Economic Affairs needs to consider what uses to allow in the digital dividend spectrum, and how to award the spectrum. As a general policy, the government of the Netherlands re-allocates spectrum on a service and technology-neutral approach, using market mechanisms (for instance, auction) aimed at maximising allocative efficiency and creating economic value, furthering competition and allowing bidders to decide the size of the bands they purchase as far as possible.

In view of this, we have adopted the following approach:

- identify potential uses of spectrum
- define two alternative scenarios for allocation of the additional spectrum from 2012
- quantify the economic value of spectrum to the economy as a whole, including consideration of the potential impact that the digital dividend spectrum may have on the future pricing of TV services
- quantify the value of the spectrum to potential users of spectrum and consider whether leaving the allocation of spectrum to market forces may result in market failures.

1.2 Potential uses of spectrum

The digital dividend spectrum is acknowledged to be some of the most valuable, combining far-reaching coverage, good in-building penetration and sufficiently high capacity to provide a wide range of uses and applications. The main uses that we have identified are:

- **Broadcasting services**: These services aim to deliver one-way, point-to-multipoint television services at a fixed location (DTT) or in a mobility situation (mobile TV). Additional spectrum that will be made available by the DSO in bordering countries could be used to increase the number of standard definition DTT channels or to launch high-definition DTT channels. It could also be used to increase the number of available channels on the existing mobile TV platform (at present ten channels are broadcast) or to launch a new competitive platform.
- **Wireless broadband services**: Frequencies in the UHF band are ideally suited to deploy cellular networks, and in particular, to deploy wireless broadband networks (based on next-generation technologies, e.g. LTE or WiMAX), especially in rural areas.

- **Existing low-power uses, such as wireless microphones**: Low-power applications (including wireless radio microphones, in-ear monitors and audio links that support events) currently use the UHF spectrum. Channel 63 of the band has been reserved nationwide for these uses, which also make use of interleaved spectrum.[3]
- **Licence-exempt services**: The digital dividend spectrum could be made available for a number of licence-exempt services, including: wireless 'last-metre' applications (such as home networks), safety-of-life applications, 'intelligent' highways, automated buildings, medical sensors, etc.

1.3 Scenarios for alternative uses

From the point of switchover from analogue TV services to DTT in December 2006, five multiplexes have been in operation, one assigned to NOS and four to Digitenne. From 2012, when neighbouring countries are expected to complete their own switchovers, 88MHz of spectrum (i.e. 11 channels of 8MHz bandwidth, which can be used to create two, additional national DTT multiplexes) will become available.[4]

Figure 1.1 shows an illustration of the band under consideration as it will look in 2012.

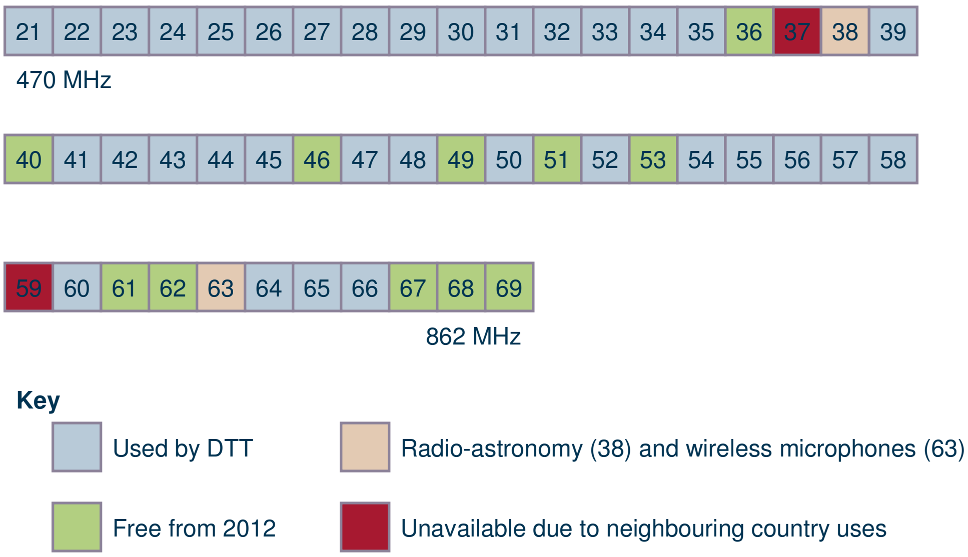

Figure 1.1: UHF band 470-862MHz from 2012 [Source: Analysys Mason, Ministry of Economic Affairs]

3 Interleaved spectrum can be defined as unused spectrum where a frequency used by a transmitter in one part of the country is effectively unoccupied outside the range of that transmitter in another part of the country.

4 Some re-negotiations are required to achieve full coverage with the second additional multiplex; alternatively, this could be used for additional mobile TV channels, which may not need full population coverage.

There is currently a debate in the industry that focuses on two particular uses of the UHF spectrum: digital terrestrial broadcasting and wireless broadband services. At the European level, the Commission has already made clear that it wishes to see a coordinated approach between Member States.[5] Additionally, the recent studies conducted by CEPT on behalf of the Commission[6] concluded that the most promising option for harmonisation, from a technical perspective, was to reserve a 72MHz band (790–862MHz) that could be used for wireless communications services.

Consequently, the two scenarios developed for this study focus on the two main alternatives that are likely to face spectrum regulators in the European Union: Scenario 1, where the entirety of the digital dividend is allocated to broadcasting, and Scenario 2, where a 72MHz sub-band is allocated to wireless broadband services.

In addition, we have defined a hypothetical Scenario 0, representing the situation where the digital dividend spectrum is not available to any of the services under consideration. This scenario is considered to enable the calculation of the value of the digital dividend spectrum under each of Scenarios 1 and 2 by considering the additional value created in the scenario under consideration compared to Scenario 0.

- **Scenario 0** assumes that no digital dividend spectrum is available to support the services under consideration.
  - The DTT platform only supports the three, national public service channels and regional channels that were available on analogue TV, over one multiplex. In this case, DTT service take-up remains at broadly similar levels to take-up of analogue TV services.
  - Wireless broadband services are rolled out using other spectrum bands (e.g. 2.6GHz).
  - Mobile TV services using the UHF spectrum are provided using only the frequencies that form the multiplex available for public service DTT broadcasts.

- **Scenario 1** assumes the continuation of availability of DTT over the existing five multiplexes, plus the following characteristics:
  - The additional frequencies freed from 2012 would be allocated to DVB services, either using DVB-T (DTT standard) or DVB-H (mobile TV standard).
  - This scenario does not require any rearrangement of the band.
  - In this scenario, DTT is a strong competitor to cable operators in the TV market.
  - Some of the additional frequencies will be used for mobile TV services, e.g. by an existing operator increasing its service offering (by increasing the number of channels) or through the introduction of a new competing operator.

5 *Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover*, Commission of the European Communities, COM(2007) 700 final, 13 November 2007.

6 *Report from CEPT to the European Commission in response to the Mandate: Technical Considerations Regarding Harmonisation Options For The Digital Dividend*, Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), 27 June 2008.

   - Wireless broadband services are rolled out using other, higher frequency bands (e.g. 2.6GHz spectrum). From the perspective of the wireless broadband service, this is identical to Scenario 0.

- **Scenario 2** assumes the continuation of availability of DTT over the existing five multiplexes, plus the following characteristics:
   - Part of the digital dividend is assumed to be allocated to telecommunication services in 2012, in the 790–862MHz sub-band (channels 61 to 69) identified during WRC-07. The digital dividend spectrum provides significantly larger cell radii in rural areas, as well as better in-building penetration.
   - In this scenario, DTT is a credible competitor to cable operators in the TV market, but not as strong a competitor as in Scenario 1, due to its provision of fewer channels.
   - For the purposes of modelling the benefits of this spectrum, we have modelled three assignments of 2×10MHz each, used by each of the three existing mobile operators to provide mobile broadband services (e.g. using LTE technology) nationally. It is assumed that a 12MHz guard band is required between the frequencies used for DTT and the sub-band for telecommunications services.
   - Users of low-power applications (such as wireless microphone) currently using channel 63 will need to be relocated to interleaved spectrum and/or a different nationwide channel (e.g. channel 40).
   - This scenario requires the frequencies used at some DTT transmitter sites to be changed (retuned).
   - Additionally, the use of wireless broadband services in channels 61 and 62 could result in reception interference in DTT in channels 59 and 60, resulting in the need for additional in-fill DTT transmitters to be deployed at some wireless broadband sites. We have considered the costs associated with such requirements as part of our economic assessment.

1.4 Value of the digital dividend spectrum for different services

We quantify the economic value associated with the use of the digital dividend spectrum by estimating the private value created for producers and consumers of the service(s) that utilise that spectrum. This value is calculated by considering the direct benefits to individuals from their own consumption of the service, less the costs of producing the service.

Private value can also be calculated by adding together the surplus of consumers and producers:

- The consumer surplus is defined as the difference between the value consumers place on a product/service and the price the consumers pay for the service. Throughout this document, we sometimes refer to the value a consumers place on the service as the consumers' 'willingness to pay' for the service.

- The producer surplus can be defined as the difference between the revenues that all producers in the market could obtain from producing a given service, minus the costs incurred in doing so (including the cost of capital).

Consumer surplus and producer surplus have been calculated following a simple assessment of the business case for each service, as shown in Figure 1.2.

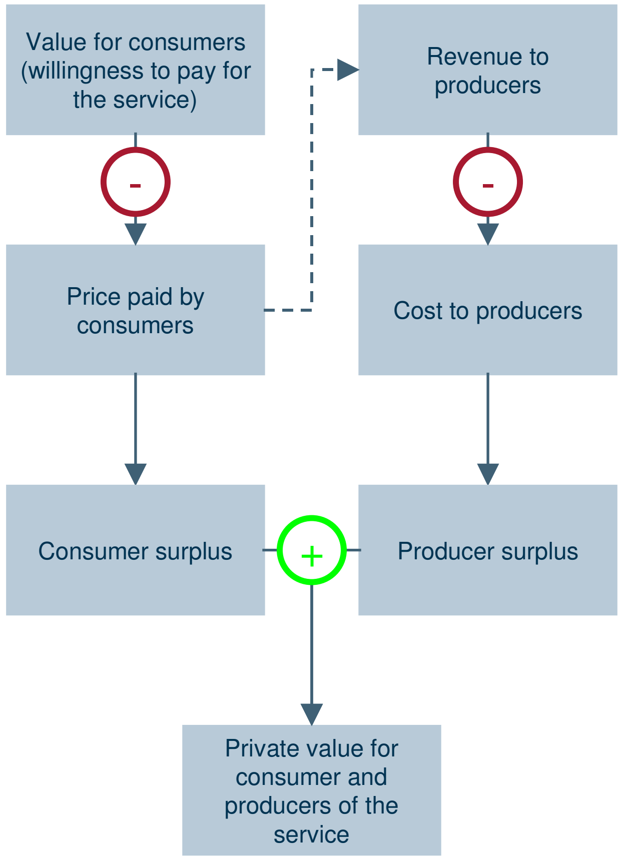

Figure 1.2: Estimating private value for each of the services modelled [Source: Analysys Mason]

At all times, we consider the incremental value that is created by the use of digital dividend spectrum i.e. the additional consumer and producer surplus arising, compared to the next-best alternative use of the digital dividend spectrum (e.g. use of an alternative frequency band or alternative delivery mechanism).

The results of the analysis of the change in private value that can be achieved if the additional digital dividend spectrum is allocated to the different services are shown in Figure 1.3

For each result in the table, we show a range of private value. This is in view of the uncertainties surrounding each of the three services that we have modelled, in particular, the future take-up of the services and the evolution of prices for the services. As such, we have considered a wide range of input parameters, which result in great variations in the final results. The base case can be considered to represent our best estimate of the likely evolution of the markets associated with each of the modelled services.

	Net present value from 2008 to 2029		
	Incremental private value of the digital dividend spectrum under Scenario 1 (EUR million)	*Incremental private value of the digital dividend spectrum under Scenario 2 (EUR million)*	*Private value of the additional digital dividend spectrum free in 2012 (EUR million)*
DTT	2400 – 8700 (base case 4500)	1500 – 7900 (base case 3600)	800 – 900 (base case 900)
Mobile TV	200 – 900 (base case 400)	-	200 – 900 (base case 400)
Broadcasting (total for DTT and mobile TV)	2600 – 9600 (base case 4900)	1500 – 7900 (base case 3600)	1100 – 1700 (base case 1300)
Wireless broadband	-	500 – 6900 (base case 2700)	500 – 6900 (base case 2700)
Total	2600 – 9600 (base case 4900)	2000 – 14 800 (base case 6300)	

Figure 1.3: *Incremental private value obtained by each services through use of the digital dividend spectrum (compared to Scenario 0, where the digital dividend spectrum is not available) [Source: Analysys Mason]*

It can be seen that the total economic value generated by use of all of the digital dividend spectrum is considerable (from approximately EUR2 to EUR15 billion, depending on the input assumptions), with a base case valuation of approximately EUR5 billion. The additional value created by use of the additional spectrum available from 2012 is estimated to range from around EUR500 million to EUR7 billion. Scenario 2 (creation of a sub-band for telecommunications services) could potentially create twice as much value than if this spectrum were used for broadcasting (Scenario 1). However, the range of estimated value of the additional spectrum under Scenarios 1 and 2 overlaps, so it cannot be stated with certainty that one scenario (and therefore, use of the additional digital dividend spectrum) is likely to create more value than the other scenario (alternative use of the additional spectrum).

The use of digital dividend spectrum for DTT, however, is likely to result in a loss of economic value generated from competing TV platforms (e.g. cable). This arises because of the loss of subscribers from the cable TV platform to DTT, and lower prices for television services on cable, brought about by competition. These both result in loss of revenue to the cable TV service providers. Broadly, this directly translates into a loss of producer surplus, since the cost of serving an incremental subscriber already connected to the cable TV network represents a relatively small proportion of the revenues. Such a loss in producer surplus is a characteristic of increasing infrastructure competition and is offset by the increase in consumer surplus resulting from the additional competition between the television platforms and therefore, lower prices for television services.

1.5 Conclusion

Our assessment of the economic value generated from the use of the digital dividend spectrum enables us to draw the following conclusions:

- The digital dividend spectrum enables significant value to be created on all the modelled platforms – potentially from EUR2 to 15 billion in total (NPV from 2008 to 2029).
- Continuing to make spectrum available for the existing five DTT multiplexes can be expected to yield significant economic benefits, primarily in the form of consumer surplus arising from lower prices for television services.
- Using the 790–862MHz sub-band for next-generation wireless broadband services (e.g. LTE) could potentially create twice as much value than if the spectrum were allocated to broadcasting (DTT or mobile TV). This arises from lowering the cost of coverage in less populated areas for operators and also making it commercially viable for the operators to increase their coverage (we estimate the digital dividend spectrum could increase next-generation wireless broadband coverage from an estimated 80% of population reached by using 2.6GHz spectrum alone to almost 100% with the use of digital dividend spectrum).

Our analysis shows that the incremental benefits of making additional spectrum available for broadcasting from 2012 is relatively modest compared to (i) the consumer benefits generated by continuing to make the digital dividend spectrum that has been released to-date available to DTT and (ii) the benefits that could be achieved through use of the additional spectrum by other services (e.g. next-generation wireless broadband).

There is also considerable uncertainty over the economic value that would be generated from use of this spectrum for each of the different services. In such circumstances, it is likely to be appropriate for the Ministry to make use of market mechanisms to determine the best use and user of this additional spectrum (e.g. through making the spectrum available on a service and technology basis, through an auction award process) in line with the general objectives of the Ministry, as stated in its 2005 spectrum policy document.[7]

To examine whether there is a risk of market failure if an auction process was used for the award of the digital dividend spectrum (which could result in a non-optimal allocation of the spectrum from the perspective of the total economic value to the country), we have calculated the willingness to pay for the spectrum released in 2012 for four different types of users:

- the **existing commercial DTT operator**, to operate six multiplexes in total (one more than is currently operational)
- the **existing mobile TV provider**, to operate the equivalent of a full multiplex and provide 20 channels

7 *Radio Spectrum Policy Memorandum 2005*, Ministry of Economic Affairs, 2005.

