Report for OPTA

The business case for fibre-based access in the Netherlands

Public version

10 December 2008

13925-504b2

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1 Executive summary

This report presents the result of the project carried out by Analysys Mason on behalf of OPTA to examine the business case for offering fibre-based services using fibre unbundling (FU) and/or wholesale broadband access (WBA).

This study is an update of our previous assessment *The business case for fibre-based access in the Netherlands*[1] dated 24 July 2008, and complements our study for OPTA in 2006 regarding *The business case for sub-loop unbundling in the Netherlands.*[2]

1.1 Background

KPN is currently in the process of implementing its next-generation network (NGN), known as 'All-IP'.

In 2006 announcements, KPN first revealed its intention to deploy a network based on fibre to the cabinet (FTTC) and very high bit-rate digital subscriber line (VDSL).

In early 2008, KPN then envisaged to roll out a based on fibre to the home (FTTH), the business case which we analysed in our July 2008 report.

Since then, it has announced a joint venture using the infrastructure of wholesale telecoms provider Reggefiber, which is planning a widely deployed FTTH infrastructure in Netherlands.

Given that the costs of deploying proprietary FTTH networks are likely to be prohibitive for alternative providers, there are two main options by which they also can offer fibre-based services:

- purchase an unbundled fibre product (FU)
- purchase a fibre-based Wholesale Broadband Access product (WBA)

This study considers the business cases for an alternative provider looking at these options and for KPN to use Reggefiber's infrastructure. These results will help OPTA formulate its policy regarding competition in NGNs.

1.2 Approach

In our modelling, we have considered an alternative provider's deployment based on FU and WBA, as well as KPN's deployment of a network based on FU. In each instance, we have

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1 http://www.opta.nl/asp/en/publications/document.asp?id=2673

2 http://www.opta.nl/download/Analysys+Final+Report.pdf

compared these deployments to the continued use of KPN's local loop via local loop unbundling (LLU). To do this, we have calculated the access network costs that are associated with each of the delivery options. It is then possible to calculate the incremental revenue relative to the LLU case that would be required to make the business case viable. This incremental revenue could come from at least one of two sources:

- from offering improved/new services, such as higher-speed broadband access and TV
- from a reduction in retail prices charged by LLU operators (aiming to maintain market share when faced with competition from other fibre offers).

As Reggefiber is currently finalising its FU reference offer, we have used in our modelling the latest draft tariff schedule considered by Reggefiber and communicated to us via OPTA. We have also used KPN's 2008 LLU and WBA reference offer.

1.3 Key findings

Figure 1.1 illustrates the average monthly cost per subscriber for access based on FU[3], LLU and WBA for an alternative operator in each type of geographical area (geotype). We have included all costs that an operator will incur in the access network (up to the central office), including: CPE, line rental, co-location, active equipment and backhaul network to the central office. Backhaul network from the central office to the core network and core network costs have been excluded. We have also assumed that only voice and broadband services are offered (though we have also run a scenario for an analogue TV overlay). For comparison, this chart includes the cost of alternative providers using sub-loop unbundling (SLU) from our previous study for OPTA. The geotypes are ordered by the density of lines in each area.

The difference between the cost for LLU and the cost for other options provides an indication of the monthly incremental revenue that must be recouped from each customer in order to cover the incremental costs. For an alternative operator, the additional revenue needed to cover the cost of using FU services rather than LLU is EUR12.0 to EUR14.9 per subscriber per month. For WBA, the difference is around EUR38.8 per month. This difference is due to the high speed component of the WBA offer for high bandwidth (100Mbit/s for EUR36.32 per month) which is the greatest part of the cost per line. Note that this speed component falls significantly with lower bandwidth, so lower-speed WBA offers can be less expensive.

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3 Costs per subscriber for FU are calculated for a monthly unbundled fibre rental price of EUR12 and EUR15, and are respectively called FU-12 and FU-15 in the rest of the document..

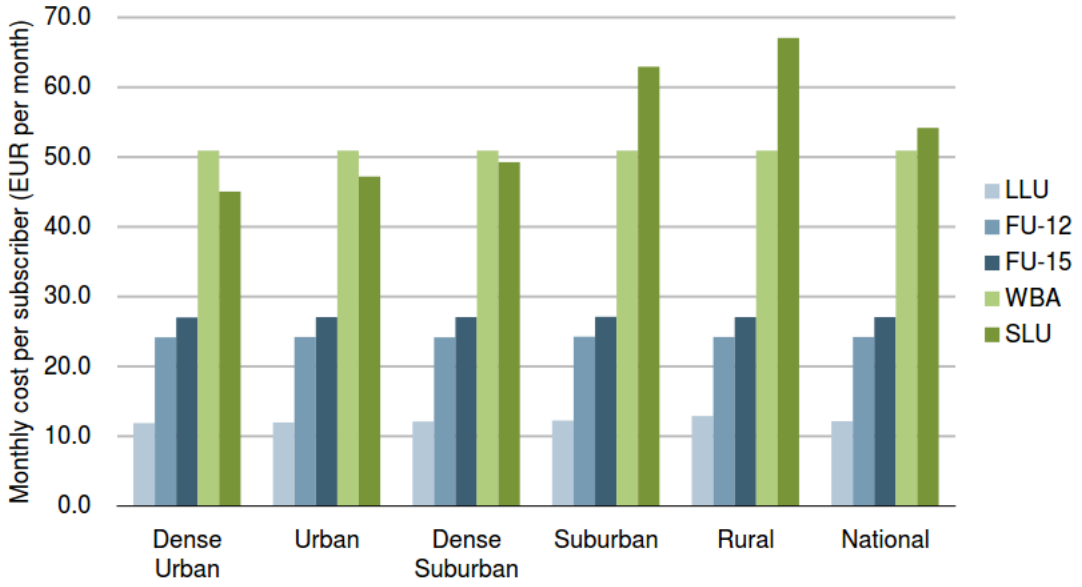

Figure 1.1: Average monthly cost per subscriber for the base-case scenario [Source: Analysys Mason]

The figure below presents how KPN's cost per subscriber for the different geotype compare with the one of an alternative operator (in our base case scenario).

KPN's high market share means that the additional revenue needed to cover the cost of using FU services ranges is substantially lower, at EUR6.2–8.7 per month.

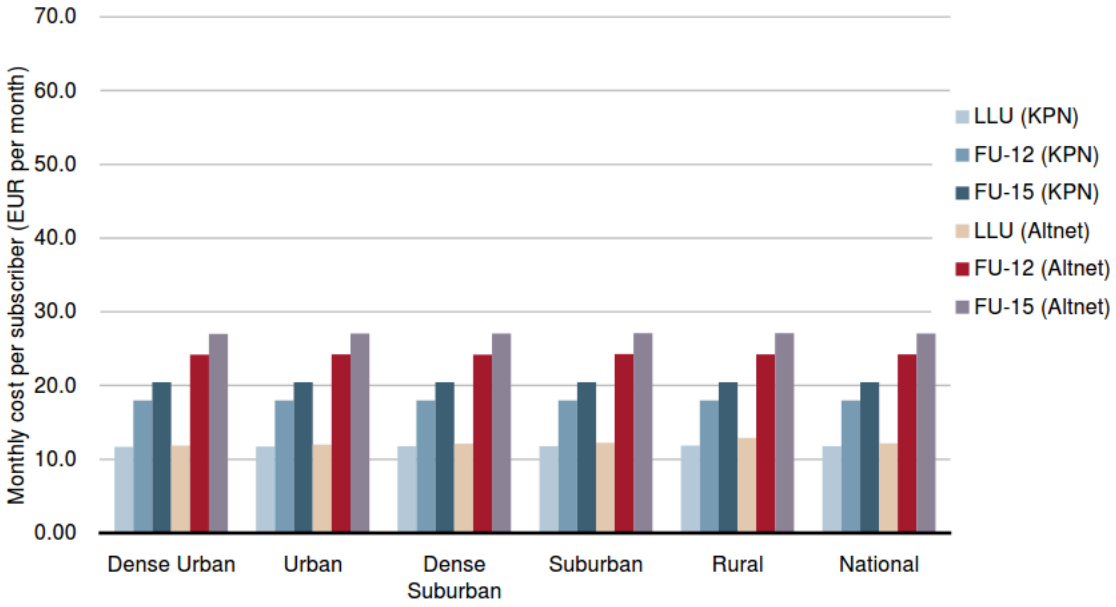

Figure 1.2: Monthly cost per subscriber per geotype for the base case scenario [Source: Analysys Mason]

1.4 Conclusions

If Reggefiber is successful at rolling out an FTTH network, the wide-scale deployment of products based on FU by an alternative provider may be viable, but is by no means straightforward. The conclusion from the previous study therefore remains unchanged. It is not yet clear that sufficient incremental revenue can be achieved to justify the additional network cost.

Existing and proposed FTTH prices offer mixed evidence as to whether the required EUR12.0–14.9 additional monthly net revenue per subscriber will be achievable:

- We understand from OPTA that KPN's proposed retail monthly pricing for FTTH will be EUR65 to EUR110[4] (including VAT), although these prices include TV. This compares to the existing KPN's ADSL plus VoIP offer of EUR35 to EUR65[5] per month and its TV offer 'Digitenne' priced at EUR7.5 per month[6]. Based on these figures, KPN aims at reaching an additional EUR22.5 to EUR37.5 revenue per month per subscriber.

- In France, Free is offering FTTH services, including limited digital TV channels, for EUR29.99 per month (the same price as its DSL offer). The Free pricing would not allow the additional costs to be recovered

If an alternative provider chooses to offer very high broadband speeds (e.g. 100Mbit/s), then FU access would appear to be less costly than WBA. This is due to the high speed component in KPN's proposed WBA reference offer (EUR36.32 per line per month for 100Mbit/s). For WBA to compete with FU, this element would have to be reduced or alternative providers would have to offer lower speeds. For example, a 30Mbit/s downstream, 4Mbit/s upstream service costs EUR7.32 per line per month, and with this bandwidth, the total WBA cost per line would then become comparable to the cost per FU line.

Based on Reggefiber's current proposal for a pricing scheme, FU deployments appear to be more subject to economies of scale than it was found in our previous study on FTTH for OPTA. This is because the FU architecture in the current report is different from the one in the previous study: previously, ODFs were assumed to be located in (relatively larger) City PoPs whilst they are assumed to be placed in Area PoPs in this report. This implies that smaller service providers have an important disadvantage to larger service providers (and especially as regards to KPN).

