“Regulatory impact”

Deliverable 6.4

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Abstract:

This document reports on the activities of task 6.4. It gives a thorough overview of the current regulatory situation and reviews regulatory trends and future directions. It indicates main stakeholder understandings and it presents quantitative evaluation of the impact of regulation by calculating the missing revenues to come to a positive business case for the physical infrastructure provider, by applying extended game theoretic analysis, and by comparing the expected equilibrium to the social optimum. The main conclusion of this analysis is that regulation can have a decisive impact on the success of NGOA deployment and user take-up.

Finally, the document formulates some regulatory guidelines to encourage and stimulate the deployment of fibre-based infrastructure, the necessary profitability of the business case for the different NGOA stakeholders, and a high service take-up rate among the European citizens in order to fulfil the Digital Agenda for Europe. The guidelines are based on the regulation impact analysis presented in this deliverable, but also on the analysis of market demand and value networks presented in previous deliverables.

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Executive Summary

This deliverable describes the current regulatory settings in Europe and its Member States and elaborates on possible recommendations towards stimulating and speeding up NGOA deployment. These recommendations are based on both qualitative and quantitative analysis, presented both in this deliverable, as well as in the other deliverables of WP6. *This document reports on the activities of task 6.4, but doesn't include the analysis of unbundled and open access models. For this work, we refer to the work presented in D6.2 and D6.3.*

Currently, there is a variety of regulatory institutions on different hierarchical levels (European, national and even regional). Although these various institutions strive for achieving one common goal, i.e. offering broadband to all in one single European telecommunications market, they each have their own rules and interpretations. The first part of this deliverable gives a clear overview of the current and planned regulatory activities, in order to help reducing the regulatory uncertainty.

Apart from this more theoretical literature overview, the authors of the deliverable also kept constant contact with the different parties involved. This allowed us to also get an overview of the different states of mind and opinions. The next section of this deliverable therefore presents the opinions of municipal networks, NRAs, local governments, etc. on the current regulatory settings, and shows that most opinions are not in line. For example, large municipal networks in Sweden argue that State Aid regulation does not apply to their networks, as long as the stay on the passive layer. This viewpoint, however, is not supported by the PTS, the Swedish NRA.

Apart from evaluating the current regulatory regimes qualitatively, we also investigate the impact of regulations quantitatively. Although the combinations of possible improvements to the business case for the Physical Infrastructure Provider significantly improve the NPV, it still stays negative for the rural area, meaning that investment is not economically viable. These results can be used as an argument in promoting to allow State Aid in those regions. Having a business case that is economically viable, clearly cannot be the (only) goal of a municipal infrastructure provider or the regulator. We therefore developed a Broadband Performance Index (BPI), allowing to quantitatively reflect the Digital Agenda targets. This BPI clearly shows the impact of competition and take-up, and can be used to steer regulatory decisions. For example, using the BPI in a competitive setting, clearly shows that open fibre infrastructures maximize the regulator's objective function.

Finally, this deliverable concludes with clear recommendations and policy guidelines, resulting from several OASE project findings.

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List of abbreviations

ADSL	Asymmetric Digital Subscriber Line
ANP	Alternative Network Provider
AOB	Alternative Operator Board
AON	Active Optical Network
ARPU	Average Revenue Per User
BDUK	Broadband Delivery United Kingdom
BEREC	Board of European Regulators for Electronic Communications
BNetzA	Bundesnetzagentur
BPI	Broadband Performance Index
BSA	Bitstream Access
BT	Bristish Telecom
CAPEX	Capital Expenditures
CMA	Communications Management Association
CO	Central Office
DA	Digital Agenda
DG	Directorate General
DG Connect	DG for COmmunication, NEtworks, Content and Technology
DOCSIS	Data-Over-Cable Service Interface Specification
DT	Deutsche Telekom
EC	European Commission
ECJ	European Court of Justice
EU	European Union
FICORA	Finnish Communications Regulatory Authority
FTTB	Fibre-to-the-Building
FTTC	Fibre-to-the-Cabinet
FTTH	Fibre-to-the-Home
FTTO	Fibre-to-the-Office
FTTP	Fibre-to-the-Premises
GE	Generic Ethernet
HC	Home Connected
HFC	Hybrid Fibre Coax
ICT	Information and Communication Technology
IT	Information Technology
KPN	Koninklijke PTT Nederland (Royal Dutch Telecom)
LLU	Local Loop Unbundling
LTE	Long Term Evolution
Mbps	Megabits per second
MIP	Municipal Infrastructure Provider
NCA	National Competition Authority

NE	Nash Equilibrium
NEM	Netwerk Exploitatie Maatschappij
NGAN	Next Generation Access Network
NGOA	Next Generation Optical Access
NP	Network Provider
NPV	Net Present Value
NRA	National Regulatory Authority
ODF	Optical Distribution Frame
OECD	Organisation for Economic Co-operation and Development
Ofcom	Office of Communications
OLO	Other Licensed Operator
OPEX	Operational Expenditures
OPTA	Onafhankelijke Post en Telecom Autoriteit
PI	Performance Index
PIA	Physical Infrastructure Access
PIP	Physical Infrastructure Provider
PON	Passive Optical Network
PPP	Public Private Partnership
PTS	Post and Telecom Agency
SGEI	Service of General Economic Interest
SKL	Swedish Association of Local Authorities and Regions
SMP	Significant Market Power
TCO	Total Cost of Ownership
TFEU	Treaty on the Functioning of the European Union
TKG	Telekommunikationsgesetz
VDSL	Very-high bit-rate Digital Subscriber Line
VULA	Virtual Unbundled Local Access
WiFi	Wireless Fidelity

1. Introduction

This deliverable will investigate the impact of regulation (on both European and national level) on the development and deployment of Next Generation Access networks. We will start by giving an overview of current regulatory regimes, where the input is collected from available literature, laws and reports, as well as by conducting interviews with the different stakeholders. These inputs can then be compared to provide some concrete recommendations on how regulations should or could look like in the future. Based on these qualitative guidelines, we will investigate the possible effects of future guidelines on the quantitative techno-economic results obtained in D6.3 [5].

This document reports on the activities of task 6.4, dealing with the specific impacts of regulation on the final business models and value networks. The task also includes an activity on the analysis of different unbundled access and open access models (infrastructure, network, service), together with the multi-operator interoperability. Such activity is very thoroughly presented in D6.2 and D6.3 [4] [5], and will therefore not be elaborated on in this deliverable.

The document first gives, in Chapter 1, a very thorough overview of the current regulatory situation, starting by the introduction of important concepts and regulatory tools and bodies. The analysis is done both at EU level and at national level, concentrating on the case study countries that we have used throughout the WP6 work, but also taking a look at other important markets and the relevant regulation trends across the Continent. Because the regulatory framework is in constant evolution, we also review regulatory trends and future directions in order to tackle to some extent the sense of "regulatory uncertainty".

In Chapter 2 we report on the regulatory issues of specific cases, as well as the position and understanding of selected relevant stakeholders. The information gathered here was collected by keeping constant contact with the different parties involved (decision makers at the European Commission, national regulators, operators of already deployed fibre networks etc.).

Chapter 3 presents a quantitative evaluation of the impact of regulation on the business case for NGOA (Next Generation Optical Access) deployment. It reports on areas where public funding might be needed, and elaborates on activities of extended version of the game theoretic analysis from T6.3. The analysis compared the expected equilibrium to the social optimum has been performed and is reported here as well.

Finally, Chapter 4 the document formulates some regulatory guidelines for enabling and ensuring the introduction of NGOA networks in Europe, aiming at moving to the social optimum.

1. Overview of regulation in place and evolution trends

Although the mind-set of all regulatory authorities is set in the same direction, namely towards offering broadband to all, and achieving one single telecommunications market across Europe, the variety and diversity of regulatory institutions on regional, national and European level, that all have their own rules, make it hard to see the overview. This section will therefore elaborate on the different regulatory institutions, on both national and European level, their decision power, recent evolutions and consequences. We will however start reviewing the so-called Digital Agenda for Europe, which sets the general framework for regulation itself.

1.1 Digital Agenda for Europe

In 2010, the European Commission has formulated some clear objectives to come to one single European telecommunications market by 2020 in its Digital Agenda [1]. These objectives require large investments in both new infrastructure and services, and especially the costs for infrastructure deployment are enormous. Although some of the objectives are progressing quite well, others seem to need a lot more attention (see also [2]).

The Digital Agenda for Europe is the European Union's roadmap for bringing the benefits of a digital society and economy to Europe's citizens. With regards to broadband, the main target has been set as follows:

"By 2020, all Europeans should have access to internet of above 30 Megabits per second (Mbps) and 50% or more of European households have subscriptions above 100Mbps."

In order to achieve such target, an EU broadband policy should promote concrete measures which could (i) foster investment by, for example, reducing investment costs and (ii) enhance infrastructure competition, taking into account that the competitive threat of alternative public and private investors (including local administrations and public utilities) would incentivize investments in NGOA by incumbent operators. Such actions should be coordinated both at EU and national levels, being this the reason why the Commission will work with Member States to generate effective national broadband plans. Moreover, the OECD has recently concluded that the cost savings in just four sectors of the economy (transport, health, electricity and education) would justify the construction of a national Fibre-to-the-Home (FTTH) network [3].

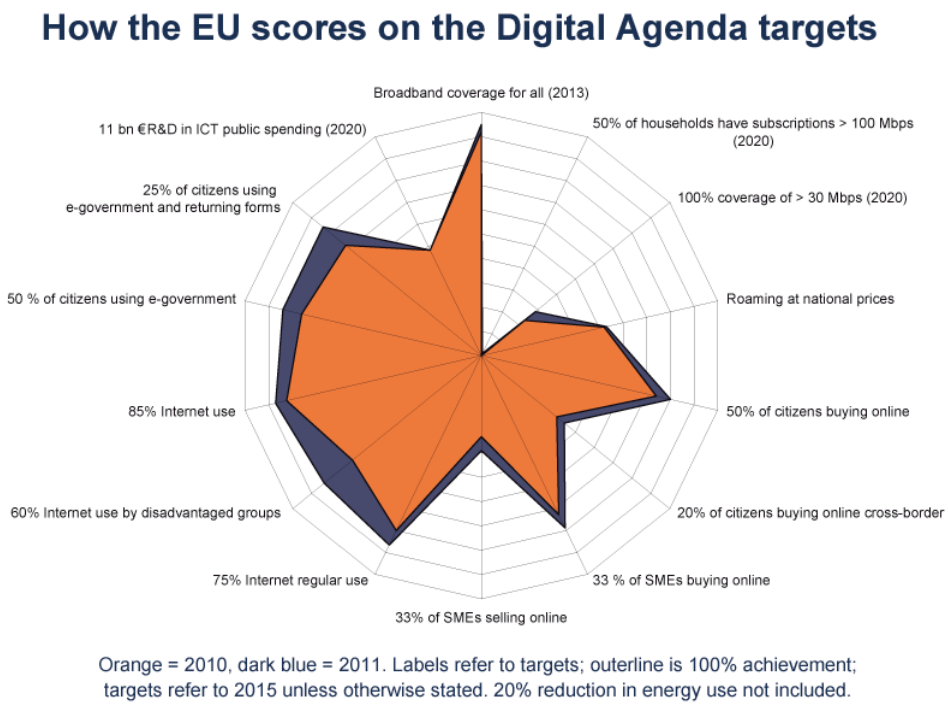


Figure 1: Digital Agenda Scoreboard

Few Member States have fully operational plans for ultra-high-speed networks with concrete implementing measures to realize their targets, notably as to the necessary funding. The broadband target will only be achieved if all Member States commit to it and set out an operational plan defining national targets. As part of the governance of the Digital Agenda, the EC will work with Member States to coordinate the establishment of national targets and will encourage peer-review processes among Member States in order to accelerate the transfer of best practice between policymakers. This work will be supported by an action-oriented broadband platform with a wide range of stakeholders.

Member State plans should comprise a balanced set of policy actions to incentivize and supplement private-sector action using the common framework resulting from a consistent and thorough implementation of the recently revised EU regulatory framework for e-communications and the State Aid Broadband Guidelines recently adopted by the Commission. Private investment should be encouraged by appropriate coordination of planning and rules for sharing physical infrastructure and by targeted financing measures to reduce risk and promote new open infrastructures.

Since the incumbents are not deploying a full scale Next Generation Access Networks (NGANs), other investment paths should be explored. Currently, the European Union does not always allow public investments in broadband. It is uncertain that the goals in the DA can be reached because of State Aid rules that block initiatives from public sector (e.g. municipalities).

Currently, there a lot of different laws, guidelines and directives on different levels of the hierarchical decision structure. National Regulatory Authorities (NRAs) should implement the directives formulated by the European Commission, but different opinions and interpretations of those directives often lead to different implementations, which hinder the development of one single telecommunications market across Europe.

According to EC, there are 3 major challenges towards achieving the DA:

- High-speed internet is a key infrastructure for the 21st century, but Europe falls far short of the necessary investments, leaving potential for growth and societal benefits untapped;
- There is little competitive pressure on incumbents to invest in modern broadband networks. Even where projects could be financially viable, alternative public and private investors (including local administrations and public utilities) are held back by high capital costs (interest rates) and the lack of long-term funding.
- There is currently no adequate strategy to publicly support the rollout of broadband networks in areas where there is no business case. Current levels of European support are sub-critical and are hampered a lack of planning and absorption capacity at the regional level.

1.2 EU regulation instruments

There are various instruments used by the European Commission to implement its objectives and goals and they have diverse degrees of enforceability vis-à-vis the Member States' legislative bodies (i.e. obligation to follow a given instrument); thus, such instruments (treaties, directives, decisions, recommendations and regulations) may have a direct or indirect effect on the laws of the EU's Member States:

- Any action undertaken by the EU is founded on *treaties* approved by the EU Member States. To achieve the set out aims, legislative acts such as regulations, decisions, directives and recommendations are used.
- *Regulations* are binding legislative acts that have to be implemented in their entirety across all EU Member States. For example, the EU has capped the maximum amount telecoms companies can charge a user for the roaming costs of their cellular telephone (EC Regulation No 544/2009) [6].
- *Directives* are not as binding as regulations. Instead, they are a goal that each Member State will implement according to its legislative processes. In the Framework Directive (Directive 2002/21/EC), the EC set out a roadmap in establishing a harmonized regulatory framework for electronic communication networks and services [7].
- *Decisions* are binding legislative acts that are directly applicable to whom it is addressed (e.g. The European Commission's March 2004 Microsoft Decision [8]).
- *Recommendations* are not binding. Instead they express the known views of an institution. In its recommendation of 30th of March 2012 (Action for Stability, Growth and Jobs [9]), the EC stressed the potential of the ICT industry in a job-rich recovery for the EU.

1.3 European regulation bodies

The main relevant regulatory body at European level is the European Commission, which takes legislative initiatives towards the Parliament, and issues directives, guidelines and recommendations. Much of the operative regulation is then delegated to the national level (through the national regulatory authorities, NRAs), which are however federated at EU level in the EC-mandated Board of European Regulators for Electronic Communications (BEREC). The EC, BEREC and NRA roles are discussed further below.

1.3.1 European Commission

The European Commission (EC) is the highest pan-EU regulation body. The Directorate General (DG) which is responsible for Broadband Access regulation is the newly formed (on 25 April, effective 1 July 2012), "DG Connect", which stands for the key areas they cover (**Co**mmunication **Ne**tworks, **C**ontent and **T**echnology). 'DG Connect' shows how the digital revolution is connecting and linking up Europe. The Commissioner for the Digital Agenda for Europe, is Neelie Kroes. The objective is *'to adapt and face the challenges of the next ten years*". The structure, culture and mission of the DG is being changed to become '*more flexible, with fewer managers, less fragmented, and better finding the links between policy and research areas*.'

1.3.2 BEREC

The Body of European Regulators for Electronic Communications (BEREC) was established by Regulation (EC) No 1211/2009 of the European Parliament and of the Council of 25 November 2009, as part of the Telecom Reform package. It replaced the European Regulators Group for electronic communications networks and services which was established as an advisory group to the Commission in 2002.

BEREC commenced its activities in January 2010. In the course of 2011 it became fully functional and ready to fulfil all its assignments as required by the current regulatory framework: *"We are committed to independent, consistent, high-quality regulation of electronic communications markets for the benefit of Europe and its citizens."*

BEREC contributes to the development and better functioning of the internal market for electronic communications networks and services. It does so, by aiming to ensure a consistent application of the EU regulatory framework and by aiming to promote an effective internal market in the telecoms sector, in order to bring even greater benefits to consumers and businesses alike.

Furthermore, BEREC assists the Commission and the national regulatory authorities (NRAs) in implementing the EU regulatory framework for electronic communications, to give advice on request and on its own initiative to the European institutions and to complement at European level the regulatory tasks performed at national level by the regulatory authorities.

The NRAs and the Commission have to take utmost account of any opinion, recommendation, guideline, advice or regulatory best practice adopted by BEREC. In particular, BEREC is requested to:

- develop and disseminate among NRAs regulatory best practices, such as common approaches, methodologies or guidelines on the implementation of the EU regulatory framework;
- on request, provide assistance to NRAs on regulatory issues;
- deliver opinions on the draft decisions, recommendations and guidelines of the Commission as specified in the regulatory framework;
- issue reports and provide advice, upon a reasoned request of the Commission or on its own initiative, and deliver opinions to the European Parliament and the Council, when needed, on any matter within its competence;

- on request, assist the European Parliament, the Council, the Commission and the NRAs in relations, discussions and exchanges of views with third parties; and assist the Commission and NRAs in the dissemination of regulatory best practices to third parties.