- a **new mobile TV provider**, to operate the equivalent of a half a multiplex in capacity and provide 10 channels
- an **existing cellular operator** to deploy LTE services.

Based on this examination, we have not identified potential market failures in respect of willingness to pay for the spectrum compared to the total economic value that could be generated from the different uses of the digital dividend spectrum. However, the award process will require careful design in order to ensure that the market is able to benefit from any pan-European allocations/harmonisation of the spectrum for particular services (e.g. creation of an sub-band for use of mobile/wireless broadband services).

In summary, we conclude that:

- The 272MHz[8] of digital dividend spectrum that has already been made available for broadcasting services should continue to be allocated to DTT, in light of the economic benefits arising from having a DTT service that provides competition to other television platforms (in particular, cable), which we expect will result in lower prices for television services.

- The additional spectrum[9] that will become available from 2012 should be awarded using market mechanisms in line with the Ministry's general approach to spectrum awards, since there is no definitive economic case for awarding the spectrum to any particular service, and we have not identified any particular market failure issues that might arise from such an award.

8 Corresponding to 34 channels which, when used for DTT, allow for five, nationwide multiplexes.

9 Corresponding to 11 channels: 36, 40, 46, 49, 51, 53, 61, 62, 67, 68, 69; when used for DTT, this allows the creation of two additional nationwide multiplexes, using the full 11 channels (88MHz); when used for wireless broadband, it enables the creation of approximately of 2×30MHz of spectrum, after accounting for a 12MHz guard-band (i.e. a useful 60MHz out of a 72MHz total).

2 Introduction

2.1 Context

Analysys Mason Ltd (‘Analysys Mason’) has prepared this report for the Ministry of Economic Affairs of the Netherlands (‘the Ministry’), in order :

- identify potential uses for the digital dividend spectrum
- estimate the economic value and limitations associated with the potential uses of all or part of the ‘digital dividend’ spectrum released by the switchover from analogue to digital TV broadcasting.

In December 2006, analogue television signals were turned off in the Netherlands – earlier than in most other European countries. At the time of the switchover to digital TV (DSO), only an estimated 30 000 households were solely dependent on terrestrial transmission to receive television,[10] with the vast majority of households connected to one of the cable networks accessible to virtually every household.

Since the switchover, digital terrestrial television (DTT) has been available on the spectrum formerly used by analogue broadcasting in the UHF band (470–862MHz) using the DVB-T standard. Two broadcasters have been allocated spectrum to operate DTT multiplexes until 2017: NOS, the national public service broadcaster, and Digitenne, now owned by KPN, the fixed incumbent operator. Both broadcasters make use of the same network, operated by KPN Broadcast, which also operates a mobile TV services using the DVB-H standard.

One consequence of the switchover to digital TV has been to enable terrestrial television to compete in the multi-channel space, where initially, cable and satellite were the only options available to consumers. Instead of the three, national channels once broadcast on analogue TV, terrestrial viewers now have access to a total of 25 channels. Although this falls short of the 60+ channels available on cable and satellite, it does provide a viable alternative to a fair proportion of households, as shown by the fact that there are now over 500 000 TV sets connected to the DTT networks.

In parallel to the DSO, the government of the Netherlands finalised bilateral agreements with neighbouring countries during the Regional Radiocommunication Conference held in 2006, in Geneva (RRC-06). This agreement will also enable additional spectrum to become available for use in the Netherlands in 2012, after neighbouring countries have switched off their analogue signals. This will provide enough spectrum to create two multiplexes[11] for digital terrestrial

[10] At the point of DSO, in December 2006, the Ministry estimates that a total of 128 000 households were receiving analogue TV, of which about 30 000 were solely dependent on this platform.

[11] Some re-negotiations are required to achieve full coverage with the second additional multiplex; alternatively, this could be used for additional mobile TV channels, which may not need full population coverage.

broadcasting, or to make a sub-band available for telecoms services, and in particular, wireless broadband access.

2.2 Objectives of the study

The term 'digital dividend' remains subject to interpretation, but the common definition, suggested by the European Commission and developed in Section 3.1 of this report, is as follows:

> The digital dividend can be described as the spectrum over and above the frequencies required to support existing broadcasting services in a fully digital environment, including current public service obligations.[12]

This arises because digital transmission is more efficient than analogue. Six to eight digital television channels can be transmitted using the same amount of spectrum previously required for one analogue TV channel.

In the context of the Netherlands, the digital dividend would therefore include the spectrum released by switching the three, national public service broadcasting (PSB) channels, as well as existing regional broadcast channels, over to digital. This requires one multiplex. Consequently, the digital dividend would consist of the spectrum associated with the equivalent of four multiplexes from 2007 to 2012, then the equivalent of six multiplexes from 2012 onwards.

This spectrum is acknowledged to be some of the most valuable, combining far-reaching coverage, good in-building penetration and sufficiently high capacity to provide a wide range of uses and applications (see Section 3).

The Ministry of Economic Affairs will need to consider what uses to allow in the digital dividend spectrum, and how to award the spectrum. As a general policy, the government of the Netherlands re-allocates spectrum on a service and technology-neutral approach, using market mechanisms (for instance auction) aimed at maximising allocative efficiency and creating economic value, furthering competition and allowing bidders to decide the size of the bands they purchase as far as possible.[13]

At a high level, the objectives of this study are to:

- identify potential uses of the spectrum
- identify any reasons why a standard, market-based approach may not be appropriate.

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12 *Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover*, Commission of the European Communities, COM(2007) 700 final, 13 November 2007.

13 *Radio Spectrum Policy Memorandum 2005*, Ministry of Economic Affairs, 2005.

Market failures may arise as a result of an auction if the willingness to pay for the spectrum of different bidders was such as to result in a suboptimal allocation from the perspective of competition and economic value. One issue which is quite prominent in the Netherlands is the historical pre-eminence of cable TV, and the impact DTT may have on cable TV pricing in future.

In view of this, our approach has been to identify potential uses and quantify the economic value of spectrum (both to the economy as a whole and to potential users of spectrum), including consideration of the potential impact that the digital dividend spectrum may have on the future pricing of TV services.

Alternative uses (scenarios) are described in detail in Section 4. We have quantitatively assessed the difference in consumer and producer surplus (together constituting private value) between the two scenarios by quantifying the changes in consumer and producer surplus in each (Section 5). This is complemented with a qualitative analysis of the changes in the competitive dynamics that are likely to occur, as well as the potential negative impact (additional costs) linked to interference between wireless broadband services and DTT.

Finally, we have considered whether leaving the allocation of spectrum to market forces may result in market failures (Section 6), as a way to inform future policy decisions as regards the release and allocation of the additional digital dividend spectrum available in 2012.

2.3 This document

This document is the final report summarising the study conducted by Analysys Mason for the Ministry of Economic Affairs of the Netherlands in June and July 2008. The remainder of this report is structured as follows:

- Section 3 defines the term ‘digital dividend’ in the international and Dutch-specific contexts, and presents a number of different uses that can be made of this spectrum.
- Section 4 describes in detail the two scenarios we have developed to assess the impact of allocating some of the digital dividend to telecoms services rather than terrestrial broadcasting.
- Section 5 details the approach we have used for the economic valuation of these two scenarios and summarises the potential impact of both scenarios on television broadcasting.
- Section 6 draws conclusions from the study, including those relating to potential sources of market failures if the future allocation of the additional digital dividend spectrum freed in 2012 were to be left to market forces.

3 The digital dividend and its potential uses

This section defines the digital dividend in the Netherlands and provides an overview of the ways in which it might be used.

Part of the digital dividend as defined in Section 3.1 is already used by digital terrestrial television; this has resulted in changes to television markets in the Netherlands. These changes, described in Section 3.3, form an important setting to the development of the scenarios in Section 4.

3.1 Definition of the digital dividend in the Netherlands

As part of the transition to digital terrestrial broadcasting to be completed in 2012, EU countries will have the historic opportunity to release and reuse a large amount of spectrum in the UHF bands IV and V (470–862MHz), where analogue, terrestrial television signals were historically broadcast. This spectrum is widely regarded as some of the most valuable in the airwaves, because of the combination of wide propagation properties and high capacity.

The European Commission has identified[14] that the digital dividend should refer to all additional spectrum that is released as a result of migrating only the existing analogue TV channels to digital. This arises because digital transmission is more efficient: potentially six to eight digital television channels can be transmitted using the spectrum previously required for one analogue TV channel.

In the Netherlands, there were historically three analogue channels, operated by NOS, the public service broadcaster (PSB), as well as regional channels. These would fit into one DTT multiplex. The digital dividend, therefore, could be defined as all the available frequencies within the 470–862MHz band, except for one multiplex.

The situation in the Netherlands differs from most other EU countries since the switchover to digital terrestrial television (DTT) and the shutdown of the analogue signal has already occurred (in December 2006). As of July 2008, there were a total of five digital multiplexes operating in the Netherlands. Of these five multiplexes, one is assigned to NOS and the remaining four to Digitenne, now part of KPN Broadcast. All assignments run until at least 2017.

Following the definition of the digital dividend favoured by the European Commission, it is therefore the case in the Netherlands that part of the digital dividend is already used by DTT services, in the form of the four multiplexes assigned to Digitenne.

In 2012, when countries neighbouring the Netherlands complete their switchovers and cease analogue broadcast, additional frequencies will become available. This follows a plan drawn

[14] See for instance *Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover*, Commission of the European Communities, COM(2007) 700 final, 13 November 2007.

during the Regional Radiocommunications Conference of 2006 ('RRC-06'), which is shown in Figure 3.1 below. As can be seen in that figure, channel 38 is reserved for radio-astronomy (and is therefore not available to other potential uses) and channel 63 has been designed as the nationwide channel for programme making and special events, including wireless microphones (although users are currently scattered across the whole band).

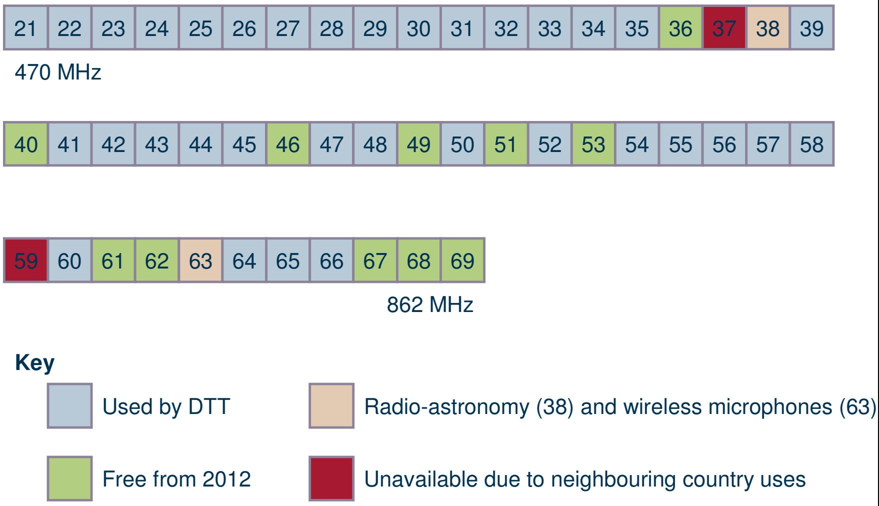

Figure 3.1: UHF band IV and V in the Netherlands, before and after 2012 [Source: Ministry of Economic Affairs, Analysys Mason]

These frequencies could be used to generate two further DTT multiplexes, after re-negotiations under the provisions of RRC-06 in order to enable full national coverage.[15] However, the UHF spectrum forming the digital dividend would also be of interest to other users of spectrum for alternative uses, which may require a re-arrangement of the existing DTT allotments.

This study focuses on alternative uses of the additional spectrum that will become available in 2012.

3.2 Potential uses of the digital dividend

There are a number of ways in which the digital dividend spectrum could be used. For each of these, this section presents:

- a brief description, including a description of likely business models, including the products and services that the candidate technology could potentially support
- identification of the frequencies within the UHF band that are potentially applicable
- alternative ways to provide these same products and services, for example, using different frequency bands, and the impact on costs.

15 Under RRC-06 initial plans, one of the additional multiplexes may not have full national coverage. We understand that solutions to this issue are being studied, including slightly more complex allotments or some degree of re-negotiations under the RRC-06 rules.

The main uses that we have identified are:

- broadcasting services, both to a fixed location and to mobile terminals
- wireless broadband services
- existing low-power uses, including wireless microphones, programme-making and special events
- licence-exempt services.

3.2.1 Broadcasting services

These services aim at delivering one-way, point-to-multipoint television services at a fixed location (DTT) or in a mobility situation (mobile TV).

Additional DTT multiplexes

Description of likely business models, products and services

One potential use of the spectrum that will be made available by the ASO in bordering countries is for the deployment of two additional multiplexes that can be used to provide additional standard- or high-definition television (HDTV) channels. Additional channels would increase the relative attractiveness of the DTT platform in the Netherlands, compared with alternative platforms, such as cable and satellite.

The business model for these services is one where a standalone broadcasting network provides transmission services to holders of multiplex licences. In the Netherlands, KPN owns the network operator (KPN Broadcast) as well as the commercial multiplex operator, Digitenne.

If more spectrum is available for additional SDTV channels and HDTV, a balance will need to be found between the two alternative uses.

- HDTV requires twice the capacity of a standard definition channel, which means that one multiplex can only carry three to four HDTV channels (using MPEG-4 compression technology). This may be an issue because of the relative scarcity of spectrum in the Netherlands.

Alternatively, it would be possible for the DTT operators to broadcast additional channels (five to six using the current MPEG2 technology and seven to eight using the MPEG4 standard). This would enable the DTT platform to compete more effectively with cable and satellite, although from a consumer perspective, the value associated with these additional channels is likely to be relatively low.

In addition, the evolution of digital terrestrial broadcasting to the upcoming DVB-T2 standard, still under development, is expected to enable a 30% increase in the capacity of a DTT multiplex. Unlike MPEG-4, which can be used jointly with MPEG-2 on a given multiplex, DVB-T2 requires whole multiplexes to be converted from DVB-T.

Digital dividend spectrum could be used to offer digital terrestrial television targeted at local communities. In addition, studies have shown that local channels can usually be accommodated within 'interleaved' spectrum, unused spectrum where a frequency used by a transmitter in one part of the country is effectively unoccupied outside the range of that transmitter in another part of the country. Finally, although local television channels are key for diversity, it is very difficult to estimate their value for consumers.

Frequencies applicable within UHF

Frequencies available for DTT multiplexes in the Netherlands have been fully defined during RRC-06. Further discussions may occur between the Netherlands and its neighbours on a bilateral basis in relation to use of individual frequencies under the terms of the RRC-06 agreement.

Alternative frequency bands and delivery platforms for these services

It is difficult to use other frequency bands (i.e. outside the UHF band) for providing broadcast terrestrial television services because existing consumer equipment (e.g. aerials, set-top boxes) only work within the UHF band, and higher frequency bands would require additional TV transmitters to be deployed. This consumer equipment consideration is less of an issue in the Netherlands because most aerials are indoors. Users will need new set-top boxes for HDTV.

Mobile TV

Description of likely business models, products and services supported

KPN is currently broadcasting mobile TV using spectrum associated with one of the digital multiplexes assigned to Digitenne. This service uses the DVB-H standard and was commercially launched on 5 June 2008.

The key business models that may develop from the current situation include:

- Integrated retailer business model – with either an independent retailer (e.g. existing broadcaster network provider) or services provided by one mobile operator directly to consumers.