Given its potential high market share of 40–50%, KPN is in a much better situation than alternative operators to recover the incremental cost of FU over LLU, as the economies of scale lead to a lower incremental cost of FU over LLU. Assuming that KPN achieves an additional EUR6.2–8.7 per retail subscriber for FU-based services (over LLU-based services) and that it maintains its current market share, we calculate that KPN's business case is viable. For KPN, the incremental cost relative

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4 Source: www.kpnglasvezel.nl, July 2008

5 http://www.kpn.com/internet/internet-bellen.htm

6 http://www.kpn.com/tv/digitenne.htm.

to LLU is between EUR5.8 and EUR6.2 less than that faced by an alternative operator. As a result, KPN business case is considerably better than the case for alternative operators.

With the exception of FU monthly price rental (which we understand from Reggefiber may vary between EUR12 to EUR15), all the other inputs, network dimensioning and unit costs are constant across all geographical areas. This means that our model provides a range of cost per subscriber using FU (FU-12- FU-15) which does not vary across different geographies. However, it is likely that in practice FU in the most urban areas may well be cheaper than for less populated areas (if only because Reggefiber's monthly price is lower).

2 Introduction

This report presents the conclusions of Analysys Mason's study undertaken on behalf of OPTA to investigate the business case to offer fibre-based services using fibre unbundling (FU) and/or wholesale broadband access (WBA).

This study is an update of our previous assessment *The business case for fibre-based access in the Netherlands*[7] dated 24 July 2008, and complements our study for OPTA in 2006 regarding *The business case for sub-loop unbundling in the Netherlands*[8].

This report presents the methodology used in our study and our key findings, and includes:

- a review of the different deployment options when offering fibre-based services
- an assessment of the business case for FU and WBA under a number of different scenarios.

In the course of our study, we established contacts and organised conference calls with the following providers in the Dutch market:

- Tele2
- Bbned
- Online
- KPN.

We were not in direct contact with Reggefiber in the course of this study and we transmitted our questions regarding Reggefiber's offer through OPTA.

2.1 Background

KPN is currently in the process of implementing its next-generation network (NGN), known as 'All-IP'.

In 2006 announcements, KPN first revealed its intention to deploy a network based on fibre to the cabinet (FTTC) and very high bit-rate digital subscriber line (VDSL).

In early 2008, KPN then envisaged to roll out a based on fibre to the home (FTTH), the business case for which we analysed in our report of July 2008.

Since then, it has announced a joint venture using the infrastructure of wholesale telecoms provider Reggefiber, which is planning a widespread FTTH infrastructure in Netherlands. In the

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7 http://www.opta.nl/asp/en/publications/document.asp?id=2673

8 http://www.opta.nl/download/Analysys+Final+Report.pdf

course of this project, we have had access through OPTA to the latest draft tariff schedules considered for FU by Reggefiber.

Reggefiber is currently deploying a passive optical infrastructure and intends to give telecoms operators access to the infrastructure. These providers are expected to develop their own retail services on the basis of Reggefiber's infrastructure. Reggefiber currently claims to cover a few hundred thousand households. In the long term, it plans to cover around 5–7 million homes.

Our understanding is that Reggefiber's FTTH deployment is based on point-to-point (P2P) Ethernet topology, with two fibres laid to each home, one for broadband and one for analogue TV.

A typical P2P Ethernet topology has at least one dedicated fibre connection between each home and the central office, allowing the fibre to be 'unbundled', and subsequently 'lit' by individual service providers: this process is called 'fibre unbundling'. Reggefiber's FTTH network is based on the deployment of two fibres being laid to each home, one for broadband access and one for analogue TV.

For alternative providers seeking to offer fibre-based services, there are – in theory at least – several different options. They can:

- deploy their own FTTH network, including the deployment of duct and fibre
- deploy their own FTTH network, running fibre through KPN/Reggefiber's duct (if available)
- purchase FU products, and use these to offer services to customers
- purchase fibre-based WBA services, and use these to offer services to customers.

Given the high fixed costs of deploying duct, it is likely that deploying a full proprietary FTTH network (including laying duct) would be unviable. Furthermore, given the low market shares of alternative providers (as regards to KPN), it is unlikely that the deployment of an FTTH network would be viable, even by re-using existing duct. The latter two of these options (FU or WBA) therefore appear more likely. Therefore, this study has considered the business case for these two options in detail.

Reggefiber's deployments and commercial offering will have a significant impact on the business case of KPN and alternative providers. OPTA is currently in the process of analysing the broadband markets and is investigating ways to promote competition in these next-generation networks (NGN). The results of this study will help OPTA formulate its policy regarding this topic.

2.2 Structure of this report

The rest of this report presents the methodology used in our study and our key findings. It is laid out as follows:

- Section 3 reviews the deployment options available when offering fibre-based services

- Section 4 describes the approach used in our modelling of the business case for providers using FU/WBA
- Section 5 provides the results of our model
- Section 6 presents the conclusions of the study.

The report includes a number of annexes containing supplementary material:

- Annex A provides a definition of geographical areas used in the modelling
- Annex B provides the costs from KPN reference offers used in the modelling
- Annex C provides the costs for Fibre unbundling used in the modelling.

3 Deployment options available to alternative providers

We have considered a number of deployment options, with respect to:

- services offered
- geographical areas covered
- network deployment options.

Each of these is discussed in turn below.

3.1 Services offered

The services that a provider expects to offer will have an impact both on the choice of equipment that is deployed (hence the costs) and on the revenues that can be gained from customers.

Broadband and voice services

Using LLU and ADSL2+, it is feasible to provide voice services and broadband services of up to 24Mbit/s, although the speed of service that can be delivered varies according to the length of copper loop. The longer the copper loop, the lower the data rates that can be delivered.

Using a P2P Ethernet FTTH deployment, operators would be able to offer broadband services with speeds of up to 1Gbit/s. This would enable them to offer services such as online gaming, high-speed file sharing and TV. Through shared LLU, it is currently possible for alternative providers to offer broadband without offering voice. This is technically possible due to the fact that voice and data are carried over the copper loop using different frequency bands; broadband uses 25kHz and above, whereas voice uses lower frequencies. In an FTTH network, shared fibre unbundling, i.e. offering only broadband services, might be theoretically possible through wavelength unbundling. However, this technology is very much in its infancy and relatively expensive. Therefore, given that the majority of providers currently using LLU services (both voice and broadband), for the purposes of this study we have assumed that all fibre unbundlers and providers using fibre-based WBA will offer both voice and broadband services (i.e. we have assumed that shared fibre unbundling is not offered).

TV services

It is already possible to offer digital TV services to many homes using ADSL2+ technology, but FTTH will significantly increase the coverage and capacity of these services. However, all of the FTTH initiatives in the Netherlands to date have chosen to deploy a second fibre to each home in

order to offer analogue TV. This is because the Dutch TV market is dominated by analogue services (current numbers indicate that analogue cable TV penetration is close to 100%)[9] which do not require consumers to purchase and install a set-top box, and allow for an easy multi-room TV-service through simple in-building wiring.

Alternative providers are faced with three broad options if choosing to offer an analogue TV service. These relate to the position in the value chain that they occupy:

- **Fully integrated providers:** The operator produces its own content, which it then distributes to subscribers under its own brand.
- **Content aggregators:** The operator purchases content from a third-party content provider. It then aggregates the programming to create its own branded channels.
- **Resellers:** The operator simply purchases branded channels from third parties and then resells them on their platform. In this case, alternative providers could purchase channels from terrestrial, cable or satellite providers and provide them over the FTTH platform.

Note that the above options are not mutually exclusive; an operator may create some of its own content as well and purchase some from a third party.

The choice of model is important as it has implications on the network deployment, as discussed further in Section 3.3. However, given that the largest alternative provider in mid-2008 had just between 5 and 10% of broadband connections, which equates to 300 000–600 000 subscribers, we think that it is unlikely that these operators will have the scale to follow either the fully integrated provider or content aggregator model. It is much more likely that they will simply resell other TV providers channels.

3.2 Geographical areas covered

Currently, alternative providers use LLU to deliver service to the majority of their broadband customers, and are typically able to reach 50–70% of the Dutch population by this means. The business case for FU is also likely to be dependent on the geographical areas covered, with the more rural areas characterised by a higher cost of passing each subscriber/home. Providers are likely to deploy infrastructure only in those areas where coverage is economically viable.

In this study we have considered the business case for providers using FU and WBA for five types of geographical area ('geotypes') ranging from dense urban areas to rural areas (see Section 4.3 for more details).

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9 Source: Merrill Lynch, 2008.

3.3 Network deployment options

In this section we firstly discuss the options available to providers to offer broadband/voice services. We then discuss the options available to offer an analogue TV overlay.

Broadband/voice services

In order to provide fibre-based broadband and voice services, providers are faced with a number of options:

- **Deploy their own FTTH network:** The operator deploys its own fibre to the customer premises.

- **Purchase FU:** The operator could purchase FU products from Reggefiber at the Area PoP (where the ODF is located). In this case, the operator would also require:
  - a co-location service from Reggefiber at the Area PoP
  - a backhaul access from the Area PoP to the City PoP of Reggefiber,
  - a co-location service from Reggefiber at the City PoP
  - access from the City PoP to their core network.

- **Purchase WBA products:** The operator could purchase a WBA product from KPN, which currently offers a bitstream product based on its FTTC\VDSL coverage, at a number of levels of aggregation (more aggregated offers require fewer points of interconnection to provide national coverage). We consider that KPN would similarly offer a WBA product based on the use of Reggefiber FU. KPN's current WBA reference offer provides three options, at a local level, available at 138 locations, known as Metro Core Locations, or MCL), regional (14 locations) or national level (one location). We have also assumed the option of a WBA product being available from the central offices. To do so, we have not included any of the 'transport'-related costs in KPN's proposed reference offer.

The cost of deploying an FTTH network is high. For example, in France, ARCEP estimates costs of around EUR2000 per subscriber (assuming a market share of 25%), even in areas of high density[10], with around half of the cost being due to infrastructure (duct and cable). Given that the largest alternative provider in the Netherlands currently has a market share between 5% and 10%, the cost per subscriber will be even higher. Therefore, we believe that this option is highly unlikely and we have only considered providers (including KPN) to offer fibre-based services via FU or WBA[11].

The first two access options (deploy FTTH and purchase FU) need to be completed by a backhaul service to the provider core network. Providers currently using LLU require backhaul from the

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10 "Very high-speed: Points of reference and outlook", ARCEP 2006

11 WBA is only considered for alternative providers since KPN would be the one offering WBA

central office to the core network. If they migrate to FU following the deployment a Reggefiber's FTTH network then additional backhaul will be required:

- from the Area PoP to the City PoP
- from the City PoP to their core network (either directly or through KPN's central office)

Regarding backhaul service from the Area PoP to the City PoP, it may not be possible for a third party, at least in the short term, to offer dark fibre or leased capacity between these locations since these PoPs are rolled out by Reggefiber. Therefore, we have considered in our modelling that backhaul services from the Area PoP to the City PoP are only provided by Reggefiber (on the basis of a draft reference offer to which we had access in the course of this project).