1.3.3 National Regulator Authorities (NRA)

The national regulatory authorities (NRAs) implement the EU regulatory framework for electronic communications and often even the postal services each in their Member State. The term "electronic communications" includes telephony, the Internet and radio and often includes media broadcasting as well.

The NRA works with consumer and competition issues, efficient utilisation of resources and secure communications. One of their most important tasks is to regulate the behaviour of operators with Significant Market Power (SMP) within the national markets in order to ensure that there is sufficient competition. Ex-ante regulations are often taken towards SMP. Included in the mandate of NRA is often the obligation to encourage measures to achieve the DA targets (in the form of national digital agendas), to monitor the efficiency of measures taken, as well as the state competition in the market.

1.4 Current Regulation

The current rules governing the telecommunication sector in the European Union were set in 2002 and revised by the European Parliament and the Council of the European Union. This revision entered into force on 18 December 2009 (after two years of discussions), and has been implemented into Member State legislation since May 2011 [10].

Currently, broadband is regulated in EU Member States by national telecoms regulators in order to avoid distortions of competition. Incumbent operators, that own an SMP, are required to provide access to their networks, which cannot be duplicated in a reasonable time period, in order to enable consumers to choose between broadband providers. The roll out of NGANs does not remove the existing competition concerns regarding broadband since incumbents could leverage the dominant position they enjoy as owners of non-replicable legacy access infrastructure to monopolize new broadband services provided over this infrastructure and thereby limit consumer choice.

As such, the wholesale broadband market warrants ex-ante regulation, under the Commission Recommendation on relevant markets (Commission Recommendation of 17/12/2007) [11]. Unless it can be established that NGA services are markets different from the current regulated wholesale broadband markets, dominant operators with SMP in these markets are within the scope of the Recommendation and access to their NGA networks should be regulated. Proper broadband regulation remains a necessity to ensure a level playing field amongst NGA investors and brings benefits to consumers, including better services, greater choice and better prices.

Taking this into account, the Commission has taken an overwhelmingly favourable view towards State measures for broadband deployment for rural and underserved areas, whilst being more critical for aid measures in areas where a broadband infrastructure already exists and competition takes place.

Within the European policy on the general access networks, two documents have been deemed to be of importance for OASE as they are directly linked to the favourable deployment of broadband networks, in which FTTH might be included from a regulatory

perspective. Firstly, a general description of each of the documents will be presented, including an overview of the main objectives and targets; then, the most relevant principles that shall be considered to deploy NGAs from an entrepreneurial point of view will be described.

1.4.1 Recommendation on regulated access to NGA networks

This recommendation [12] establishes a common approach within the European Union for the regulation of fibre-based networks. Fibre networks complement or replace the traditional copper-based wired networks that can offer only limited internet speeds; fibre deployment is of the utmost importance for meeting the broadband targets set out in the Digital Agenda [1]. The Recommendation includes several features to ensure promising market outcomes based on the combination of incentives to invest and competition from other market players:

- First, to enable investors to make attractive and fair profits, any regulated prices for access to fibre networks will fully reflect investment risk for the investing companies, normally in the form of granting a risk premium.
- Second, competition will be preserved by granting new market entrants reasonable access to the new fibre infrastructures. The Recommendation gives NRAs sufficient leeway to support fair market entry and infrastructure-based competition.
- Third, there can be flexibility in national regulation to reflect market differences in urban and rural areas. For example where competition is strong, or market dynamics change, NRAs will be able to adapt or withdraw their regulatory measures to reflect this.

The scope of this Recommendation primarily covers remedies to be imposed upon operators designated with SMP on the basis of a market analysis procedure carried out under Article 16 of Directive 2002/21/EC. However, where it is justified on the grounds that duplication of infrastructure is economically inefficient or physically impracticable, Member States may also impose obligations of reciprocal sharing of facilities on undertakings operating an electronic communications network in accordance with Article 12 of that Directive, which would be appropriate to overcome bottlenecks in the civil engineering infrastructure and terminating segments. Moreover, it should be noted that a regulation on an SMP may have the effect to impose a de-facto regulation to the whole market, as is currently being debated in Sweden (see below for more details).

Consistency of regulatory approaches taken by NRAs is of fundamental importance to avoid distortions of the single market and to create legal certainty for all investing undertakings. It is therefore appropriate to provide guidance to NRAs through the different instruments issued by the EC that aim at preventing any inappropriate divergence of regulatory approaches, while allowing NRAs to take proper account of national circumstances when designing appropriate remedies.

1.4.2 EC Guidelines for broadband networks and State Aid

The Broadband Guidelines [13] outline the rules and conditions on how public funding could be provided to build broadband networks in line with the European Union State Aid rules. The Guidelines provide guidance for governments and public authorities on how to finance very high speed, NGA networks, as well as addressing the funding of traditional broadband networks (like ADSL, cable, Wi-Fi networks).

The main aim of the Guidelines is to facilitate a rapid deployment of NGAs in Europe by providing to all stakeholders (including local and regional authorities, as well as network operators) a clear, predictable and comprehensive framework for the public financing of such networks; this framework is further detailed by the investment principles described in the following sections, and extended through the investment models proposed by the Guide to Broadband Investment. The latter means EU State Aid rules would play a role in channelling public funding to areas where private companies have no commercial incentives to invest – for instance because of the high costs of deploying broadband networks, the low population density or the low levels of economic activities. State Aid can have a crucial role to extend adequate broadband services to all European citizens – no matter whether they are living in large urban areas in small villages.

In case a Member State member supports the rollout of broadband by way of an equity participation or capital injection into a company that is to carry out the project, it becomes necessary to assess whether this investment will be regarded by the EU as State Aid. In principle, State Aid can play a useful role in cases where the market does not provide sufficient broadband coverage.

Assessing the existence of State Aid is relevant as in its “pure” form it might not favour free competition. The concept of “pure” State Aid is defined in Article 87 of the European Community Treaty as "any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods that shall, insofar as it affects trade between Member States, be incompatible with the common market".

1.4.2.1 Definition of public investment as State Aid

A public investment is qualified as State Aid in the following circumstances:

- The measure has to be granted out of State resources;
- It has to confer an economic advantage to undertakings;
- The advantage has to be selective and distort or threaten to distort competition;
- The measure has to affect intra-Community trade.

On the other hand, there are two hypotheses in which public investment is not regarded as State Aid in accordance with the Case-law of the European Communities (European Court of Justice - ECJ):

- When the capital placed by the State – directly or indirectly – at the disposal of an undertaking in circumstances which correspond to normal market conditions, this investment cannot be regarded as State Aid on the basis of the principle of equal treatment within State Members;
- When the Member States may consider that the provision of a broadband network should be regarded as a service of general economic interest (SGEI)[1] as qualified by the *Altmark* criteria[2], the State funding may fall outside the scope of State Aid.

[1] Defined in Article 86(2) of the Treaty of the European Community.

[2] The four conditions to meet in accordance with the Altmark criteria are: (a) the beneficiary of a State funding mechanism for an SGEI must be formally entrusted with the provision and discharge of an SGEI, the obligations of which must be clearly defined; (b) the parameters for calculating the compensation must be established beforehand in an objective and transparent manner, to avoid it conferring an economic advantage which may favor the recipient undertaking over competing undertakings; (c) the compensation cannot exceed what is

1.4.2.2 Market failure principle

Where the market does not provide sufficient broadband coverage or the access conditions are not adequate, State Aid may play a useful role. Specifically, State Aid in the broadband sector may remedy a market failure, i.e. situations where individual market investors do not invest, even though this would be efficient.

As an example, the Commission found a proposal (June 2012) to grant €6 million of public financing for Birmingham, UK, for the construction of an ultra-fast broadband network to be in line with EU State Aid rules, in particular because it would have been open to all operators and would therefore promote competition. The target areas of the funding are two districts in Birmingham where private operators had no or only very limited investment plans in the next three years (2012-2015). This means that in the absence of this project most consumers would only be able to use basic broadband services or very expensive business leased line services [8].

1.4.2.3 Description of black, white and grey areas

In order for the EC to assess whether State Aid for NGA networks is compatible with Article 87(3) (c) of the European Community Treaty, black, white and grey area designations are used. Because this designation is mostly in the assessment of traditional broadband development, it requires a more refined definition to take into account the specificities of the NGA networks, as explained below.

- *White area* refers to an area where NGA networks do not at present exist and where they are not likely to be built in three years. It certainly includes an area where there is no basic broadband infrastructure. It also includes areas where only one basic broadband provider is present. However, in the latter case, Member States must prove that the current services are not sufficient to satisfy the needs of citizens and business users and there are no less distortive means. Recent examples of rural areas (regarded as white since no broadband or NGA services were available) that have been deserved are Ireland and Slovenia, as per decisions no. N 607/2009 and N 172/2009 where the European Commission decided favourably for grant of State Aid.
- *Grey areas* are areas where only one NGA network is in place or is being deployed in the coming three years. In order to have such State Aid approved by the Commission, Member States must provide evidence that the current or planned NGA network is not sufficient to satisfy the needs of citizens and business users and there are no less distortive means. This was the case in Appingedam [14], where various broadband offers were already provided over two existing networks (DSL and cable), at prices similar to those of other regions in The Netherlands. The measure would distort competition due to its discriminatory impact on existing or future private networks; consequently, the

necessary to cover all or part of the costs incurred in the discharge of the SGEI, taking into account the relevant receipts and a reasonable profit for discharging those obligations; and (d) where the beneficiary is not chosen pursuant to a public procurement procedure, the level of compensation granted must be determined on the basis of an analysis of the costs which a typical undertaking, well run, would have incurred in discharging those obligations, taking into account the relevant receipts and a reasonable profit.

construction of an additional network with state funding would address neither a market failure nor a cohesion problem so State Aid was prohibited.

- Finally, *black areas* are areas where more than one NGA network exists in a given area or will be deployed in the coming three years: no subsidies are allowed in this case.

1.4.2.4 Scope of the possible investments based on the EC guidelines for access networks

With regard to the above mentioned explanation of the principles upon which public funds shall be invested, different vehicles can be used to channel public funds for the deployment of basic broadband networks as well as NGA networks to areas where private operators do not invest. The distinction between areas (black/grey/white), is then adapted to the situation of NGA networks (whose deployment is still at an early stage) by requiring Member States to take into account not only existing NGA infrastructures but also concrete investment plans by telecom operators to deploy such networks in the near future.

The Guidelines for broadband networks explicitly mention that "investing in infrastructure, rather than investing directly in services, will help to ensure that a Managing Authority does not distort the market, which could be detrimental to end users. The Managing Authority must consider the type of infrastructure along three dimensions: the scope of the network, the performance of the network, and the ability of the network to support competition" [9]. Based on this idea, the guide proposes the following investment vehicles:

- *Bottom-up*: a group of end users (frequently organized as a 'co-operative') decides to invest in the deployment of a network. Public involvement is usually limited to issuing grants or guaranteeing loans, and/or facilitating access to publicly owned infrastructure such as ducts.
- *Private design, build and operate*: a private company receives funds (often in the form of a grant) from the public sector to assist in network deployment, but the private company retains full ownership.
- *Public outsourcing*: a public sector body outsources the construction and operations of the network to the private sector under a long-term agreement, but the public sector body retains ownership of the network.
- *Joint venture*: public and private sector bodies both retain a stake in the network, as both provide equity or resources.
- *Public design, build and operate*: the public sector constructs and operates the network itself, retaining full control and offering services on a retail or wholesale basis. However, this model is not further considered in the guidelines as it is not frequently implemented by the Member States Managing Authorities[3].

1.5 National Regulation

A very general overview of the current regulation in the countries where the case studies were extracted for OASE is included in this section, pursuant to demonstrate whether the European policy has been reflected or not.

[3] Although the "Public design, build and operate model" is a type of Joint Venture, the difference between them is related to the origin of equity invested and moreover, the operation and the ownership of the revenues generated by the particular model.

1.5.1 Sweden

The overall objective is for Sweden to have world-class broadband. A high use of IT and the Internet is good for Sweden in terms of growth, competitiveness and innovation. It contributes to the development of a sustainable society, helps also to meet the challenges of an increased globalisation, climate change and an ageing population in a sparsely populated country. A prerequisite for meeting the challenges set out in the Digital Agenda is access to high-speed broadband across the country. This means that the Swedish targets are set to have, in 2020, 90% of all households and businesses with access to at least 100 Mbit/s, while 40% of households should be reached by 2015. It is important that Swedish businesses and households in all parts of the country can take advantage of the opportunities offered by powerful broadband access. Then traditional work practices can change, new services and business models can evolve and new behaviours can emerge.

The central point is that electronic communications and broadband access should be provided by the market. The government should not control the market, nor the development of technology. Their task is to create good conditions for the market and remove barriers for development, by seeing to that there is a relevant regulation in place.

Municipal planning responsibilities are clarified, by reinforcing in the Planning and Building Act the connection to the infrastructure for electronic communications. The government has also initiated a so-called Broadband Council for collaboration and dialogue on the deployment of broadband. Furthermore, the Swedish NRA, Post and Telecom Agency (PTS) is assigned the task of investigating how suitable frequency bands for electronic communications can be used to improve accessibility in areas which lack broadband access, or with low-capacity and low-quality broadband. The level of functional Internet access within the universal service will also be revised.

On the other hand, despite FTTB/FTTH networks having been deployed massively in Sweden for over a decade now, regulation impacting fibre access networks (be it directly or indirectly) has only recently started to appear.

In May 2010, the Swedish NRA, PTS, passed decisions regulating the wholesale market for (physical) network infrastructure access (including LLU and shared access) as well as the wholesale market for broadband access. The Decision on the market for physical network infrastructure access (LLU) includes both copper and fibre lines. In addition to the provisioning of fibre access, it also obliges the incumbent to deploy new fibre infrastructure in existing ducts, if a requesting operator is willing to pay the cost of investment. This decision has, however, been appealed in some parts, and a Court ruling on this issue is still pending. Concerns have been expressed that the reference offer of the incumbent does not correspond to the Decision of the NRA, as it among other things does not allow the purchase of access to fibre between the incumbent's Metropolitan Point of Presence and network termination points connecting buildings, so-called "Fibre to the Building", FTTB[4].

In August 2009, the Government introduced an amendment to the competition law (which came into force on 1 January 2010) that is aimed at preventing the State municipalities or regional governments from engaging in commercial activities in a way that is harmful to

[4] On 10 February 2011, PTS issued an injunction ordering the incumbent to provide access to FTTB, in accordance with the Decisions and to adjust the reference offer accordingly. On 25 February 2011, the incumbent appealed the injunction to the administrative court.

competition. The new legal provisions came as a response to the numerous complaints that have been received by the national competition authority (NCA) regarding the problems encountered by private operators when competing with public ones. Certain operators still consider that some housing companies owned by the municipalities are trying to eliminate competition by allowing only one electronic communications provider to offer services in their blocks of flats.

In 2009, the PTS has been assigned the task to study open networks and services, and reached the following conclusions:

1. Openness creates the prerequisites for innovation and competitiveness but must be balanced against other interests worthy of protection, such as incentives to invest and network security.
2. Openness is promoted by securing non-discrimination and effective competition.
3. Openness is of great significance and it is therefore important that suppliers in their marketing activities and in applicable terms and conditions, provide clear and specific information with respect to lock-in periods and restrictions relating to Internet access and access to services.

The report concluding the study states that one essential challenge to openness today is *restrictions in access to passive infrastructure* (e.g. dark fibre). A second major challenge can be traced back to insufficient consumer mobility due to long lock-in periods, high transition costs and other *lock-in effects*[5]. One challenge which affects several levels in the value chain relates to openness when managing electronic communications over the Internet, *network neutrality*. The report suggests several measures aimed at securing openness, measures which take all interest worthy of protection into consideration – especially incentives to invest and network security. PTS suggests stronger principles for equal treatment when building new infrastructure, increased access to existing infrastructure, information designated to consumers regarding possible pitfalls, the importance of openness and, finally, increased transparency regarding the existence of potential limitations of Internet traffic such as prioritization of traffic and blocking of services.

Somewhat controversially, PTS has recently decided to introduce a price regulation for the SMP TeliaSonera. The price regulation is based on four broad and complex models. These models calculate the cost (or would-be cost) for Telia to install fibre in the entire country, to every household and business. A price per connection is then calculated, and because Telia currently only has *x*% of the broadband market, the price that Telia can charge is *x*% (currently roughly 50%) of the calculated price per connection. While this regulation only applies to TeliaSonera, this puts a de facto price regulation on the whole market that is below the actual price of dark fibre. If another actor, a municipality network, for instance, charges the actual deployment cost, it risks losing customers to TeliaSonera. If it tries to compete with TeliaSonera to retain customers and applies TeliaSonera's regulated price, it risks be taken to court for illegal State Aid for setting a price below what it production costs (which the PTS model states). This in turn also leads to a re-evaluation of municipality networks which can affect municipal finances and thus provide fewer economical opportunities for fibre investment. More on the current debate can be found in section 1.5 on future directions, as well as in the Stockholm case study.

[5] A third challenge – less immediately relevant to FTTx – is based on an increasing demand for mobility, leading to a *shortage of spectrum enabling wireless communications with high area coverage*, which limits the ability to access the Internet from any location.

1.5.2 The Netherlands

The market structure in the Netherlands was long based on a market duopoly between the incumbent KPN and two geographically split cable operators: Ziggo and UPC. Recent developments in fibre deployment however changed this market view: the emergence of new actors providing passive, dark fibre infrastructure, like Reggefiber on a national scale and companies like HSLNet (in Heesde-Leende) and OnsNet (in Neunen) on a more local, municipality level, provide a new version of competition in the overall broadband market.