- Wholesaler business model – with either an independent wholesaler (e.g. existing broadcaster network provider) or services provided by one mobile operator to its competitors.

- Mobile TV network jointly owned by mobile operators – with the mobile operators establishing a joint venture to deploy and operate a single network.

Additional spectrum could be used by existing mobile TV providers to offer a wider selection of channels. There could also be some value, from the perspective of competition, for instance, to launch a second network or use an additional multiplex to increase the number of broadcast channels.

Alternative technologies such as DMB and MediaFLO could also potentially use this band. DMB builds on the Digital Audio Broadcast (DAB) standard developed for radio, and could be an alternative to DVB-H for the broadcasting of a significant number of TV channels to mobile devices. MediaFLO is Qualcomm's proprietary technology. Following trials, Qualcomm claims that MediaFLO can either offer more channels in the same spectrum (e.g. 30 compared to 15–20, with DVB-H in a 8MHz channel) or can offer an equivalent number of channels using less spectrum than DVB-H.

In March 2008, the EC formally endorsed DVB-H as the preferred European standard for broadcast mobile TV, and is urging its 27 member states to adopt DVB-H instead of other broadcasting technologies.

Frequencies applicable within UHF

Dedicated, broadcast mobile TV networks (e.g. based on the DVB-H standard) would benefit from the balance between range of coverage and antenna size provided by UHF frequencies, compared to most alternative proposed frequency bands (e.g. L-Band). For this reason, the UHF band is regarded as the most interesting frequency range for the deployment of broadcast mobile TV networks.

In order to ensure sufficient separation with GSM in the 900MHz band, mobile TV providers typically prefer frequencies in the low to middle part of the band. In any event, this is only a minor issue, as it simply prevents use of mobile TV and GSM at same time on a given handset.

Alternative frequency bands and delivery platforms for these services

The main alternatives to using UHF spectrum for mobile TV are Band-III and L-Band. Two multiplexes (one in the Band III, one in L-Band) should be auctioned in the coming months. This auction will be technology neutral. The upcoming Band-III auction would not release sufficient spectrum to enable all technologies to operate in this band (e.g. DVB-H requires a minimum 5MHz channel bandwidth).

The other alternative is to use 3G spectrum (2GHz or 2.6GHz) to deploy any of the broadcast mobile TV technologies described above or MBMS. MBMS enables a 3G operator to transmit the same video (or other data) to all users in a particular coverage area, from a single cell to the entire network. Operators can allocate one or more channels of 64kbit/s, 128kbit/s or 256kbit/s within each cell to broadcasting or multicast purposes. The capacity set aside in the cell for MBMS cannot then be used for other purposes, such as voice telephony or other point-to-point services.

There is also the possibility to continue using the existing point-to-point, on-demand technology (unicast), as provided by Vodafone. It will, nonetheless, remain an inferior quality to broadcasting.

3.2.2 Wireless broadband services

Description of likely business models, products and services

As mobile communications technology evolves, more and more bandwidth can be made available to mobile users for broadband services, provided that sufficient spectrum is available.

Terrestrial wireless operators argue that frequencies in the UHF band are ideally suited to deploy cellular networks, particularly for enabling 3G networks and wireless broadband networks (e.g. based on WiMAX or LTE) to be deployed in less-populated areas.

According to the WiMAX Forum, an entity formed to promote the standard, WiMAX is "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL".[16]. Microprocessor firm, Intel, is a leading proponent of WiMAX. Although WiMAX offers both time division duplex TDD and frequency division duplex (FDD) profiles, the most likely deployment will use TDD (which requires unpaired spectrum).[17]

LTE (Long-Term Evolution) is an evolution of the international 3GPP project aiming at improving the current UMTS standard. Its goals are to increase spectral efficiency, lower costs, improve services and use of refarmed spectrum opportunities, and to integrate better with other open standards. Although LTE will also offer TDD and FDD profiles, it will most likely be deployed using FDD, which requires paired spectrum. LTE delivers better performance with large channel bandwidths, and is expected to be deployed by mobile operators as an overlay to their existing 3G networks.

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16 http://www.wimaxforum.org/technology/

17 At this stage, all the WiMAX mobile profiles use TDD.

Digital dividend spectrum could therefore play a key role in bringing mobile broadband services to rural areas and to other households that are not served by other wireline broadband technologies (currently 5% of the population) or will not be covered by fibre. Above all, this new spectrum will increase competition, as it will enable fast data rates over wireless to be delivered to less-densely populated areas, as well as provide better indoor coverage than spectrum in the 2.6GHz band.

Frequencies applicable within UHF

The 2007 World Radiocommunication Conference (WRC-07) identified a sub-band between 790MHz and 862MHz as appropriate for electronic communication services.

The potential use of this sub-band and how it will be allocated is still under discussion, and work is ongoing in CEPT ECC Project Team 1. The proposed allocation suggested by the WRC-07 is illustrated below.

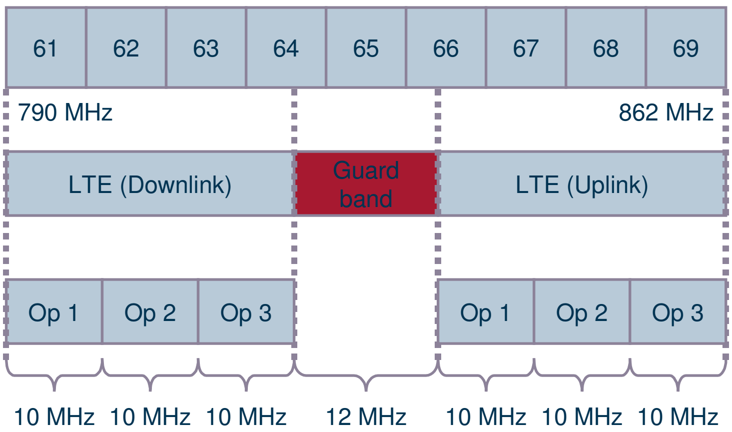

Figure 3.2: WRC-07 identification of the sub-band [Source: CEPT, Analysys Mason]

Alternative frequency bands and delivery platforms for these services

In urban areas, wireless broadband services can be provided using a variety of frequency bands. Most of these are in use for existing cellular services, which are likely to continue operating in the foreseeable future, but some of the 190MHz of spectrum in the 2.6GHz band to be auctioned in late-2008 would certainly provide an alternative medium to UHF.

In the most remote rural areas of the Netherlands, it may be uneconomical to use higher frequencies (such as the 2.6GHz band soon to be auctioned in the Netherlands), as these areas would require several times the number of base stations to achieve a similar coverage. Additionally, the UHF spectrum is expected to provide better indoor coverage than spectrum in the 2.6GHz band.

The 900MHz spectrum, currently used for GSM, may be refarmed and used for 3G services, particularly in rural areas. For LTE, however, operators are likely to need more bandwidth.

3.2.3 Other uses of the digital dividend spectrum

Existing low-power uses, including wireless microphones

Description of likely business models, products and services	The many uses of low-power applications include wireless radio microphones, in-ear monitors and audio links that support theatre productions, radio/television broadcasts and other events (ranging from major music concerts to church services).
Frequencies applicable within UHF	During the Regional Radiocommunication Conference in 2006 ('RRC-06'), channel 63 of the band was designated as a nationwide channel for low power uses such as wireless microphones. Despite this, users of low-power applications (such as wireless microphones) are scattered across the whole band, making use of interleaved spectrum in many areas. These users are also able to interleave with DTT in other parts of the UHF spectrum.
Alternative frequency bands and delivery platforms for these services	In the case where the 790–862MHz sub-band is used for telecoms services, users of low-power applications (such as wireless microphones) may be able to use channel 40 on a nationwide basis. It may also be possible for them to interleave with other users, but sharing with 'high-density' systems (such as cellular) is not considered feasible. Regardless, some users of low-power applications may require new equipment. For the purpose of this study, we have assumed that users will continue to make use of the interleaved spectrum in the part of the band used for DTT; we have therefore not considered this use further in the scenarios described in Section 4.

Licence-exempt services

Description of likely business models, products and services	The digital dividend spectrum could be made available for a number of licence-exempt services, including: wireless 'last-metre' applications (such as home networks), safety-of-life applications, 'intelligent' highways, automated buildings, medical sensors, etc.

Frequencies applicable within UHF	License exempt stakeholders claim that they could use UHF spectrum with a power limit of around 100mW in order to limit interference. There is a possibility for theses services to use interleaved spectrum.
Alternative frequency bands and delivery platforms for these services	There may be alternative licence exempt bands, and there will be scope for use in interleaved spectrum. It may also be possible for licence-exempt services to use 'detect and avoid' (cognitive radio) techniques to share frequencies with other uses in the future.

3.3 Changes in TV markets since the introduction of digital terrestrial broadcasting

The television market in the Netherlands, and in particular, pay TV, presents some differences with many other European market, due to the historical predominance of cable access television (CATV). Since digitisation, the terrestrial broadcasting platform has achieved a considerable increase in subscriber take-up. Consequently, understanding the recent market dynamics presented in this section are important as a basis to understand likely future developments.

Market overview

In the last few years, growth in the number of households has been slowing, reaching 7.2 million in 2007. In the meantime, the number of pay TV subscriptions has been growing steadily, surpassing the number of TV households in the country (7.041 million against 7.037 million) in 2006. At present, the potential for growth lies in households with multiple TV sets and premium content that may require more than one subscription per household.

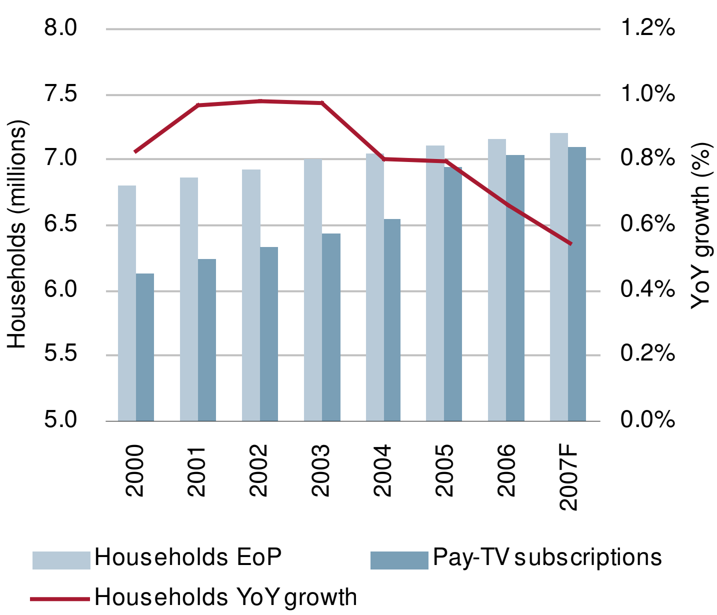

Figure 3.3: Households and pay TV subscriptions evolution [Source: Euromonitor, ScreenDigest, Analysys Mason]

Historically, the Dutch TV market has been dominated by the cable TV industry. In the past few years though, the situation has begun to change, with alternative platforms gradually increasing their market share (see Figure 3.4 below). The audiovisual landscape has significantly changed following the analogue switch-off in December 2006, when the Netherlands became one of the first countries to complete the transition to digital terrestrial TV (Luxembourg was the first to switch off, in September 2006).

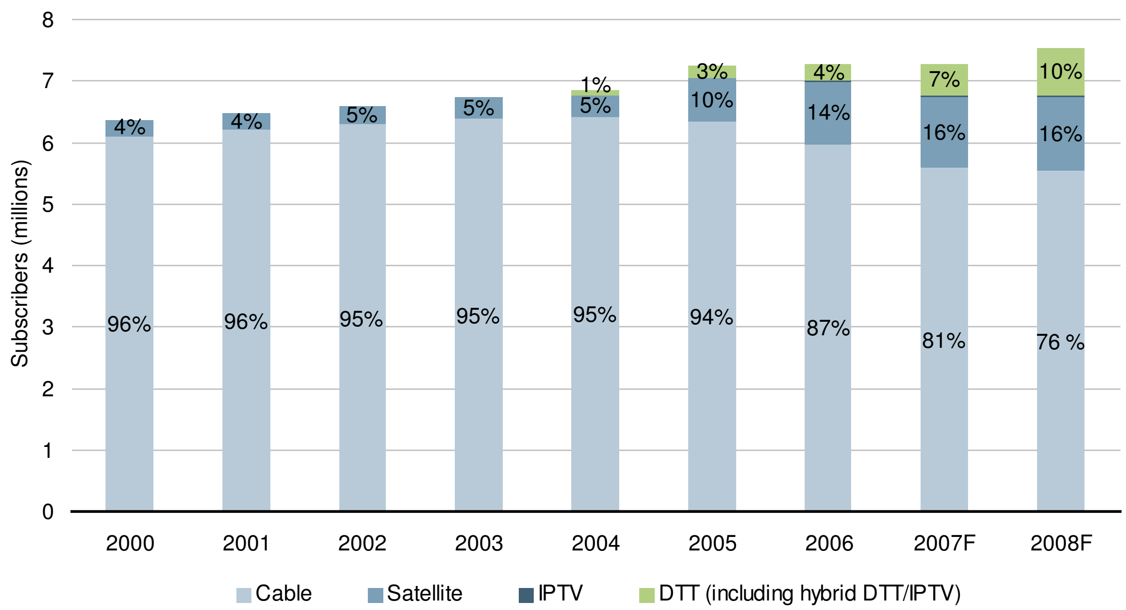

Figure 3.4: *Distribution of pay TV subscriptions [Source: ScreenDigest, Analysys Mason]*

There are three nation public service broadcasting channels (Nederland 1, 2 and 3) operated by NOS. Together they achieved a 35.7% audience share between 6pm and midnight in 2006. Other channels include those operated by RTL Nederland (RTL, RTL4 and RTL5, with a 25.9% audience share) and the channels operated by SBS broadcasting group (SBS6, NET5, Veronica, with a 20.5% audience share).

TV viewing in the Netherlands is concentrated around a relatively few channels. As shown in Figure 3.5 below, in 2006, the four, most-viewed channels had an audience share of 53% between 6pm and midnight and the ten, most-viewed secured a share of as much as 87%.

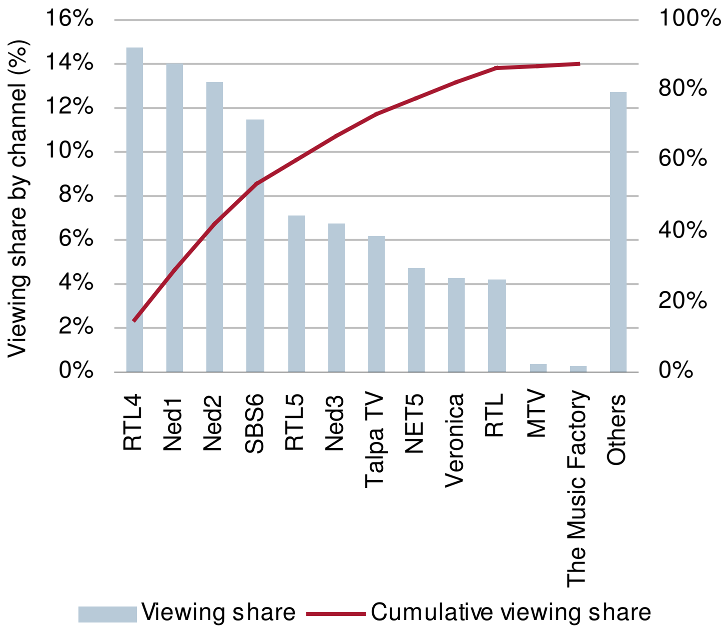

Figure 3.5: Viewing share in the Netherlands between 6pm and midnight for 6+ years [Source: Informa, 2006]

On the financial side, the TV industry remains profitable. Since the household fee for watching TV and listening to the radio was abolished in 2000, public channels have received funds through advertising and public subsidies, the latter accounting for EUR500 million each year. Those revenues enable in-house production for around 70% to 75% of programme content. TV advertising expenditures, which, according to ZenithOptimedia, accounted for EUR866 million in 2007, are still growing steadily and have not been visibly affected by online advertising.