Our approach to the evaluation of the business case for sub loop unbundling in the Netherlands has been consistent with our previous study on the business case for sub-loop unbundling (2006). As such, we have limited the scope of our model to the network architecture between the customer premises equipment (the CPE in this instance is a Media converter) and the central office. With regard to backhaul service from the City PoP, we therefore consider two cases:

- If the City PoP is co-located with KPN's MDF, then no backhaul is required from the City PoP to the central office. The provider can also continue to use the backhaul solution in use for LLU. In order to compare LLU to FU and WBA at the MDF level in our study, we have not modelled backhaul services from the central office to the provider core network

- If the City PoP is not co-located with KPN's MDF, we have modelled a backhaul service from the City PoP to the central office location. This allows us to compare at the MDF level. the LLU cost with that of FU and WBA. To this end, we have considered two basic options: a backhaul service provided by a third party (leased line or dark fibre) and a backhaul service provided by KPN (which in the absence of a reference offer for bandwidth above 155 Mbit/s from KPN, we modelled on the basis of the transport component of its WBA offer, from the MDF to MCL locations)

Analogue TV overlay

The network deployment for an analogue TV overlay depends on the business model chosen.

Fully integrated providers and content aggregators are likely to deploy a similar network topology to a cable operator:

- They will aggregate content at a central location to form their programming channels.
- These programming channels will be streamed to head-ends via fibre/leased lines or using dedicated satellite capacity.
- At each head-end, the signal will be converted into an analogue optical signal and transmitted via fibres to each home. Note that an unbroken fibre feed is required from each head-end to each home.

- Each head-end usually serves a large number of customers (>100,000), more than is served by a typical central office.

However, operators that choose the reseller model do not require a dedicated programming feed. We have identified two main delivery mechanisms:

- Standard reseller: Operators inject the TV feed in the network:
  - At each head-end (typically City PoPs), digital TV signals are received, via a standard satellite or DTT aerial or equivalent.
  - These feeds are aggregated using a combiner, which shifts their frequency and combines them into a single feed (effectively this selects the programming channels that are to be resold from all available feeds). The combined feed is converted into an analogue optical signal and transmitted from the City PoP to all Area PoPs on a dedicated fibre for each Area PoP.
  - In each Area PoP, a splitter then allows the distribution to the customer on the dedicated analogue TV fibre.

- Pure reseller: Operators resell the TV service, with a TV feed provided by a wholesale player
  - In this case, the TV feed is distributed by a wholesaler to the Area PoP. The service provider only needs to collect the analogue TV feed at covered Area PoPs and then distributes it to selected subscribers on a dedicated analogue TV fibre.

As outlined in Section 3.1, it is unlikely that a provider (at the potential exception of KPN) will have the scale to follow a fully integrated provider and content aggregator model. Moreover, based on our contacts with operators, we believe that, to benefit from stronger economies of scale, alternative operators are more interested[12] in a 'pure resale' model. Therefore, in this study we have limited our modelling to a pure reseller model. Furthermore, given that a second fibre is required to offer an analogue TV overlay, it is only possible for fibre unbundlers to unbundle this second fibre. Operators purchasing WBA at either the local, regional or national levels will be unable to offer analogue TV as an additional service (though IPTV could still be possible) as they will have no physical access to this second fibre.

12 Depending on the details of the offer that may be provided by Reggefiber or KPN

4 Description of the model

The main objective of this study is to investigate the business case for offering fibre-based services using FU and/or WBA.

In order to assess these business cases, we have developed a model that calculates the costs of these approaches relative to LLU. By examining the differences between the costs between FU/WBA and LLU, it is possible to calculate the incremental revenue over LLU that the operator would need to generate in order for the business case for FU/WBA to be positive. This incremental revenue could come from one of two sources:

- from offering improved/new services, such as higher-speed broadband and TV
- from a reduction in retail prices from LLU operators (aiming at maintaining market share when faced with competition from other fibre offers).

In this section, we describe the methodology adopted in our modelling.

4.1 Model overview

We have developed a cashflow model that computes the costs over a twenty-year period faced by a provider investing in either FU or WBA instead of continuing to use an existing LLU or copper loop solution.

Figure 4.1 below illustrates the calculation flow used in the model.

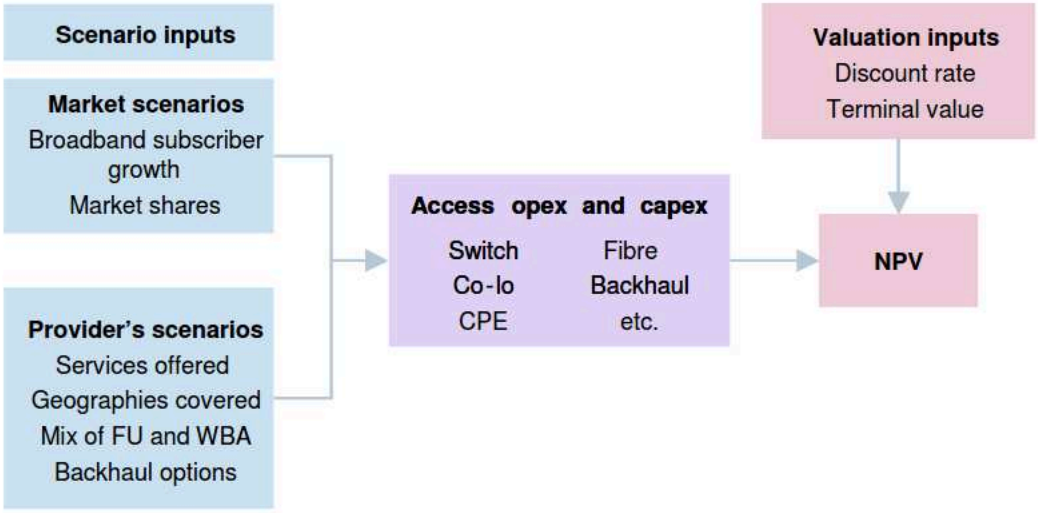

Figure 4.1: Overview of model methodology [Source: Analysys Mason]

The model contains a number of inputs that can be modified by the user to test specific scenarios. We list below the major inputs that can be changed:

- **Market shares**: the user can enter the market share in 2008 and 2019 for the areas served by the provider. The model is able to model various growth patterns to adjust for different assumptions about market maturity. At the moment, we have based our analysis on a linear interpolation between the two dates (and a constant market share after 2019).
- **Services offered**: the two options considered for the alternative provider are broadband and voice, and broadband, voice and analogue TV.
- **Geographical areas covered**: the user can select how extensively each geographical area is served (by FU, WBA or LLU).
- **Possibility that the City PoP is not co-located with KPN MDF**: In this case, we can select the backhaul solution used to connect the City PoP and the MDF/central office.
- **Analogue TV share :** the user can enter a specified take-up of TV services to be taken into account in the calculation

Network design algorithms are used to calculate the number of assets required in the network based on these scenarios. Total costs are calculated by multiplying unit costs with the number of each required asset.

In addition to calculating the in-year incremental cashflows over the twenty-year period, the model also calculates a net present value (NPV) on the basis of a discount rate equivalent to KPN's current regulated weighted average cost of capital (WACC) (9.21% nominal). The model can also take into account a terminal value, which is calculated based on a simple multiplier of the final year cashflows. However, given the long period of the model, we have not considered any terminal value multiplier in our base case scenario.

4.2 Market share

In our base case, we have assumed that the modelled alternative provider has a 5–10% market share of households (lines) in the areas in which it is rolling out. In case the operator chooses to only serve a certain percentage of all households in the Netherlands (as it is likely to be the case), this approach results in a lower total market share. For example, as can be seen in our base case scenario where alternative operators are rolling out to roughly 50–70% of the country in the long term, their line share over the total number of lines in the country then reaches approximately 3–7%.

4.3 Approach to modelling geographical coverage

It may be possible for providers to cherry pick individual central offices to offer FU or WBA (though currently KPN are not proposing to offer WBA from central offices); however we do not believe that they will choose to deploy services at such level of granularity. This is because it would be difficult to market providers' services if availability is inconsistent. Furthermore, there are certain economies of scale that can be achieved by deploying to larger contiguous areas.

Therefore, we have categorised KPN's regions according to five geotypes, ranging from dense urban areas to rural areas. This enabled us to evaluate the impact of deploying infrastructure across different geographical areas.

The proportion of households within each geotype, derived through data from the *Centraal Bureau voor de Statistiek* (CBS), is illustrated below:

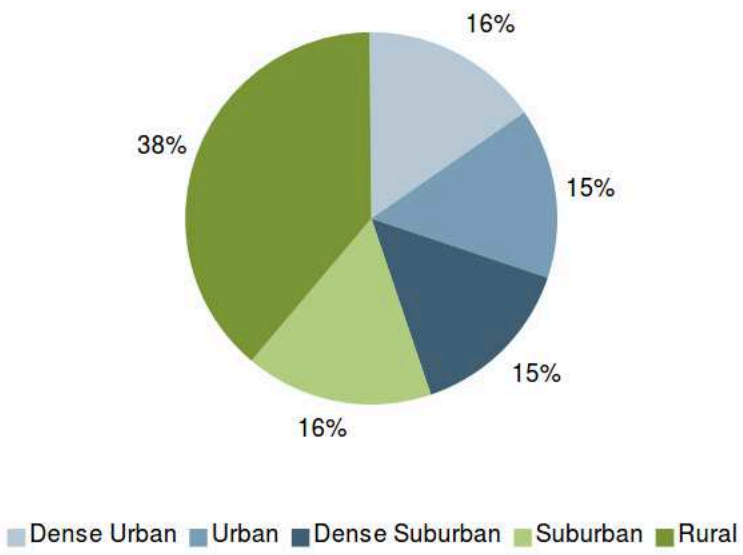

Figure 4.2: Percentage of total households in each geotype [Source: Analysys Mason]

A description of these geotypes is provided in Figure 4.3 below.

	Dense Urban	Urban	Dense Suburban	Suburban	Rural	National
Density (inhabitants per sq km)	2,996	1,333	846	584	241	439
Share of lines	14%	15%	15%	16%	40%	100%
Network topology						
Number of central offices	65	89	123	174	849	1,300
Number of street cabinet	3,503	3,275	3,397	4,355	9,470	24,000
Lines per CO	18,920	12,934	9,353	7,243	3,652	6,071

Figure 4.3: Geotypes used in the modelling [Source: Analysys Mason]

4.4 Network costs

In this section, we discuss the network costs associated with the deployment options available to providers.

4.4.1 Deployment options available to providers

In this subsection, we discuss the network costs associated with each of the service delivery options.

For all options we have excluded the cost of the network from the central office (e.g. we take into account all the network cost between the CPE and the central office).

Note that details of costs taken from KPN reference offers that were used in the modelling are outlined in Annex B.