The national regulatory authority, OPTA (Independent Post and Telecommunications Authority of the Netherlands), was established in 1997 in order to promote competition and protect consumer's rights. OPTA is responsible for the implementation and enforcement of telecommunications policy.

The country is furthermore characterized by a strong awareness about the influence and economic importance of NGA networks, and the government was supportive in many fibre deployment initiatives. The first fibre trials were carried out in the 1990s, and in 2003, KPN published an ambitious plan that acknowledged the future need for the virtually unlimited capacities of fibre optics [53]. Another aspect of fibre rollout the report stresses, is that there is no need for multiple fibres to the same home, as they consider it to be an overkill capacity-wise and unneeded increase in cost. They therefore argue that the fibre infrastructure (physical, dark fibre) should be considered a natural monopoly, which is not economically duplicable. Competition should and can arise however, albeit on the services level. However, this "Deltaplan Glas" initiative required cooperation between KPN and the cable operators, and because the latter were not interested ("Why would a cable company assist the competition, as they are experiencing the limits of ADSL?" [54]), and because there was a lack of support from the Parliament, the idea of a nationwide shared fibre infrastructure was never executed.

The national government was triggered, and started the "Kenniswijk" (Knowledge Quarter) project, which allowed direct subsidies for stimulating ICT services and broadband infrastructure. Kenniswijk granted a €800 subsidy to each household, which the latter invested in the cooperative OnsNet. In turn, the citizens received a one-year contract for 100 Mbps symmetrical Internet connection at no charge. A series of steps lead to the creation of a company: "Netwerk Exploitatie Maatschappij Neunen B.V." (NEM B.V.), which is responsible for operating the passive fibre network. The company OnsNet acts as an NP by offering open access to the service layer. The ownership of NEM B.V. changed in 2006 when the installation company Reggefiber acquired the majority of shares.

Another well-known fibre initiative involving the public sector is the FTTH deployment in Amsterdam. In this case, the municipality of Amsterdam invested one third of the initial estimated amount in the FTTH deployment. Although challenged in court multiple times, the public funding was allowed because the investment of all parties would be done under the same, normal market conditions. For more details, we refer to section 2.6, where we explain the regulatory struggles in the case of Amsterdam in more details.

On the other hand, there exist initiatives in the Netherlands, where public funding was not allowed. Probably the most well-known example is the municipality of Appingedam, where the European Commission decided to rule against the municipality plan for provisioning of a dark fibre, open network, since they judged that "Public support for broadband can bring benefits to citizens and businesses in regions where fast Internet access is not available on reasonable conditions. However, State Aid for the planned network in Appingedam is neither

justified nor proportionate as broadband services are already provided by several private operators." (Nelie Kroes [14]).

Not only is the Netherlands one of the frontrunners when it comes to FTTH deployment in Europe, the regulatory regime of OPTA is also worth mentioning. KPN was the first operator to have concluded a compliance charter with the NRA in 2008, and had been regularly reporting on its performance as part of a stricter monitoring regime. Later, OPTA, having taken the view that it had realised sufficient compliance activities across its whole organisation, has decided to bring this operator back under the common monitoring regime. The new rules provide among others, for an increased fine for an SMP operator in the case of what the national legislation would consider as "very serious offences" (i.e. events that would endanger competition as considered by the NRA), and for all operators in the case of repetition. Regulations furthermore include obligatory unbundling obligations for KPN, at prices that were set as an agreement between the incumbent and the NRA. For exact numbers, we refer to D6.3 [5].

More striking however, are the price caps set by OPTA for ODF access to the fibre infrastructure owned by Reggefiber, which were determined based on discussions and a mutual agreement between the regulator and operators. This regulation can be considered to be a direct consequence of the acquisition of an important part of the shares (41%) of Reggefiber by KPN (which, after a profound analysis in collaboration with OPTA, was allowed by the competition authority). The caps depend on the region (e.g. you will pay a higher fee for renting a dark fibre in a rural than in a dense urban area) and on the amount of fibre pairs you lease (based on the well known principle of economies of scale). For more details on the absolute numbers, we again refer to D6.3 .

1.5.3 Germany

The NRA in Germany is the Federal Network Agency - Bundesnetzagentur (BNetzA)[6]. The basic functions of the agency are supervising and ensuring abidance by the laws of Telecommunication (Telekommunikationsgesetz, TKG [27]), and executing and implementing the directives of the EC. The agency focuses on ex-ante control. It is present country-wide through regional subsidiaries and cooperates frequently with the Federal Cartel Office. Other functions are the compilation of the "Infrastructuratlas" and the issue of the yearly activity report [22]. Several regulations regarding telecommunication and technology have been formulated in context of broadband, FTTH networks and cooperation. Only some will be mentioned in the following.

Within the discussion of the regionalisation of markets, a consultation on geographically differentiated regulation in the context of the definition and analysis of market no. 5 (Wholesale broadband access/bitstream access) was placed and responses were collected in 2008. The BNetzA decision against a regionalisation of markets in Germany has been published on 21.10.2009 [39].

[6] There are two other entities with a say in FTTH regulation in Germany: the Monopolies Commission (an independent body consulting the federal government on competition policy and regulation), whose latest *opinion document* favours a market-driven fibre network construction and the usage of existing fibre infrastructures of municipalities, and existing market players; and the Federal Cartel Office (which represents the independent competition authority), which in 2010 issued *"Guidelines regarding the assessment of FTTH cooperation related to the terms of competition laws in Germany"* stating that cooperation in the FTTH infrastructure context will be assessed under the competition law.

There is actually a discussion in opening the cable network (coax) and related HFC broadband offers to competitors using BSA and wholesale products (Market 5). But up to now this is only a wish of BNetzA to cable network operators, purely voluntary, no regulation takes place yet [31].

In the German broadband strategy [32] the BNetzA was dedicated to define Guidelines for Next Generation Access networks for a growth and innovation oriented regulation. These guidelines were published in March 2010 [33].

The guidelines from the European Commission regarding State Aid for open access networks (currently under revision as mentioned above) and fibre based infrastructures (published 17.09.2009 [39]) have been considered by BNetzA when defining the Guidelines for Next Generation Access (NGA) networks, March 2010 [14].

One outcome of the previous discussion was the foundation of the NGA Forum in May 2010 with the consensus that open access requires clearly defined interfaces and processes, in order to realise network overarching services general. The general requirement document was published in May 2011 [34]. Within this activity, 18 partners defined all relevant technical (incl. e.g. resource allocation), process related as well as business aspects / interfaces for Layer II BSA pre- products which are required for providing services to the customers.

Facing future NGA networks BNetzA decided on March, 2011 finally on regulatory obligations imposed on Deutsche Telekom with respect to the physical network infrastructure access market (EU market 4), including LLU [35]. BNetzA finally decided that fibre unbundling can be subject to a more relaxed price control than unbundling of copper loops. BNetzA would only intervene ex-post in cases of abusive pricing. The European Commission criticised the draft as not being fully aligned with the NGA recommendation [36]. In particular, the European Commission did not agree with BNetzA's proposal to relax price control for fibre unbundling. Whereas BNetzA found it sufficient to intervene only ex-post in cases of abusive pricing, the Commission insisted on applying ex-ante price control based on cost orientation.

To summarise, more relaxed price control than on established wholesale access products can be seen for fibre unbundling and the new layer 2 BSA products. This behaviour considers intervening only ex-post in cases of abusive pricing and takes into account the need to encourage investment in the roll out of NGA networks [36].

1.6 Towards the Future

To support the planning process, the EC will strengthen the monitoring of NGA deployment. This will utilize a revised form of existing instruments such as the Digital Competitiveness Report [15], which identifies and analyses the ICT sector and brands it as a key driver of the EU economy, and a new Digital Agenda Scoreboard that will detail performance indicators to enable individual Member States to monitor and compare broadband plans. The Scoreboard will be assisted by a new web-based tool to disseminate statistics and research reports on the broadband economy [16].

A very general overview of the actions taken by the countries where the case studies were extracted for OASE is also included in this section; these are mainly on-going actions that are being implemented from a regulation standpoint in order to comply with the Digital Agenda set by the EU.

1.6.1 Regulatory trends at European level

The European Commission is focusing mainly on two activities. Firstly, the EC is carrying out public consultations with regards to a revised version of the Broadband Guidelines (described in the beginning of this document) and other documents in order to publish them once they have gathered enough feedback; secondly, the EC is carrying out the same type of consultations regarding civil works.

By the end of 2013 the EC shall reinforce and rationalize the use of funding of high-speed broadband through EU instruments under the current financial framework.

The Commission also calls upon Member States to:

- → Implement rapidly the NGA Recommendation and anticipate key aspects of the European Radio Spectrum Policy Program.
- → Set national broadband targets and adopt operational plans that are in line with the European broadband target.
- → Take national actions to reduce broadband investment costs.

From a legal perspective, there is an expected reform called: *"Proposal for a Regulation of the European Parliament and of the Council on Guidelines for Trans European Telecommunications Networks and repealing Decision (No 1336/97/EC)" [17].*The content of this document will repeal and replace Decision 1336/97 of the European Parliament and of the Council of 17 June 1997 on a series of Guidelines for trans-European telecommunication networks.

The proposed intervention will be pursuant to Article 172 Treaty on the Functioning of the European Union (TFEU), which provides a legal base for the European Union intervention supporting the establishment and development of trans-European networks in the areas of transport, telecommunications and energy infrastructures.

The current Telecommunications Guidelines have been proposed and adopted as a Decision of the European Parliament and of the Council which is specifically addressed to the Member States, rendering the Guidelines fully binding for all the Member States in accordance with the explanation provided in the introductory section of this document.

However, the instrument will facilitate in particular the deployment of telecommunications' infrastructure and promotion of services by private entities (including operators, utilities, equipment manufacturers, etc.) and regional and local authorities. With more actors besides the Member States becoming involved in the planning, development and operation of digital telecommunication networks, it is important to ensure that the Guidelines are binding for all. The Commission has therefore chosen a Regulation as the legal instrument for this proposal.

The EC is currently carrying out public consultations with regards to the latest version of the Broadband Guidelines (which is still a draft). The main difference with regards to the released version of the Guidelines is the distinction in between the basic broadband and the NGA; indeed, the draft of the new version of the Guidelines includes the concept of white, grey and black areas for both types of access networks. The currently proposed version of the Guidelines has this definition of NGA:

> *"At the current stage of market and technological development, NGA networks are wired access networks which consist wholly or partly of optical elements fibres until the customer premises (the home/apartment, i.e. FTTH; or the multi-dwelling unit's basement, i.e. FTTB) and which are capable of delivering broadband access services*

with enhanced characteristics (such as fundamentally higher throughput) as compared to those provided over existing copper networks. They are able to deliver services at very high speeds, and support a multitude of advanced digital converged services, and represent a future-proof infrastructure. At the current stage of market and technological development, NGA networks are therefore wired fibre-based or advanced upgraded cable networks."

1.6.2 Regulatory trends in Sweden

The price regulation for the SMP's fibre access introduced by PTS has generated a lively and somewhat bitter debate. The reason is that it is believed that the introduced price regulation represents a de-facto standard price that is going to make any fibre investment uneconomical and even politically unattractive (due to the risk to incur in State Aid allegations). This is indeed a widely held position in the market and there is a degree of uncertainty on the future of this contested regulation, especially after a report commissioned to Deloitte by the Swedish Association of Local Authorities and Regions (SKL) [18]. The report's goal was to examine the impact of price regulation and its results pointed to several risks, and concludes that there is nothing that shows how a regulated charge for dark fibre will benefit end users through lower prices and better choices.

SKL points out that many municipalities have invested heavily in fibre networks to ensure access to modern broadband for its inhabitants. Municipalities have built up those networks because private companies were not interested. Now those public investments risk freezing completely. SKL even paints a scenario in which the market will develop to only hold a dominant player, i.e. is a return to the monopoly Sweden was in 20 years ago. "Paradoxically, says SKL, TeliaSonera, which is the operator being regulated, is in fact the one who ultimately will be the big winner. Indeed, it is argued, the price of access to TeliaSonera's fibre network, normative for all players and even the country's municipal networks, must relate to that regulated price, which is below the actual cost of providing fibre. TeliaSonera can solve its funding by subsidizing investments in fibre infrastructure with money from other parts of its business, for example, from its existing monopoly on the copper market. This is impossible for the municipal networks that only rent out dark fibre and therefore have no other income that can cover up."

TeliaSonera, on their side, is backing the requests that regulation is phased out, or that the calculation model should be modified. This regulation and the specific model used is claimed to be based on old circumstances, not anymore there, and that the market and also the regulatory agenda has changed dramatically. Interestingly, TeliaSonera blames, in a recent statement [19], the model to "indirectly affect market conditions for over 150 local network owners that compete with the regulated infrastructure. Incorrectly estimated cost of a product, in general or for a specific geographic area, can have major negative impacts on the market. It decreases the opportunity to invest in new infrastructure for both TeliaSonera and other players, and denies those players the opportunity to compete". Furthermore, TeliaSonera believes that "the current calculation model is the main cause of the regulatory uncertainty regarding price regulation discussed by market participants in recent years. The model's increasing scope and complexity contributes to a lack of transparency and that is why, today, very few stakeholders still understand the basic assumptions in the model, let alone how the model works altogether. This in itself creates uncertainty in the market because it is difficult

to predict how price levels will evolve over time and it could also lead to litigation with an uncertain outcome."

Given all this (it should be added that at the time of writing, a referral is being written by Stokab to BEREC on that topic), it should be expected that these rules are going to be amended in some way, if not repelled altogether, at least in their current form.

1.6.3 Regulatory trends in the Netherlands

Recent evolutions in the regulatory environment in the Netherlands include actions on multiple levels: spectrum licenses, revision of unbundled pricing, etc. We will here only elaborate on the ongoing discussions on unbundling, which might impact the FTTH deployment and market structure in the (near) future.

Analogously to the obligatory unbundling of the FTTH access network, OPTA has filed a proposal for unbundling of KPN's FTTO (Fibre-to-the-Office), the business market. OPTA ascertains that KPN has an SMP in this market. In order to promote competition, KPN will be obliged to allow other providers unbundled access to its business fibre networks, so they can over retail services to business customers [55]. The obligation includes transparency, non-discriminatory access and caps on ODF charges. In an earlier investigation, OPTA didn't judge KPN to have an SMP in the business market, but had to revise its decision after BEREC expressed to have serious doubts about this judgement. Currently, the proposal is in its revision phase, in which all operators are allowed to react. A first reaction by KPN clearly shows its disunion with the proposal: KPN argues that the proposed regulation will not facilitate market entry by new providers, nor will it increase price competition. They further foresee a large amount of negative effects, like an increase in the – already substantial – uncertain investment climate that characterizes fibre-based access network deployments [56].

Apart from this specific regulation, several important market decisions of OPTA were annulled by the Court in 2010. Roughly half of all of the decisions, which have been challenged before the Court since 2009, are still pending. This of course has led to regulatory uncertainty, which has been reflected in both the operators' business decisions and in the market in general.

In the meantime, the NRA has commenced a new round of market analyses, which would be applicable for the regulatory period of 2012-2014. The NRA will need to take into account the concerns of the court and the operators involved, as well as the necessity to co-operate closely with market players and the competition authority.

1.6.4 Regulatory trends in Germany

There is actually a discussion ongoing about a new approach to regulation of fixed and mobile networks. One complexity in there is that the ex-ante regulation must be adapted to multiple technological & commercial developments in communications networks and services states e.g. Dr. Ulrich Stumpf (WIK) at a conference in Bogota in June 2012 [41]. His proposal is a symmetrical ex-ante regulation which provides a complementary instrument to promote a variety of objectives. Some of his conclusions and possible success factors for regulation are:

- Ensure interoperability of services and end-to-end connectivity
- Address market power independent of dominance
- Avoid economically inefficient or physically impracticable duplication of access infrastructure to end-users

- Promote net neutrality
- Raise transparency and reduce switching costs
- Protect the environment, public health, public security and try to meet town and country planning objectives

There might be another chicken-and-egg problem that FTTH infrastructure deployments suffer from. On the one hand side, BNetzA decides for ex-post regulation schemes after the market has formed and dominance has been achieved by one player. On the other hand, since this requires enormous investments in fibre rollout, a good business case in advance with stabile wholesale price assumptions has to be in place in order to show enough profitability for any investor.

One example might be interesting in this context, the regulation by OPTA (Netherlands) has already defined maximum prices for unbundling fibre access which will remain stable for the upcoming years ([42]: page 5, footnote 21: The maximum tariff per line for ODF FTTH access in the different areas will be EUR 15.19-18.33 per month in 2012). They will only be increased by adding the consumer price index for each year of the regulatory period. But this is at time the only example in Europe doing so.

Overall it can be concluded that substantial parts for a stable future regulatory framework in Germany are in place already but some points regarding the financial risks of deploying FTTH infrastructures are not clarified yet for the deploying organization. On the other hand it can be concluded from the broadband coverage analysis that in Germany > 50% of households have the possibility to access ≥ 50 Mbit/s connectivity offers and this is continuously increasing. In addition, a new technology option called vectoring VDSL [46] might even shift the FTTH deployment again towards the future since it would allow using the copper line assets without deploying a new infrastructure.