Cable TV has historically been the main TV delivery medium

Cable TV was launched in 1971. Since then, cable TV take-up has included more and more households, reaching a peak of 89% of households in 2003. With a cable subscription in almost every household, the Netherlands is one of the most-cabled countries in the world; in 2006, only South Korea was ahead, with a penetration of 91%.

There are a number of reasons that may explain this significant, continuing adoption of cable. First, with an almost ubiquitous cable network (as of 2006, more than 95% of TV households were passed by a cable network), cable TV is widely available. Secondly, until the launch of DTT, the public broadcaster had only been offering three national terrestrial channels, compared to 32 channels for a standard cable package.[18] This competitive advantage is now partly offset by improved terrestrial and satellite offers, with the latter offering packages to rival cable in breadth of content. Finally, consumers have traditionally perceived cable TV as a public utility. Indeed,

18 This refers to the historical analogue cable packages; basic digital cable packages now offer a minimum of over 60 channels.

several operators past and present (e.g. Essent, Delta) are or were utility companies, offering a range of services such as electricity, gas or water.

Historically, the cable TV industry has been very fragmented, with many local operators. In recent years, however, the industry has been rapidly consolidating, with the latest phase of teaming being the merger of Casema, Essent Kabelkom (@Home) and MultiKabel to form Zesko (brand name Ziggo). This merger was the result of the acquisition of the three cable operators in 2006 by Warburg-Pincus and Cinven (two private equity firms) for a total investment in excess of EUR5 billion. The new entity is now the largest cable operator in the Netherlands, with 54% of the cable TV market (in terms of subscriptions). Zesko and UPC, the second largest cable firm, together represent a cumulated market share of 91% (see Figure 3.6 below).

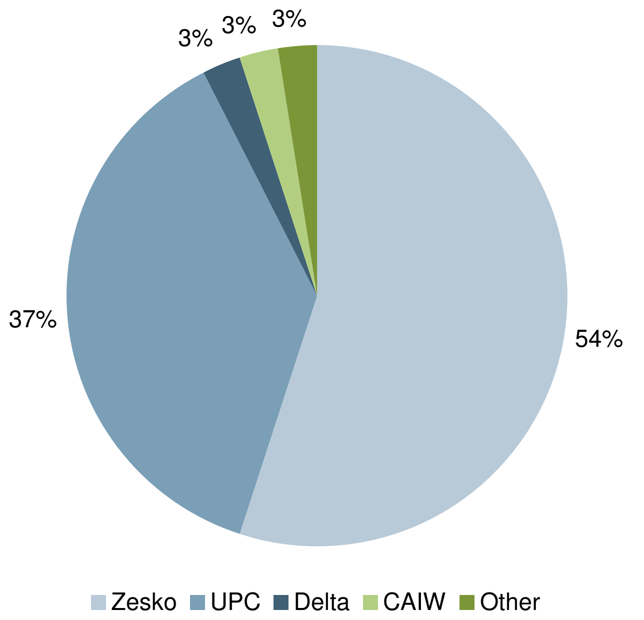

Figure 3.6: Cable TV market concentration in 2007 [Source: OPTA]

This market concentration has been fuelling competition and innovation among cable companies. Cable TV providers are now offering a wide range of services, ranging from telephony (first launched in 1996) and Internet access (since 1999) to digital TV (DVB-C, launched in 2000), as well as high-definition TV channels and VOD (launched respectively in 2006 and 2007). Subscribers are now migrating to digital cable TV, to gain access to more channels and better quality. Internet over cable is losing ground against DSL; whereas cable accounted for about two thirds of all broadband Internet connections in the beginning of the century it now accounts for less than 40%.

In the past few years, satellite, DTT and IPTV have all gained market share. Cable TV remains strong, but attractively priced packages and bundles from alternative providers may continue to harm the cable TV market.

Finally on the regulatory side, all cable companies are expected to offer a minimum of 15 TV programmes of which 6 are 'must-carry' channels; local authorities often increase this minimum to 30. This must-carry obligation is applicable under the terms of the Dutch Media Act and only applies to cable operators. Firms operating other platforms are not required to follow this legislation. As a result of this discrepancy, the European Commission has asked the Netherlands to analyse the potential impact of these obligations on competition. In November 2006, the Dutch parliament also called for obligations to be imposed on the cable industry to allow access to third parties. Recently, OPTA, the electronic communications regulator, announced its intention to force cable operators to offer access to their networks as well wholesale services.

Satellite services are gaining market share

CanalDigitaal, the satellite operator, is a well-established player, having launched in the mid-1990s. Despite this, it has only been gaining significant momentum in the past few years. In 2007, it achieved its best market share to date at 12% (in terms of subscriptions). This progress is mainly due to significant improvements made to programme packages, as well as the transition from analogue to digital terrestrial broadcasting that generated important migration to affordable satellite packages.

CanalDigitaal stands is currently a pure-player in the pay TV market, offering a broad variety of TV packages at comparatively attractive prices. For instance, its Basis package is the most affordable 40+-channel package available (see Figure 3.7 below). New product lines, such as HDTV channels (launched in 2008) and VOD (announced for 2008), are likely to further strengthen CanalDigitaal's position in the market.

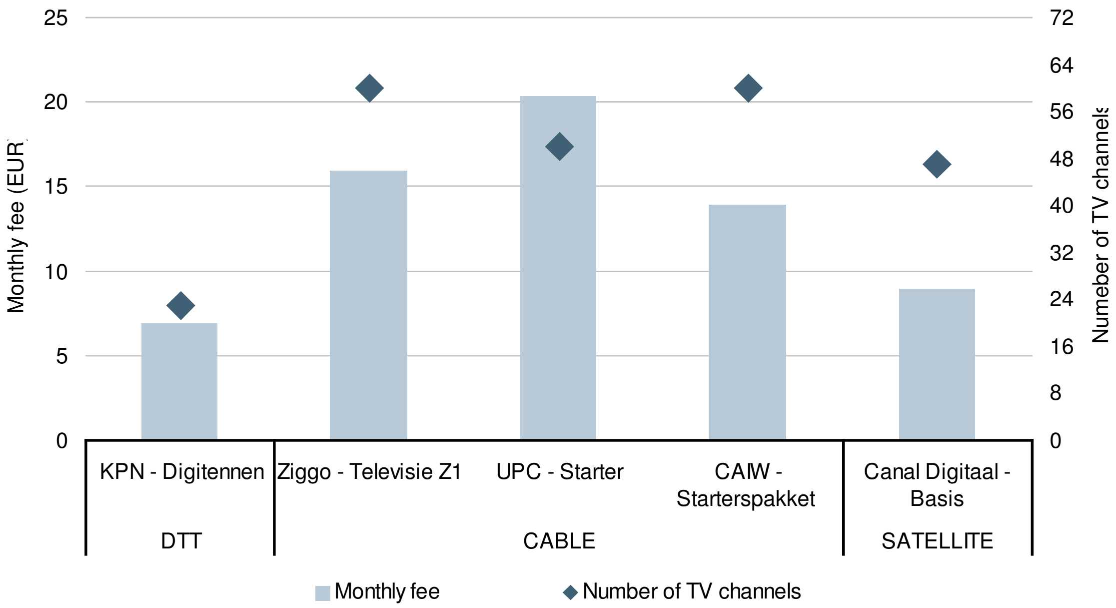

Figure 3.7: Comparison of standard TV packages [Source: Analysys Mason]

The shift to digital broadcasting has increased the attractiveness of terrestrial TV

In December 2006, the Netherlands was one the first countries to switch-off its analogue terrestrial signal that broadcast the three public TV channels.

The transition from analogue to digital began in 2003, with the launch of the first DTT services (using the DVB-T standard) by Digitenne. On the night of 10 December 2006, the analogue signal was turned-off and analogue terrestrial TV viewers had to migrate to one of the four available TV platforms: DTT, cable, IPTV or satellite.

Although DTT offered a significant improvement compared to analogue terrestrial TV, take-up was slow, as the complete roll-out was spread over six years from 2003 to 2008. DTT really took off in 2005, thanks to its increased availability and the addition of new channels, as well as a decrease in price.

Digitenne, controlled by KPN since 2006, offers a 23-channel package for a monthly fee of EUR6.95, which can be enhanced to 25 channels by paying an additional fee for premium channels (e.g. sport). Its subscriber base has been growing rapidly in the last two years, almost doubling from 265 000 in 2006, to 487 000 in 2007. HDTV has not been launched yet.

IPTV take-up remains marginal

IPTV was launched in 2005 by Tele2 (Versatel at the time). KPN, the leading provider of DSL access, followed two years later. So far, IPTV take-up has been quite low, although Tele2's Internet + TV bundle is one of the most attractive bundles available on the market (see Figure 3.8, below.

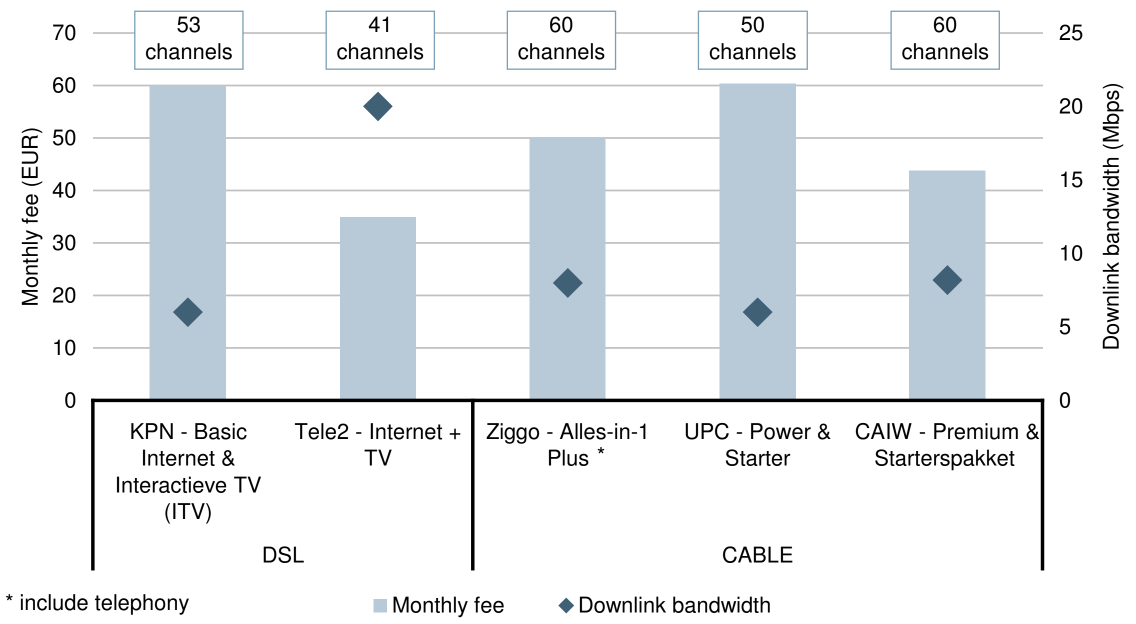

Figure 3.8: Comparison of Internet + TV bundles [Source: Analysys Mason]

The strong penetration of cable TV and satellite explains the lack of interest for IPTV. But with 60% broadband market share as of 2007, DSL operators have a strong position in the pay TV market. With the roll-out by KPN of its all-IP network, and the planned deployment of FTTH and FTTC based on VDSL, KPN is expected to offer bandwidth in the order of 50Mbit/s. Such bandwidth would enable real-time HDTV streaming to all KPN's VDSL subscribers. Consequently, a major driver for IPTV growth will be the rate at which HDTV demand increases. So far, however, HDTV has not gain significant momentum, only a few HD channels are available on cable and satellite platforms and IPTV platforms have not launched such services yet.

4 Scenarios for allocation of the digital dividend

This section outlines two alternative scenarios for the utilisation of the digital dividend spectrum from 2012. These scenarios form the basis for all the subsequent analysis of the consumer surplus (the difference between the value consumers place in a service and the price they pay for it) and the producer surplus (the revenue that a producer gets from a service, minus production costs) that can be derived from using this spectrum. Taken together, consumer and producer surplus form what we have called 'private value'.

4.1 Introduction to the scenarios

From the point of switchover from analogue TV services to DTT in December 2006, five multiplexes have been in operation, one assigned to NOS and four to Digitenne. From 2012, when neighbouring countries are expected to complete their own switchover, 88MHz of spectrum (i.e. 11 channels of 8MHz bandwidth, which would be equivalent to two additional national DTT multiplexes) will become available.[19]

The uses of the channels in the 470–862 band are shown in Figure 4.1:

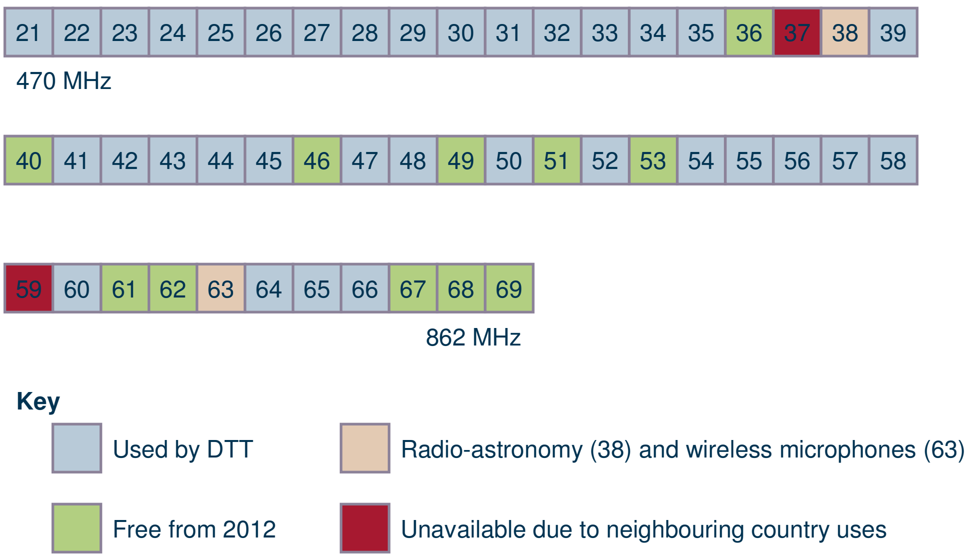

Figure 4.1: UHF band 470-862MHz from 2012 [Source: Analysys Mason, Ministry of Economic Affairs]

[19] Some re-negotiations are required to achieve full coverage with the second additional multiplex; alternatively, this could be used for additional mobile TV channels, which may not need full population coverage.

Theoretically, any of the uses described in Section 3.2 could occupy part or all of the spectrum free from 2012. Some applications, such as wireless broadband, may require some re-arrangement of the band in order to have more contiguous channels available.

There is currently a debate in the industry initiated during the World Radiocommunications Conference in 2007 (WRC-07) which focuses on two particular uses of the UHF spectrum: digital terrestrial broadcasting and wireless broadband services. At the European level, the Commission has already made clear that it wishes to see a coordinated approach between Member States.[20] Additionally, the recent studies conducted by CEPT on behalf of the Commission[21] concluded that the most promising option for harmonisation, from a technical perspective, was to reserve a 72MHz band (790–862MHz) that could be used for wireless communications services.

Consequently, the two scenarios developed for this study focus on the two main alternatives that are likely to face spectrum regulators in the European Union: Scenario 1, where the entirety of the digital dividend is allocated to broadcasting, and Scenario 2, where a 72MHz sub-band is allocated to wireless broadband services. In both scenarios, we have assumed that other uses, such as low-power applications can be expected to continue to be used in interleaved spectrum.