LLU

The modelled network architecture includes customer premises equipment (the CPE in this instance is a DSL modem), rental of local loops from KPN, co-location space and associated services, and equipment installed at the MDF site.

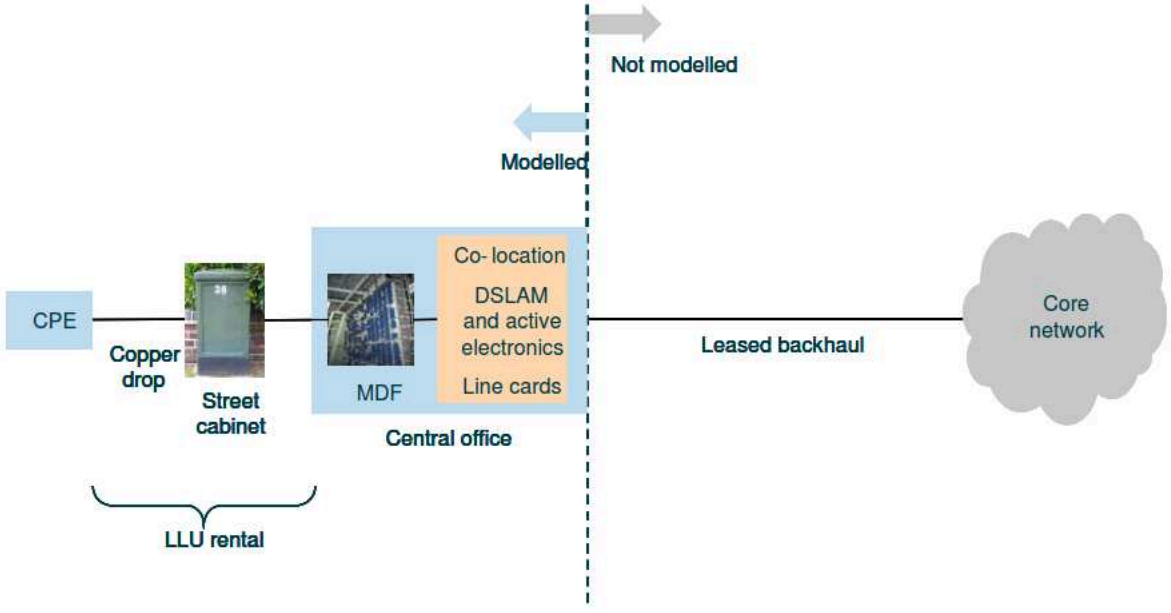

Figure 4.4: Network architecture modelled for LLU [Source: Analysys Mason]

Local loop costs Current LLU set-up, line rental, and disconnection charges from KPN's 2008 MDF access services offer have been placed in the model. The charges are assumed to remain constant in nominal terms.

Equipment costs We have made use of Analysys Mason's estimates for the cost of CPE, DSLAMs/MSANs and line cards, and predict a reduction in cost of 2% each year. The annual maintenance of all electronics equipment is estimated to be 15% of the initial capex.

Co-location costs MDF co-location recurring and non-recurring charges stated in the KPN MDF access co-location offer 2008 are applied in the model. These charges are assumed not to reduce over time.

Fibre unbundling

The network architecture for a service provider using FU is included below in Figure 4.5. With its planned FTTH deployment, Reggefiber will adopt a model where an Area PoP building contains equipment type such as optical distribution frame (ODF) and Ethernet switches, and these Area PoP will be connected to City PoPs (comparable to KPN's central offices). Based on OPTA understanding of Reggefiber dimensioning rules, we have considered that the average number of lines per Area PoP is 2000–3000, and that the number of Area PoP per City PoP is 15–25 (therefore each City PoP will cover on average 50 000 lines). These dimensioning rules are considered to be stable over time and per geotype.

The City PoP has a greater line capacity than a typical KPN central office and may not necessarily be at the same locations as KPN's existing central offices. For the purpose of our modelling, and in the absence of further insight into Reggefiber FTTH plans, we have assumed in our base-case scenario that Reggefiber's City PoP will be co-located with KPN's MDF. However, we have also modelled an option that allows us to measure the impact of Reggefiber City PoP not being co-located with KPN central office.

The costs included in the model are

- CPE (in this case a media converter)
- rental of fibre loops from Reggefiber
- co-location space and associated services at the Area PoP
- Ethernet switches (with 100Mbit/s Optical cards) at the Area PoP
- dark fibre backhaul from the Area PoP to the City PoP
- Ethernet switches (with 10Gbit/s Optical cards) at the City PoP
- co-location space and associated services at the City PoP
- and if relevant (e.g. if City PoPs are not co-located with KPN MDF at the KPN central office), backhaul from the City PoP to the KPN central office.

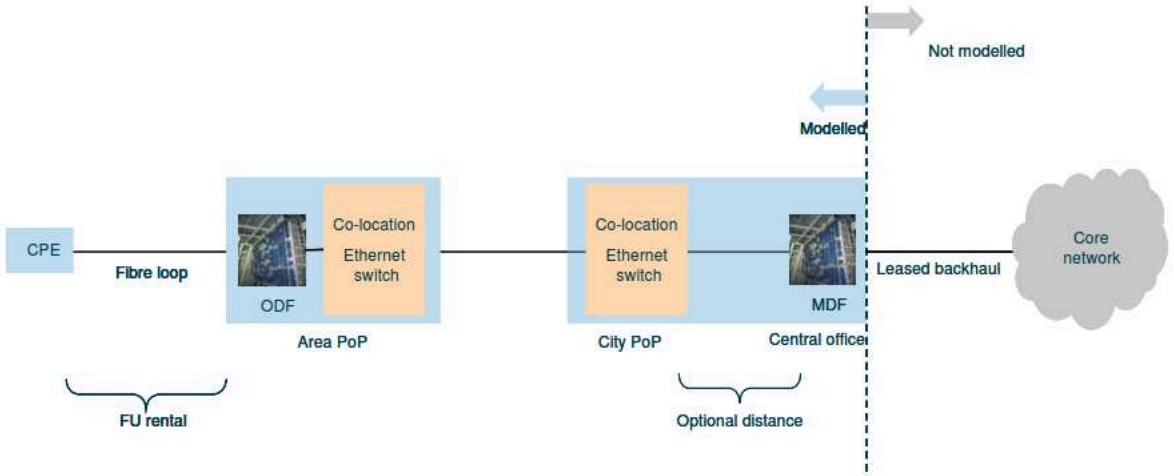

Figure 4.5: Network architecture modelled for FU [Source: Analysys Mason]

Local loop costs

We understand that Reggefiber plans to apply a price for a two-fibre unbundled line (one fibre for analogue TV and one fibre for voice and broadband) within a range of EUR12 to EUR15 per month per home[13] depending on the construction cost in each area.

Given the uncertainty over how this price will vary in practice (within the specified range) in specific geographical location, we have run the model with both the minimum monthly price rental of EUR12 and the maximum monthly price rental of EUR15 (called respectively FU-12 and FU-15 in the remaining of this document). We have assumed that these costs will remain stable over time.

Equipment costs (at Area PoP and City PoP)

We have used Analysys Mason's estimates for the cost of Ethernet switches and have checked the consistency of these data with operator estimates. We have assumed that they will reduce in cost by 2% each year, and that the annual maintenance of these electronics is estimated to be 15% of the initial capex.

Co-location costs (at the Area PoP and City PoP)

We understand that Reggefiber plans to provide the following co-location offer at the Area PoP:

- One-off fee (installation fee) for EUR3000
- Recurring co-location charge at a different price according to the number of operators at Area PoP: EUR500 per provider for 1 operator, between EUR250 and EUR400 per provider for 2 providers, between EUR175 and EUR325 per provider for 3 providers.

13 The installation fee is EUR100

We have estimated the pricing scheme for co-location at the City PoP is the same as in KPN's central office (see below).

These charges are assumed to be stable over time.

Backhaul from the Area PoP to the City PoP

We understand that Reggefiber plans to offer a dark fibre backhaul service for EUR600 per month for a redundant backhaul and between EUR200 and EUR400 for a non-redundant backhaul. The redundant backhaul is assumed to be the preferred solution for KPN, while alternative providers use the non-redundant backhaul. We have assumed backhaul charges to be stable over time.

If relevant – Backhaul costs from the City PoP to KPN central office

In our base-case scenario, Reggefiber's City PoPs are considered to be co-located with the KPN MDF at its central office, and therefore no additional backhaul cost is considered.

If Reggefiber's City PoP is assumed not to be co-located with KPN's MDF, then three backhaul options are available:

- From a third party:
  - leased lines offer, for which we estimated a cost on the basis of European leased lines prices benchmarked in a study for the European Commission (which we extended for higher speed than STM-1)
  - dark fibre offer, for which we estimated a renting cost to be around EUR4.5 per meter per annum
- From KPN, in the absence of a leased line reference offer for bandwidths over 155 Mbit/s, we have used the transport component of its WBA offer (Section 3 of KPN's WBA reference offer which is dependent on the locations at which the product is purchased – local, regional or national – and the quality of service provided – premium, medium or best effort). We have used local transport (MCL level) and medium quality of service in the base case.

For all these backhaul options, we have assumed these charges to be stable over time.

It should be noted that we considered alternative operators to follow the same type of deployment as KPN, whereas in practice alternative operators may opt for a more focused roll out.

Analogue TV overlay for FU

In the model, we have included scenarios whereby a provider offers an analogue TV service. As discussed in Section 3.3, we have assumed that such an operator will follow a pure reseller model

and buys the service from a wholesaler at an estimated price between EUR4 and EUR6 per subscriber. As a result, we have estimated an average monthly cost per subscriber served. We have also considered that analogue TV subscribers will be provided with a more expensive CPE than FU subscribers (as the CPE will need to combine media and RF converter as opposed to a simple media converter for FU CPE).

We have assumed that there is no incremental line rental charge for access to the second fibre, which is used to provide the analogue TV service (as it is our understanding that both fibres are included in the monthly FU price of EUR12 to EUR15).

WBA

The network costs for WBA include a CPE (media converter) and WBA charges from KPN. As KPN does not offer an MDF delivery WBA product, we have modelled a hypothetical product with delivery of the bitstream service at the central office, by removing the transport component from KPNs WBA pricing.

This network architecture is illustrated below.

