

Deployment of Fiber Optic Networks within the Framework of PPP Projects

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Extended Abstract

The roll out of fibre optic networks in many instances requires substantial amounts of investment. For classical telecommunication network operators the roll-out of fibre in the access part of their network will involve technological uncertainty as well as market uncertainty and a lack of a (completely defined) regulatory framework. Generally due to business cases which may not be fully sustainable at this point in time, especially regarding the demand situation caused by a low population density, one can not always assume that a market solution will be found for such investment projects. Because of the obligation toward shareholders for sustainability and often short term ROI requirements, traditional operators face an additional barrier for such investments and have only few incentives to invest. This brings us to the conclusion that traditional (incumbent) network operators are mainly not in the position and/or willing to deploy a fibre based broadband communication network financed by private capital to 100 % and that there will be areas where the rollout of such networks will not be likely. There will be cases in which the business plan is not sufficiently sustainable and therefore a network operator will seek support at different levels from a third party, e.g. by specific financing programs or via public private partnership (PPP) projects in order to share the risk and to have partners to conduct the network roll out. These PPP projects require an administrative and commercial solution / framework which for example allows for the participation of the public side (e.g. a municipality or other public institutions) in such a project without violating the regulations for their economic activity if they are part of the state organisation.

This paper is analysing conditions and solutions in cases where a public financing and support is needed to make such investments available and to ensure that the network roll out will be realized. The paper is organised as follows:

In the first section we look at investments in the telecommunication sector in general and particularly into fibre optic access networks. Thereby we consider that liberalised telecommunication markets in European countries have existed for more than a decade now and that this has led to customer choice and to substantially broadened possibilities for end users to choose different suppliers. Different technologies have prevailed in different phases throughout that time and we have seen significant extensions of networks and operators in the market. Currently, the discussion regarding fixed networks stands at a point where DSL in the access part may be substituted by fibre optic networks. However, the investments into such networks are very extensive and are much higher than the upgrade of copper to DSL. Such investments imply that regions, companies and institutions have long-term advantages from the utilization of these networks. On the other hand to realize the advantages it is first required to conduct substantial investments. In this process the viability of a business case will be assessed.

The population/economic density as well as the usage are the major drivers for the consideration of the economic viability. In this context we analyse studies that have been made in

order to identify the minimum requirements for a business case into fibre optic networks and the respective telecommunication investments.

In the second chapter we look in more detail into the economic viability of business cases. Many cities and regions had to consider how to calculate the roll-out of broadband networks in general and particularly fibre optic networks, but also looking for a broader support of such a project. Thereby, we would analyse and refer to examples of business cases that have been studied in Athens in Greece as well as Whittlesea in Australia. These examples show a different composition of investors and different strategies regarding how to develop the network and for what type of services to use it. Considerations not only from the telecom sector but also from the housing sector and public sector which profit from the investment into fibre optic networks will be taken into account.

In the third chapter we look at solutions to overcome the uncertainty resulting from the demand situation, technology uncertainties and regulation. PPP models are one of those solutions which represent cooperation between the public institutions and private enterprises in order to realise certain services. These types of cooperation can have different facets and involve public institutions in different ways. We look at the more formal part which comprises contractually regulated forms of cooperation which cover the complete lifetime from the planning up to the deployment and the operation including the maintenance and the usage of the network. Especially regarding regions with a low usage or with low population density the role of municipalities or public utilities is very specific. In such regions it can be argued that the benefits generated from the networks have to be initiated and pushed by public institutions. This does not only hold true for telecommunications networks but also for other types of public infrastructure such as water, gas, power and road infrastructure. Therefore, PPP cooperation regarding the roll out of fibre optic networks may allow on the one hand an optimisation of the coverage of those areas with these networks and cost reduction for operators in order to make the deployment of the networks viable. The associated sharing of tasks between operators and municipalities on the one hand as well as the benefits and risks of each partner will be looked at in this section.

In this section, we will also look at major elements of such PPP cooperation and pinpoint those parts which potentially create difficulties from a formal and/or practical point of view. Each of those elements - be it the availability of personnel of the public institutions, financing topics or open access considerations etc. - will be looked at and pointed out in order to provide support to avoid problems for such projects. In this context it is important to understand whether and how public institutions like municipalities and ministries can get involved in the roll out of fibre networks and their operation. Such activities are commercial businesses in the legal sense and the possibilities for public bodies to participate in such commercial activity may be limited. Depending on the degree of the involvement and the type of support, there are ways, however, to circumvent the risk that such networks will not materialize on the one hand and that the involvement of a public body would violate the legal framework. Especially state-aid rules need to be observed very carefully in this respect.

CONTENTS

1. THE FRAMEWORK FOR TELECOM INVESTMENT	5
1.1 THE SITUATION AT THE TIME OF MARKET LIBERALIZATION	5
1.2 THE SITUATION TODAY AND THE DEVELOPMENT SINCE MARKET OPENING	7
1.3 THE CHALLENGES IN TODAY'S MARKETS	9
1.3.1 Market uncertainty.....	9
1.3.2 Regulatory uncertainty	10
1.3.3 Conclusion.....	11
2. IS THERE A BUSINESS CASE FOR FIBRE?	13
2.1 ELEMENTS OF A BUSINESS CASE	13
2.2 OPERATIONAL MODELS IN A LAYERED STRUCTURE	17
2.3 CONCLUSIONS.....	21
3. PPP: PRACTICAL IMPORTANCE AND IMPLEMENTATION. THE CASE OF TELECOMMUNICATIONS AND FOR FIBRE ROLLOUT	23
3.1 IDEAS BEHIND PPP.....	23
3.2 EXAMPLES IN THE TELECOMMUNICATIONS INDUSTRY.....	24
3.3 INTERACTION BETWEEN THE PUBLIC AND THE PRIVATE SECTOR.....	27
3.4 PPP DESIGN FOR FIBRE ROLLOUT	28
3.5 THE TRIGGER FOR PPP FOR FIBRE ROLLOUT	32
3.6 CRITERIA FOR SUCCESS	34
4. CONCLUSIONS	36
REFERENCES.....	37

1. The Framework for telecom investment

1.1 The situation at the time of market liberalization

Copper based access networks have for a long time been the major infrastructure for electronic communications organized as a monopoly. When the market was opened, access regulation allowed new entrants to use this infrastructure which to a large extent was completely written off and thus no immediate investment risk existed for additional copper lines at least for incumbent operators. Voice was the dominating service and narrowband internet access was just about to develop.