Our general approach is to calculate the incremental value arising from use of the digital dividend spectrum, over and above the next best alternative (e.g. use of an alternative frequency band). In order to quantify the value of each scenario, we have calculated the private value of a hypothetical Scenario 0, representing the situation where the digital dividend spectrum is not allocated to the service under consideration. The value attributable to the digital dividend spectrum in each scenario is the difference between the private value of the scenario under consideration (with digital dividend spectrum) case minus that of Scenario 0 (without digital dividend spectrum).

4.2 Scenario 0: No digital dividend spectrum

Scenario 0 assumes that the digital dividend spectrum is not available for the services considered., In this scenario:

- The DTT platform only supports the three national public service channels and regional channels that were available on analogue TV, over one multiplex. In this case, DTT service take-up remains at broadly similar levels to take-up of analogue TV services and cable remains the main platform for delivering multi-channel television services and its prices are not affected by the DTT platform.
- Wireless broadband services are rolled out using 2.6GHz spectrum.

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20 *Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover*, Commission of the European Communities, COM(2007) 700 final, 13 November 2007

21 *Report from CEPT to the European Commission in response to the Mandate: Technical Considerations Regarding Harmonisation Options For The Digital Dividend*, Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), 27 June 2008.

- Mobile TV services using the UHF spectrum are provided using only the frequencies that form the multiplex available for public service DTT broadcasts.

Service	*Scenario 0 – no digital dividend spectrum*
Digital television – DVB-T	One multiplex available, broadcasting only the three national public service channels Demand remains what it was for analogue TV, i.e. 30 000 households
Mobile TV – DVB-H	Spectrum only available in the UHF band for the current service (one operator, ten channels)
Wireless broadband	Service provided using 2.6GHz spectrum. Population coverage reflects the economics of provision, maximising the return on investment for each operator

Figure 4.2: Scenario 0: summary by service [Source: Analysys Mason]

4.3 Scenario 1: All spectrum is allocated to broadcasting

In this scenario, as in Scenario 2 but unlike in Scenario 0, we are assuming continuation of availability of DTT over the existing five multiplexes.

Under the Scenario 1, the additional frequencies freed from 2012 would be allocated to DVB services, either using DVB-T (DTT standard) or DVB-H (mobile TV standard). This scenario does not require any rearrangement of the band, and therefore, provides for the following allocation of spectrum:

- Channels 21–36, 39–58, 60–62 and 64–69 will be allocated to DVB services, resulting in one multiplex for public service broadcasting and six multiplexes for commercial broadcasting
- Channel 38 will remain allocated to radio-astronomy
- Channel 63 will remain the reserved nationwide channel for wireless microphones, programme making and special events.

In this scenario, DTT take-up is considerably stronger than in Scenario 0 and also above take-up in Scenario 2, below.

In this scenario, additional frequencies will be used for mobile TV services. We have estimated the private value gains that would be realised if this additional spectrum was used to increase the number of channels from 10 currently to 20 in 2012, with only one operator, or if it was used to increase competition by enabling a second operator to provide a competing service.

Wireless broadband services are rolled out using other, higher frequency bands (e.g. 2.6GHz spectrum).

Service	*Scenario 1 – all the digital dividend spectrum is allocated to broadcasting*
Digital television – DVB-T	Six multiplexes available In the long run, 32 standard-definition channels and 8 high-definition channels Demand grows rapidly in line with recent growth, then again after 2012 when more channels become available
Mobile TV – DVB-H	Frequencies available for either: • one operator to extend its offering to 20 channels: demand grows, ARPUs are increased by additional channels from 2012 • another new operator offering 10 channels, with stronger demand and lower prices / ARPUs resulting from an additional operator
Wireless broadband	Service provided using 2.6GHz spectrum Population coverage reflects the economics of provision, maximising the return on investment for each operator

Figure 4.3: Scenario 1: summary by service [Source: Analysys Mason]

4.4 Scenario 2: sharing the digital dividend with next-generation wireless broadband

In Scenario 2, part of the digital dividend is assumed to be allocated to telecommunication services in 2012. The WRC-07 identified the 790–862MHz sub-band (channels 61 to 69) as suitable for mobile services.[22] The digital dividend spectrum can prove to be a very valuable asset for wireless broadband operators, as it provides significantly larger cell radii in rural areas, as well as better in-building penetration.

Although the current DTT allotments make use of part of this sub-band, the Ministry of Economic Affairs has identified a potential reallocation, shown in Figure 4.4, below. The existing five DTT multiplexes would be broadly unchanged, except for RRC-06 layer 1 (Digitenne 1), for which bilateral negotiations with Germany will be required to ensure that population coverage remain unchanged.

22 Final Report from CEPT in response to the EC mandate on WAPECS, January 2008.

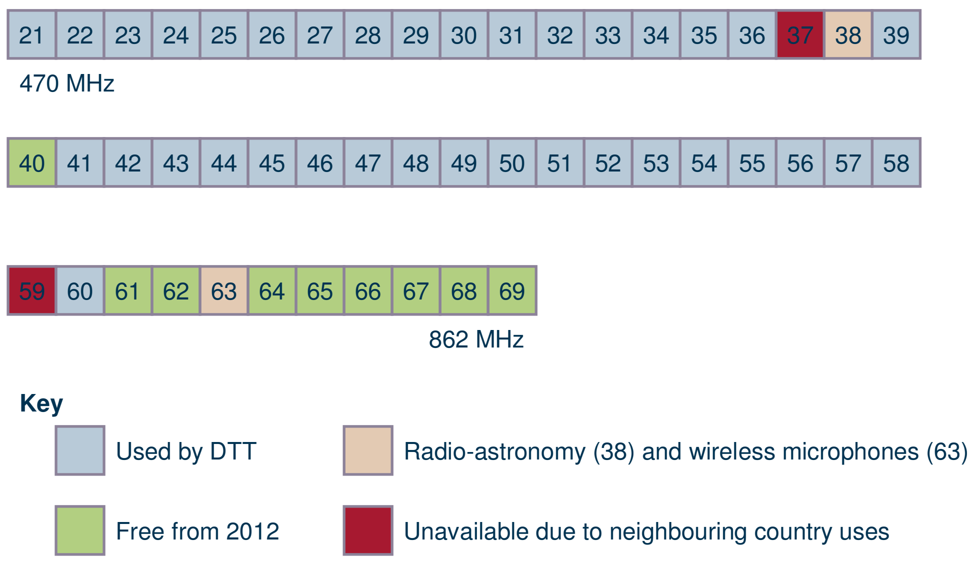

Figure 4.4: Proposed reallocation of spectrum freeing up the 790-862MHz sub-band [Source: Analysys Mason, Ministry of Economic Affairs]

Wireless broadband users could make use of either time division duplex (TDD, for instance WiMAX) or frequency division duplex (FDD, for instance UMTS or LTE) technologies/modes of operation.

- To avoid harmful interference, combining TDD and FDD technologies would require a 10MHz guard band, which appears difficult to put into practice within the sub-band
- FDD technology is currently used by the three mobile operators, and LTE is widely regarded as the natural evolution of 3G technologies in Europe
- TDD technology might be slightly less well-suited than FDD to the large cells that can be achieved with lower frequency spectrum, because of the need to compensate for time delays. Given the relatively even topography of the Netherlands and the importance of in-building coverage, this is likely to be a less important consideration than in other countries.

For the purpose of this scenario, we modelled three assignments of 2×10MHz each, used to provide LTE services nationally by the three existing operators. This would leave a 12MHz guard band, centred on channel 65, between the downlink and uplink spectrum, which is sufficient for LTE (and could potentially be reduced to 8MHz). This is shown in Figure 4.5 below.

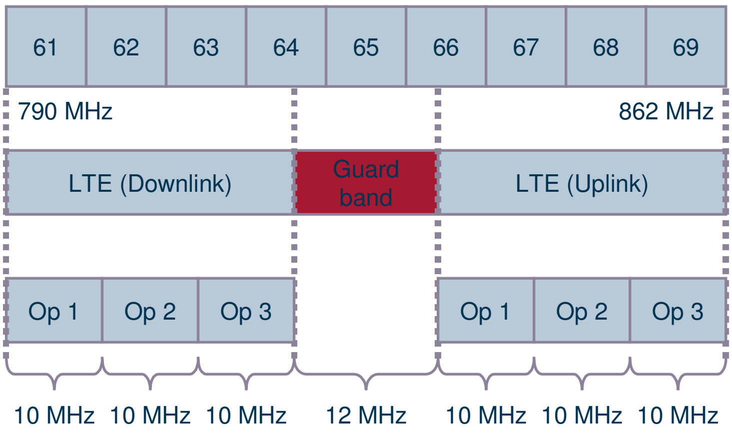

Figure 4.5: Proposed spectrum allocation for telecoms services [Source: Analysys Mason]

Users of low-power applications, such as wireless microphone, currently using channel 63 will have to be relocated to interleaved spectrum and/or a different channel (e.g. channel 40), at a cost which is difficult to quantify without access to targeted primary research, but is likely to be relatively small compared to other costs involved in this scenario.

The use of wireless broadband services in channels 61 and 62 could result in interference on the reception of DTT in channels 59 and 60, resulting in the need for additional in-fill DTT transmitters to be deployed at some wireless broadband sites. We have considered the costs associated with these requirements as part of our economic assessment.

In this scenario, DTT becomes a credible competitor to cable operators in the TV market, but not as strong as in Scenario 1, due to the lower number of channels that it can provide. The number of DTT multiplexes remains at five, with some frequencies used for the current DVB-H service. Compared to Scenario 1, we assume that take-up of DTT will be more limited.

Under this scenario, it may still be possible to deploy a sixth multiplex in a significant area of the country through further reorganising of the frequencies associated with existing multiplexes. In view of the uncertainty over whether such a sixth multiplex is possible, and the extent of coverage that it would offer, we have not considered this as part of Scenario 2. However, we also note that such a sixth multiplex could generate additional economic benefits which we have not quantified under this scenario.

Service	*Scenario 2 – sharing the digital dividend spectrum*
Digital television – DVB-T	Five multiplexes available, of which one is shared with mobile TV In the long run, 32 standard-definition channels and 4 high-definition channels Demand grows rapidly in line with recent growth
Mobile TV – DVB-H	Spectrum only available in the UHF TV band for the current service (one operator, 10 channels)
Wireless broadband	Service provided using a combination of UHF and 2.6GHz spectrum, by all three existing mobile operators Population coverage is increased to reflect more beneficial economics in rural areas

Figure 4.6: Scenario 2: summary by service [Source: Analysys Mason]

5 Estimation of the value of spectrum under each scenario

This section describes the approach taken to estimate the value of the digital dividend under the two scenarios. It also highlights the different components of value that were estimated, some of which are expressed in absolute terms while others can only be considered in contrast to Scenario 0 (no digital dividend spectrum). Finally, Section 5.3 presents the overall, quantitative results of the study.

5.1 Methodology for establishing the value of the digital dividend spectrum

We have followed an incremental approach as part of our methodology, which seeks to answer two questions for each service:

- If a service can only be delivered using UHF spectrum, what is the benefit (and/or cost) to consumers of having access to this service, and to producers of providing this service?
- If a service can be delivered using alternative frequency bands, what is the incremental benefit (and/or cost) to consumers and producers of having a service delivered using the digital dividend spectrum, compared to a situation where this spectrum would not be available?

Private value has been calculated for each service modelled in the scenarios. As mentioned earlier in this report, private value is defined as the sum of consumer and producer surpluses.

- The consumer surplus is defined as the difference between the value consumers place in a product/service and the price the consumers pay for the service. Throughout this document, we sometimes refer to the value a consumers place on the service as the consumers' 'willingness to pay' for the service.
- The producer surplus can be defined as the difference between the revenues that all producers in the market could obtain from producing a given service, minus the costs incurred in doing so (including the cost of capital).

Consumer surplus and producer surplus have been calculated following a simple assessment of the business case for each service, as shown in Figure 5.1.

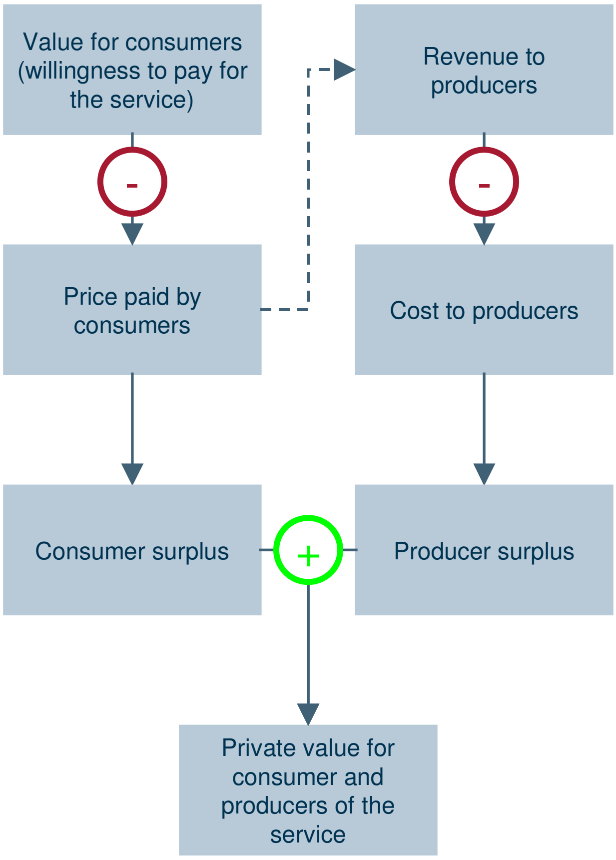

Figure 5.1: Estimating private value for each of the services modelled [Source: Analysys Mason]

In order to estimate the value attributable to the digital dividend spectrum, we have calculated the difference in private value between each of Scenarios 1 and 2 and the case in which the digital dividend spectrum is not available (Scenario 0). For each service, we have also estimated the impact of the case where additional digital dividend spectrum is available on consumers and producers of related services, in particular, on competing services such as cable TV when looking at DTT. Estimating this impact is critical to obtain a fair representation of the value created or destroyed in each scenarios, because they can be very significant. This approach is summarised in Figure 5.2, below.