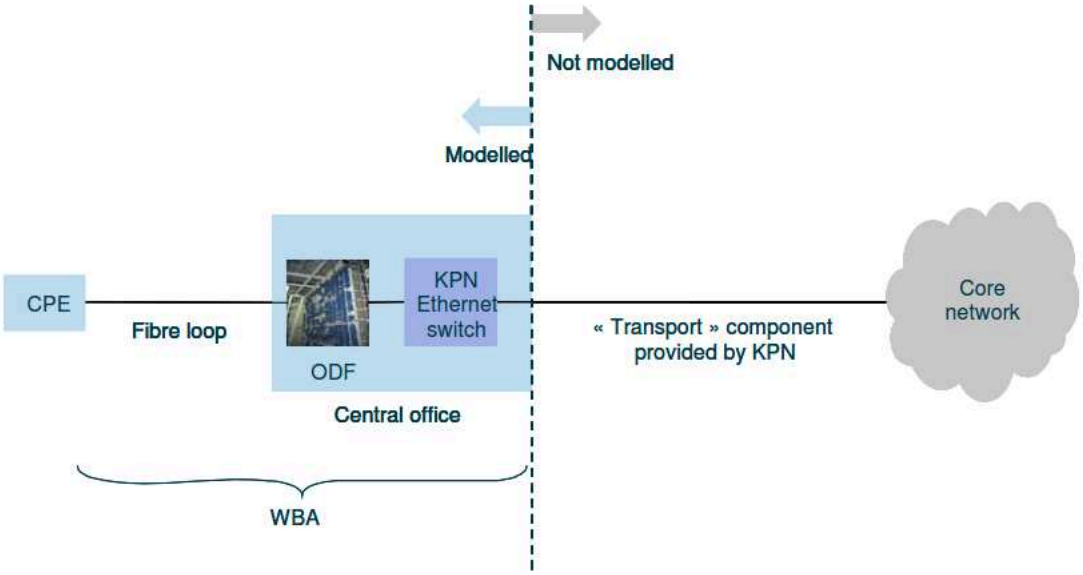

Figure 4.6: Network architecture modelled for WBA [Source: Analysys Mason]

The source of WBA line rental prices is KPN's proposed WBA reference offer. The line rental includes:

- **Network access tariff** (EUR19 per line per month plus EUR25 initial connection charge). It should be noted that, we have assumed that KPN will charge a significantly lower connection charge than the EUR425 in its proposed reference offer[14].

- **Access speed tariff**. We have assumed that if an alternative provider is to generate significant incremental revenue from fibre services, then it will need to offer a significantly faster service than are possible through LLU. In our base case, we have assumed a speed of 100Mbit/s. KPN's proposed access speed tariff at this speed is EUR36.32 per line per month. However, this price falls rapidly at lower speeds (e.g. at a speed of 30Mbit/s, this fee is EUR7.32 per line per month).

4.4.2 Summary

Figure 4.7 below summarises the network costs that are included for each of the options discussed above, and also indicates which of the costs are largely fixed costs (i.e. incremental costs are not triggered by new subscribers joining the network), those that are partially variable with the subscribers (i.e. additional costs may be incurred if sufficient new subscribers are acquired) and those that are fully variable with the number of subscribers.

	Fixed costs	*Cost partially variable with subscribers*	*Cost fully variable with subscribers*
LLU	Co-location costs	DSLAMs/ MSANs	CPE Rental of local loops Line cards for DSLAM/MSAN
FU	Co-location costs	Ethernet switches Backhaul	CPE Rental of fibre loops
Analogue TV overlay			CPE Resell costs
WBA			CPE Line rental (network access and speed tariff elements)

Figure 4.7: Summary of costs modelled [Source: Analysys Mason]

[14] Based on: http://www.kpn-wholesale.nl/files_content/documenten/nonsecure/2008-01394-KWA.pdf

5 Results from the model

In this section, we provide the results of our modelling. We firstly discuss the business case for alternative providers using either FU or WBA. We then discuss briefly the business case of KPN using FU.

5.1 The business case for alternative providers

We have evaluated a number of different business cases for alternative providers to use FU or WBA. For each case, we present the costs relative to a situation in which operators provide local loop access and have invested the associated up-front costs.

[Confidential:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX].

We then consider that alternative providers progressively connect to Reggefiber's City PoPs. We assumed that they would connect up to 85% of Reggefiber's City PoPs, therefore representing [Confidential: XXX] of households in the Netherlands, which is equivalent to a typical roll-out for alternative operators using LLU.

Base-case scenario

For our base-case scenario, we have selected the following inputs:

- The modelled operator chooses to offer just voice and broadband services, it does not offer analogue TV.
- The alternative operator has a 5–10% share of the market in the areas of the Netherlands where the operator is rolling out its services. If we assume 50–70% coverage, this translates into serving 3–7% of all households in the Netherlands.
- We have taken the FU price range provided by Reggefiber (EUR12 to EUR15 per month) and we provide results for these two extreme cases. For LLU and WBA, we made use of KPN's existing reference offers.
- We have estimated that each City PoP was co-located with the KPN MDF at its central office.

The various costs associated with the provision of fibre-based services can be broken down into different categories:

- **Backhaul capex** – fixed and one-off cost for enabling transport to the different network nodes. This can include (as applicable) the initial set-up cost for dark fibre, leased lines or the set-up of the necessary ports and VLANs for KPN's WBA transport service.
- **Co-location capex** – charges for the installation of equipment in the central office.
- **Equipment capex** – charges for any hardware needed for the respective technologies. As an example, this includes the cost of DSLAMs/MSANs and line cards for LLU and Ethernet switches for FU.
- **CPE capex** – cost for equipment that is provided to the consumer, enabling them to make use of the services offered.
- **Backhaul opex** – recurring cost for the use of backhaul services. This includes when applicable distance or traffic related charges for the different methods of transport or the rental charge for leased lines.
- **Co-location opex** – recurring charges for the placement of equipment in the local exchange, effectively being a rent for the occupied room.
- **Equipment opex** – maintenance cost for the equipment used, including electricity and repair costs.
- **Local loop opex** – line rental charges (for LLU, FU or WBA), as well as disconnection and connection charges.

For the base case, Figure 5.1 shows how total costs vary depending on which strategy an operator adopts. The modelled costs for LLU are included for comparison.

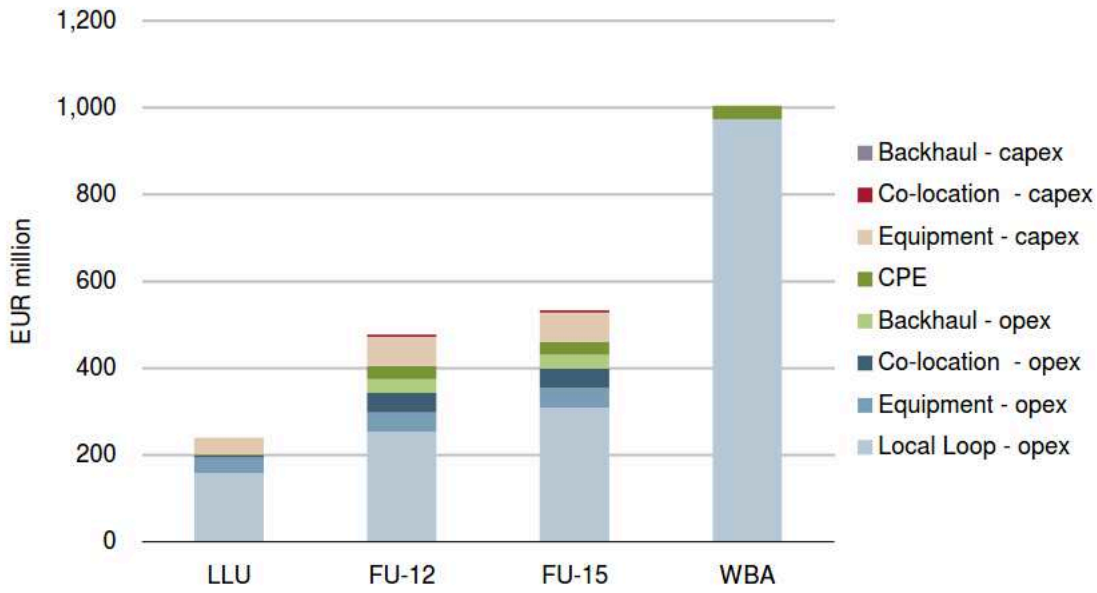

Figure 5.1: NPV (over 20 years) of the cost of a fibre network under different scenarios using inputs from the defined base case (60% of the households covered) [Source: Analysys Mason]

Figure 5.1 above shows that LLU is a significantly cheaper option than either WBA or FU. However, it should be noted that the LLU costs only represent the ongoing costs of leasing and maintaining services, since we assume that the network is already deployed. Of the two fibre-based services (assuming a 100Mbit/s service), FU is cheaper than WBA. This is driven by the high WBA charges for high access speeds (EUR36.32 per month for 100Mbit/s). Note that this charge falls significantly with lower speeds (as illustrated in one of our sensitivities below in Figure 5.7).

We have also considered how the cost per subscriber varies across the different geotypes. Figure 5.2 illustrates the monthly cost per subscriber for each service delivery option for each individual geotype. For comparison, in this chart we have also included the cost of alternative providers using SLU from our previous study for OPTA. The geotypes are ordered by line density.

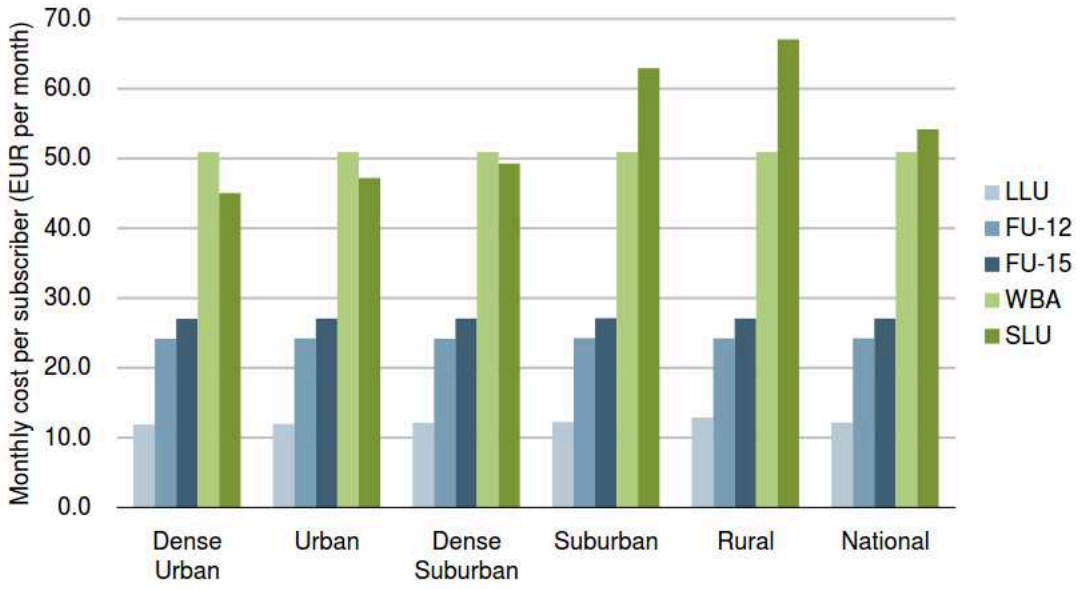

Figure 5.2: Monthly cost per subscriber per geotype for the base case scenario [Source: Analysys Mason]

The LLU cost per subscriber is EUR11.9 in the dense urban geotype and increases to EUR12.9 per month in the less densely populated area with a national value at EUR12.2.