1.6.5 Regulatory trends in other countries in the EU: the example of Finland

Another fibre price regulation (besides the one being put in place in Sweden) has encountered even more problems, even at the proposal stage. According to a proposal, fibre access would receive two different types of regulation. One is the "wholesale broadband access" which is given at a higher network level and the second one is the "network infrastructure access" which allows the alternative operator to use a greater part of its own network.

The Commission is concerned that the proposal does not use important regulatory tools, such as effective non-discrimination and price obligations, and that dominant operators can charge excessive prices due to their position. The European Commission has therefore called, on 18 October 2012, on the Finnish telecoms regulator (FICORA) to revise its proposal on regulated access to dominant operators' broadband networks, which would damage competition and make investment in competitive broadband services difficult.

“Regulators have to ensure stable and predictable prices for broadband, but also introduce effective safeguards against discrimination, so that dominant operators do not get an unfair advantage. FICORA's proposal is lacking both”, European Commission Vice President Neelie Kroes said. Besides, under the Telecoms Directive, the commissioner asked FICORA to make a proposal which can create a transparent and predictable regulatory environment for Finnish broadband.

However, if FICORA applies non-discrimination rules and proves that other well developed alternative infrastructures like cable or LTE could provide sufficient competitive safeguards, it will not be necessary to price-regulate new generation fibre networks. It remains to be seen how fibre price regulation will evolve in Finland or other EU Member States.

2. Stakeholder understanding and regulation issues in selected use cases

The deployment of new networks entails decisions on three levels: technical, business and political. On both the European and national level, there are currently different entities responsible for those three different levels. They often take decisions separately, without consulting the other levels. The different entities also don't have access to the same information. The combination of these two facts leads to mismatches in regulation. It is therefore important to aggregate the available information and search for synergies between the different levels, but while securing that people don't interfere with each other's specialty.

By keeping constant contact with the different parties involved (decision makers at the European Commission, national regulators, operators of already deployed fibre networks etc.), we managed to get an overview of the different states of mind and opinions that are present within this domain. OASE has also developed a questionnaire, which worked as a support in this respect (see Appendix).

2.1 Municipal networks

An idiosyncratic representative of assertive municipal FTTH networks is Stokab, with whom OASE members have had a constant contact, and which also sit in the Alternative Operator Board (AOB). Another member of the AOB is Mälarenergi, a smaller network in Central Sweden. We have had constant dialog with the Swedish association of Regions and Local Government (SKL).

The general viewpoint and understanding of regulation among large municipality networks (such as Stokab and Mälarenergi) is that State Aid regulation does not apply to municipalities building FTTH, as long as one stays on the passive layer. This is a contested view by other actors, e.g. the Swedish regulator, who has a much more conservative view, although concrete actions have not yet been taken. The rational for the Swedish municipal networks' reasoning is that the passive infrastructure is open for all to use, and that the actor building out is not making a profit.

SKL, despite including also municipalities which in the past had installed vertically integrated FTTH networks, has until now indirectly supported the viewpoint of e.g. Stokab, and encouraged their members to go down the value chain and only drive the passive infrastructure.

As mentioned in the previous chapter, PTS has recently imposed some regulation onto the SMP Telia. Despite the regulation only holding for Telia, this has raised considerable preoccupation among the municipality networks, on grounds that this creates a de facto standard that is harmful to the further deployment of FTTH/FTTB (see Section 1.6.2). There is a fear that this will to put a stop to all investment if not repelled. See, for instance, these two recent statements.

On 6 May 2012 Stokab declared [20] (authors' translation from Swedish):

> "Stokab [believes] that price regulation of dark fibre connections is counterproductive in that it inhibits the continued fibre deployment […]. Stokab does not share the PTS's view of the rational for price regulation given the

> situation in Sweden and globally. Regulation of dark fibre connections is moreover not covered by the EU Commission's definition of "leased lines" […]. Instead of a comprehensive regulation of dark fibre connections, a joint effort should take place to bring about a well-developed IT infrastructure, accessible and open to all market participants on equal terms. This promotes competition and creates a market dynamic that is good for both the telecom industry and Swedish business in general. Stokab therefore advises against price regulation, the measure being neither appropriate nor reasonable.

That same statement also considers the specific situation in Stockholm:

> "Overall Stokab believe that […] Stockholm has an effective dark fibre market. There is also no sign that it would not remain the case for a long time to come. International comparisons show that Stokab's fibre network is a world-class network and that Stockholm is at the very forefront globally in terms of IT development. This applies to access to dark fibre technology, with effective competition on the wholesale and retail markets. Without a well-functioning market in Stockholm, this would not be possible. The company attracts considerable international interest, attention and visits from all over the world. The dynamics that prevail in the Stockholm market are probably unique in the world. […] Ex-ante regulation of the dark fibre market in Stockholm should be completely phased out.

More recently, Stokab also criticised the model used to calculate the regulated price and on 6 May 2012 declared [21] (authors' translation from Swedish):

> "PTS has on unclear grounds chosen to ignore the largely held views on the hybrid cost model raised under the consultation procedure. PTS maintains instead that the actual production cost estimated, regarding the fibre connection of a multi-family property, should be reduced based on the take-up rate (number of active customers). This is plainly an incorrect approach, as the actual production cost of such a connection is the same regardless of how many customers are connected. PTS also mixes up copper and fibre in a hybrid model for price regulation. The result is that investment in fibre networks becomes unprofitable, since price regulation does not allow for cost recovery. Price regulation will therefore result in a number of negative effects. Competition in the market will be distorted and turn disproportionately against pure dark fibre providers. These do not have the opportunity, as the SMP operator to cover the deficit as a fibre investment will be funded by the revenues from other activities, mainly copper-based services."

2.2 Swedish NRA

Against a certain widespread understanding in Sweden (see Municipal networks), the position of the Swedish regulator (PTS) though is that staying on the passive level is no guarantee that the market is not distorted. For instance, if a service is currently provided by other actors on commercial terms and on a competitive ground, installing a fibre infrastructure which allows for others to come onto the market at potentially lower prices is per se distorting the market. Naturally, that would not apply if the fibre network is responding to a need which the market (with the current infrastructure) cannot provide. This can be seen as an academic question. In any case, PTS's mantra is that the market should take care of NGA deployment.

2.3 Municipalities and local governments

We would say that there is a very poor understanding of the technical and business implications of broadband access. There is much confusion on concepts like ”internet”, ”broadband” and ”fibre”.

However, there is a growing political persuasion that broadband is a key precondition to the successful socio-economic development of regions and cities, and that a more active role is demanded from local governments. However, fear of ending up in State Aid controversies is often making local governments very careful.

2.4 European Commission

The mantra among the EC is that the market should take care of NGA, but unofficially, many start realising that something must be done to break the status quo. There is in general keen interest in bottom-up approaches like those seen in the Netherlands and Scandinavia, but fear of ending up in State Aid situations is still pervasive. At any rate, the feeling is that we are at a turning point and that we should be expecting a change in attitude, as it is becoming ever clearer that the current approach of leaving things up to the currently dominating market players is not going to work as well as it worked for e.g. the mobile market. This can also be sensed in the current version of the proposed amended Guidelines on State Aid, in which much focus is given to Open Access.

Also, it should be noticed that keen interest has been shown to OASE studies in open access and uncaptured values (see D6.3).

2.5 Private alternative operators

Despite having e.g. Vodafone on the AOB, it has proven difficult to have dedicated interviews with private alternative operators. On the other hand, the many interactions we had at e.g. workshops organised by OASE (on FTTH, open access and municipal initiatives), as well as during seminars and meetings with participation from managers and policy makers, all seem to point to a common theme and “lamentation”.

The common feeling among these actors is that regulation does little to curb the incumbents’ domination, and that PPP projects are all too often relying on these actors, hence increasing this dominance. This leads to rather defensive and antagonising positions, although examples of cooperation with the incumbent on e.g. infrastructure sharing do occur. Strong and clear guarantees from the regulators are often a precondition for these actors to become involved at all.

2.6 The Amsterdam story

In 2001, the City Council of Amsterdam, observing ad-hoc plans being made for the deployment of fibre by private parties, places the topic of fibre networks on the political agenda, being concerned about a possible ‘digital divide’ emerging in the city. A second reason for involvement is the wish to channel the related digging activities to reduce the level of inconvenience to the public. To address the issues properly, the Council commissions an investigation. The resulting report, issued in 2002, concludes that the ‘market’ will most probably not deliver an ‘open’ infrastructure, nor fibre connections to every home and

enterprise in Amsterdam, within the next 15 years [58]. Considering the economic and social importance, the Council decides on the implementation of a city-wide FTTH project, with as cornerstone a Public Private Partnership. The PPP would implement an open access passive network infrastructure, supporting service level competition [59]. Subsequently, the city establishes a limited liability company Glasvezelnet Amsterdam (GNA) in 2006, in which the municipality participates for 1/3, the four housing corporations for 1/3, and investors for another 1/3; each for €6 million [60]. Because the municipality played an active role in the deployment, the CityNet project has been under close watch by the regulatory authorities and other municipal corporations across the world. CityNet was taken to court twice by the Dutch cable operator UPC and only after three years, the European Commission approved the project, stating that the investment of the municipality (city of Amsterdam) wasn't State Aid as long as private companies invested at the same time and on the same terms. However, the debate on the topic in the Parliament has resulted in more tight rules for participation of municipalities (and housing corporations) in telecommunication projects, becoming part of the 2006 revision of the Telecom Law [57].

2.7 National policy makers, the BDUK example

National broadband policies and rollout plans are starting to take shape although with mixed results. Here we report one controversial example for the purpose of illustrating how different stakeholders still have conflicting views, and how national plans still find it hard to gather consensus.

In order to incentivise a diverse range of network deployments that would therefore enhance competition and (hopefully) increase the rate of fibre rollout, the UK government allocated £530 million in the current spending period (lasting 58 months) "to stimulate commercial investment to roll out high speed broadband in rural communities". The goal of the project is to create "the best superfast broadband in Europe" [61]. However, since its launch in July 2010, the project has been plagued by problems. The project is called Broadband Delivery UK (henceforth BDUK), and is under the oversight of the UK government's Department of Culture Media and Sport.

Three-and-a-half months after the launch of the project, an address by Robert Sullivan, head of the BDUK project, admitted that it was not clear to BDUK exactly what the term "best in Europe" was intended to mean [62]. While rejecting the idea of speed as the single most important factor, a scorecard based on a number of parameters was suggested; but it was noted that this would need to be done in consultation with consumers and businesses. Nonetheless, one of the key factors of the eventual government target was a minimum broadband speed. However this target, set at 2 Mb/s per household, is so unambitious that Prof. Peter Cochrane, the former head of BT's research laboratories, told the House of Lords Communications Committee that the government "might as well not bother" [63].

From the start, then, the BDUK project has been plagued by a lack of clear direction and mandate. Nevertheless, work was undertaken to solicit requests for funding for a number of rural broadband networks. Under the BDUK scheme, local authorities are encouraged to request money from the BDUK fund in order to promote local deployments that will satisfy particular local needs. Cumbria, a large north-western UK county dominated by a rough mountainous terrain and therefore problematic for wireless and mobile access, began a tendering process to select a network installer, utilising £40m from the BDUK fund.

Nine companies were invited, and seven quickly withdrew stating, among other things, that the restrictions imposed by Physical Infrastructure Access - PIA (and its high price) made the business case unworkable and actually preferential to BT who, as discussed in the previous section, would continue to enjoy access to a wider range of revenue streams on their future network, the security of revenue from their current network, and the preferential usage of their infrastructure in order to carry out deployment.

Despite this initial early display of a significant lack of confidence, the process did however continue, and culminating in tenders from both BT and Fujitsu. Yet both of these trends were subsequently rejected by Cumbria County Council who stated concerns that the networks would not have been capable of reaching their targets [64]. As a result of this, Fujitsu withdrew completely from the BDUK process in Cumbria as well as two further areas, citing a lack of a "clear path towards mass market", leaving only the incumbent operator, BT, in the bidding process [65]. This has left BT as the only company that has won any regional tender under the BDUK programme, and this seems likely to continue.

This systemic bias towards the incumbent operator has resulted in criticism of the BDUK process as being simply a grant to BT to fund extensions of its fibre network that it was already planning to undertake. Concerned over this potential State Aid nature of the BDUK programme, the project was placed on hold by the European Commission while it was thoroughly investigated [66].

This situation was worsened by the recent revelation by a whistle blower within the Department of Culture, Media and Sport that suggests that BT has been reporting inflated costs for such networks in order to receive additional funding [67], as well as revelations that the BDUK project has thus far spent nearly £3m on just consultations alone.

2.8 Attempts at infrastructure separation: the UK story

Infrastructure separation is one of the remedies being debated across Europe, and indeed, the OASE project has analysed open access business models in which the different roles are taken by different business actors. Britain is one of the countries where infrastructure separation of the incumbent has been attempted through some regulation, so we give some account of this here.

Within the UK, regulation of the telecommunications market is performed by the Office of Communications (Ofcom) within the government's Department of Culture, Media and Sport. In addition to the regulation of the fixed and mobile telecommunications industries, Ofcom is also responsible for the broadcasting and postal industries, and seeks to increase competition within all these disparate areas.

One of the most important tasks of Ofcom is to regulate the behaviour of the dominant operators within the UK markets in order to ensure that there is sufficient competition. Since its formation into its current state in 2003 (prior to this date, regulation of the telecommunications sector was overseen by the more narrowly defined Oftel body) the most significant change ushered in by Ofcom has been to split the national incumbent monopolist telecommunications provider, British Telecom (BT) into wholesale (Openreach) and retail (BT Retail) sections. This course of action was decided upon in order to increase competition in the retail market by opening up the retail-wholesale relationship.

It is unclear, however, to what extent this has been a success. Despite the division into the two sections, which ought to encourage diversification and a widening of product offers from

Openreach, it quickly became clear that this was not actually occurring. A further consultation from Ofcom resulted in a range of proposals to encourage NGA deployments [68]. The two that were adopted were Virtual Unbundled Local Access (VULA), allowing bitstream open access and designed to give a similar experience to the LLU available on the traditional network, and Physical Infrastructure Access (PIA), referred to as duct and pole sharing [69].

Both of these products have proven controversial. The original pricing of Openreach's PIA product was so high that any NGA deployment utilising it would have experienced significantly higher costs than a Generic Ethernet (GE) product from BT in the same area. Following complaints this price was lowered in 2011 [70]. However, despite this new lower price, uptake has been non-existent with no bids for this product after a year of availability [71]. This has been linked to the terms of service for utilisation of the PIA product, which contains a number of significant restrictions. Firstly, PIA may not be utilised to provide access for businesses or other commercial customers; secondly, PIA may not be utilised to provide wireless last mile access; and finally, PIA may not be utilised to provide backhaul for fixed, mobile or wireless traffic [72]. This significantly reduces the attractiveness of PIA, especially in rural cases where there may be a need for wireless technology deployments to avoid high infrastructure costs. In addition, the inability to provide either business services or backhaul services may reduce potential revenue by up to 50 to 60% in rural areas, while allowing BT access to the entirety of the revenue stream. This pushes the break-even period for programmes toward the 20-25 year timescale, rather than the 10-12 years expected of BT's FTTC VDSL programme.

VULA has also come in for significant criticism. Openreach's refusal to allow for dark fibre access (coupled with the lacklustre response to the PIA product offering) will force providers into utilising virtual services, and this may consolidate Openreach's lead in fibre deployment [73]. Despite a similar warning from the British parliament’s House of Lords Communications Committee that the UK was creating an anti-competitive broadband market, the government has ignored recommendations to improve the situation [74].

Ofcom has therefore received a great deal of criticism of its handling of the situation. A number of commentators have branded Ofcom a failure and demanded its abolition [75]. The UK trade body, the Communications Management Association (CMA), has been particularly critical of the policy outcomes to date, accusing both Openreach and Ofcom of holding up the process and representing a “toxic combination of regulatory timidity and the self-interest of license holders” [76].

Of particular note is the way in which the CMA has contrasted the slow and inefficient performance of the UK regulator with the “dynamic, hands-on approach” taken by its Swedish counterpart PTS. This is, perhaps, due to a difference of focus. While Ofcom is designed to promote competition, in practice this role is mostly orientated around the regulation of operators who reach Significant Market Power (SMP) status, and ensuring that there is no monopolist activity, PTS provides guidance on funding applications for fibre projects and encourages local fibre deployments; this is considered outside the remit of Ofcom.

To conclude, investment in the telecommunications infrastructure by the UK government has been considered to be a critical failure; with heavy criticism from end-users, sector companies, the media, and the UK parliament’s House of Lords Communications Committee. The BDUK project, in particular, has been a notable failure of policy; 20 months into the project there has been little benefit to the taxpayer from the money spent thus far. The

situation in Cumbria, mirrored across the other potential rural fibre rollouts, stems from a systematic failure in the BDUK process, which lacks a well-defined set of goals or a mechanism to reduce the natural advantages enjoyed by the incumbent operator (BT), so as to create an environment conducive to and encouraging competition in the sector.

3. Quantitative evaluation

After having given a good overview of the available regulations, and having described the opinions of some major stakeholders, we will now evaluate the potential impact of regulation quantitatively. We evaluate where public funds are needed to improve the business case for the Physical Infrastructure Provider (PIP), we compare the expected equilibrium to the social optimum, since the regulator should try to enforce a kind of social optimum. Analysis of regulation on roll-out success and take-up is performed. The broadband performance index is introduced and utilised and game theory analysis is performed on the FTTH deployment business case.