The copper access networks have been built by the incumbent network operators and were financed in a monopoly environment. The layout was targeted for a ubiquitous availability of the copper loop. Since liberalisation was introduced, investments in the access networks have been scaled back and strategy focussed on the exploitation of existing assets. Digital subscriber line is the successor technology to the analogue transmission over the local loop. The first digital technology was ISDN with a transmission rate of 144 kbit/sec. This was followed by asymmetric DSL technologies designed to allow data transmission in addition to the basic PSTN/ISDN connectivity. Figure 1 shows the evolution of DSL technologies.

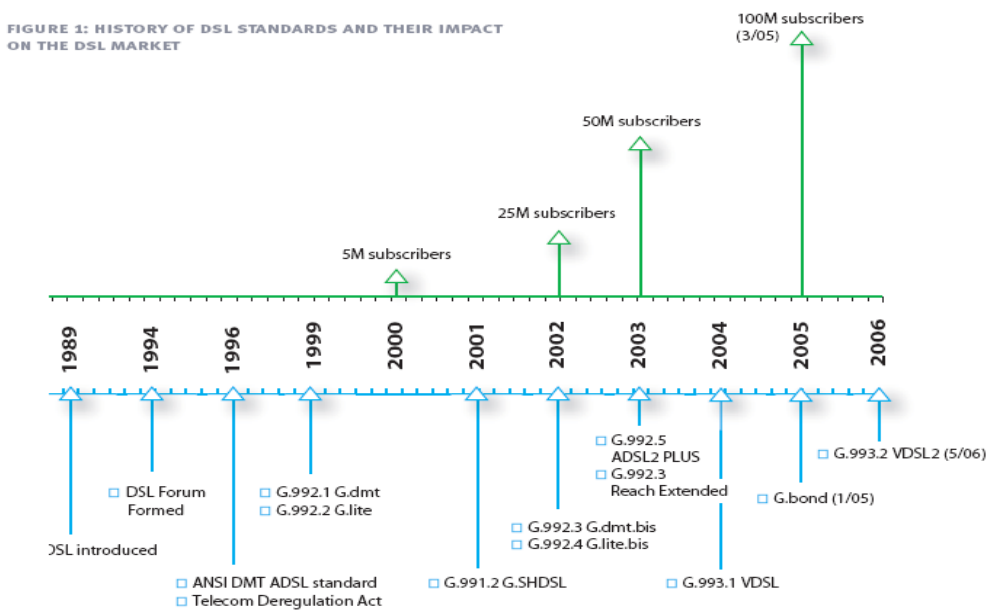


Figure 1: History of DSL standards¹

¹ See <http://www.scantec.de/modules.php?name=News&file=article&sid=395> and AWARE: VDSL2, The Ideal Access Technology for Delivering Video Services, Revision 2, White Paper 2006, p.2

While ADSL can be deployed from the central office, VDSL2 – allowing higher speeds – requires a hybrid network, consisting of fibre and copper. As Figure 2 shows bandwidths over 50 Mbit/sec. are only possible up to 1 km distance on copper wires. For longer copper loops there is no benefit in deploying VDSL versus ADSL, because it does not offer superior bandwidth.

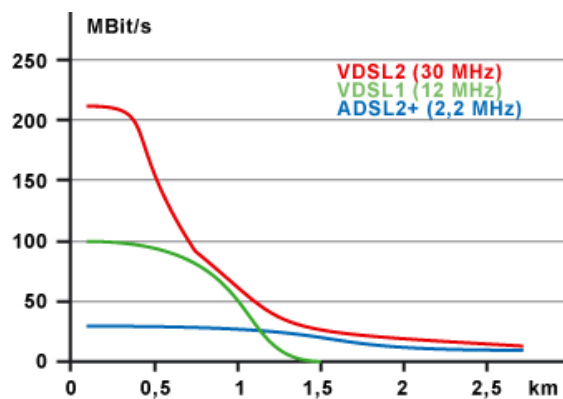


Figure 2: Bandwidth vs. distance for various DSL technologies²

These networks have widely been regarded as economic bottlenecks in the past, especially after the market opening in many countries which demonstrated that competition could be established on the conveyance level fairly easily but that it was difficult (economically) to replicate the copper based access network. The bottleneck character of the access networks depends partially on the existence of cable networks as alternatives. Regulators have therefore imposed obligations on incumbent operators to make this essential facility available. Business models of alternative operators depend to a large extent on physical (unbundled local loop) or virtual (bitstream) access to the local loop.

In the first years, the market showed substantial growth on the one hand but also price decreases for voice transmission. The access – less subject to competition – did not experience price decreases but rather a rebalancing. The market development started to change with the advent of mobile telecommunications and the accelerating fixed mobile substitution. In more recent years, many countries have experienced a - sometimes strong – decline of fixed access lines whereas broadband connections based on DSL have grown.³ In this situation we now see that decisions have to be made with respect to a new infrastructure (fibre) which has to justify its business case and which has to be financed in a competitive environment.

² See <http://www.elektronik-kompndium.de/sites/kom/0305236.htm>

³ The most recent report was published by the EU commission on 28 November 2008, see http://ec.europa.eu/information_society/policy/ecom/comm/doc/implementation_enforcement/broadband_and_access/Broadband_data_july_08.pdf, and especially pp. 17 and pp. 40 for DSL.

One of most intensively debated political goals is infrastructure based competition. Alternative technologies in the access are cable networks and wireless solutions. Both technologies display technical constraints. Cable is only available in specific regions while wireless is not deemed capable of becoming equivalent to wired technologies in terms of economical provision of the same bandwidth.

We conclude that copper-based access – being an economical bottleneck – is becoming a technical bottleneck as well. Since broadband is regarded as a main driver for economic growth and employment, the question of upgrading (or replacing) the copper access networks gains importance.

Copper access networks have been established in times of monopoly. Justifying this investment against a monopoly situation and growing demand was easy. After competition was introduced investments are more critical. Incumbents become more prudent as they would like to avoid making investments which pave the inroad to new competitors via regulation and new entrants will focus their investments on attractive market segments. However, broadband is an essential utility for the information society and requires access networks capable of handling the growing bandwidth.

As a delicate balance has to be struck between investment incentives and competition, the technical characteristics of fibre may have a tendency for restating the access monopoly – dependent on the market conditions in specific locations. So, access based on fibre could also become an economic bottleneck again. The regulatory approach will determine whether this will be the case. At the current time, no full regulatory setting and framework for access to fibre has been achieved. The whole discussion about the regulatory policy for what is called next generation access (NGA) networks is still ongoing. As we will show below, this creates some investment uncertainty in the market as the viability of investment depends on the type of access and tariff regulation. This holds true for potential investors as well as for those companies building their business case on regulated wholesale products.