This is mainly due to the fact that there are fewer households per central office in rural areas, leading to increased costs of co-location, equipment and backhaul per subscriber

The cost per line of FU equates to EUR24.2 for a FU at EUR12 per month and around EUR27.1 for a FU at EUR15 per month. These costs are stable across the different geotypes. This can be explained by the fact that, under the FU case all the drivers and inputs (e.g. number of lines per Area PoP, number of Area PoP per City PoP, equipment costs, monthly line rental) are considered

to be identical. In practice, it is quite likely that some elements (including Reggefiber's charge per fibre) will vary per geotype, providing a higher cost per line in the less densely populated areas.

The cost per subscriber for WBA is much higher, at EUR50.9 per month. As there are no fixed costs associated specifically with central offices to provide this service, the cost per subscriber is constant across all geotypes.

The cost per subscriber of SLU (calculated in our 2007 study) is higher than FU, at around EUR45.0 per month in the most densely populated geotypes. Given that alternative providers can offer higher speeds and more services using FU, this suggests that FU would be a preferred option to SLU. It is also worth noting that the cost gap between SLU and FU widens in less densely populated geotypes. This is because FU cost does not vary per geotype in our model whereas the SLU cost per line increases as a result of fixed costs (at street cabinet and central office) being supported by fewer lines in less densely populated geotypes than in dense areas.

The difference between the LLU cost per line and the cost per line for other options provides an indication of the monthly incremental net revenue that it would be necessary to recover from each customer in order to cover the incremental costs. For example, Figure 5.2 shows that the incremental net revenue needed to cover costs to use FU services rather than LLU is between EUR12.0 and EUR14.9 per subscriber per month. For WBA, the difference is around EUR38.8 per month.

Increased market share

With similar inputs to the base case, we have assessed the impact of increased market share for an alternative operator.

Figure 5.3 below shows the total cost per line if the alternative provider reaches a share of addressable lines of respectively 5%, 10%, 20% and 30%.

There is a small decrease in the cost per subscriber for LLU (less than EUR1 per month). This occurs because some of the costs (co-location, backhaul and Ethernet switches) have elements that are not variable with the number of subscribers so when increasing the number of subscribers the implied cost per subscriber decreases only slightly. However, overall, the scale of an operator does not appear to be an important driver of costs (at least once the network has already been deployed).

This is in contrast with FU and SLU, for which a change in market share has a significant impact on the cost per subscriber. This results in a narrowing gap between FU and SLU for very high market shares.

The cost per subscriber for WBA also changes depending on the operator market share. This is due to the volume discount offered by KPN (a 5% discount for 20 000 lines up to 20% for over 150 000 lines).

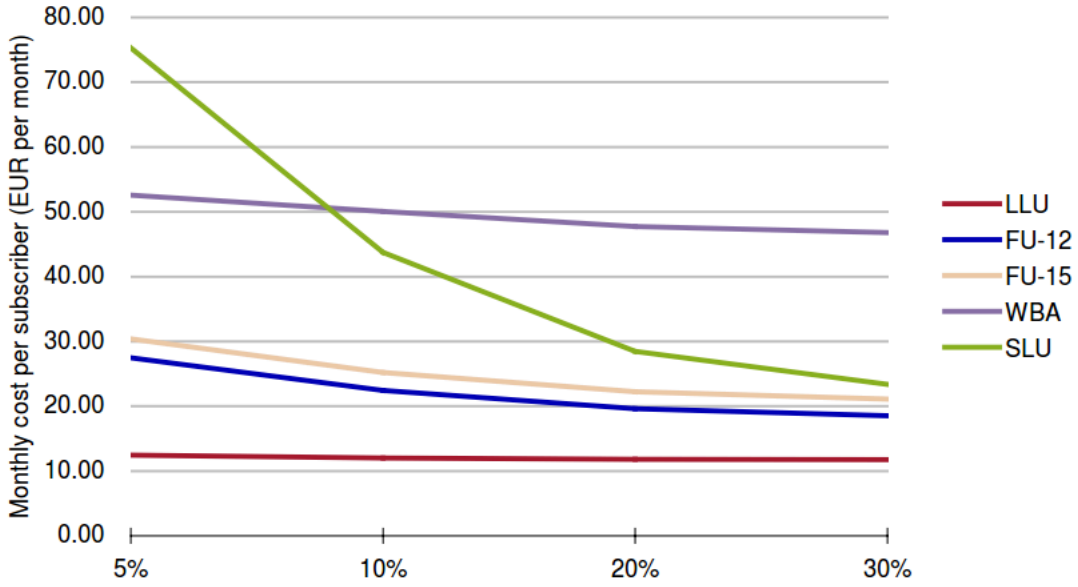

Figure 5.3: Average monthly cost per subscriber for an operator with various market shares [Source: Analysys Mason]

On the next figure, we have plotted the share of cost that relates to the main cost categories for each technology.

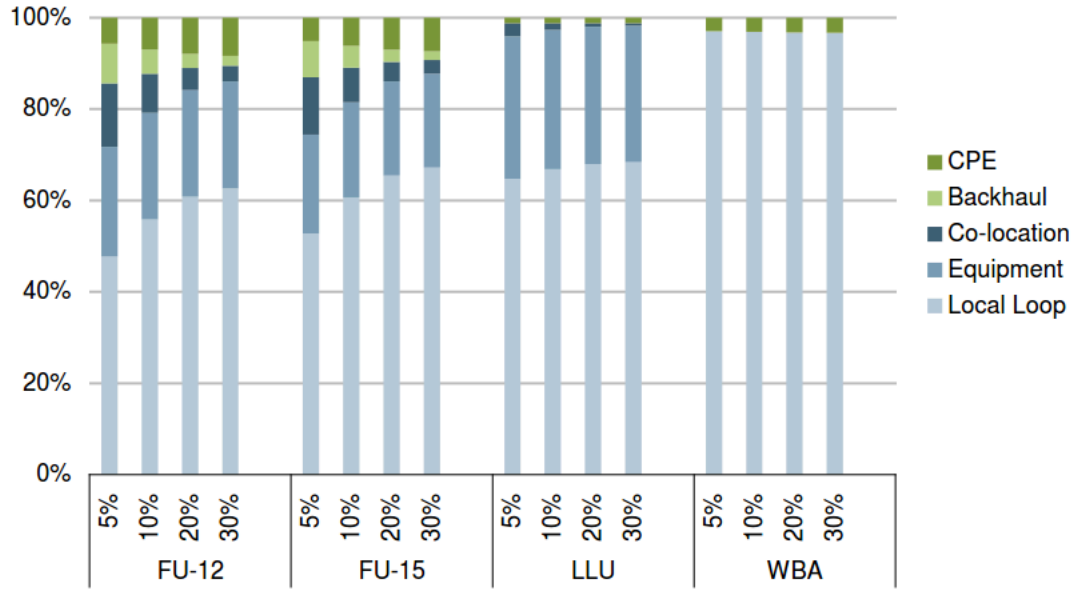

Figure 5.4: Share of different cost categories for each technology with different market shares [Source: Analysys Mason]

We can see that in LLU and WBA, the fraction of cost associated with each category does not change much with market share, because the vast majority of costs are variable costs. On the opposite, for FU, the share associated to each cost category changes significantly with market share, since costs like co-location, backhaul, and equipment which are mainly fixed costs see their relative impact decrease at higher market shares. For instance, these costs represent approximately 60% of all costs at a 5% market share but less than 40% of all costs at a 30% market share.

This shows that FU has higher economies of scale than LLU and WBA.

Offering analogue TV

We have considered the business case of a fibre unbundler choosing to offer analogue TV. We have assumed that the operator follows a pure reseller model for analogue TV, and have evaluated two different take-up scenarios. In the first scenario, 30% of the alternative provider's subscribers take up the TV service, while 70% sign up for TV in the second scenario. Note that we have only considered this option for a provider using FU, as in our understanding, it is not currently possible to offer an analogue TV service via WBA.

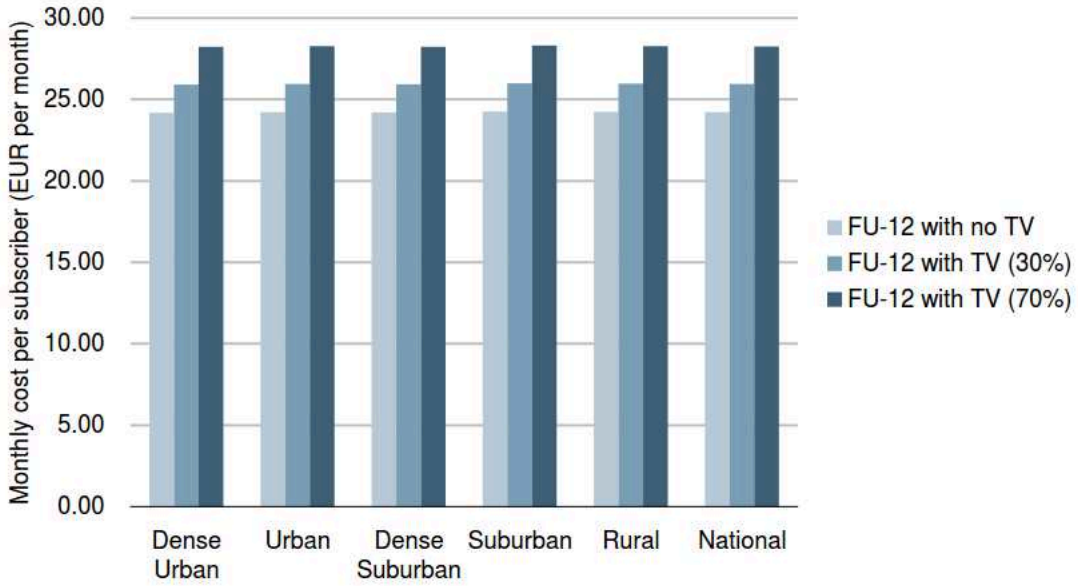

Figure 5.5: Average monthly cost per subscriber per geotype for various TV shares on the basis of FU-12 [Source: Analysys Mason]

For a 30% and 70% take-up of TV services, the cost per subscriber for the option with analogue TV (and therefore the incremental TV revenue that would need to be generated in order to recover this cost) is respectively EUR1.7 and EUR4.0 higher than our base case scenario (with no TV option).