3.1 Where can or should public funds help the PIP business case?

In [5] we have calculated the PIP business case in detail. The scenarios for rural, urban and dense urban areas with the reference adoption curves aggressive, likely and conservative have been studied and the needed revenues per Home Connected (HC) have been calculated. In most cases however, these revenues were much higher than the typical revenues found in the case studies and the regulatory pricing caps set by the different national regulatory authorities.

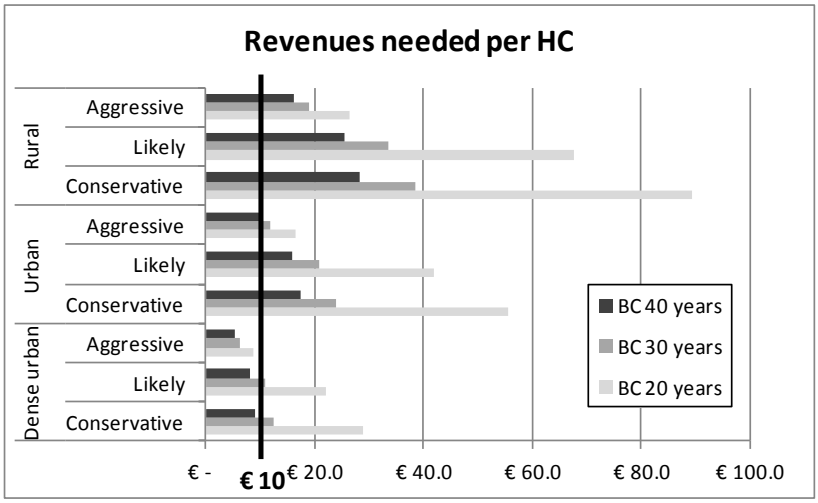


Figure 2: Revenues needed per HC as resulting from PIP business case analysis in [5]

It is shown that, even with a planning horizon extended until 40 years, the business case for the Physical Infrastructure Provider remains very difficult. In order to cover the costs with the assumed revenue of 10 euro per customer per month (Figure 2), in the urban area there is 7.6 euro missing for the conservative adoption curve and 5.7 for the likely curve. In the rural area there is resp. 18.4, 15.5 and 6.2 euro missing for the conservative, likely and aggressive curve.

Different options to help the business case were studied, and although all of them led to significant improvements, it is in most cases not enough to have a viable business case. We will therefore investigate here the impact of combined improvements on the overall business case, for the urban and rural area (since under good market conditions, our work in [5] has shown that deployment in a dense urban area can definitely be economically viable).

Figure 3 shows that there is, in the best case of demand aggregation, still 6% revenue missing to cover all the costs, while a reuse of a "large" availability of existing ducts still lacks 26%.

If however, both optimization options are combined, i.e. a demand aggregation of 40% with a large duct availability, the PIP has a positive NPV of about €1.15 million after 20 years!

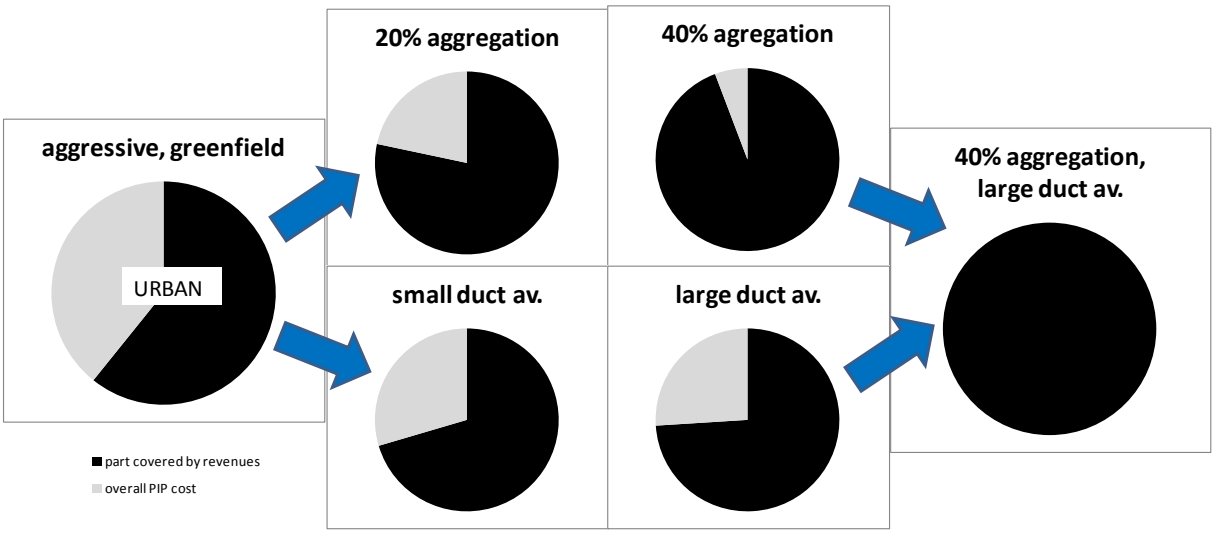


Figure 3: Possible savings by demand aggregation and reusing available ducts for the urban area

When investigating the rural area, the results are less optimistic. Demand aggregation reduces the "missing cost part" to 42% and large duct availability to 56%, but even when combining both savings, the business case is still not positive (Figure 4): still 31% of the Total Cost of Ownership (TCO) for the passive infrastructure cannot be covered by the revenues.

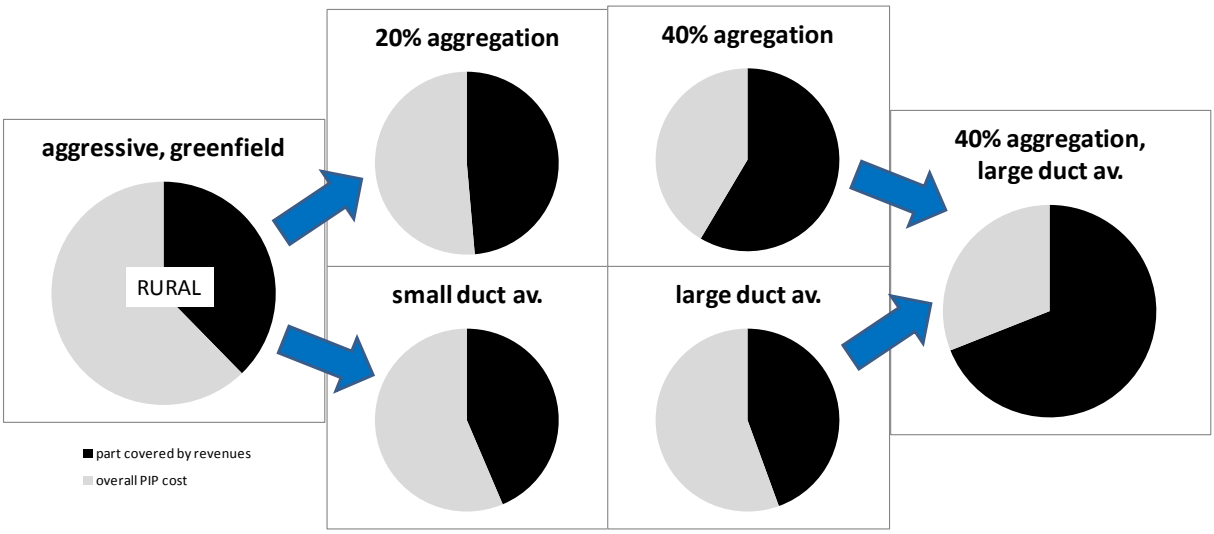


Figure 4: Possible savings by demand aggregation and reusing available ducts for the rural area

We can therefore conclude that, despite of the potential additional revenues from e.g. non-telco customers, the cost reduction based on duct reuse and the positive impact of demand aggregation on the timing of the revenues, it is clear that the business case for the rural area would most probably not be economically viable. In this regions, public funding might be the only way out.

Pure State Aid can be an option only in the so-called white areas, where no NGA network is present or likely to be built in the next three years. Otherwise, in case the provision of a broadband network is regarded as a service of general economic interest ("SGEI") [13], State

funding might fall outside the scope of State Aid and therefore could be a solution to make the case economically viable. In a third option, State funding might still be involved (e.g. in a PPP structure) when the capital placed by the State - directly or indirectly- is at the disposal of an undertaking in circumstances which correspond to normal market conditions.

3.2 How to measure the objectives from the Digital Agenda?

Not only the business case for FTTH rollout should be strong, the public policy case of fibre is of equal importance, especially when public investment is considered in the rollout of fibre infrastructure. The public policy case should take into account additional parameters next to the profitability of the project. In order to analyse this case, a performance index was developed, to measure the impacts of fibre networks and take-up. First, this broadband performance index will be introduced. Next, the different FTTH revenue scenarios from D6.2 [4] will be compared on this BPI, to indicate which scenario is the most socially optimal.

3.2.1 What is a social optimum and how to measure it?

National regulatory authorities (NRAs) have to take a plethora of objectives and effects into account when taking regulatory decisions. The regulated prices for copper access types are one of the main tools NRAs have at their disposal to influence the retail market for broadband access. Decreasing these prices is believed to decrease the entry barrier for OLOs (Other Licensed Operators), which should increase the competition on the retail market [77]. Resulting from this increased competition, a price pressure on retail offers could be observed. A secondary effect is the push towards more profitable investments for the incumbent. As their profit margins on the existing copper broadband market decrease, they will look towards NGAN investments. Although such effects will most certainly play, other authors have argued that a decrease of wholesale access prices could have negative effects on NGAN investment [78] and [79]. Expected revenues play a major role in the economic viability of new investment projects. If these remain too low, the investment can be abandoned. With price pressure on copper retail prices, and a higher required ARPU (Average Revenue Per User) for NGAN investments to be profitable, the price gap between both offers could increase, pushing customers towards the cheaper offer. As such, the expected uptake of the NGAN offer and the resulting payoff could decrease drastically, resulting in a postponement of NGAN investment.
Therefore, it is very important to have adequate prediction tools to assess the impact of regulatory decisions. In the following paragraph, both existing Broadband Performance Indices (BPIs) and a more NGAN oriented BPI will be used to indicate the possible impact of LLU price changes.

3.2.1.1 Measuring Broadband performance

In the Digital Agenda, Europe indicates the focal points for any digital advances [1]. It covers a variety of goals, ranging from higher access speeds, better broadband coverage and more frequent use of eServices. The Digital Agenda offers a clear view on the different important aspects for NRAs in their national broadband policy, but offers no quantification possibilities or descriptions making its use as a comparative index impossible.
Additionally the Digital Agenda is also missing the aspect of competition, while this is also of key importance in European and national broadband policy. The copper incumbents have been forced to open up their network to OLOs, and reducing the significant market power

(SMP) continues to be a key objective. Focussing policy on the Digital Agenda goals while neglecting their impact on competition should be avoided. It has been shown that monopoly or oligopoly typically results in market power for suppliers, reducing the optimal output quantity and selling it at higher prices, thereby reducing the consumer surplus.
Translating the Digital Agenda into a ready-to-use performance indicator is not straightforward. Policy makers need to measure the national performance on each aspect of the Digital Agenda. Some dimensions, like the number of people using eGovernment or eCommerce, might be hard to quantify objectively. Even when all indicators are measured, it still remains unclear how these different aspects add up. Which aspect is the most important to attain? Is broadband coverage the most important, or is it the use of eServices? Additionally, the Digital Agenda does not allow for a comparison between different scenarios (e.g. simulation outcomes, regions or countries, etc.).
As a starting point for a new performance index, the predecessor of the Digital Agenda was studied. The broadband performance index (BPI) was introduced in 2008 to benchmark the overall performance of Member States on a range of factors [80]. These factors include speed, rural coverage, affordability, innovation and other socio-economic dimensions. More importantly, it also takes into account the competition as it includes a competition-coverage indicator. Its description covers an extended calculation method, complete with weight factors of the different dimensions, to come to one number reflecting broadband performance. Normalisation through re-scaling is used, according to the equation below. The weight factors were discussed between the European Commission and NRAs in order to best reflect the importance of each dimension.

$$I_{ci} = \frac{x_{ci} - min_c(x_i)}{max_c(x_i) - min_c(x_i)}$$

The BPI offers an easy to use quantitative Performance Index (PI) to assess broadband performance; still its definitions are outdated and no longer applicable to predict the impact of regulatory decisions on nowadays broadband market. Using this PI without any updates or changes can easily lead to incorrect conclusions and faulty policies failing to achieve what was aimed for. In the following sections, we will show how to update this PI to capture more reliably the current market and new advances in access networks.

3.2.1.2 Towards an NGAN oriented performance index

The previous section clearly indicated that a good broadband performance index in which current and next generation technologies and the market functioning (e.g. competition and pricing) are included, is currently missing. Here, we will propose a new broadband performance index for which we start from the original BPI and make changes where necessary. In this section we indicate the different updates made to the original BPI. Each dimension of the BPI will be elaborated on, and each change will be motivated.

A. Broadband rural coverage
The rural coverage of broadband is the first dimension of the BPI, with a weight factor of 12.8%. For this parameter, it is important to define both broadband and rural coverage. In the original BPI, broadband was defined as access speeds over 2Mbps. It may be clear that the introduction of NGAN will not improve this indicator, while this goal is present in the Digital Agenda. Additionally, NGAN is expected to be introduced in the more dense areas, since these areas offer the best business case.

This definition should be altered towards NGAN coverage. We propose to define NGAN in the updated index as a network offering access speeds over 30Mbps in the line of the Digital Agenda. This means that it includes both the upgrade of existing cable and copper networks as the rollout of FTTX networks. A future BPI should base its definition of broadband threshold on objective measurable data. This could for instance be calculated using a formula based on the maximum deployed access speeds and on attainable speeds with next generation technologies. Depending on the considered scenario and regulatory focus, the definition of rural coverage can be maintained, or could be relaxed to full coverage including deployments in urban areas. In case of optical access networks, it was already indicated that rollout will initially focus on urban areas. Relaxation means that when NGAN is rolled out in urban areas, this also improves the broadband performance of the area.

B. Competition coverage

Above, we discussed the importance of a PI taking into account the different policy goals of NRAs. The competition dimension was included in the BPI, weighted at 16.7%. Competition coverage is the combination of two factors, namely the market share of new entrants and national coverage. In this definition, it is important to define what a new entrant is. OLOs can clearly be seen as new entrants, especially since their total market share in most markets is very limited. However, the BPI also includes cable operators in the new entrants segment. While this may hold for most cases, some exceptions should be allowed. For example, in Flanders, the cable operator currently holds a market share of around 55% of all broadband users, while the former monopolist only holds 40% [81]. In this case, the cable operator can no longer qualify as a new entrant.

The BPI should be altered to only include real OLOs with a non-significant market share. Additionally, when NRAs should decide to open up the cable network to OLOs as well, the market share of those operators should also be included in this dimension [82].

C. Broadband price

Broadband price is the umbrella covering three different dimensions of broadband pricing, to reflect the affordability of broadband. The first dimension is the median broadband price, corrected for speed (weight = 8.7%). This indicator is retained for the NGAN oriented BPI, with a minor change in the calculation method: the median is changed for the average price, which will allow using this index in more specific smaller scale (e.g. city networks) situations and theoretically abstracted (e.g. with less offers) studies. The two other dimensions of the broadband price are the average price for broadband slower than 2 Mbps and for broadband offering speeds between 2 and 8 Mbps (weights 3.8% and 3.4% resp.). While these were the typical speed baskets when the BPI was first launched, technological evolution has resulted in raising access speeds, towards 50 Mbps or even higher. Leaving these speeds out of the analysis would neglect the positive impact of network investments. Therefore, the speed baskets should be updated towards more future proof baskets, in which the ‘low’ speed baskets represent all offers under 30 Mbps, while all retail offers with NGAN speeds are classified in the ‘high’ speed basket. As mentioned before the broadband threshold of 30 Mbps is based on the Digital Agenda and should be continuously updated.

D. Speeds

Coverage, competition and affordability were all covered in the previous parameters of the updated BPI. However, as the introduction of NGAN speeds to end consumers will most likely result in an increased uptake of advanced services, speed is also an important dimension of the BPI, split up in two separate parameters.

The average speed is the first indicator (weight = 9.8%). It may be clear that with more NGAN being rolled out and taken up, the value of this indicator will rise. We therefore choose to retain this dimension in the NGAN oriented BPI. However, the second indicator, the percentage of subscribers with access speeds over 2 Mbps, is no differentiator towards NGAN (weight = 8.3%). For example in Belgium, almost 100% of the country is covered with DSL services, so upgrading the network towards NGAN would have no impact on this aspect. But when translating the Digital Agenda goals, which aim at full coverage of 30 Mbps, the change to this parameter is quite straightforward. The speed dimension in the NGAN oriented BPI should include both average speed and coverage of 30 Mbps (or again the broadband threshold).

E. Other dimensions

The original BPI also includes dimensions like the take-up of advanced services and the socio-economic context (weights 19.6 and 17.4 resp.). Advanced services was interpreted as the number of customers using eServices, like eGovernment, eCommerce or eBanking. Socio-economic factors include ICT spending and PC penetration. We believe it is important to also include such parameters to assess the impact of regulatory decisions. However, when using performance indices to predict the impact of regulatory decisions, the quantification of these parameters would come with a large amount of work and a high degree of uncertainty. Therefore, these dimensions are left out of the analysis further in this paper. For a visual comparison of the original BPI and the new NGAN oriented BPI, we refer to Figure 1 and 2.