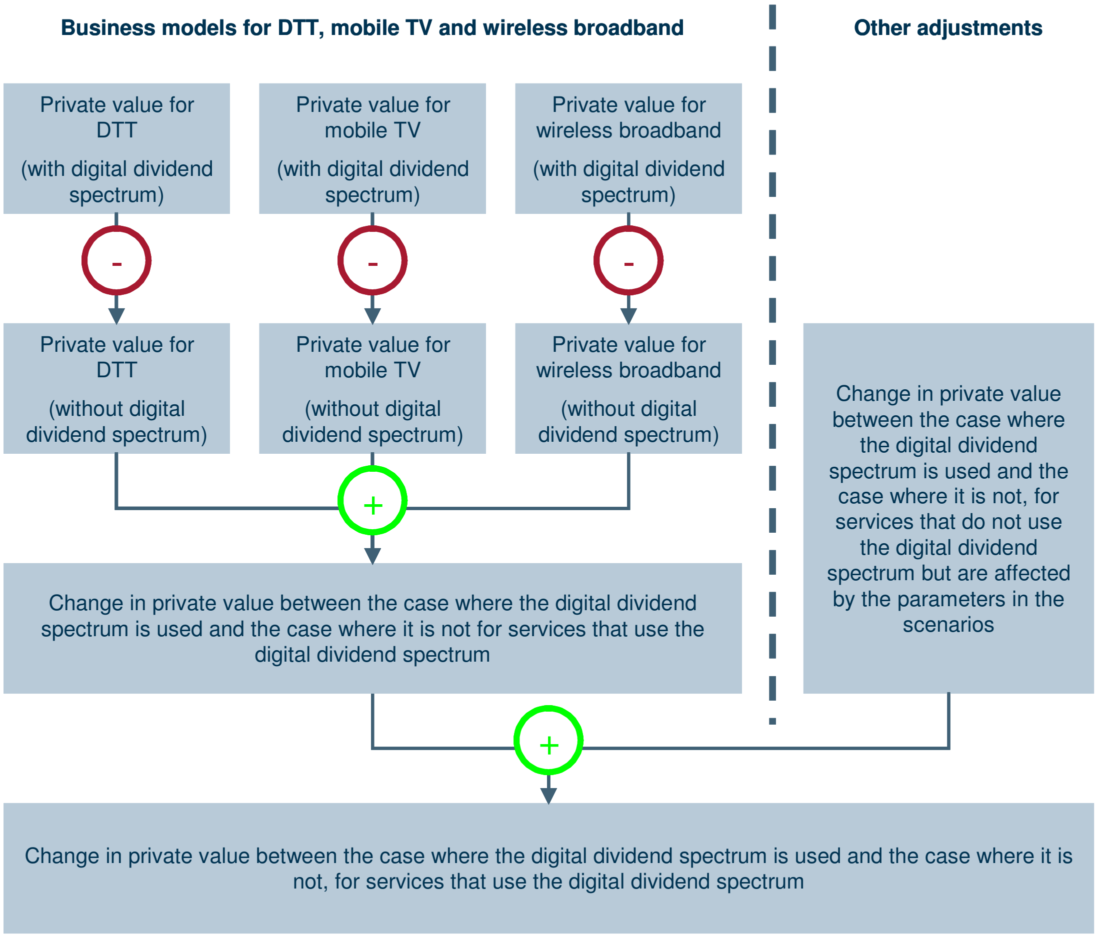

Figure 5.2: *Adjustment to private value due to the impact of each scenario on related and competing products [Source: Analysys Mason]*

We have calculated the change in private value between the different scenario by calculating the net present value of the difference between 2008 and 2026,[23] using a discount rate that has been set to the risk-free rate in the Dutch economy (estimated at inflation + 2% in nominal terms).

For simplicity, we have estimated all amounts exclusive of tax, in nominal terms, although some of the parameters in the business models take explicit account of inflation and value-added tax. When commercial discount rates are applied, for instance, when calculating return on investment and different potential buyers' willingness to pay for spectrum, these are expressed in nominal pre-tax terms.

23 This corresponds to the valuation of licences starting in 2012 and running for 15 years, starting from the perspective of consumers and producers in 2008.

5.2 Components of value

5.2.1 Value to consumers and producers of the services modelled

As indicated above, we have modelled private value by considering both consumer surplus and producer surplus.

These can be illustrated by assuming a simple demand and supply equilibrium, characterised by the current price and demand for a given service, and either a constant elasticity (approach used for the wireless broadband service) or by directly estimating the willingness to pay for the service, which provides the choke price[24] (approach used for the DTT and mobile TV services). This is shown in Figure 5.3.

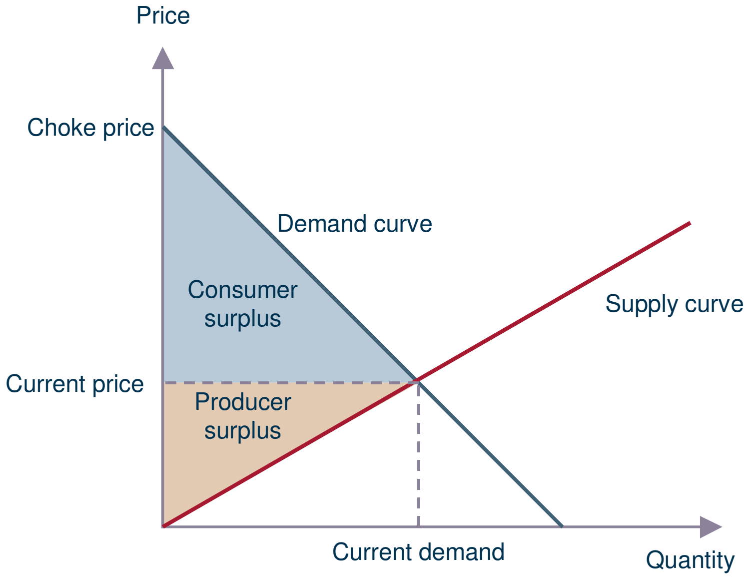

Figure 5.3: Demand and supply equilibrium with a straight-line demand curve [Source: Analysys Mason]

In order to assess the private value created for producers and consumers of a given service, in each scenario, we have developed business models for DTT, mobile TV and wireless broadband.

Digital terrestrial television (DTT)

► *Consumer surplus*

In order to calculate the surplus created for consumers of DTT services, we have estimated the average value that consumers would place on a given package of TV channels, and the prevailing market price.

24 Price above which demand is zero.

The willingness to pay for television services depends on the number of channels available, whether they are received in standard- or high-definition format, and whether they can be described as ‘premium’ channels (typically, channels broadcasting films or premium sports, for which consumers expect and are willing to pay in addition to the basic package).

In the absence of primary research specific to the Netherlands, we have used the results of a study conducted in the UK[25] to estimate the willingness to pay (WTP) for television channels. This has allowed us to generate the curve shown in Figure 5.4 below, for basic channels. This curve was also used to estimate the expected additional value for premium channels.

We recognise that the use of this UK data may not be entirely reflective of the situation in the Netherlands, where consumers have been used to paying for television and to having access to multi-channel packages since the 1970s; however, in the absence of any comparable market data, it does provide a basis upon which to compare the relative attractiveness of different packages.

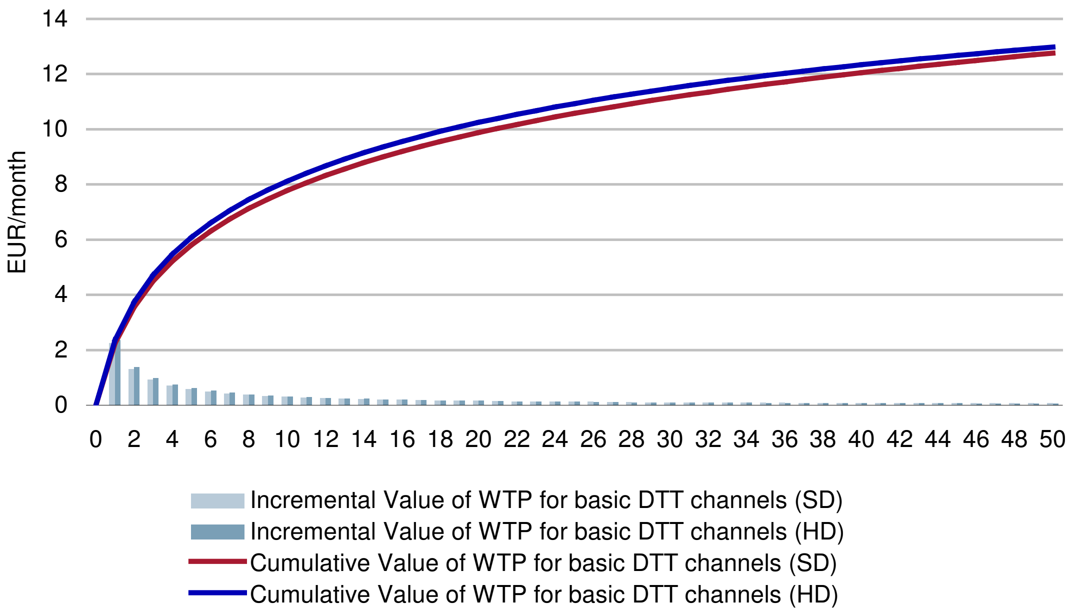

Figure 5.4: Willingness to pay (WTP) for television channels [Source: UK Department for Trade and Industry, Analysys Mason]

Our assumptions on each of these parameters are shown in Figure 5.5 below, and depend on the date and the scenario considered. High-value channels are first converted to high-definition, and we have modelled a transition period during which high-definition channels remain broadcast in standard-definition in parallel (‘simulcast’).

25 *Stated and revealed preference survey of digital television services*, DTI, November 2004.

	Until 2012	*2012–2016*	*After 2016*
Scenario 0 – no digital dividend to broadcasting			
Standard definition channels	3	3	3
High definition channels	-	-	-
Scenario 2 – sharing the digital dividend with next-generation wireless broadband			
Standard definition channels	25	36	32
High definition channels	-	4	4
Scenario 1 – all spectrum to broadcasting			
Standard definition channels	25	36	32
High definition channels	-	4	8

Figure 5.5: Channels shown on the DTT platform, by type [Source: Analysys Mason]

We have projected average prices paid through an estimate of the evolution of the average revenue perceived by pay TV DTT operators in each scenario. This depends on the level of attractiveness of the DTT platform, which, in turn, is a function of the number and type of channels available. In Scenario 0 (no digital dividend spectrum), the public service multiplex is assumed to be available for free.

► *Producer surplus*

In order to calculate the producer surplus on the DTT market, we have modelled an integrated operator, thereby simplifying the value-chain, as shown in Figure 5.6, below. We have modelled a situation where there is only one broadcast network, shared by all the multiplex holders. This is currently the case, with KPN Broadcast providing network services to both its own multiplex operator (Digitenne) and to the public service broadcaster, NOS.

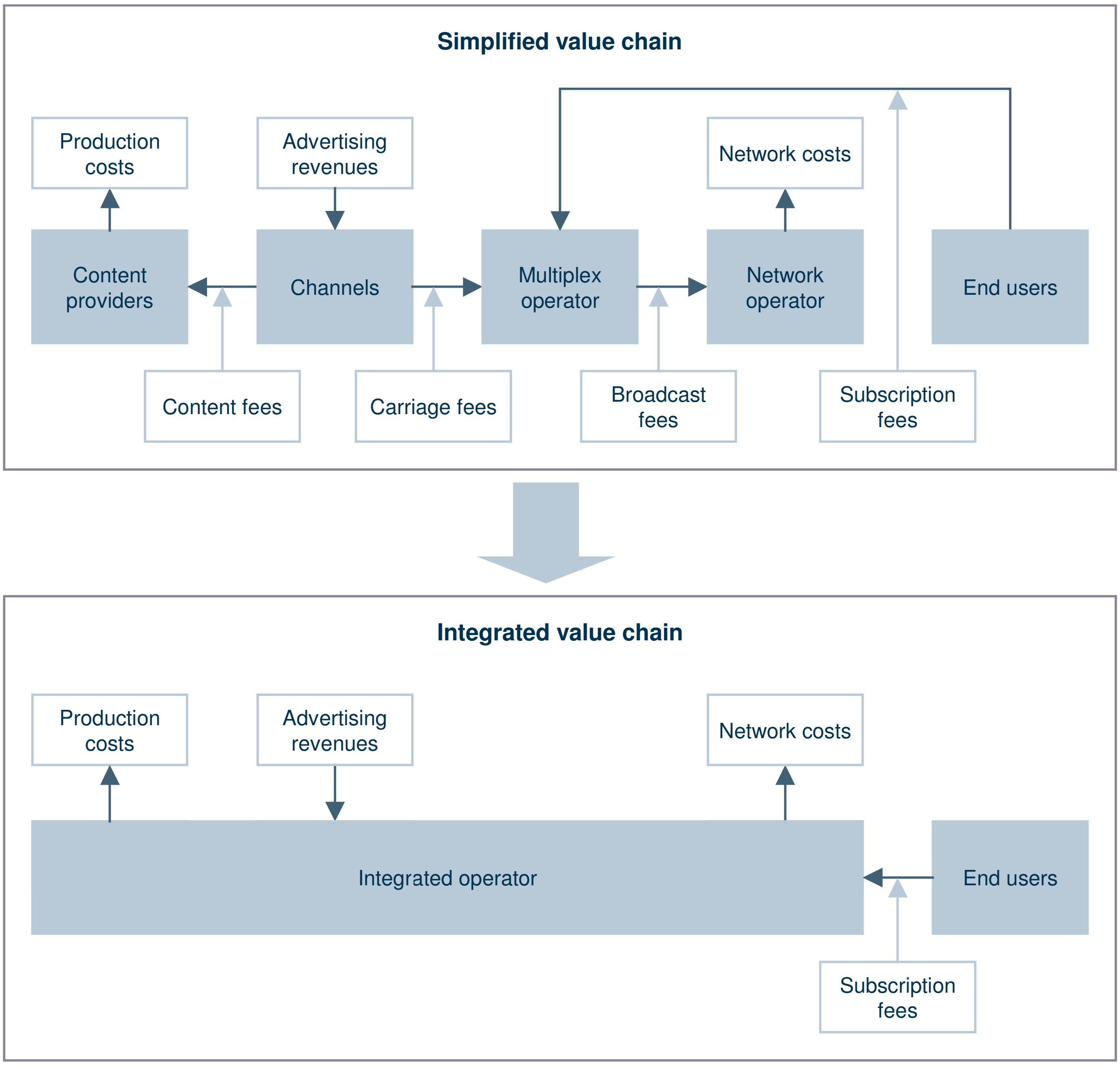

Figure 5.6: *Simplified value-chain for DTT services [Source: Analysys Mason]*

The first component of producer surplus is the revenue collected from subscribers in the form of subscriptions and one-off charges. This is equivalent to the cost of services for users (excluding value-added and sales tax).

Another important source of revenue for the DTT platform is the revenue captured from advertising. As the DTT platform gains market share, advertising spend will be progressively redirected from other platform towards DTT. For the purpose of this study, we have assumed that the total advertising revenue available to TV platforms increases in line with GDP and is then split across all TV platforms as a function of their market share. We therefore assume that the total TV advertising revenue does not vary with the number of competing platforms.

On the cost side, the integrated DTT broadcaster is faced with content costs, modelled as a percentage of revenues and network costs, partly on a per-site basis and partly as a percentage of revenues. Investment costs predominantly relate to building and upgrading sites. In Scenario 2, additional frequency retuning and new site deployment costs must be incurred in order to compensate for the anticipated loss of coverage in the east of the country and mitigate interference caused by the wireless broadband service in channels 61 and 62.

Mobile television (DVB-H)

► *Consumer surplus*

The consumer surplus for mobile TV is calculated using a similar approach as for DTT, using a curve representing the willingness to pay for a given number of channels. This is translated into consumer surplus by netting out the average price that users pay, which is assumed to decrease sufficiently to enable a reasonably significant take-up of the service.

In Scenario 1, we have examined two variants: one where two networks compete, each offering 10 channels, and one where one single network can provide 20 channels. In the first variant, consumer surplus is created through a steeper ARPU decline linked to increased competition. In the second variant, the willingness to pay of subscribers increases when the number of channels available increases.

► *Producer surplus*

The mobile TV operators function under a similar model as the DTT operators. They receive revenues from subscriptions and advertising, and bear costs linked to content acquisition and network deployment and operations.

Advertising revenues are allocated on the basis of the relative viewing time of DTT and mobile TV, and are assumed to partly cannibalise DTT advertising revenues.

On the cost side, we have modelled the DVB-H network as a low-power, low-tower architecture, based on collocation with cellular sites. Consequently, the only investment needed is assumed to be the upgrade of a cellular site to broadcast mobile TV. We have assumed that outdoor coverage is provided to 80% of the country, and that the cell radius for mobile TV transmitters can be larger than the equivalent cellular radius, to reflect a lower quality of indoor penetration. This is evidenced in KPN's current network deployment, as shown on their website. [26]

Other costs modelled include: network opex, subscriber acquisition costs, including handset subsidies, staff costs, marketing and advertising and other general and administrative costs.