1.2 The situation today and the development since market opening

The market has changed fundamentally since market opening. In the first years – referring especially to Europe – there was a strong growth in all segments (fixed, mobile, data) but at some point saturation was reached and meanwhile traffic volumes in fixed networks decrease as far as voice communication is concerned. Voice telephony for sure has become a commodity and is only a (small) part of the traffic transported over IP networks with substantial bandwidth capabilities. Internet usage, file sharing and broadband applications are the main drivers of the fixed network market. The expectation of customers with respect to the provision of broadband services to their homes has risen dramatically starting at 1, 2 or 6 Mbit/sec. and meanwhile reaching 20, 50 or even 100 Mbit/sec. Clearly, the copper networks are not able to provide this any longer, and even with the help of DSL, demand has become too strong to rely on this technology for the future. Thanks to strong demand, DSL is still growing in many countries at this moment, but in others it has already surpassed its peak

and is being substituted by access networks with capabilities of 50, 100 or more Mbit/sec. This can be seen in Japan where DSL demand exploded in the period 2003-2005 and now is on a declining trend and has been overtaken by FttH in early 2008.

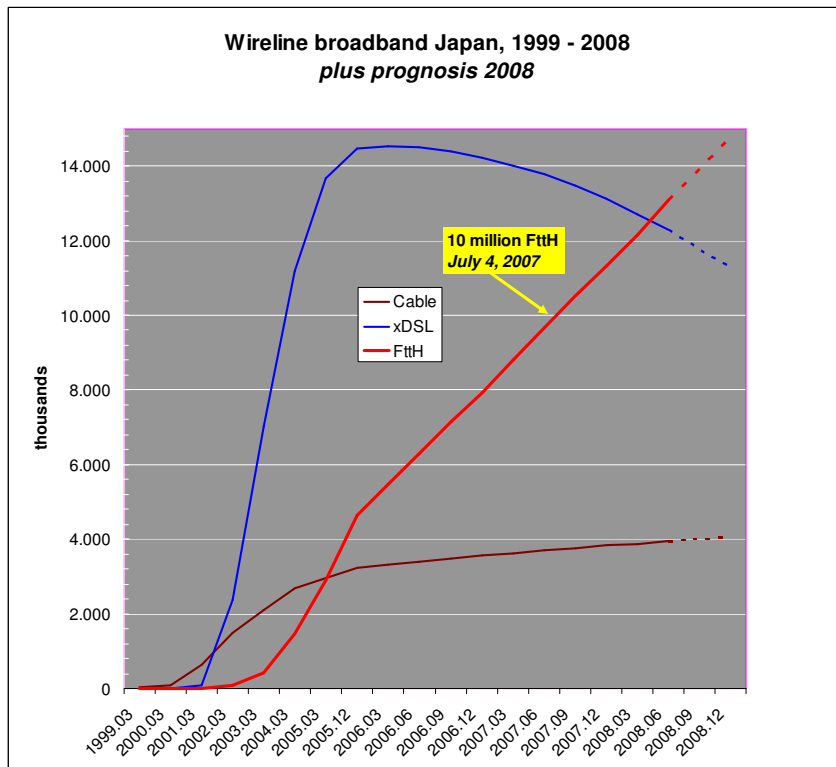


Figure 3: Broadband technologies in Japan⁴

To understand the market development for broadband communication one needs to analyse whether and why broadband influences the economy. Demand for broadband does not only come from the user side but is also derived from other segments of the industry and also from the general public. State-of-the-art telecommunications infrastructure in general and broadband in particular are widely regarded as necessary prerequisites for economic growth. Studies⁵ underline that advanced telecommunications services in general and broadband in particular are drivers for employment, productivity and enhance general welfare. In this respect we can regard broadband infrastructure as a utility like streets, water and electricity and the question arises if financing should be done in a similar way – although the degree of competition and market opening may be significantly different.

⁴ See Ministry of Internal Affairs and Communications, Disclosure of Quarterly Data concerning Competition Review in the Telecommunications Business Field, 17 September 2008.

⁵ Foras (2006), Crandall (2007), Lehr, Osorio, Gillett, Sirbu (2006).

Additionally, the telecom market has moved from monopoly to competition (on all levels of the infrastructure and value chain). This implies that there are no such things as stable and secure revenue streams. Network rollout and the massive investments have to be borne by revenue from competitive business fields and not on inherited rents from the past. This may lead to reluctance to invest under uncertain conditions of payback – especially for companies which are actually or potentially regulated and would have to share the benefits of new technology with new entrants at regulated prices.

1.3 The challenges in today's markets

Traditionally telecom operators are the entities responsible for access networks. However these networks have been rolled out under monopoly conditions. Today telecoms operators are reluctant to invest in next generation access networks. These obstacles can be grouped into two main categories:

1.3.1 Market uncertainty

The market uncertainty comprises two aspects: This is the uncertainty on the demand side (“demand uncertainty”) as well as the uncertainty on the supply side (“investment uncertainty”). The first aspect refers to the difficulty for telecommunications operators of assessing the demand side of the market. We have alluded to this aspect in chapter 2. This demand uncertainty is accompanied by an investment uncertainty on the supply side, because the companies that may be investing are currently unsure regarding the regulatory framework that may apply to NGA but also regarding the overall project costs and technological developments.

Obstacles can also be interrelated, e.g. the lack of regulatory clarity may (in addition to demand uncertainty) lead to hesitancy in investing in long-lived assets like fibre optic cables. Therefore, investment uncertainty could arise as an obstacle resulting from demand and regulatory uncertainty. The investment uncertainty focuses on the amount of investment and the share of investment for each major building block of the activities. If state-of-the-art fibre infrastructure is deployed in the access network, the crucial question remains as to whether the take-up rate of networks, services and usage will allow the economic viability of the investment to materialise, and this is one of the main hurdles for infrastructure investment.

Whether investments in physical infrastructure will form a sustainable business case for the future (and if so, based on which technology), or whether service-based competition will prevail in the future, is difficult to answer. The assessments of the supply and demand side are also interrelated and influence each other in a cyclical way. This means that, while the public value of next generation broadband for society and the economy as a whole is potentially high, the large scale of investment combined with a significant number of uncertainties surrounding the prospects for recouping that investment mean that the potential private value available to investors is comparatively weak. Considering this gap, the current infrastructure, and planned investments in that infrastructure, may not be able to support the demand for

bandwidth in the medium- to long-term. This implies the requirement to consider the responsibilities of the parties involved for investments in next generation access networks to overcome this gap.