Different extent of the provider's backhaul core network

We have considered the case that Reggefiber City PoPs are not be co-located with KPN's MDF, and that a backhaul link needs to be considered between the City PoP and the MDF.

We have considered that the alternative operator would have for the following options:

- buy a leased line from a third party
- buy a dark fibre from a third party
- buy a transport service from KPN.

The figure below illustrates these three options. For a City PoP to MDF backhaul based on leased lines and dark fibre, the additional costs per subscriber respectively represent an increase of EUR0.2 to EUR2.4 compared to the base case subscriber cost per line. We believe that the transport component of WBA offer does not represent the real price to be paid by operators for the short distance between CP and MDF. However, it is an interesting reference point in that it its not consistently much more costly than other options (EUR6.6 higher than the base case).

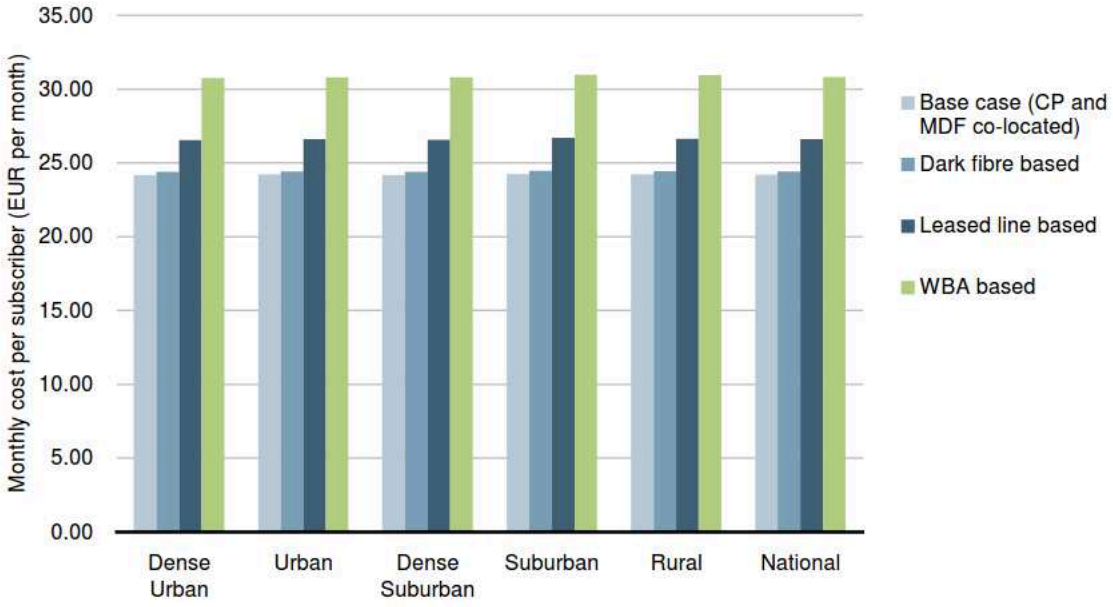

Figure 5.6: Monthly cost per subscriber per geotype for various backhaul when CP not co-located with MDF [Source: Analysys Mason]

Reduction of KPN's WBA charges

As discussed above, WBA appears much more expensive than FU due to the high charges for an access speed of 100Mbit/s in KPN's proposed WBA reference offer (EUR36.32 per month). By contrast, the charge for a 30Mbit/s is 7.32 per line per month. As an illustration, we have run a

scenario in which the access speed charge for WBA is reduced to EUR7.32 per month, as presented in Figure 5.7 below.

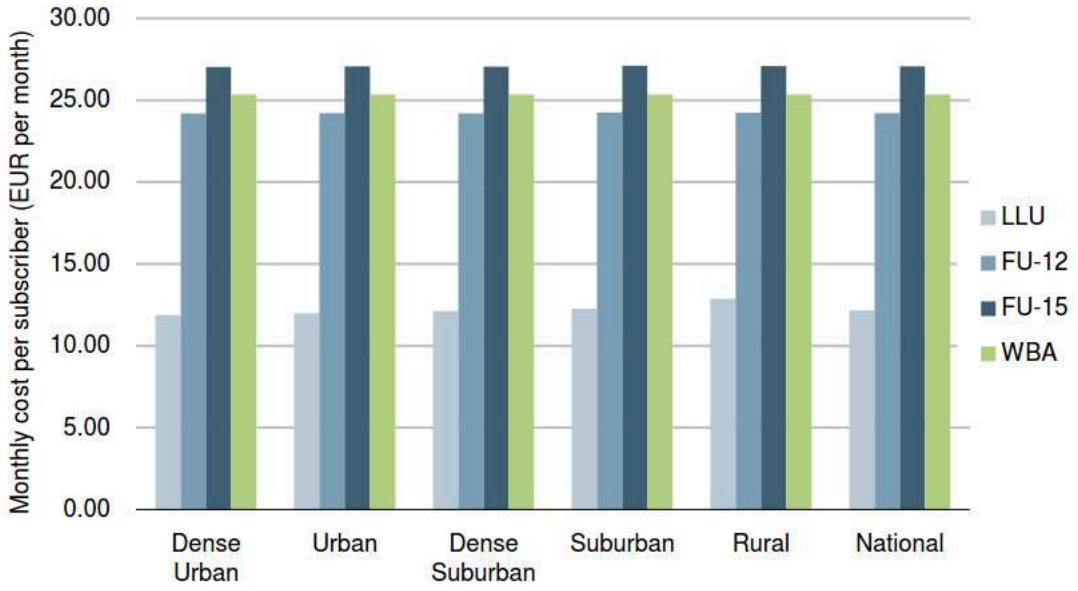

Figure 5.7: Monthly cost per subscriber per geotype when the speed tariff is set to EUR7.32 [Source: Analysys Mason]

This reduction in charges gives an average cost per subscriber of EUR25.4, which is in the same range as the cost per subscriber estimated for the FU case (FU-12 – FU-15). However, since it is likely that the cost per line for FU would be at the lower end of this range for dense areas and towards (or even above) the upper end for less populous areas, Figure 5.7 shows that KPN WBA with an appropriate monthly pricing might be an interesting solution in low-density areas.

5.2 The business case for KPN

KPN is expected to use Reggefiber's FTTH network in the same way as alternative operators; as such we have based our model for KPN's business case on the alternative operators' business case changed a limited number of parameters:

- We have considered that KPN will connect to 100% of the City PoPs in Reggefiber FTTH network (versus 85% for alternative operators). This will allow KPN to offer fibre-based service to around [Confidential: XXX] of the population in the long term.

- We have considered that KPN's share of lines covered will reach 40–50% (versus 5–10% for an alternative operator), which represents its current market share[15].

The figure below presents the cost per subscriber for the different geotypes and how KPN's cost compares with the one of alternative operator (in our base case scenario).

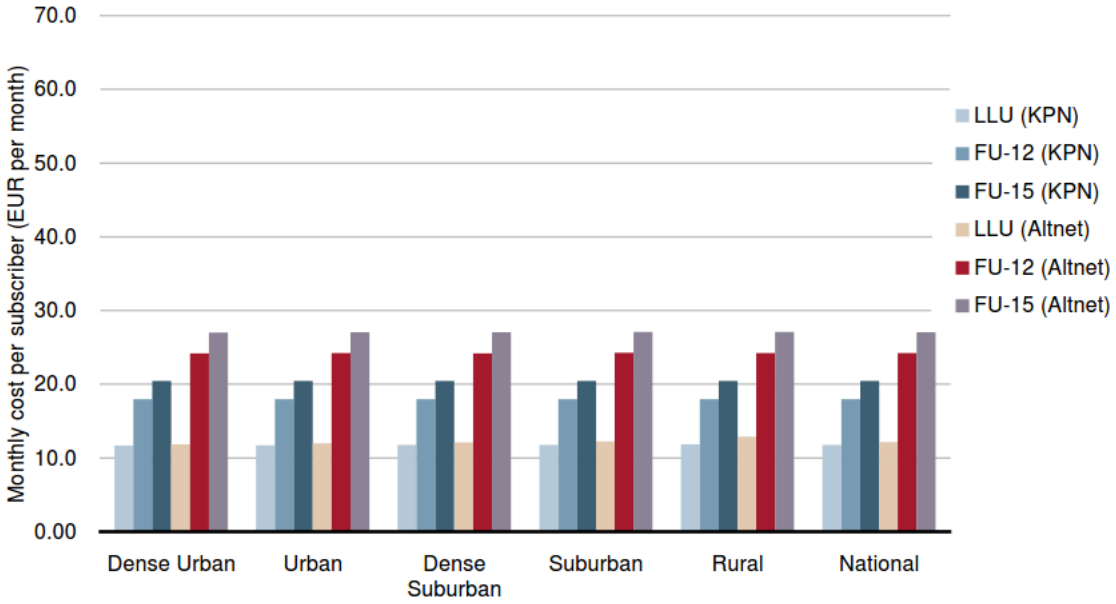

Figure 5.8: Monthly cost per subscriber per geotype for the base case scenario [Source: Analysys Mason]

For KPN, the cost per subscriber for FU ranges between EUR18.0 and 20.4 per month, which represents an incremental cost of EUR6.2 to EUR8.7 relative to LLU. This compares, for alternative operators, with an incremental cost of EUR12.0 to EUR14.9 (as presented in Section 5.1) in addition to the LLU cost. As a result, KPN requires a much lower additional ARPU than alternative operators to recover the incremental cost of FU over LLU.

[15] Source: Telegeography

6 Conclusions

FTTH in the Netherlands is still at an early stage of development. Recently, Reggefiber released ambitious FTTH deployment plans to reach up to [Confidential: XXX] of population. However, Reggefiber's reference offer for FU has yet to be finalised, and its detailed network dimensioning (e.g. size of Area PoP and City PoP, co-location in City PoP etc.) is still not finalised. It should be noted that Reggefibers tariff proposal is a commercial offer and not necessarily a cost-oriented tariff. Nonetheless, we believe that this study is able to draw the following conclusions with a reasonable amount of certainty.

6.1 Business case for alternative operators

The widespread deployment of services based on FU by an alternative provider may well be viable, but is by no means straightforward. The conclusion from the previous study therefore remains unchanged. For a voice and broadband only service, we estimate that the incremental cost per subscriber relative to LLU is between EUR12.0 and EUR14.9 per subscriber per month. If an alternative provider were also to offer analogue TV services then this range will increase to EUR13.7–18.9 for a take-up to TV services of between 30% and 70%.

Existing and proposed FTTH prices provide mixed evidence as to whether the required incremental monthly net revenue per subscriber will be achievable:

- We understand from OPTA that KPN's proposed retail monthly pricing for FTTH will be EUR65 to EUR110[16] (including VAT), although these prices include TV access. This compares to KPN's existing ADSL plus VoIP offer of EUR35 to EUR65 per month[17] and its TV offer 'Digitenne' priced at EUR7.5 per month[18]. Based on these figures, KPN aims at reaching an additional EUR22.5 to EUR37.5 revenue per month per subscriber.