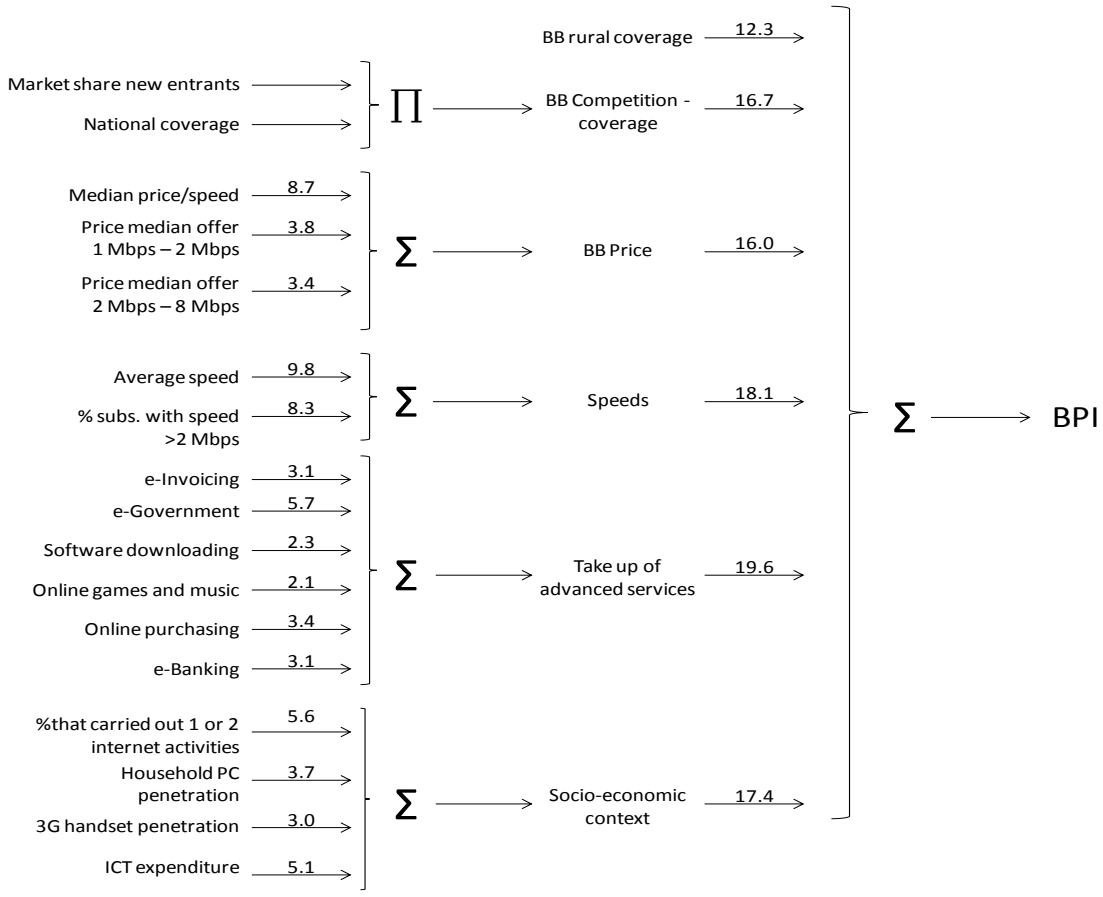


Figure 5: From the existing BPI

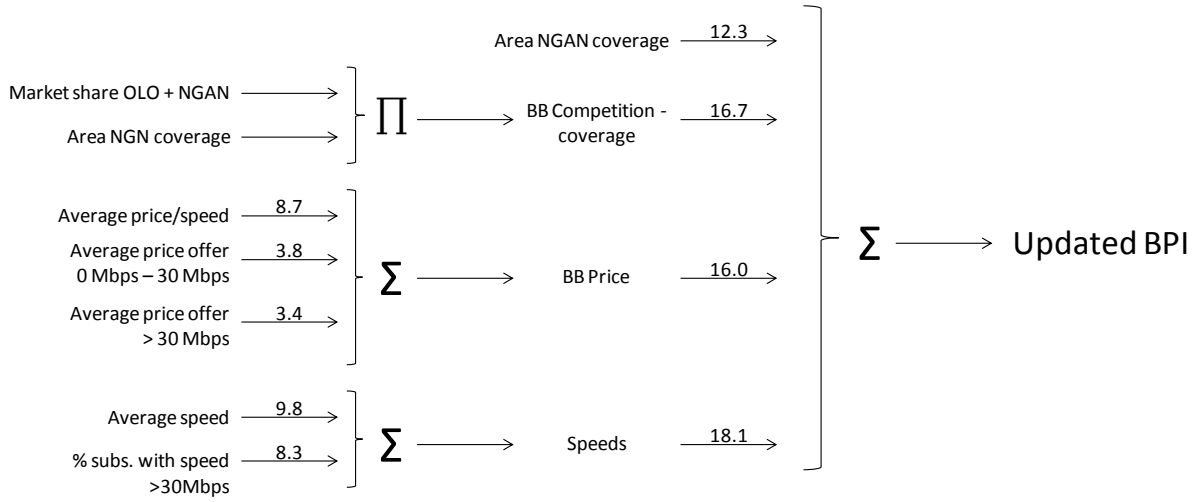


Figure 6: Towards an NGAN oriented BPI

3.2.2 Evaluation of the different case study scenarios in the light of the extended BPI

With the BPI developed above, it is now possible to compare the different revenue scenarios from D6.2 [4]. In D6.2, four future scenarios for the three countries discussed (the Netherlands, Germany and Sweden) were introduced. Each of the scenarios differs on inter- and intra-platform competition. In scenario 1 and 2, inter-platform competition disappears with the introduction of fibre, while for scenario 3 and 4, this competition continues to exist in 2030. However, the market share of the existing copper infrastructure decreases significantly. We refer to D6.2 for a description of the revenue scenarios.

3.2.2.1 The Netherlands

The Netherlands are characterized by a high total broadband penetration of 87.3%. Additionally, a strong cable presence (34%) can be observed, but only marginal take-up of fibre (2.7%). For the BPI, speeds and price levels are also required. According to point-topic [83], the market share of other licensed operators is around 10%. The values used can be found in Table 1. Broadband coverage in the Netherlands is currently 100%. However, this includes VDSL and cable coverage. FTTP coverage is only at 12.8%.

Table 1: Market parameters in the Netherlands [83]

Player	Price level	Speed (DL)	Market share
DSL	€35.00	20 Mbps	40.60%
OLO	€35.00	20 Mbps	10.00%
Cable	€36.67	30 Mbps	34.00%
Fibre	€55.32	60 Mbps	2.7%

The four different revenue scenarios for the Netherlands will have a drastic impact on the future BPI. In the first two scenarios, where inter-platform competition disappears, this will be reflected in a lower score on competition. Additionally, when only one NP is present,

competition is completely absent on the lowest two layers. However, on the service level, competitors can play freely. Although there is a reduction in competition, due to the large coverage of fibre (assumed to be 100% in 2030), this negative impact will be compensated. Additionally, higher scores on speed will also offset the reduction in competition. In Table 2, it can be seen that this reduction of competition in the intra-platform competition with only 1 NP has a negative impact on the quantified Digital Agenda goals, as is to be expected. However, this is not the case when 2 NPs can compete on top of the physical infrastructure. When inter-platform competition occurs, with fibre competing for market share with the existing infrastructures, the largest increase in achieving the DA targets can be observed, if competition is allowed on the active layer. Infrastructure competition offers the largest opportunities for reaching the DA increase.

Table 2: BPI in the Netherlands

Scenario	**BPI (normalized to 2011)**
Current situation	1
Intra-platform / 1 NP	0.9530
Intra-platform / 2 NP	2.2888
Inter-platform / 1 NP	1.089
Inter-platform / 2 NP	1.6990
Market model	1.5874

In these four scenarios, fibre uptake is assumed to be high after 20 years, covering almost half of the market. It can be expected that price competition, together with performance increases of copper and cable infrastructure might reduce the expected uptake of fibre offers. The evolution of the fibre take-up has also been modelled with a market model, simulating the uptake of offers based on price competition (see also D6.3 [5]). Previous research has indeed shown that customers are price sensitive with regard to broadband, and the willingness to pay a fibre premium is low. In Figure 7, the changes of market share under price competition are shown. The full lines represent the impact of price competition, when consumers are only price sensitive, and do not take into account quality differences between different offers. The dashed lines show how the market division changes under price and quality competition. It is clear that under the latter assumptions, we come close to scenario 3 and 4, but with a more conservative uptake for fibre, which also results in a smaller decline of the DSL market share. The impact on the BPI can also be found between the result of scenario 3 and 4, with a score of 1.5874.

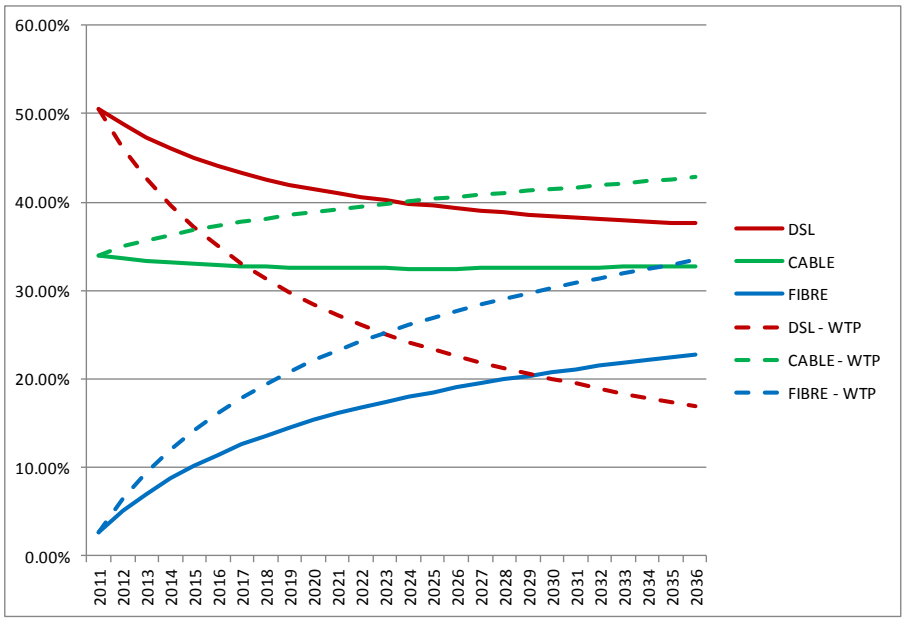


Figure 7: market share evolution in the Netherlands

3.2.2.2 Germany

Compared to the Netherlands, the total broadband penetration in Germany is considerably lower (66.1%), with the largest market share for DSL. Fibre only accounts for 0.1%, and the presence of cable is also smaller than in the Netherlands. Coverage of FTTP in Germany is at the moment around 2.6%, while NGAN coverage is at 41.5%. On the DSL market, the incumbent still has a strong presence of over 50%. The values used in the calculations of the BPI can be found in Table 3.

Table 3: market parameters in Germany [83]

Player	Price level	Speed (DL)	Market share
DSL	€29.95	20 Mbps	30.00%
OLO	€29.95	20 Mbps	24.00%
Cable	€33.28	30 Mbps	12.00%
Fibre	€40.46	60 Mbps	0.1%

Again, the same trends as in the Netherlands can be observed. Under the absence of inter-platform competition and only 1 NP, the low score for competition has a negative effect on the BPI. When two NPs are active on the physical infrastructure, the BPI increases significantly, with 188% compared to the current situation. The larger increase compared to the Netherlands can be accounted to the differences in current coverage and take-up of the fibre network and services. Under the more conservative scenario, where consumers continue to purchase access on the legacy infrastructures, the rise in BPI is larger when there is only one NP (compared to the intra-platform competition case). Again, the market model was run for the German case. In the Netherlands, the results from this model came close to the predicted market shares from D6.2 [4]. However, in case of Germany, a different trend can be observed. While D6.2 estimated a large uptake of fibre services, the market model indicates a substitution effect between cable and fibre. Before moving to fibre, end users adopt cable

first, and the market share of cable comes close to the Dutch numbers. Again, this results in a NGOA oriented BPI increase between scenarios 3 and 4.

Table 4: BPI in Germany

Scenario	BPI (normalized to 2011)
Current situation	1
Intra-platform / 1 NP	1.2077
Intra-platform / 2 NP	2.8783
Inter-platform / 1 NP	1.2878
Inter-platform / 2 NP	2.3433
Market model	1.9138

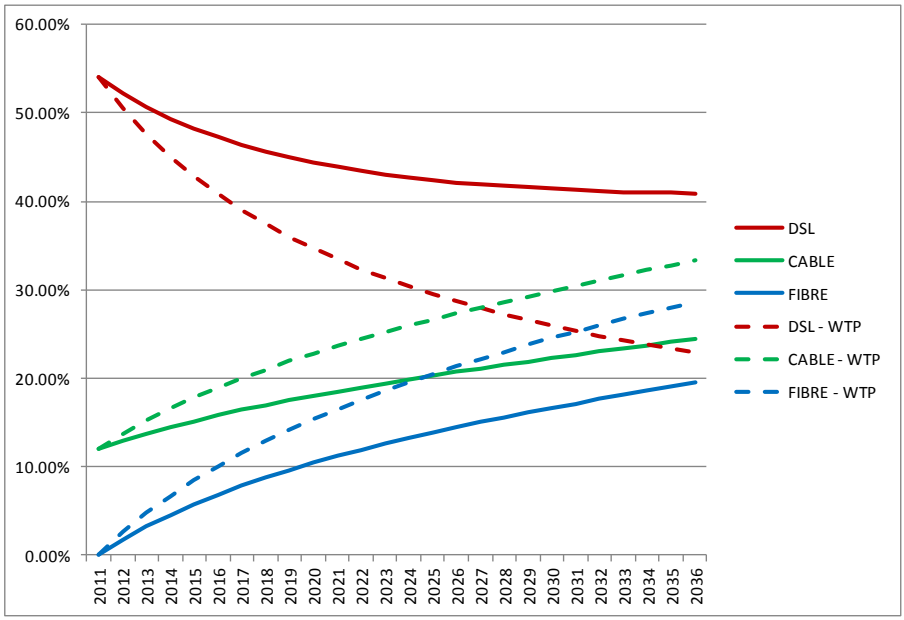


Figure 8: market share evolution in Germany

3.2.2.3 Sweden

Compared to the previous two countries, Sweden has the largest fibre penetration. Coverage is up to 34.8%, and uptake of fibre subscriptions already reaches 15%, five times higher than uptake in the Netherlands. Several reasons for this high uptake can be found. First, DSL and DOCSIS 3.0 coverage is low compared to the other countries. In Germany, coverage of these technologies is around 40%, for the Netherlands this is almost 100%. On the contrary, in Sweden, VDSL coverage is only at 10%, and DOCSIS 3.0 just over 25%. Resulting from this, FTTP has the largest coverage, and can thus reach more people. Secondly, fibre broadband services are put at an interesting price level, below the average DSL and cable services (Table 5).

Table 5: market parameters in Sweden [83]

Player	Price level	Speed (DL)	Market share
DSL	€36.81	20 Mbps	26.00%
OLO	€36.81	20 Mbps	7.30%
Cable	€34.00	30 Mbps	12.20%
Fibre	€29.34	60 Mbps	15.0%

When looking at the changes in broadband performance based on the four revenue models from D6.2, it can be observed that the two models with only 1 NP result in a lower BPI compared to the current situation. The main reason for this is the reduction of competition. In the previous two countries, this was offset by a large increase in coverage. It is clear that such coverage gains cannot be reached in Sweden.

With extra competition on the NP layer, significant gains in the BPI can be reached. Again, the optimistic intra-platform competition promises the largest BPI gains. The more realistic inter-platform competition scenarios, as well as the market model scenario (Figure 9) offer a BPI increase of over 40% (Table 6).

Table 6: BPI in Sweden

Scenario	BPI (normalized to 2011)
Current situation	1
Intra-platform / 1 NP	0.8609
Intra-platform / 2 NP	2.0398
Inter-platform / 1 NP	0.9145
Inter-platform / 2 NP	1.6742
Market model	1.4186

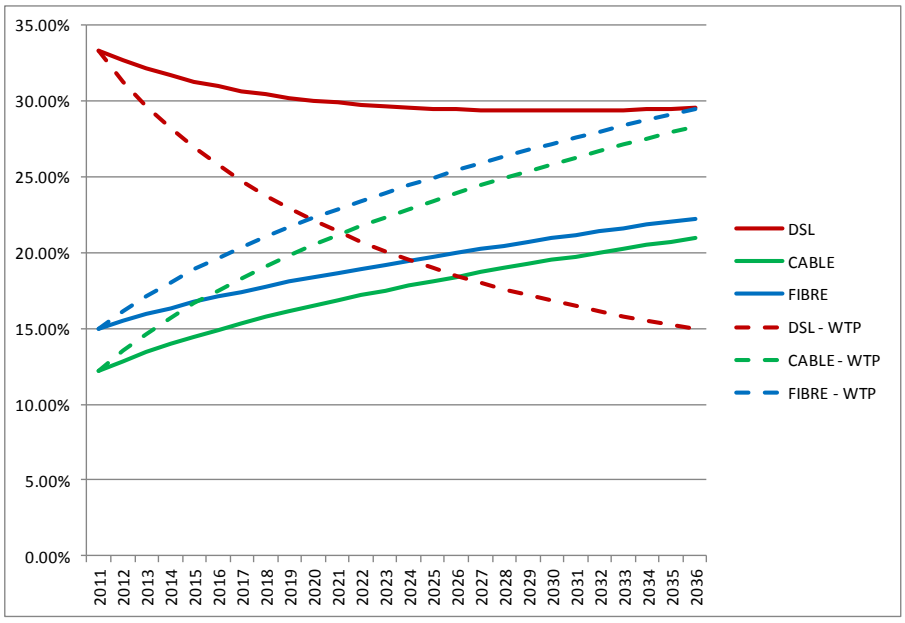


Figure 9: market share evolution in Sweden

3.2.3 Relevance of the updated BPI on the game between multiple players in an open access environment

The previous results indicated different scenarios for the future broadband market, and how the market division impacts the broadband performance index. However, the BPI developed here is not only a predictive tool for the performance of future broadband markets, it can also be used as a policy instrument. Indeed, when a policy maker or regulator can take into account the different strategies from the market players, the BPI can be used to derive the most optimal situation. Policy can then be adjusted to also reach this optimum.