1.3.2 Regulatory uncertainty

The regulatory uncertainty concerns the elements of the current regulatory framework (such as existing obligations and remedies, e.g. to offer certain infrastructure wholesale products) as well as the future design of the regulatory framework, especially with respect to the position of the regulatory authority regarding the balance between infrastructure-based and service-based competition. It is as yet unclear what (if any) obligations may be levied upon networks which are being rolled out at this point in time. Under such regulatory uncertainty, investments tend to be regarded as risky, and may not be made in such high volumes as when the investment conditions in the regulatory framework were clear. The desired regulatory certainty is intended to give clear directions with respect to the balance between infrastructure-based and service-based competition. Where economically feasible, infrastructure-based competition is favoured above service-based competition due to the advantages that can be achieved e.g. a structural safeguard with respect to independence of new entrants. However, to make this type of competition happen, usually a longer period of time is necessary. Therefore, service-based competition may have advantages in the short term.

Looking at other regions, one can conclude that e.g. the EU after 1998 has taken a positive approach to the “parallel roll-out” of ICT infrastructures. In the framework of discussing the regulation of next generation access, the recent publication of the draft recommendation on the regulation of next generation access cast some doubt on this policy. This draft recommendation⁶ contains an extensive discussion on different technical implementation of next generation access and the use of different infrastructures and defined regulatory principles for the regulation of access to these infrastructures and network elements. From the outset, one can conclude that the regime is designed to grant a large number of access options which may again impact the incentives to invest in such networks as opposed to use such networks on a wholesale basis. As “compensation”; investors in NGA shall be awarded with a risk premium for their investment.

Infrastructure competition has the advantage that it creates competitive pressure throughout the value chain. It also requires less regulation, since the same needs do not arise as with competition in services with regard to ensuring that competitors can obtain access to the infrastructure on non-discriminatory terms higher up in the value chain. At the same time the duplication of infrastructures is an economic concern in case such duplication would lead to inefficient investment and inefficient market entry as this could harm all market players.

⁶ See http://ec.europa.eu/information_society/policy/ecommm/library/public_consult/nga/index_en.htm and http://ec.europa.eu/information_society/policy/ecommm/doc/library/public_consult/nga/dr_recomm_nga.pdf

Concluding from these uncertainties it is necessary to consider if other stakeholders should intervene to overcome these obstacles.

1.3.3 Conclusion

The rollout of fibre optic networks takes place in a world with a large degree of uncertainty. This uncertainty may imply certain obstacles for the optimal amount of investment. Also other analysis, show a similar summary of the reasons for uncertainty on the part of the operators (Figure 4).⁷

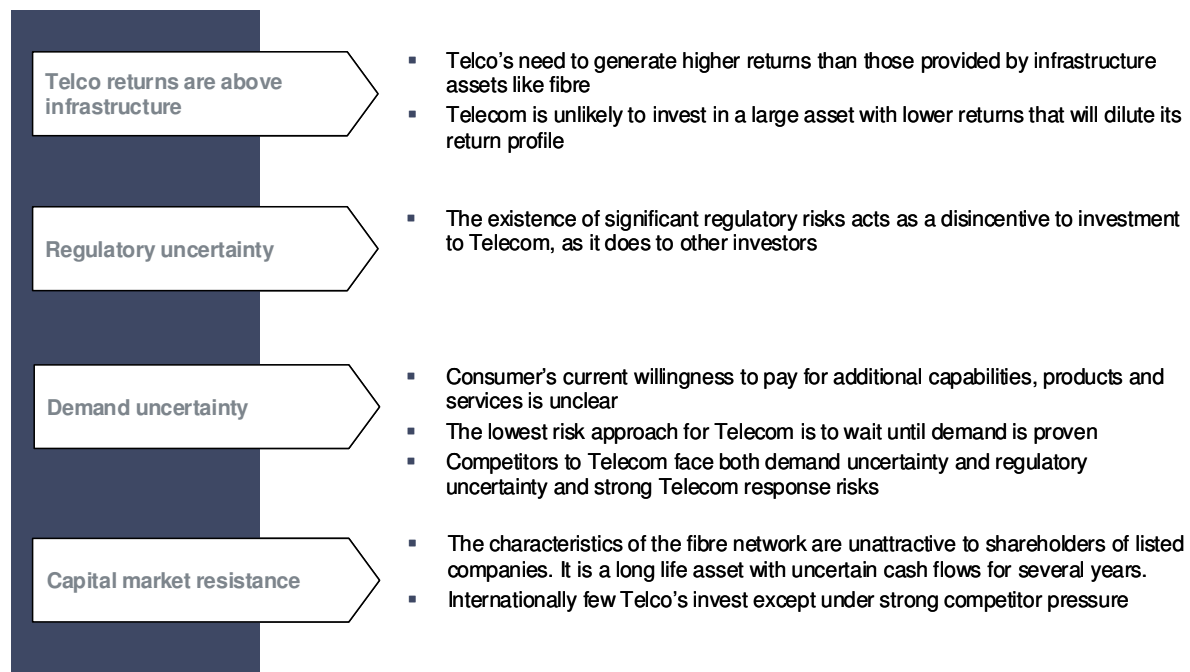


Figure 4: Obstacles to invest

Fibre optic cables are long-lived assets and will not yield return-on-invest soon. Since much of the investment is sunk anyway the first carrier to deploy fibre may have a significant competitive advantage. Although in some regions two or more operators are willing to invest, in other areas the fibre network will turn out to be a natural monopoly.

"In markets where facilities-based competition for next generation broadband access platforms proves unsustainable (or insufficiently robust), last-mile facilities will remain a[n economic] "bottleneck." In such situations, policymakers will need to consider how best to regulate open access to bottleneck "last-mile" facilities. If there are inadequate facilities-based alternatives, then failure to ensure open access will pose a severe threat to competition in all of the upstream and downstream equipment and service

⁷ New Zealand Institute (2007)

*markets that depend on access to a digital conduit between the home and wider-area network services.*⁸

We can distinguish between three cases with regard to roll-out of fibre access networks. Different policies are necessary in these regions:

- No carrier is going to invest. In some geographical areas market forces will not suffice to upgrade the access network or deploy alternative technologies. If for political, economical or strategic reasons, an upgrade of the access network is deemed necessary, public intervention might be considered. This can come in various shapes – investment funds, investment by municipalities or others e.g. developers or utilities. In the end, the commercial and regulatory environment may imply that a business case is not viable. In such a situation, instruments of public finance will have to be discussed of which PPP models are one alternative.
- One carrier invests in fibre-optic access networks. Due to the significant sunk cost this carrier will have a competitive advantage (in absence of other operators to use this infrastructure) which otherwise can also be a disadvantage if the operator would be subject to intensive wholesale regulation. In order to maintain competition in upstream and downstream markets an open access policy could be a useful policy to be implemented.
- Two or more carriers build high speed access networks. In this case regulators only need to intervene ex-post in case of market failure.