- In France, Free is offering FTTH services, including limited digital TV channels, for EUR29.99 per month, the same price as its DSL offer. The Free pricing would not allow the additional costs to be recovered.

For an alternative provider choosing to offer very high broadband speeds (e.g. 100Mbit/s), then FU appears less costly than WBA. This is due to the high-speed element in KPN's proposed WBA reference offer (EUR36.32 per line per month for 100Mbit/s). Either this element would have to be reduced or alternative providers would have to offer lower speeds for WBA to compete with FU. For example, the speed element for a 30Mbit/s service is just EUR7.32 per line per month.

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16 http://www.kpnglasvezel.nl/nederland/?id=20, July 2008

17 http://www.kpn.com/internet/internet-bellen.htm

18 http://www.kpn.com/tv/digitenne.htm.

Based on Reggefiber's current proposal for a pricing scheme FU appears to be more subject to economies of scale than it was found in our previous study on FTTH for OPTA. This is because the FU architecture in the current report is different from the one in the previous study: previously, ODFs were assumed to be located in (relatively larger) City PoPs whilst they are assumed to be placed in AreaPoPs in this report. This implies that smaller service providers have an important disadvantage to larger service providers (and especially as regards to KPN).

With the exception of the monthly rental price for FU (which we understand from Reggefiber may vary between EUR12 to EUR15), all inputs, network dimensioning and units costs are constant across all geographical areas. This means that our model provides a range of costs per subscriber using FU (FU-12 – FU-15) that does not vary across different regions. However, it is likely that in practice FU in the most urban areas may well be cheaper than for less populated areas (if only because the Reggefiber monthly price is lower).

If the City PoP were not to be co-located with KPN's MDF, then we have estimated that the extra cost per subscriber per line for FU will typically be in a range of EUR0.2 to EUR2.4 based on third-party backhaul. This does not change our conclusion on the viability of the FU business case for alternative operators, which remains possible but not straightforward (because it requires significant additional revenue over the LLU case).

6.2 Business case for KPN

Given its potential high market share of 40–50%, KPN is in a much better situation than alternative operators to recover the incremental cost of FU over LLU, as the economies of scale lead to a lower incremental cost of FU over LLU. Assuming that KPN achieves an additional EUR6.2–8.7 per retail subscriber for FU-based services (over LLU-based services) and that it maintains its current market share, we calculate that KPN's business case is viable**.** The KPN incremental cost relative to the LLU case is EUR5.8–6.2 less than that faced by the alternative operators. As a result, KPN business case is considerably better than the case for alternative operators.

Annex A: Definition of geographical areas

To be consistent with our previous study, we have retained the same geographical areas ('pseudo-MCL' areas) that were modelled previously. In this annex, we recall how 'pseudo-MCL' areas have been determined in our previous study.

The definitions are derived from the following information:

- number of households per street cabinet
- MDF to which each street cabinet is currently connected
- ZIP6 code for each street cabinet
- ZIP6 code for each MCL
- region associated with each ZIP4 code.

Determining the MCL areas involved a two-step process:

- defining MDF areas
- using the MDF areas to define MCL areas.

Each of these steps is outlined below in turn.

A.1 Definition of MDF areas

In order to determine pseudo-MDF areas we undertook the following steps:

- assigned each street cabinet to the relevant ZIP4 region
- used the association between street cabinets and MDFs to calculate, for each ZIP4 region, the number of households connected to an MDF via a street cabinet lying in this region
- assigned each ZIP4 region to the MDF with the largest number of households connected via a street cabinet in this region.

This resulted in the definition of MDF areas composed of contiguous blocks of ZIP4 regions. We defined 1300 MDF regions in this way (this is slightly lower than the actual number of 1359 MDFs; we believe the discrepancy is due to the fact that the information for ZIP4 regions is not as up to date as that for ZIP6 regions).

A.2 Definition of MCL areas

We assume that each MCL area is composed of the set of existing MDF areas that are closer to that MCL than to any other MCL. In order to determine these areas, we undertook the following steps:

- assigned each MCL to the centroid of the relevant ZIP4 region
- constructed Voronoi polygons around each MCL location. These allocate to each MCL the area that is closer to that MCL than to any other MCL
- assigned to each MCL all MDF areas for which the centroid lies within that MCL's Voronoi polygon.

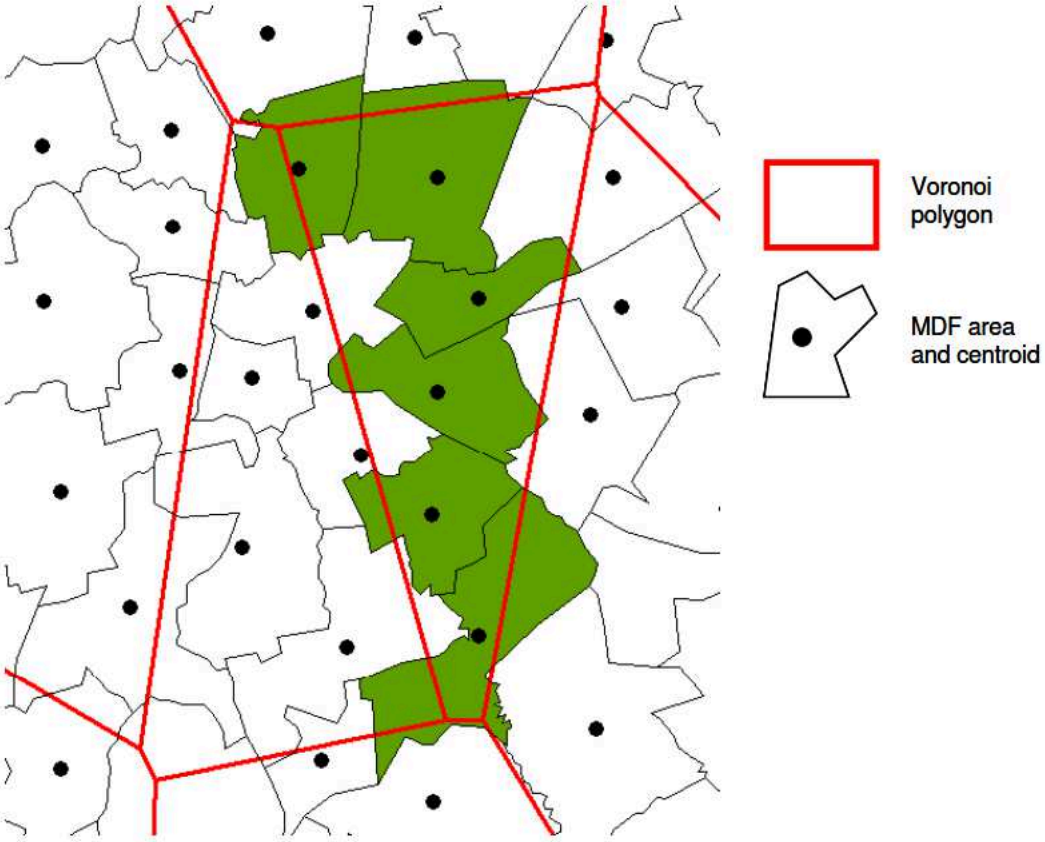

Figure A.1: Allocation of MDF areas to Voronoi polygon associated with each MCL (the green MDF regions are those allocated to the MCL with the associated Voronoi polygon) [Source: Analysys Mason]

Annex B: KPN reference offers used in the modelling

For LLU, we took most of the prices from:

- The 2003 KPN Reference offer for MDF Access Services[19] (updated in 2007):
  - monthly rental charge: EUR7.83 for full LLU, EUR0.19 for shared LLU
  - initial charge per customer: EUR13.85 for full LLU, EUR14.95 for shared LLU
  - disconnection charge: EUR6.96 for full LLU, EUR11.55 for shared LLU
- The 2004 KPN Reference Offer for Collocation[20] (updated in 2007):
  - initial co-location charge: EUR14,559 for 1-rack, EUR30,999 for 3-rack and EUR45,808 for 5-rack
  - recurring yearly co-location charge: EUR0 or 1-rack, 2,084 for 3-rack and EUR2,315 for 5-rack.

For WBA, we relied on KPN's proposed WBA Reference offer[21]:

- Access:
  - monthly rental charge: EUR19.00
  - initial charge per customer (line): EUR25
  - initial charge per customer – FTTH (delivery): EUR425
  - disconnection charge: EUR25
  - access speed tariff:
    - EUR36.32 for 100Mbit down, 10Mbit up
    - EUR13.32 for 40Mbit/s down, 8Mbit/s up
    - EUR12.32 for 40Mbit/s down, 6Mbit/s up
    - EUR9.82 for 40Mbit/s down, 4Mbit/s up
    - EUR7.32 for 30Mbits/s dows, 4Mbits/s up.
- Transport:
  - Setup 1 Gbit port: EUR22,500 (local)
  - Setup 10Gbit port: to be decided (local – we assume this to be EUR40,000)
  - Setup VLAN: EUR200 (per VLAN)
  - Transport tariff: **Local**: EUR6 (premium), EUR5 (medium), EUR4 (best effort)

19 http://www.kpn-wholesale.nl/nl/1856-Reference_Offer_ULL.html..

20 http://www.kpn-wholesale.nl/templates/dispatcher.asp?page_id=1855.

21 http://www.kpn-wholesale.nl/nl/1936-Wholesale_Broadband_Access_Service.html.

Annex C: Reggefiber draft tariff schedule FU used

For Fibre Unbundling, we took the following charges:

- Access:
  - installation fee: EUR100
  - fibre line rental: EUR12 to EUR15
  - discount rate monthly rental charge[22]:
    - 2.5% discount on City Pop lines if over 2000 lines are ordered at the City Pop
    - 5% discount on City Pop lines if over 3500 lines are ordered at the City Pop
    - 7.5% discount on City Pop lines if over 4500 lines are ordered at the City Pop
    - 10% discount on City Pop lines if over 6000 lines are ordered at the City Pop
    - 12.5% discount on City Pop lines if over 9000 lines are ordered at the City Pop
    - 15% discount on City Pop lines if over 13000 lines are ordered at the City Pop
    - 17.5% discount on City Pop lines if over 18000 lines are ordered at the City Pop
    - 20% discount on City Pop lines if over 26000 lines are ordered at the City Pop
- Colocation:
  - Installation fee in Area Pop: EUR3000
  - Collocation monthly fee for considered provider in Area Pop: EUR500 (if 1 provider), [Confidential: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX]
- Backhaul:
  - Monthly fee: EUR600 for redundant backhaul [Confidential: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX]

[22] This is based on the assumption that a roll-out area will resemble a City PoP area