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26 http://www.kpn.com/web/show/id=581469 and http://www.kpn.com/web/show/id=581497

Wireless broadband

► *Consumer surplus*

The wireless broadband model considers the business case of an existing 3G operator, upgrading its network to offer very fast mobile Internet access using LTE technology in the 2.6GHz band and, if available, the digital dividend spectrum. From the perspective of such an operator, the business case should be considered as an extension of its existing business, which is assumed to be a nationwide 2G / 3G / HSPA voice and data service, potentially using re-farmed GSM spectrum in the 900MHz band, particularly in rural areas.

Consequently, from a consumer surplus perspective, the important parameter to quantify is the value that users place in very fast broadband compared to the upcoming evolution of the current HSPA technology. Consistent with this approach, we have modelled the premium that users would pay for such a service, over and above the prices for HSPA data services.

One significant difference between the two scenarios is the coverage achieved by the new wireless broadband networks. Our models suggest that in Scenario 1, where the network only uses 2.6GHz spectrum, propagation limitations mean that it becomes uneconomic to cover more than 79% of the population. Conversely, if digital dividend spectrum is available, we have estimated that covering almost 100% of the population would still be economically viable. These coverage

We have estimated the thresholds by identifying the coverage which maximises the net present value of the investment for an operator.

Because of this difference in coverage between the two scenarios, some potential subscribers who would take-up fast wireless broadband services if they were in the coverage area will, if the digital dividend spectrum is not available for wireless broadband, remain HSPA users (Scenarios 0 and 1).

In Scenario 2, the UHF spectrum allows operators to operate with a markedly reduced cost base. Part of these cost savings are assumed to be passed on to consumers via price declines, which, in turn, are assumed to spur demand according to assumptions on elasticity, as shown in Figure 5.7: .

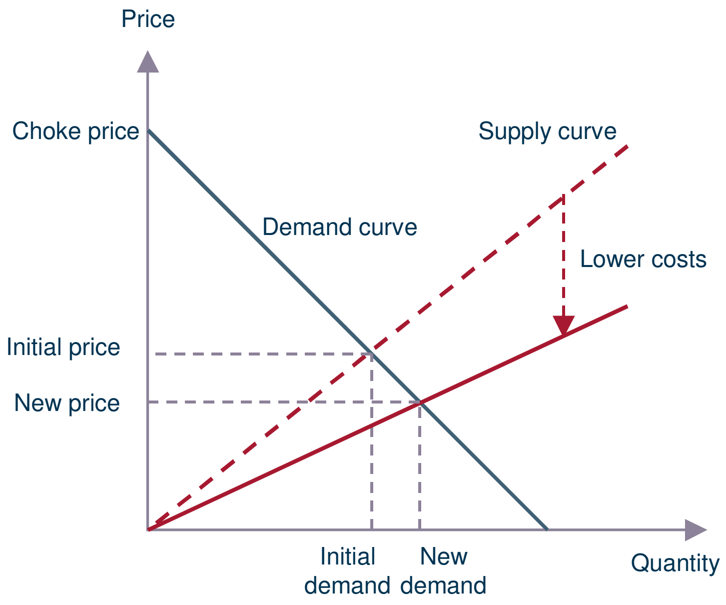

Figure 5.7: Impact on demand of reduced costs past as lower prices [Source: Analysys Mason]

The overall approach to calculating consumer surplus is shown in Figure 5.8 below.

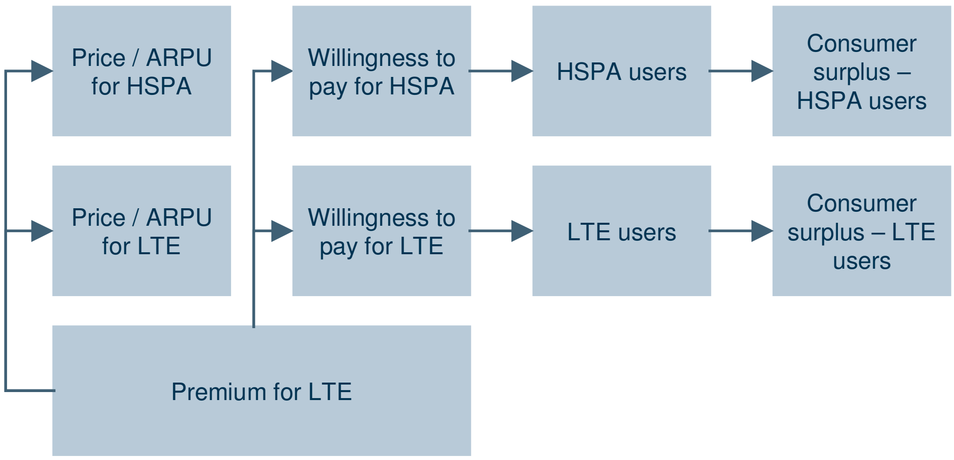

Figure 5.8: *Illustration of the approach to calculating consumer surplus in the wireless broadband model [Source: Analysys Mason]*

► *Producer surplus*

In order to quantify the producer surplus that can be created by allocating some of the digital dividend spectrum to wireless broadband services, we have produced a detailed business model, incremental to the existing business of a cellular operator in the Netherlands. The producer surplus calculated in all scenarios is the incremental surplus that can be obtained by offering wireless broadband services in addition to existing 2G and 3G services.

The revenues considered in the calculation of this producer surplus are purely those incremental to revenues an operator would receive from offering only HSPA, and therefore, reflects the premium paid by subscribers for fast mobile broadband services, over and above the current generation of services.

On the cost side, we have considered in detail the additional costs that will be borne by the operator. These are linked to the investment and maintenance of sites and radio equipment. Whenever possible, costs are minimised by sharing existing infrastructure. In the case where only 2.6GHz spectrum is available to deploy the new network, only 75% of sites can be shared, compared to 95% in the case where UHF spectrum is available.

The larger cells that can be created using the UHF spectrum rather than 2.6GHz result in a cost saving for the operator. These savings are modelled to feed through partly to the producer, and partly through to consumers via a decrease in prices, as described above.

The overall approach to calculating the producer surplus for wireless broadband services is shown in Figure 5.9, below.

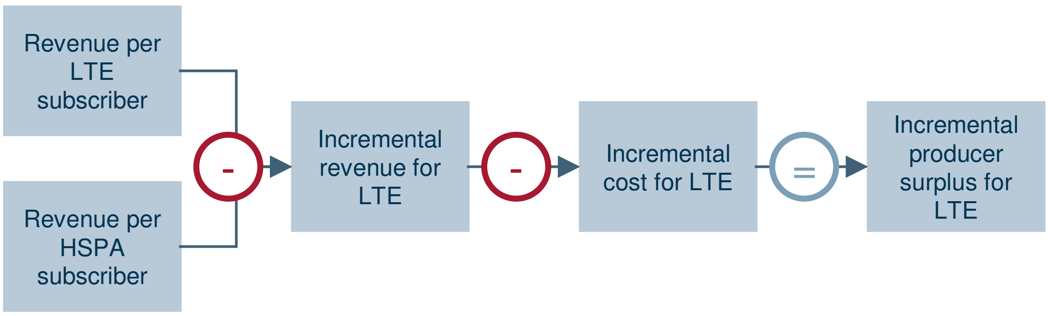

Figure 5.9: Illustration of the incremental approach to calculating producer surplus in the wireless broadband model [Source: Analysys Mason]

5.2.2 Change in private value for producers and consumers of related and competing services

In addition to the change in private value enabled by using the digital dividend spectrum for each of the three services modelled (DTT, mobile TV, wireless broadband), we have estimated the additional impact that the assumptions made in each scenario may have on the broader market in which these services are provided (e.g. competing platforms).

Such adjustments do not apply to mobile TV and wireless broadband, as they would still be provided, albeit with slightly different economics, in the case where the digital dividend spectrum is not available. However, they are crucial to a more detailed understanding of the benefits of the digital dividend for terrestrial broadcasting, since the digital dividend has enabled the creation of a multi-channel terrestrial broadcasting service that competes with the cable providers on a significant part of the TV market.

We have considered the following adjustments in order to correct the change in private value due to DTT in each scenario:

- surplus that consumers switching from cable to DTT would have obtained on cable
- potential surplus that could be created for remaining cable consumers through DTT resulting in lower cable prices
- surplus that cable operators would have derived from users switching to DTT
- potential surplus lost to cable operators if DTT were to result in lower cable prices
- surplus lost to cable operators through DTT capturing part of the advertising market.

Adjustments to consumer surplus

► *Surplus that consumers switching from cable to DTT would have obtained on cable*

In the case where the digital dividend spectrum is not available, the vast majority of DTT subscribers would instead subscribe to a cable TV service. By doing so, they would have created some consumer surplus. This surplus would have been a function of prevailing prices in the cable market in the case where the digital dividend spectrum is not available, and of the value that these users attach to the cable package.

Consumers are assumed to behave rationally. Consequently, people switching from cable to DTT do so because they can increase their consumer surplus by subscribing to the DTT platform rather than to the cable platform. The consequence of this assumption is that the consumer surplus created on the DTT platform is higher than the consumer surplus lost on the cable platform.

► *Potential surplus that is created for remaining cable consumers if DTT were to result in lower cable prices*

We have assumed that, in the case where the digital dividend spectrum is not available, cable prices rise in line with inflation (following recent market trends). In the scenario where the digital dividend spectrum is allocated to broadcasting, it is possible that the DTT platform could result in a reduction in prices by the cable operators if significant numbers of consumers were to consider the DTT platform as a viable alternative to cable TV and be willing to make a full switch to DTT. We have therefore modelled such a reduction in prices on the cable TV platform in this scenario.. In the scenario where some spectrum is allocated to wireless broadband, prices are assumed to remain broadly constant in nominal terms, therefore decreasing in real terms.

The difference between the prices that would have prevailed in the cable market in the case where the digital dividend spectrum is not available (no commercial DTT) and the prices modelled in each of the two scenarios results in a significant increase in the consumer surplus for cable subscribers in the two scenarios where some or all of the digital dividend spectrum is available for DTT, calculated as shown in Figure 5.10.

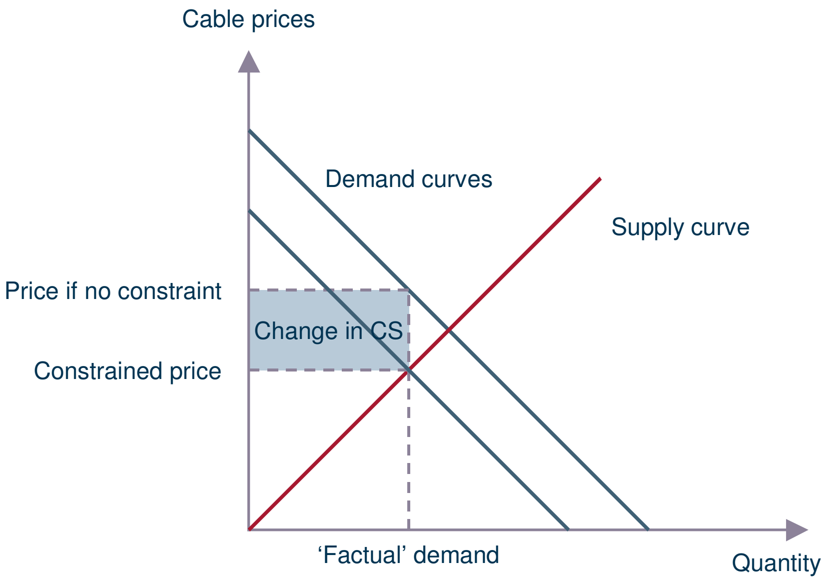

Figure 5.10: Potential change in consumer surplus linked to a reduction in cable prices arising from competition from DTT platform [Source: Analysys Mason]

Adjustments to producer surplus

► *Surplus that cable operators would have derived from users switching to DTT*

In Scenarios 1 and 2, most of the DTT platform's subscribers migrate from a cable network. This movement removes some of the revenues that the cable operator would have had in the case where the digital dividend spectrum is not available. We have modelled this as a shift in the demand curve, as shown in Figure 5.11.

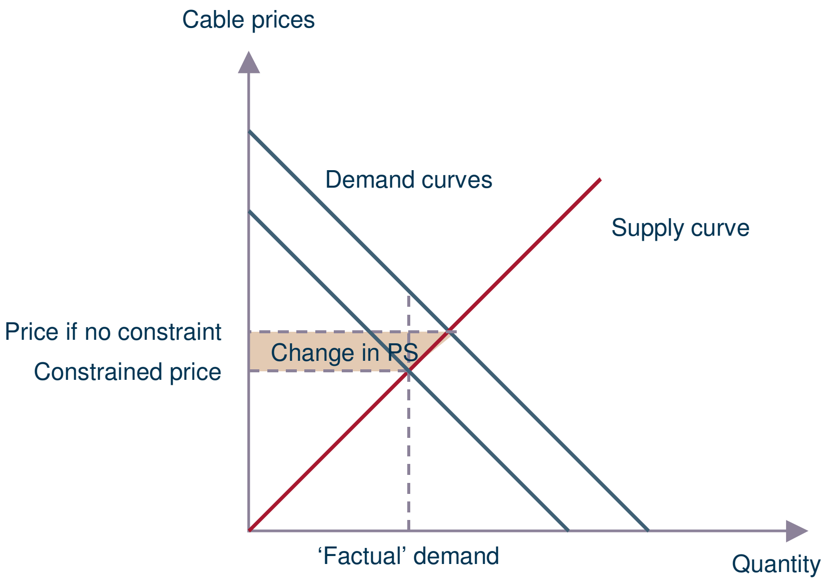

Figure 5.11: Change in producer surplus of cable operator because of demand shifting to DTT [Source: Analysys Mason]

► *Potential surplus lost to cable operators if DTT were to result in lower cable prices*

As mentioned above, we have assumed that, in the case where the digital dividend spectrum is not available, cable prices would rise with inflation. In both Scenarios 1 and 2, where some or all of the digital dividend spectrum is available, we have assumed that cable prices are significantly lower, which results in a lower producer surplus for cable operators than in Scenario 0. This is quantified by calculating the loss of revenue for the subscribers who remain on cable in Scenarios 1 and 2, based on the difference in revenue per subscriber (ARPU) with Scenario 0.

► *Surplus lost to cable operators through DTT capturing part of the advertising market*

As described in Section 5.2.1, we have assumed that the total advertising revenue available to pay TV platforms is a fixed quantity, which evolves in function of the GDP of the country. It is then split across all platform proportionally to their market share. Consequently, the share of the advertising market which is gained by the DTT platform is conversely lost by the cable networks as subscribers move from cable to DTT.

The impact of this is to net off the producer surplus contributed by advertising revenues on the DTT platform.

5.2.3 Additional benefits and costs that have not been modelled

In Scenario 2, where wireless broadband services are deployed in channels 61 to 69, users of low-power applications, such as wireless microphones currently operating in this band, and in particular, in the reserved nationwide channel 63 will have to retune their equipment to make use of interleaved spectrum. This will have a cost that has not been quantified, due to the lack of primary data. It is likely, however, that this will be a relatively small cost, one or more orders of magnitude below the other costs incurred in Scenario 2.This study focuses on estimating the impact of different scenarios on the private value that can be derived from different services. We recognise that there are several other effects, such as broader social values arising from different services (e.g. a better-informed democracy, higher educational standards or a more inclusive society) and other externalities (e.g. investment spillovers, non-internalised network effects, and potential health effects). However, we expect that while these effects may have considerable value, the actual incremental value arising from digital dividend spectrum is relatively small, as demonstrated in our work on the digital dividend for Ofcom. Ofcom has indicated that its research[27] concluded that for the considered uses of the digital dividend spectrum, the additional value arising from such broader social values and other externalities was no more than 15% of the private value i.e. such additional benefits were not a key factor that should determine the future use of the digital dividend spectrum.