From a general perspective therefore we conclude that whether private investment will be made available in sufficient amounts for such networks is uncertain. In that situation, policy makers, potential investors, operators and regulators will need to ask themselves. Possible measures (on a very general level) are to e.g. support such network rollout by a targeted regulatory environment. Another alternative approach is to involve the public sector more actively as the topic at hand – the basic infrastructure for communication – may not be realized with some kind of support, e.g. financial funding, the establishment of cooperation models and / or the creation of PPP models.

⁸ Lehr, Sirbu, Gillett (2005)

2. Is there a business case for fibre?

2.1 Elements of a business case

A business case for fibre rollout will have to look at the investment side (CAPEX and of course OPEX) and also at the revenue side. Although it is generally stated that a fibre based next generation network will have lower costs in the end and thus be operated more efficiently, there seems to be substantial reluctance to undertake investment in the construction of such networks.

Many studies have been undertaken and different results have been published. A list of results shows a large variety of assumed costs per fibre access:

- Orange – **1.000 €** (roll-out starting 2009)
- NeufCegetel – **1.200 €** (250.000 customers planned until end of 2009, 300 Mio. € CAPEX)
- Departement of the Hauts-de-Seine – **500 €** (400 Mio. € CAPEX, 820,000 homes passed, 59 Mio. € subsidy)
- ViaEurope – **300 €** (Sweden)
- Vario – **1.500 €** (Switzerland)
- CYTA – **800 €** for PON, **920 €** for PtP (Elena Kattirdji, Cyprus)

These examples show a large variety of possible outcomes. All models can be based on different technology options as well as different environmental conditions. In the end, the costs per user depend highly on the penetration achievable and the technology choice. The commercial success of the project naturally depends on the ARPU achievable and the customers' willingness to pay.

Greece which has been one of the countries with a broadband market which developed very slowly, has initiated a fibre project. The results of the cost analysis are contained in the figure below:

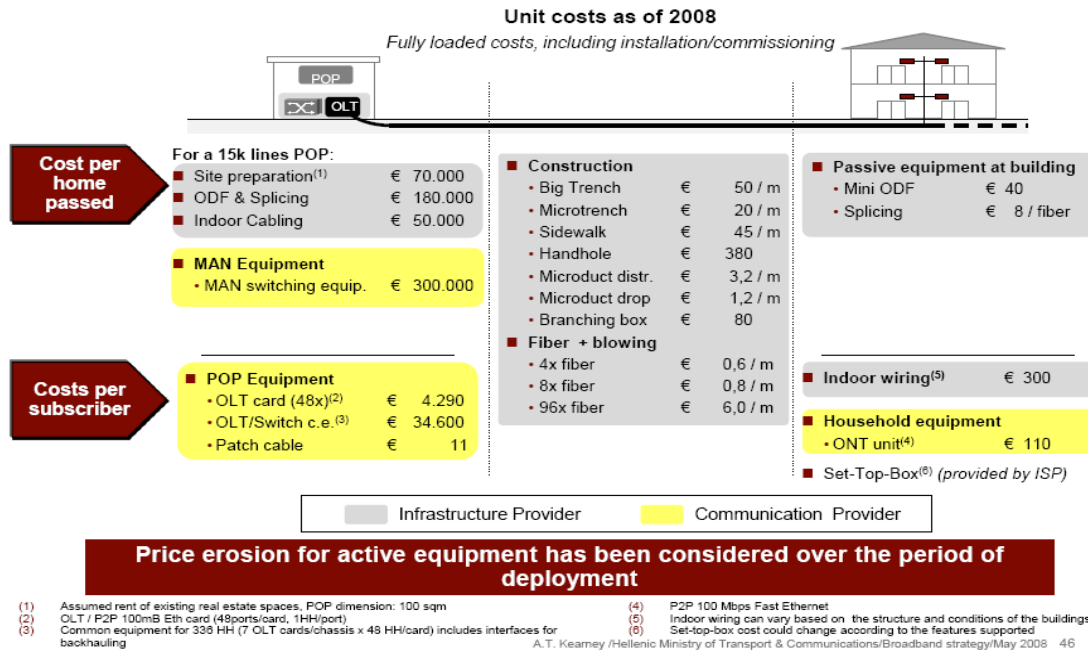


Figure 5: CAPEX assumptions to deploy FttH point to point⁹

From this, it was possible to derive the economic viability of the business case for different regions with deviating commercial conditions.

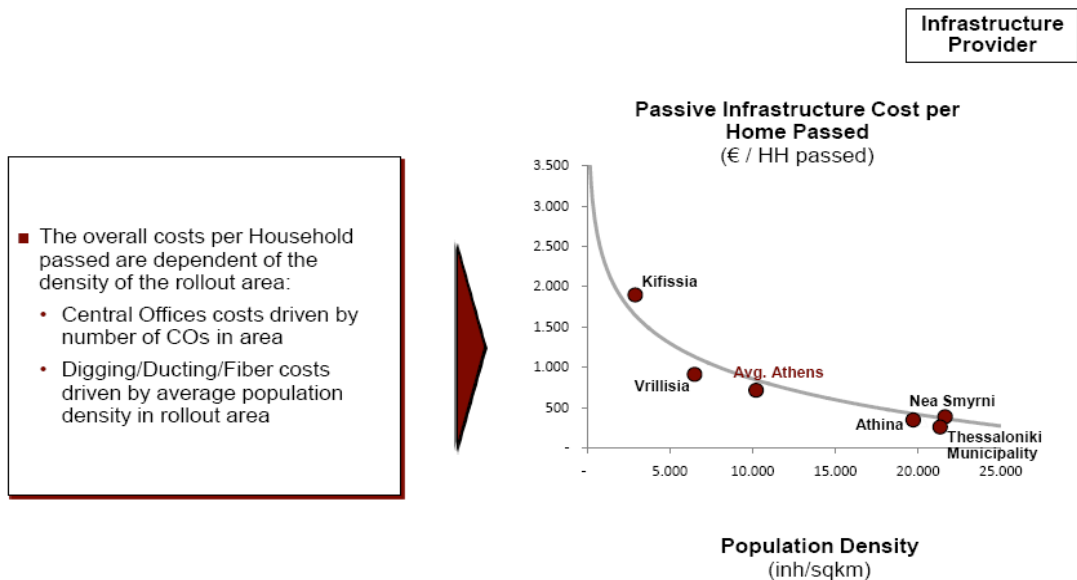


Figure 6: Total cost of passive infrastructure by municipality¹⁰

⁹ A.T. Kearney, Developing the Hellenic Ministry of Transport and Communications 5-year broadband strategy for Greece, Athens 2008, p. 46.