In this section, we will indicate how the dynamic interplay between different actors impacts the resulting equilibrium in the market, and how policy makers can steer towards these equilibriums. In D6.3, it was indicated how the rollout of a new fibre infrastructure by a public MIP (Municipal Infrastructure Provider) distorts the existing broadband market. With the entrance of a new player, the market shares of the existing players are under pressure, which will result in strategies by these players to safeguard their profitability and market. The competition between these infrastructures resulted in two equilibriums, strategic combinations where no players have the intention to change strategy. In the first equilibrium, the newly deployed fibre infrastructure is not opened to other ANPs (Alternative Network Providers). In this case, telco's and ANPs on the legacy copper network cannot migrate to the fibre network, but they maintain their market share on copper. However, from a profitability view of the public MIP, this situation results in a negative case, since uptake on their network remains low. In the second equilibrium, the public MIP operates an open network, allowing other players to become ANP on their fibre infrastructure. It was shown that this was also a Pareto optimal situation, from profitability view.

However, a public MIP might have, next to a business case, a strong public policy case. A public actor investing in fibre infrastructure has social welfare as goal. Closing the digital divide, universal high speed broadband access, etc. are only a few examples. However, it is hard to measure the impact of fibre on the public policy case. Here, by translating the goals of

the Digital Agenda into an NGAN oriented performance index, social welfare is measured through a proxy.

In order to check the public policy case, and how the public MIP can steer towards social optimum, the infrastructure competition game from D6.3 is repeated. However, instead of using a Net Present Value (NPV) objective function for the public MIP, their objective function is now modelled through the NGAN oriented BPI proposed here. The payoffs of the ANPs and Telco remain the NPV in millions € after 25 years. The results of the game can be found in Figure 10.

		Regulator							
		CLOSED			OPEN				
Telco	STAY	5.60	2.42	4.95	5.60	2.42	4.95	COPPER	ANPs
		-∞	-∞	-∞	5.55	3.15	4.97	FIBRE	
	MIGRATE	-∞	-∞	-∞	6.92	2.90	4.45	COPPER	
		-∞	-∞	-∞	6.82	3.46	4.50	FIBRE	
	OWN	-30.00	2.23	4.45	-30.00	2.23	4.45	COPPER	
		-11.00	2.81	4.50	-31.00	2.81	4.50	FIBRE	

Figure 10: Infrastructure game and the public policy case

Comparable with the infrastructure game in D6.3, the prevailing Nash Equilibriums (NE) are again located at the same strategic combinations. Either the equilibrium is at [STAY-CLOSED-COPPER], or at [MIGRATE-OPEN-FIBRE]. An additional NE is at [OWN – CLOSED – FIBRE]. The second Nash equilibrium is also Pareto optimal. As a public MIP, it is clear which future broadband market is preferred. The public policy case is maximized in the Pareto optimal solution. As policy maker, it is obvious that they will opt for an open network infrastructure, in order to maximize take-up on high speed broadband. Additionally, competition is increased on the fibre network through this choice, as the other actors will choose to migrate to the fibre infrastructure. An additional Pareto optimal solution is [MIGRATE – OPEN – COPPER]. Since both Pareto optimal solutions are located in the open network branch, the regulator can reach these by enforcing an open network solution. If competition plays freely after this decision, the strategic combination with the highest BPI will be reached without extra regulatory steering.

In D6.3, it was indicated that the infrastructure is only profitable when all existing players migrate to this network. However, this is dependent on the regulated access and connection charges. The difference between these two is the revenue margin for the ANPs, and drives their decision to migrate to the fibre network. This margin has two requirements. First, it has to be large enough to result in a positive business case for the ANP. Obviously, if the margin is too small, no ANP will migrate to the fibre infrastructure. Secondly, since existing players have a legacy infrastructure, the margin needs to be sufficient to counter the profitability of the legacy network. Indeed, if the profitability of the legacy network is higher than the profitability of the ANP business, these actors will not migrate.

A regulator has the ability to influence both the access and the connection price, he can also influence the margin for the ANPs. As such, he can impact the viability of the ANPs and the public MIP, taking into account the BPI. In the following games, the impact of decreasing the access price will be studied.

In the first game, the impact of a decrease of the access price by €1 to €11.14 is shown. By decreasing the access price, the regulator improves the profitability of the fibre business case

for the ANPs, encouraging them to migrate to the fibre network. This can be observed in Figure 11. For the ANP migrating to fibre, the difference between the copper and fibre business case is clearly enlarged by the access price decrease. Additionally, when taking into account that the public MIP, which has a public policy case next to a business case, passes on these decreases to its retail customers, the BPI is increased slightly due to an increased uptake of fibre. If the lower access price also impacts the retail prices of the other offers, the effect might even be higher, as it will even further increase the fibre uptake. This could be the case when the public MIP also offers broadband access to populations to decrease the digital divide.

If the payoff of the regulator is measured through the BPI, it is clear that he will prefer the lower access price. This effect, caused by an increased uptake on the fibre network, is small but obvious for all possible strategies of the other players. Only one NE prevails, [MIGRATE – LOW – FIBRE], which is also a Pareto optimal solution.

		Regulator							
		LOW access price			HIGH access price				
Telco	STAY	4.84	2.537	4.50	4.84	2.535	4.50	COPPER	ANPs
		4.75	3.329	6.66	4.75	3.328	4.86	FIBRE	
	MIGRATE	8.32	3.075	3.82	6.77	3.073	3.82	COPPER	
		8.00	3.684	5.67	6.54	3.683	4.21	FIBRE	
	OWN	-25.00	2.318	3.82	-24.00	2.317	3.82	COPPER	
		-27.00	2.952	5.67	-26.00	2.951	4.21	FIBRE	

Figure 11: Impact of access price decrease on profitability and BPI

However, decreasing the access price has a large impact on the viability of the Public MIP business case. In the infrastructure competition analysis of D6.3, it became clear that its business case is under a lot of pressure. Only the best case, migration of existing players and a dynamic market, results in a profitable case. When access prices are fixed by the regulator, he may not endanger the incentive of the public MIP to roll out the network. Setting the regulated access prices too low will result in a negative business case. A regulator must make the trade-off between profitability and the public policy case. The impact on the business case is shown below.

		Public MIP							
		LOW access price			HIGH access price				
Telco	STAY	4.84	-31.00	4.50	4.84	-30.00	4.50	COPPER	ANPs
		4.75	-5.20	6.66	4.75	-0.91	4.86	FIBRE	
	MIGRATE	8.32	-13.00	3.82	6.77	-9.90	3.82	COPPER	
		8.00	6.28	5.67	6.54	12.20	4.21	FIBRE	
	OWN	-25.00	-29.00	3.82	-24.00	-28.00	3.82	COPPER	
		-27.00	-7.80	5.67	-26.00	-4.30	4.21	FIBRE	

Figure 12: Impact of access price decrease on public MIP profitability

The same game as in Figure 11 is played, but now the objective function for the regulator is the NPV of the public MIP business case. As expected, the dominant strategy for the MIP is the highest access price, as this maximises its revenues. Due to the low price sensitivity on the broadband retail market, price increases have only a small effect on the take-up. However, this situation is not Pareto optimal, it does not result in a social optimum. Both Pareto optimal situations are located in the case of low access prices. The strategic combination [MIGRATE

– LOW – FIBRE] even coincides with the Pareto and Nash solution from the BPI game in Figure 11, and still results in a positive case for the public MIP. It is thus possible to find an optimal solution between reaching the Digital Agenda goals and the profitability of the infrastructure provider.

3.2.4 Conclusions

The three case studies above introduced the concept of broadband performance in fibre rollout and uptake. In order to measure this public policy case, a broadband performance index was developed, based on the Digital Agenda and the existing BPI. Using the index on three different cases shows how different competition scenarios impact the public policy case. In all case studies, moving towards an intra-platform competition scenario with only one NP active on the physical infrastructure has a negative effect on the BPI. Indeed, in such a scenario, without competition on the NP layer, the BPI is negatively impacted. However, it should be noted that the absence of competition on the NP layer does not mean there is complete absence of competition on the retail market, as several service providers can still compete on top of this NP layer.

When allowing extra competition on the NP layer, there is a clear increase in BPI, and this scenario should be preferred by a regulator when making regulatory decisions, also when inter-platform competition is present.

In order to take consumer behaviour into account, the market share was also modelled based on a market model, starting from current market shares. Using such a model, the uptake of fibre in 2030 was estimated more conservative than the revenue models 3 and 4, but it still results in a positive public policy case.

The NGAN oriented BPI not only serves as a predictive tool for broadband performance, when several future scenarios are compared. It can also be used as policy tool, allowing policy makers and regulators to make decisions regarding fibre networks. In D6.3, it was already shown that a public MIP should clearly opt for an open network under infrastructure competition to maximize its payoff. Although profitability is an important aspect for this public MIP, especially with EU legislation taken into account, the public policy case may be their most important driver. Here, the infrastructure competition game from D6.3 is repeated, now taking into account the NGAN oriented BPI as a proxy for this public policy case. The same equilibriums occur as in the game from D6.3, but it is clear that the policy maker clearly prefers an open fibre infrastructure, as this maximises their objective function. The Pareto optimal strategic combinations coincide, clearly indicating that the most profitable business case also results in the most opportunities to reach the Digital Agenda goals.

Regulated access prices can play a major role in the uptake of fibre networks. For existing players on the broadband market, the choice between migrating to the new infrastructure and staying on the legacy network depends on the differences in profitability between the two. By decreasing the regulated access prices, a regulator increases the margin for ANPs and thus their business case. As such, it can be expected that uptake of the fibre network will rise. However, a trade-off exists between the profitability of the ANP and the public MIP. In D6.3, it was shown that a positive case for the MIP only occurs when all players migrate to this network. Reducing the monthly access price can endanger the profitability, and thus the incentive to roll out a network. However, it has been shown here that lower access prices are still profitable for the MIP, and even result in a social optimum, both in reaching the Digital Agenda goals and profitability for all actors.

4. Conclusions and OASE recommendations

Here, we draw the main conclusions from the business modelling, policy and regulatory analysis performed during the project, and put forward OASE's recommendations towards policy makers in order to encourage investment in FTTH deployments and, to make NGOA economically viable, to create a profitable business case for the actors involved, and to give rise to a positive environment for end users and society at large.

4.1 Main conclusions and lessons learned

The calculations presented in D5.3 and D6.3 make clear that building parallel FTTH infrastructures for competing vertically integrated actors is too expensive for there to be a business case for more than one actor.

Because fibre infrastructure deployment requires massive upfront investment, the PIP business case can in some cases – even for a single PIP – become volatile. Identification of measures which allow to increase revenues early on in the project lifetime or reduce deployment cost is crucial. In D6.3, the business case for different types of open access has been analysed, concluding that

- in dense urban areas a business case may be made for parallel operators placing equipment in central offices where they can access last-mile connections (either from an independent PIP, or in an unbundling scenario).
- As population density is reduced, it becomes difficult to make a business case for parallel operators to place active equipment in all CO.
- Demand aggregation is an effective measure to guarantee early adoption and therefore earlier return on investment.
- Duct reuse should be stimulated as it has an important impact on the deployment cost.
- Transaction cost can represent significant hurdles to the successful implementation of open access models, hence reducing the gains from infrastructure sharing. There is therefore a clear potential gain in promoting standardization, both at technical and business level, in order to reduce such costs.
- A lot of indirect or cross-sectoral effects can be expected from a fibre deployment. This could be an additional stimulus for national, regional or municipal governments to invest. In this way public support (state-aid in a form or another) may be desirable, possibly in terms of long-term loans, or long depreciation periods.
- On the other hand the NP is based on recurring costs, so public support there would have to take the form of mere subsidy, which would be unadvisable in the long term.
- It is clear that the in-house deployment and CPE costs are significant. Business models that allow to allocate these costs to house or home owners should get enough attention.

4.2 OASE recommendations

As a consequence, it is recommended for that:

- *Multiple NPs should have access to any customers, limited to one NP to one customer at one point in time.* This means that there is a limited set of NP offering network

connectivity in a certain area and that an end user can freely choose between them. However, the end user is only connected to a single NP at a certain point in time.

- *Regulatory unbundling measures only hold in "black areas"* since FTTH deployments are left to market forces in "black areas" (typically urban and especially dense urban areas), and only regulatory unbundling measures similar to ADSL are put in place to guarantee competition.
- *In "grey" and "white areas"*, where bitstream access is the only sustainable way to ensure competition, regulation should put in place to encourage an open network provider (either with own fibre infrastructure or, with fibre provided by an independent PIP) to deliver end-user connectivity to competing service providers under non-discriminating and transparent terms.

Public support (state-aid in a form or another) *may be desirable:*

- Deployment of the physical infrastructure is mainly CAPEX driven, therefore support may be granted in terms of long-term loans, or long depreciation periods, in order to increase the investment horizon (D6.3 has shown how sensitive the business case is to the investment horizon) On the other hand the NP is mainly OPEX driven, so public support there would have to take the form of mere subsidy, which would be unadvisable in the long term.

And in any case:

- The construction of passive infrastructure to be shared on equal and non-discriminatory ground. The PIP should be technology agnostic, meaning that fibre consolidation should take place at flexibility points in which fibres can be connected, and in which both active and passive equipment can placed. This is important to maximise the potential wholesale customer base for a PIP (some NP may run PON, some AON, some hybrids thereof, and the passive infrastructure should be built so that all solutions are sustained). In case of the cabinet flexibility point: calculation did show that significant additional costs have to be recurred and all involved parties have to share these in a fair manner. In certain cases especially in "grey" and "white" areas this requirement hardens even more the difficulties of the business case and one should carefully assess if it is necessary.
- *There should be a coordinating rule set in place.* This rule set needs to be defined between all players within one dedicated area. In general this count for all possible open access scenarios including fibre unbundling but is even more relevant for wavelength unbundling and bitstream access. This agreement should include all relevant technical (incl. e.g. resource allocation), process related as well as business aspects / interfaces required for providing services to the customers. In best case there is a basic framework already defined by a public authority. If a coordinating role is required this can be taken by one player or one independent entity to be agreed on.
- *Dynamicity of market share should be properly supported by technology*. There should be an open operating mode for resource allocation. It should allow a dynamic allocation of resources based on market demands with a to all other providers transparent allocation of resources and control accordingly. For example, taking varying market shares into account requires rearrangement of fibre released or wavelength to other providers.

Many of these concepts are indeed already contained in the EC Guidelines on NGA State Aid, and should be strengthened.

We have preliminary looked into transaction costs and seen how they too can represent significant hurdles to the successful implementation of open access models, hence reducing the gains from infrastructure sharing. There is therefore a clear potential gain in promoting standardization, both at technical and business level, in order to reduce such costs:

- Supporting standardisation and discussion forums, as well as future research projects on open access would lead to a more attractive business case in the medium term.

APPENDIX

A1. Interviews: questionnaire to stakeholders on regulation

The following questionnaire was used as a support tool when interviewing different stakeholders to compare different opinions, and indicate where possible pitfalls or misunderstandings lie. The interviews consisted in conversations based on the questionnaire, rather than answers to specific questions.

A) QUESTIONS FOR ALL STAKEHOLDERS

1. What does the market failure principle mean in practice?
2. Does the current regulatory regime suffice to reach the goals set out in the Digital Agenda, or should it be revised?
    - Do you think that the 2020 objectives will be reached, or are these objectives deliberately set too ambitious in order to guarantee that enough effort is made?
    - Should State Aid be allowed more?
    - Do you think it would be beneficial to allow public investment only on the passive infrastructure?
3. Is regulation stimulating competition on all levels?
    - Is or should a different regulation be implemented for dark fibre (passive infrastructure) and wholesale (active infrastructure)?
    - Is State Aid or public investment easier allowed on one specific layer?
4. Is or should a difference be made between the pricing of dark fibre and the pricing of the copper local loop unbundling?
    - Is the price regulated?
    - Who has decided on this price setting?
    - What was the reason for implementing this?

B) QUESTIONS FOR EUROPEAN COMMISSION

5. How does the EC make sure that the rules are enforced?
    - Are there certain consequences for Member States that do not succeed in achieving the goals?
    - Who will be held responsible?
    - Who will be punished by whom?

C) QUESTIONS FOR NRAs

6. Does your country have a Broadband Strategy?
    - How was it set up? Who took which decisions?

- Is it formulated on technical, business-oriented or political level?
- Does it include guidelines, directives or concrete laws? Does it include concrete fines or other consequences when not followed?
- How do you coordinate the follow-up of this strategy?

A2. Market modelling module

The market modelling module aims at calculating the market shares of different players, based on their strategy. Price, or quality-corrected price, is the typical strategy on which market division can be based. However, not only the market division is influenced by price, the total market size is also driven by this factor. In economy, price elasticity is used to indicate this effect. It gives an indication of how the total demand varies in function of price changes.