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[27] *Preparatory study for UHF spectrum award*, Analysys Consulting, DotEcon, Aegis, 2006, available at http://www.ofcom.org.uk/consult/condocs/ddr/report_analysys/

5.3 Results

5.3.1 General principles used in deriving private value

As mentioned in Section 5.1, private value has been calculated on a net present value basis, using a 'risk-free' discount rate broadly equivalent to inflation + 2%, based on the Dutch Long Term Interest Rate[28]. In order to compare the different scenarios ("no digital dividend spectrum", "all spectrum to broadcasting", "sharing the digital dividend with next-generation wireless broadband"), we have discounted the consumer and producer surpluses from 2004, which marks the start of the DTT platform.

5.3.2 Incremental private value of each scenario

In this section, we have considered the additional value that can be derived by each of the groups of services modelled (fixed and mobile broadcasting; wireless broadband) by using the additional digital dividend spectrum that will become available in 2012.

Subsequently, we have taken into account the impact of DTT on the cable market, to understand the overall impact of DTT obtaining more digital dividend spectrum.

Incremental private value in the two scenarios, for the services considered

Figure 5.12, below, summarises the range of results that can be expected in terms of the value of the digital dividend under each scenario:

- In Scenario 1, broadcasting is allocated the whole digital dividend spectrum, whilst wireless broadband is limited to other spectrum bands (e.g. 2.6GHz)
- In Scenario 2, broadcasting retains the spectrum it currently occupies, and wireless broadband is allocated the 790–862MHz sub-band.

[28] 4.35% as defined by European Central Bank, Q1 2008.

	Net present value from 2008 to 2029		
	Incremental private value of the digital dividend spectrum under Scenario 1 (EUR million)	*Incremental private value of the digital dividend spectrum under Scenario 2 (EUR million)*	*Incremental private value of the additional digital dividend spectrum free in 2012 (EUR million)*
DTT	2400–8700 (base case 4500)	1500–7900 (base case 3600)	800–900 (base case 900)
Mobile TV	200–900 (base case 400)	-	200–900 (base case 400)
Broadcasting (total for DTT and mobile TV)	2600–9600 (base case 4900)	1500–7900 (base case 3600)	1100–1700 (base case 1300)
Wireless broadband	-	500–6900 (base case 2700)	500–6900 (base case 2700)
Total	2600–9600 (base case 4900)	2000–14 800 (base case 6300)	

Figure 5.12: Incremental private value obtained by each services through use of the digital dividend spectrum (compared to Scenario 0, where the digital dividend spectrum is not available) [Source: Analysys Mason]

The base case documented in the table represents the case described in Section 5.2 above, and represents our best estimate of the likely evolution of the markets and services considered. There is, however, some unavoidable uncertainty, hence the decision to show a wide range of results rather than a single value.

It can be seen that the total economic value generated by use of all of the digital dividend spectrum is considerable (from approximately EUR2 to EUR15 billion depending on the input assumptions), with a base case valuation of approximately EUR5 billion. The additional value created by use of the additional spectrum available from 2012 is estimated to range from around EUR500 million to EUR7 billion. Scenario 2 (creation of a sub-band for telecommunications services) could potentially create twice as much value than if this spectrum was used for broadcasting, however the ranges of estimates of the value of the additional spectrum under Scenarios 1 and 2 is overlapping hence it cannot be stated with certainty that one scenario (and hence, use of the additional digital dividend spectrum) is likely to create more value than the other scenario (alternative use of the additional spectrum). This is illustrated in Figure 5.13 below.

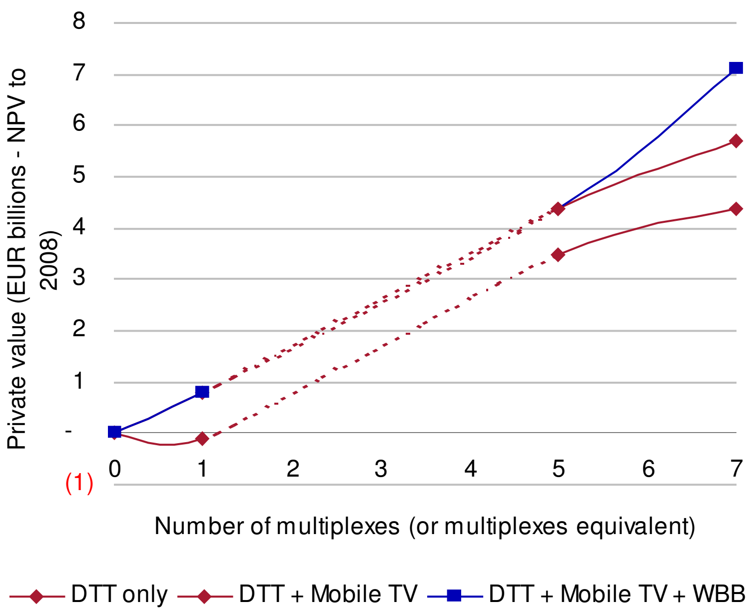

Figure 5.13: Value of additional spectrum [Source: Analysys Mason]

The usage of digital dividend spectrum for DTT is however likely to result in a loss of economic value generated from competing TV platforms (e.g. cable). This arises because of the loss of subscribers from the cable TV platform to DTT, and lower prices for television services on cable, which both result in loss of revenue to the cable TV service providers. This broadly directly translates into a loss of producer surplus since the cost of serving an incremental subscriber that is already connected to the cable TV network is relatively small as a proportion of the revenues. Such a loss in producer surplus is a characteristic of increasing infrastructure competition and is offset by the increases in consumer surplus resulting from the additional competition between the television platforms and therefore lower prices for television services.

Broadcasting and wireless broadband would use slightly different amounts of spectrum, with broadcasting occupying 11 additional 8MHz channels, or 88MHz in total, and wireless broadband only 72MHz.[29] The equivalent creation of private value, using the base case from the above table, is shown per MHz in Figure 5.14.

29 When used for DTT, the spectrum free from 2012 allows the creation of two additional nationwide multiplexes, using the full 11 channels (88MHz); when used for wireless broadband, it enables the creation of three lots approximately of 2×30MHz of spectrum, after accounting for an additional 12MHz guard-band (i.e. 60MHz out of a total of 72MHz may be used).

	Value of the additional digital dividend for the service (EUR million)	MHz of spectrum allocated	Value per MHz (EUR million)
DTT	900	N/A	N/A
Mobile TV	400	N/A	N/A
Broadcasting (total)	1300	88	15
Wireless broadband	2700	72	38

Figure 5.14: Incremental private value generated by the services considered thanks to the digital dividend spectrum from 2012 [Source: Analysys Mason]

An additional benefit to cellular operators obtaining some digital dividend spectrum would be the possibility to cover nearly 100% of the population with next-generation mobile broadband services. Without this spectrum, our models indicate that population coverage may only reach about 80%.[30]

Impact of use of digital dividend spectrum on economic value generated by alternative platforms

As detailed in Section 5.2 above, having a commercial DTT platform competing with the established cable networks potentially has a significant impact on the cable platform, in the form of lost revenue to the cable operators and potentially an increase in consumer surplus to cable subscribers through lower prices.

Figure 5.15 below summarises the impact on the cable platform of the use of the additional digital dividend spectrum (that will become available from 2012) for digital broadcasting (i.e. Scenario 1) compared to the use of the additional spectrum for wireless broadband services (i.e. Scenario 2). It can be seen that we estimate there will be a gain in consumer surplus on the cable platform of approximately EUR400 million, but a loss in producer surplus of approximately EUR1.5 billion (NPV from 2008 to 2029).

30 This assessment relates to an existing cellular operator with nationwide GSM coverage.

	Net present value from 2008 to 2029		
Adjustment	*Effect on consumer surplus of allocating the additional digital dividend spectrum to DTT (EUR million)*	*Effect on producer surplus of allocating the additional digital dividend spectrum to DTT (EUR million)*	*Effect on private value of allocating the additional digital dividend spectrum to DTT (EUR million)*
Surplus that consumers switching from cable to DTT would have obtained if they had remained on cable	(300)		(300)
Potential surplus that could be created for remaining cable subscribers if competition from DTT platform resulted in lower cable prices	700		700
Surplus that cable operators would lose from users switching to DTT		(400)	(400)
Potential surplus that could be lost by cable operators if the DTT platform resulted in lower cable prices		(700)	(700)
Surplus lost by cable operators through DTT capturing part of the advertising market		(400)	(400)
Total	400	(1500)	(1100)

Figure 5.15: Additional adjustments to private value linked to changes on the cable market [Source: Analysys Mason]

Consequently, allocating at least some of the digital dividend spectrum to DTT (as is the case currently) results in an increased consumer surplus for both DTT and cable consumers, but in a reduced producer surplus for cable operators.

These results are to be expected, since: when two (or more) infrastructures compete, instead of having a monopoly, the partial replication of assets causes a fall in producer surplus, all else being equal, because the revenue available in the market is split across two (or more) infrastructures, whereas most of the costs must still be incurred.

However, increased competition arising from an additional platform is a very positive benefit from the perspective of consumers: our analysis shows a significant increase in consumer surplus in all cases where digital dividend spectrum is made available for additional DTT channels.

Moreover, a DTT platform with only three channels, as modelled in Scenario 0 (no digital dividend spectrum), would require significant public subsidy (negative producer surplus) which is avoided in the scenarios where digital dividend spectrum is made available for DTT.

5.3.3 Examination of potential market failures

To examine whether there is a risk in market failure if an auction process were used for the award of the digital dividend spectrum which could result in a non-optimal allocation of the spectrum from the perspective of the total economic value to the country, we have calculated the willingness to pay for the spectrum released in 2012 for four different types of users::

- the existing commercial DTT operator, to operate six multiplexes in total (one more than currently);
- the existing mobile TV provider, to operate the equivalent of a full multiplex and provide 20 channels;
- a new mobile TV provider, to operate the equivalent of a half a multiplex in capacity and provide 10 channels;
- an existing cellular operator to deploy LTE services.

For each of these providers, we have examined whether there is a significant risk that the incentives of the producer to purchase the additional digital dividend spectrum (determined by the incremental producer surplus it can generate from the spectrum) is out of line with the total private value (which includes consumer surplus) that is generated by the service provided by the producer. In other words, is there a chance that a firm producing a service (A) could generate a producer surplus significantly higher than a firm producing a different service (B), but that service (B) would in fact result in a higher total private value than service (A)? If this were the case, a potential market failure could arise since the provider of service (A) would win spectrum in an open auction, whilst greater economic value for the Netherlands would in fact be generated by the provider of service (B).

Based on this examination, we have not identified any potential market failures in respect of willingness to pay for the spectrum (producer surplus) compared to the total economic value that could be generated from the different uses of the spectrum.

6 Conclusion

As mentioned in the introduction to this report, the two objectives of the study were to:

- identify potential uses of the spectrum
- identify any reasons why a standard market-based approach to the award of the additional dividend spectrum (free from 2012) may not be appropriate.

In response to the first point, we have reviewed the main candidate uses of the digital dividend spectrum. We have subsequently identified two scenarios for the use of the additional spectrum freed in 2012: one where broadcasting is allocated the additional spectrum, and one where next-generation broadband services use the 790–862MHz sub-band.

For each result in the table, we show a range of value. This is in view of the uncertainties surrounding each of the three services that we have modelled, in particular the future take-up of the services and the evolution of prices for the services, and as such we have considered wide ranges of input parameters which results in large variations in the final results. The base case can be considered to represent our best estimate of the likely evolution of the markets associated with each of the services modelled.

	Net present value from 2008 to 2029		
	Incremental private value of the digital dividend spectrum under Scenario 1 (EUR million)	*Incremental private value of the digital dividend spectrum under Scenario 2 (EUR million)*	*Incremental private value of the additional digital dividend spectrum free in 2012 (EUR million)*
DTT	2400–8700 (base case 4500)	1500–7900 (base case 3600)	800–900 (base case 900)
Mobile TV	200–900 (base case 400)	-	200–900 (base case 400)
Broadcasting (total for DTT and mobile TV)	2600–9600 (base case 4900)	1500–7900 (base case 3600)	1100–1700 (base case 1300)
Wireless broadband	-	500–6900 (base case 2700)	500–6900 (base case 2700)
Total	2600–9600 (base case 4900)	2000–14 800 (base case 6300)	

Figure 6.1: Incremental private value per services [Source: Analysys Mason]

This analysis of private value enables us to draw the following conclusions:

- The digital dividend spectrum enables significant value to be created on all the platforms modelled – potentially from EUR2 to 15 billion in total (NPV from 2008 to 2029, which is the end of the period we modelled).
- Continuing to make spectrum available for the existing five DTT multiplexes can be expected to yield significant economic benefits, primarily in the form of consumer surplus arising from lower prices for television services.
- Using the 790–862MHz sub-band for next-generation wireless broadband services (e.g. LTE) could potentially create twice as much value than if the spectrum were allocated to broadcasting (DTT or mobile TV). This arises from lowering the cost of coverage in less populated areas for operators and also making it commercially viable for the operators to increase their coverage (we estimate the digital dividend spectrum could increase next-generation wireless broadband coverage from an estimated 80% of population that would be covered through using 2.6GHz spectrum alone to almost 100% with the use of digital dividend spectrum).

The usage of digital dividend spectrum is however likely to result in a loss of economic value generated from competing TV platforms (e.g. cable). This arises because of the loss of subscribers from the cable TV platform to DTT, and lower prices for television services on cable, which both result in loss of revenue to the cable TV service providers. This broadly directly translates into a loss of producer surplus since the cost of serving an incremental subscriber that is already connected to the cable TV network is relatively small as a proportion of the revenues. Such a loss in producer surplus is a characteristic of increasing infrastructure competition and is offset by the increase in consumer surplus resulting from the additional competition between the television platforms, and therefore lower prices for television services.

In terms of the additional spectrum that will be available from 2012, our analysis shows that the incremental benefit of making this additional spectrum available for broadcasting is relatively modest compared to (i) the benefits generated by continuing to make the digital dividend spectrum that has been released to-date available to DTT and (ii) the benefits that could be achieved through use of the additional spectrum by other services (e.g. next-generation wireless broadband). There is also considerable uncertainty over the economic value that would be generated from use of this spectrum for the different uses. In such circumstances, it is likely to be appropriate for the Ministry to make use of market mechanisms to determine the best use and user of this additional spectrum (e.g. through making the spectrum available on a service and technology basis, through an auction award process) in line with the general objectives of the Ministry as stated in its policy document.[31]

[31] *Radio Spectrum Policy Memorandum 2005*, Ministry of Economic Affairs, 2005

As described in Section 5.3.3, we have not identified potential market failures in respect of willingness to pay for the spectrum compared to the total economic value that could be generated from the different uses of the spectrum. However, the award process will require careful design in order to ensure that the market is able to benefit from any pan-European allocations/harmonisation of the spectrum for particular services (e.g. creation of a sub-band for use of mobile/wireless broadband services).

In summary, we conclude that:

- the 272MHz[32] of digital dividend spectrum that has already been made available for broadcasting services should continue to be allocated to DTT, in light of the economic benefits arising from having a DTT service that provides competition to other television platforms (in particular cable), which we expect will result in lower prices for television services
- the additional spectrum[33] that will become available from 2012 should be awarded using market mechanisms in line with the Ministry’s general approach to spectrum awards, since there is no definitive economic case for awarding the spectrum to any particular service and we have not identified any particular market failure issues that might arise from such an award.

32 Corresponding to 34 channels which, when used for DTT, allow for five nationwide multiplexes

33 Corresponding to 11 channels: 36, 40, 46, 49, 51, 53, 61, 62, 67, 68, 69; when used for DTT, this allows the creation of two additional nationwide multiplexes, using the full 11 channels (88MHz); when used for wireless broadband, it enables the creation of approximately of 2×30MHz of spectrum, after accounting for a 12MHz guard-band (i.e. 60MHz out of a total 72MHz total may be used).