A second business case worth discussing is the calculation for a community fibre network of the city of Portland. The specific item is that the city of Portland conducted a calculation for a wholesale business case and a retail business case to decide whether to deploy a network for a vertically integrated telecommunications provider or an open access network with a non-discriminatory access to all interested service providers.

The city completed the financial analyses for both the retail and wholesale business structures for this project because it was important for the City to understand the retail economics for two reasons. First, if the City wants to enable an open access network, they must understand the challenges that will face the retail service providers that choose to use the wholesale network. Second, if the open access business case doesn't work out, then the City might want to consider the retail approach as a fall back for getting the desired fibre infrastructure.

The basic assumptions for both cases were:

- the City builds and operates a FTTP network that passes all homes and businesses;
- the network is capable of supporting multiple retail service providers that will offer video, voice and data services to the residential and commercial markets;
- the providers will be responsible for all customer facing contact including marketing, sales bulling and customer service;
- the City's relationship with the providers will be on a business-to-business basis;
- the City will sell wholesale access on the local network from the head end to the service specific ports on the optical network terminal (ONT) on the subscriber's dwelling.¹¹

At the end the contractor has calculated the same network construction budget (outside plant) for both cases. The calculation based on new equipment and materials as well as updated construction labour rates. The updated capital costs per home and business passed in Portland was calculated to be \$765 for this study. A breakdown of the capital budget per passing is shown in the following figure:

¹⁰ A.T. Kearney, Developing the Hellenic Ministry of Transport and Communications 5-year broadband strategy for Greece, , Athens 2008, p. 55.

¹¹ Uptown Services LLC, Phase 2 Business Case for a Community Fiber Network, Portland 2007, p. 39.

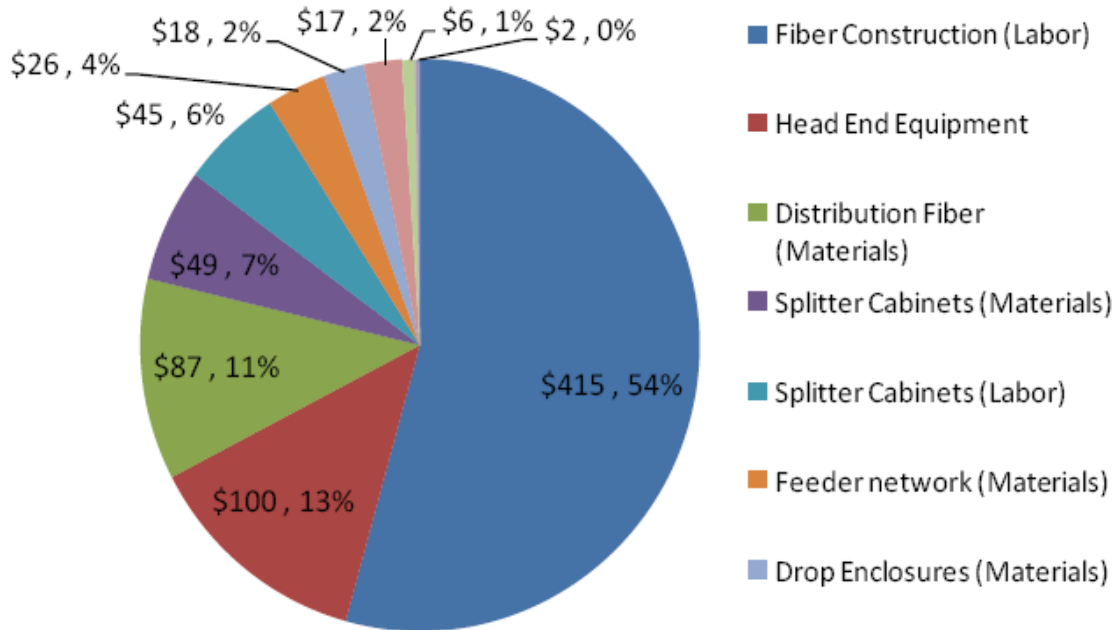


Figure 7: Capital requirements¹²

Furthermore the following figures show the overall financial performance of both business cases.

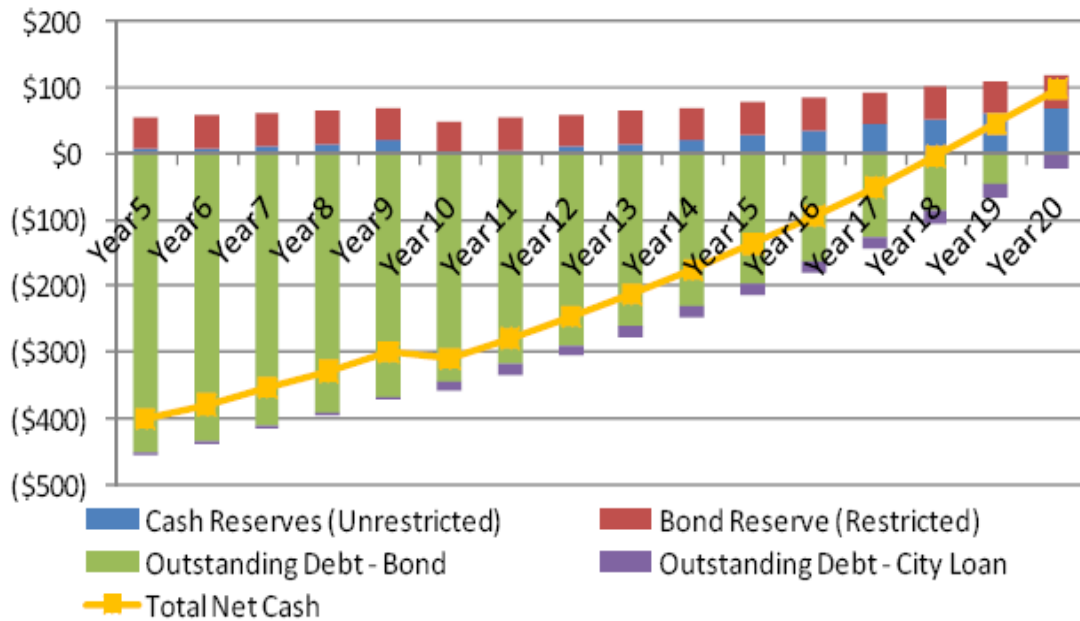


Figure 8: Financial performance of the wholesale business case¹³

¹² Uptown Services LLC, Phase 2 Business Case for a Community Fiber Network, Portland 2007, p. 48.