The calculator present in this module allows to estimate the elasticity based on different factors. For example, the price that impacts the total demand could differ. For some products or services, it is possible that an increase of the highest price on the market has a positive effect on the total demand (in case of Veblen or Giffen goods). This is typically the case for luxury products, where the prestige linked with the product rises with the price and thus increases demand (Veblen). Otherwise, it can also occur for common products. A rising price for bread results in a higher demand, since lower income groups notice a large effect of this price on their income, so they start substituting other more expensive food with bread.

However, in general it is the average price level or the lowest price on the market that drives the demand. The price drop for computers, cars or plain tickets has had a positive effect on demand. An example of how a decrease in prices influences the total market is shown in Figure 13.

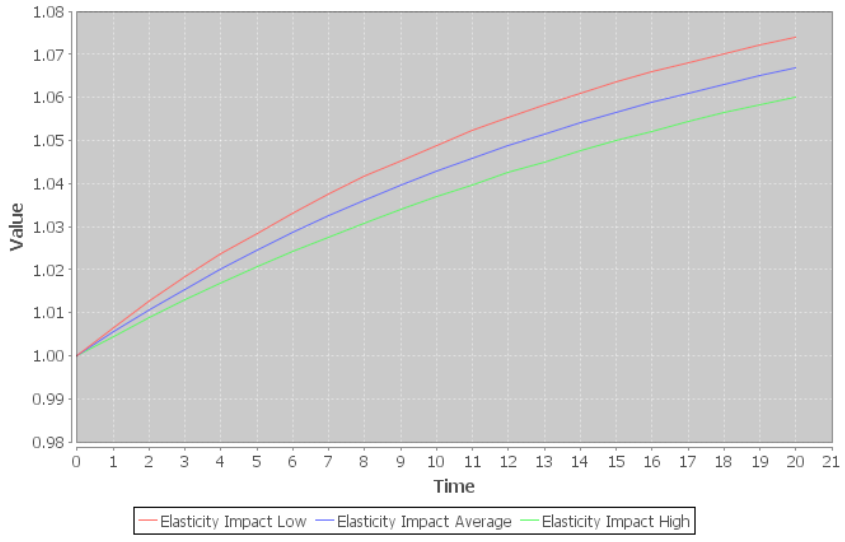


Figure 13: Impact of two decreasing prices on demand

The elasticity concept as described above has an impact on the total market. This object is also available within the market module, and it allows to define a market based on a minimal, maximal and expected market potential, together with an elasticity. When strategies are defined for the market, a corrected yearly market potential is estimated based on the elasticity.

With the total market estimated, it has to be divided between the different actors active on the market. Before estimating the total market share of each actor, it has to be decided which part of the market is available to be divided between the different actors. The introduction of a new product or service will not immediately change the entire market distribution, since only a percentage of all customers can change between offers. A subscription can only be stopped after x months or lock-in of customers all have the effect that some customers cannot switch between offers. Only a part of the market can redistribute between offers, the so-called free market. This free market constitutes of the customers who consider switching, but also the new market that became available in that period, e.g. due to adoption increase. In Figure 14, only 10% of the total market is available to churn each period.

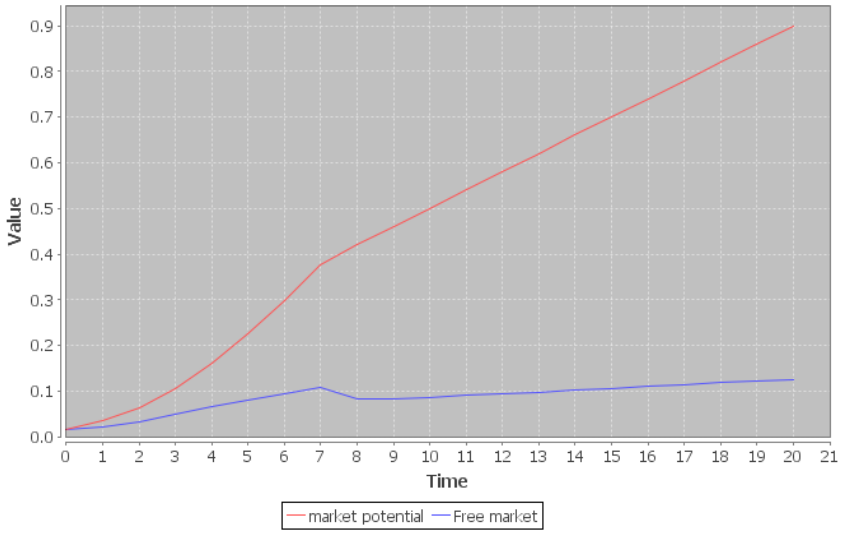


Figure 14: Determining the free market

It is this free market that can be divided between the different players. Based on the strategy of each player, a distribution parameter is calculated. Different models exist to determine these parameters. As was already indicated in the introduction , price difference might influence the distribution of customers. The lowest offer captures the largest part of the free market, but other offers till have some adoption. With the price difference between different offers increasing, the cheapest offer captures increasingly more of the free market. This is typically referred to as cross-elasticity. Other models exist, where the offer with the best price or quality captures all of the free market, a Winner-Takes-All model. An example of each distribution model can be found in Figure 15 and Figure 16.

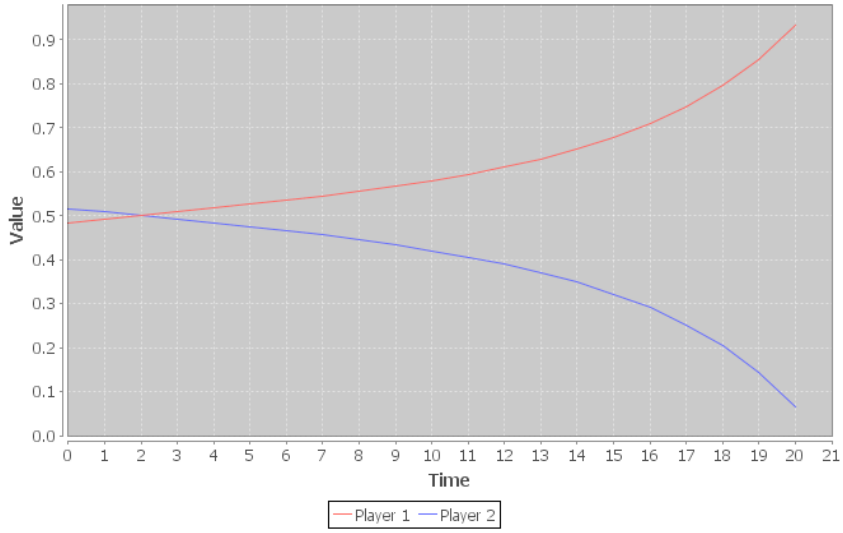


Figure 15: Distribution based on churn

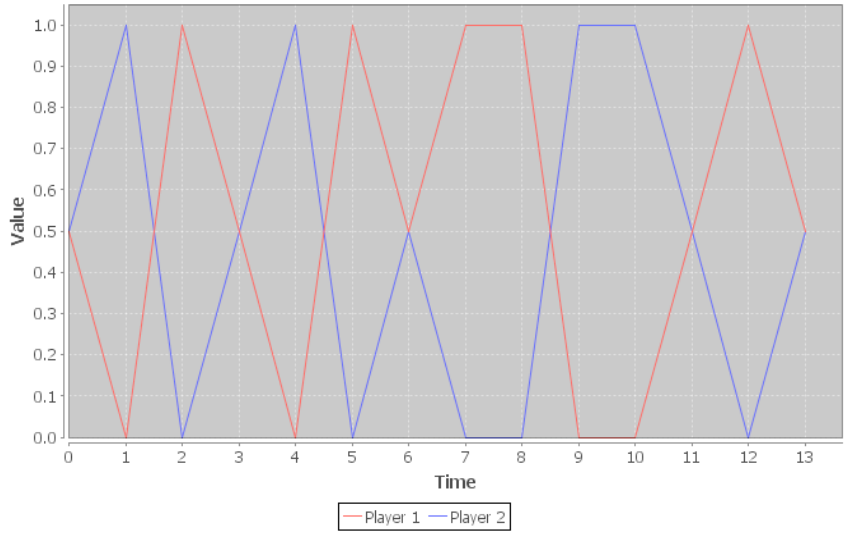


Figure 16: Distribution based on Winner-Takes-All

Combining these four aspects, Elasticity, Market, Free Market and Market Division allows to model the market shares of all players in the market Figure 17. It should be noted that the module can work with initial market shares, where the market evolution is determined from a given starting position.

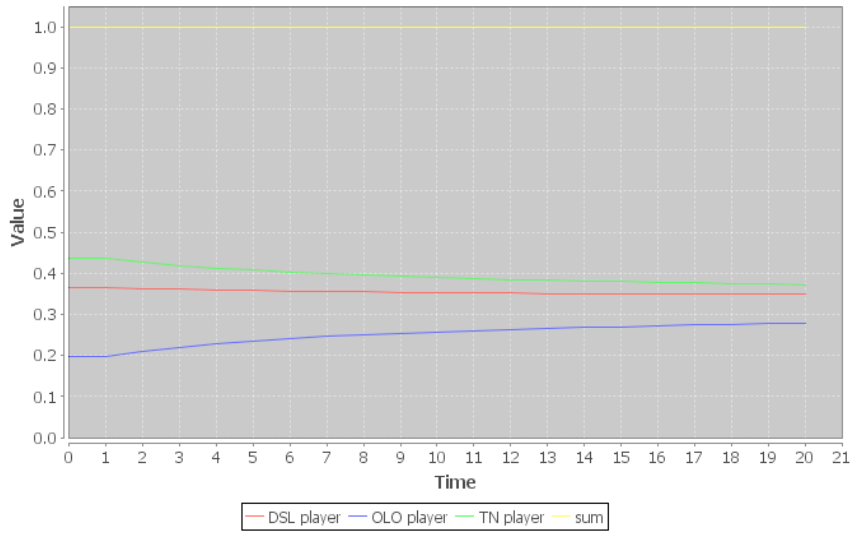
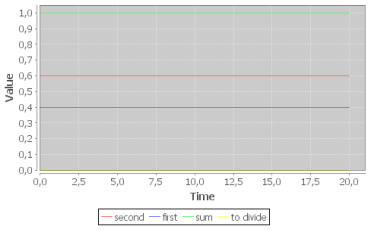
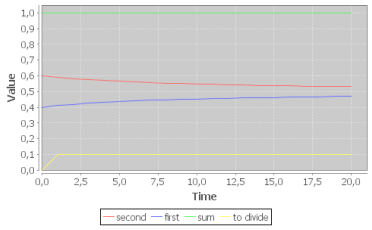
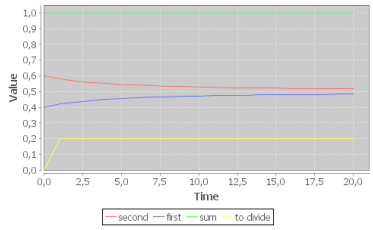
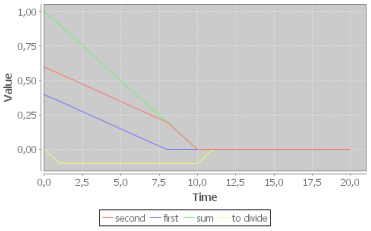
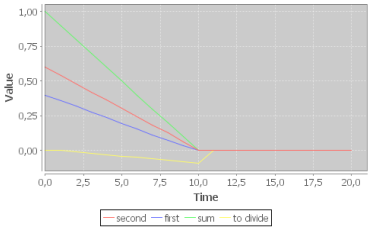
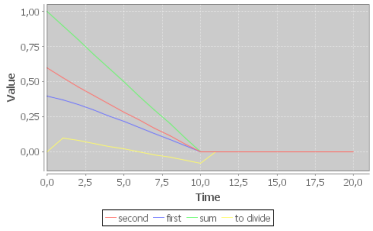
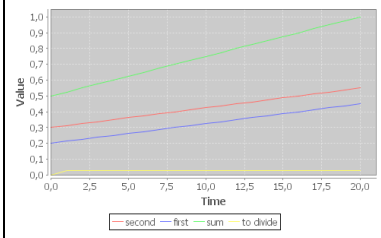
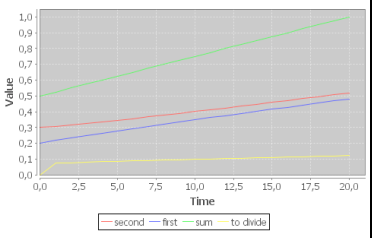
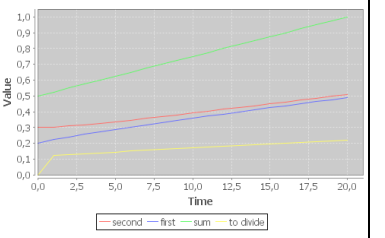


Figure 17: Estimating the adoption per player

Some more stylized examples of the usage of the market model can be found below. Note that these are not realistic values as they typically go out of reach of typical elasticity and inter product price discrimination factor. These examples are only intended to see the influence of changing one parameter at a time and how this will change the market shares of 2 different players. Throughout the remainder of the example is built around two offers which can have the same price – taking out the inter product price discrimination factor influence. The second subsection shows stylized examples when the two offers have a different pricing but where one offer stays constant and the lowest priced offer – taking out the broadband elasticity influence.

2 offers with the same price

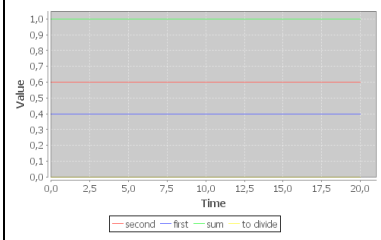
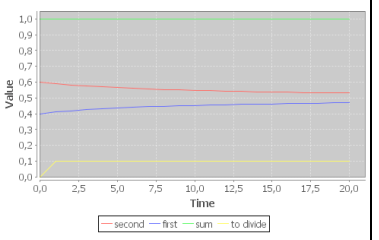
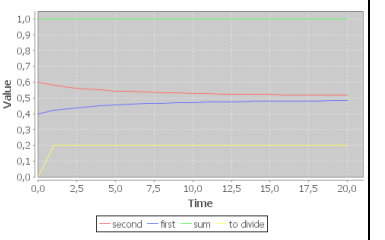
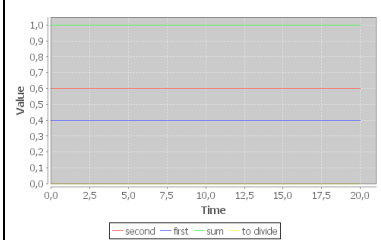
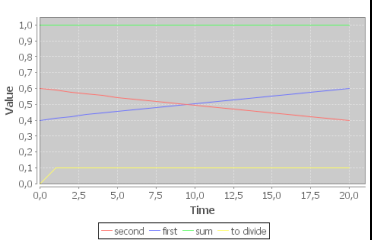
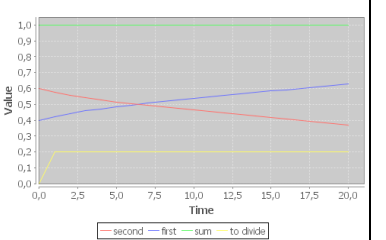
	No Yearly Churn	*10% yearly churn*	20% yearly churn
constant equal prices			
Increasing equal prices, full elasticity			

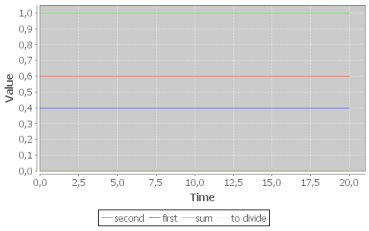
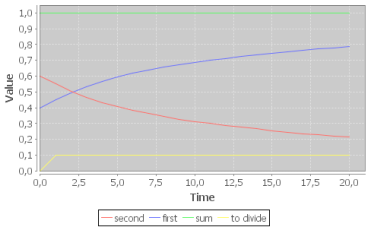
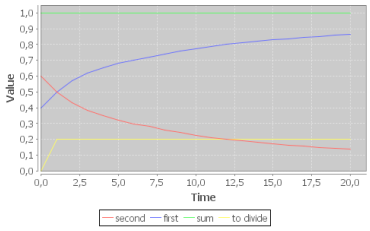
decreasing equal prices, ull elasticity			

When two offers have the same price, the market shares will remain the same even when the churn is high and the market is growing or shrinking. In the case the initial market is (unjustly) not evenly divided, the market shares will grow to each other with a speed depending on the churn. This is shown in the figures below. All examples start from an initial market split of 40%/60%. We left out the cross-elasticity as this will have no influence when prices are equal in each year and the distribution between the two offers is 50%/50%. In the cases of increasing/decreasing prices, full elasticity is considered, leading to an increase or depletion of the customer base. Finally in the case of decreasing prices, the initial market potential is only set at 50% of the total theoretical 100% market potential leading to an increase in market potential with gradually decreasing prices.

2 offers with different price

When the pricing of both offers is not the same, the lower price offer will gain a larger share with the extra gain depending on the difference in price and the cross elasticity between the different offers. Additionally the larger the churn the more customers will be divided between the different offers per year and the higher the influence of the move of customers to the lowest priced offer. The following table gives an overview of offers with different prices in which the pricing of the first is constant and the pricing of the second is increasing. This means that the influence of normal elasticity is non-existing.

	No Yearly Churn	*10% yearly churn*	20% yearly churn
No cross elasticity			
Low cross-elasticity			

High cross-elasticity			

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