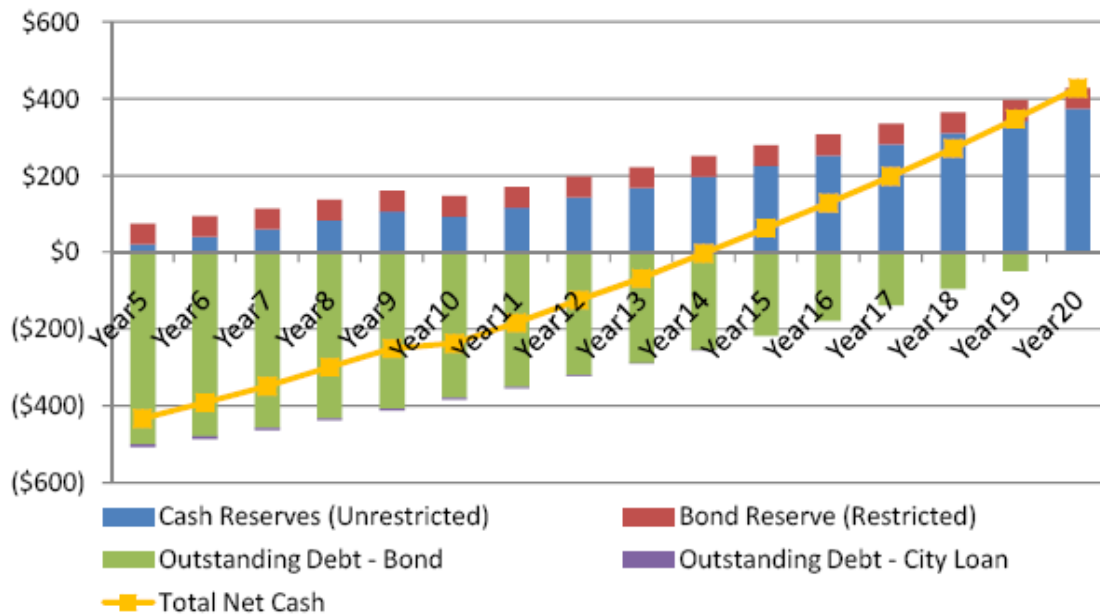


Figure 9: Financial performance of the retail business case¹⁴

Finally it is important to point out that the retail case actually provides better returns with lower risk to the City, but the wholesale case fits better with the stated goals of the City to enable an open access network.

2.2 Operational models in a layered structure

A number of projects have materialized with FttX solutions. Thereby, different aspects to incentivize network rollout have played an important role.

All projects show that in a competitive telecom market with usually vertically integrated business models the concept of fibre networks requires a new perspective. Not always will it be possible to establish such networks if the vertically integrated business model of combining networks and services prevails. A robust economic model requires the cost being distributed to those who benefit from it. Clearly, the beneficiaries of such investments are various kinds of users but also the economy as a whole due to the increased attractiveness and competitiveness of the location. Therefore, such networks may have facets of public good character. As we have shown demand on access infrastructure is not only expected from the consumer side but also – even more – from enterprises. As many sectors of the economy and indeed the society as a whole benefit from next generation access infrastructure the question arises

¹³ Uptown Services LLC, Phase 2 Business Case for a Community Fiber Network, Portland 2007, p. 51.

¹⁴ Uptown Services LLC, Phase 2 Business Case for a Community Fiber Network, Portland 2007, p. 61.

if the public should at least pay part of the infrastructure. The incentives for investment by the “usual suspects” (i.e. the telecommunications industry) are rather weak.

Infrastructure based competition has the advantage, that it creates a competitive pressure throughout the value chain. At the same time there is awareness, that in many respects it is not economically viable to have parallel infrastructures.¹⁵ This depends specifically on the geographical region. Some regions already enjoy competitive broadband infrastructures, while other areas are only served by one or no broadband provider.

One useful approach to analyze who could participate and how a viable business case could be built is to conduct an analysis of the elements of the value chain and the layers in fibre optical networks.

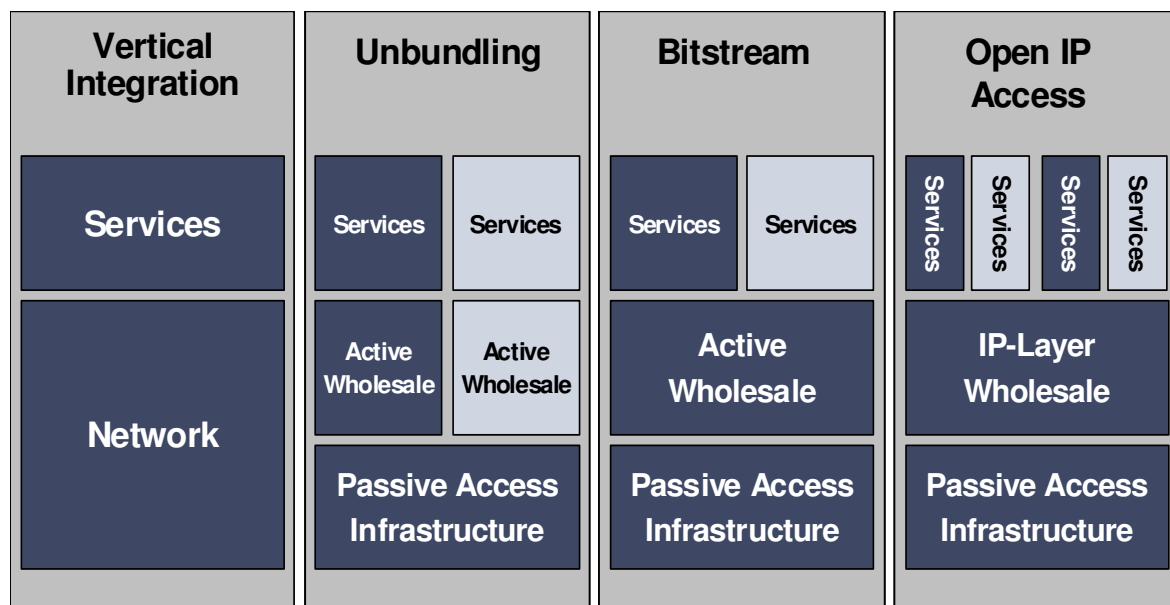


Figure 10: Exploring a new open access model?¹⁶

The figure demonstrates that there are various layers of the “infrastructure” from the passive infrastructure via dark fibre links, activation of fibre by the operation of equipment and the supply of services. Such a layered analysis of the value chain can reveal potential for those who have ownership of parts of the value chain and may be interested to participate in the network rollout.

Where service based competition prevails, it is crucial which part of the network should be shared between operators. The majority probably thinks that it is natural and logical that ducts should be shared between competing actors. Ducts therefore do not have to be com-

¹⁵ July 2005 SOU 2005:97 När en räcker: mastdelning för miljön (When one is enough: mast sharing for the environment)

¹⁶ See Felten, B.: Exploring an Open Access Model, 2008, p. 5

pulsorily exposed to competition. Probably the best solution for all parties is for excavations to be carried out only once, with competition-neutral ways of obtaining payment from competitors. This implies – as demonstrated in the first graph of this section – that a coordinated approach to passive infrastructure establishment should take place.

One level above ducts there is the cabling, e.g. fibre cable. In a number of areas a neutral party has laid out a sufficient quantity of fibre so that several actors who lease fibre can share the same cabling. One can correspondingly discuss layer by layer, where in the infrastructure model it is more acceptable to have monopoly-like situations and where there is a requirement for competition. The further up in the structure model we get, the greater the prerequisites for competition. To that geographical factors may be added – the more densely the area, the stronger the arguments for establishing parallel, competing infrastructures.

These arguments have led us to the concept of operational models. The operational models refer to the split between monopoly like behaviour and sustainable competition. In our opinion, one can look at the stepwise “ladder” which may refer to the different activities needed to set up infrastructure for telecommunications purposes and offer services. This type of differentiation between the operational models can be demonstrated graphically in Figure 12:

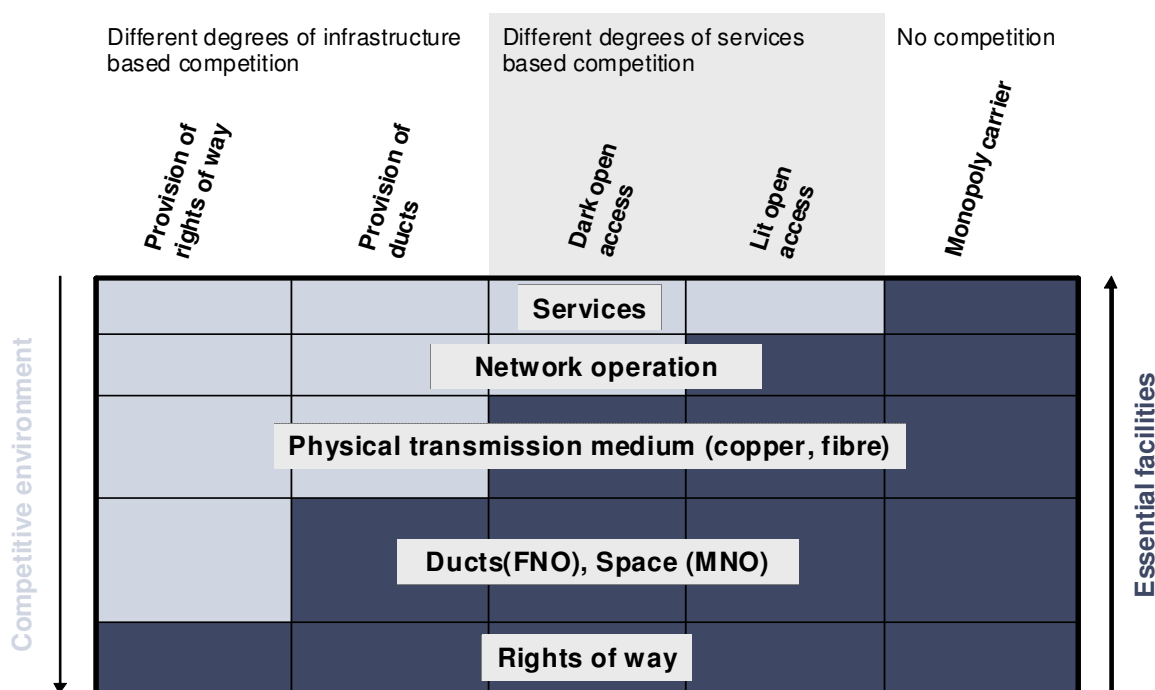


Figure 12: Operational models¹⁷

¹⁷ See Juconomy Consulting: Regulatory issues related to the deployment of telecommunications networks in new property developments, <http://www.tra.org.bh/en/pdf/FinalStudypublicpresentation.pdf>

At this stage it can be stated that the features and characteristics of the operational models relate to regulatory characteristics/regulatory approaches. Liberalisation of telecommunications networks started with the operational model on the right hand side. The political and economic goal is to reach the left hand side model, which refers to infrastructure based competition. The area coloured in light blue indicates the extent of the value chain which can be provided in a competitive setting. Depending on the specific conditions of a project it means that in some cases one will see only service based competition on the retail level and in other cases also infrastructure based competition e.g. on the level of deployment of fibres will exist. The different models are characterized by the following facets:

- **Corridors are provided by the land owner – the telecommunications operator provides ducts, physical transmission (cable) and services**

In this model the service corridors are provided. Operators can provide their own infrastructure. There is however the risk that no operator puts in infrastructure. Additionally this might lead to very inefficient use of investment.

- **Ducts are being provided by the developer or the municipality and shared between different users – the telecommunications operator provides physical transmission (cable) and services**

Operators rent or buy ducts from the developers or the municipalities. Therefore no economic replicability of ducts is assumed. Rules need to be in place for non-discriminatory and equal access to these ducts on fair terms. A question thereby is why developers should move into this direction and what incentives for developers are.

- **Cables are provided by the developer or the municipality – the telecommunications operator provides services**

In this operational model also cables are provided in a monopoly like manner. This infrastructure is handled as other utilities and wholesale services are offered on a non-discriminatory, equal and fair basis to other operators. This approach has been called “wholesale model” in our overview of operational models and can come in two different sub-forms due to the fact that the developer could offer the cables “dark” or “lit”.

- **A monopoly like solution**

This includes the provision of passive and active elements and the services. This option involves some kind of exclusivity in return for investment infrastructure. The underlying assumption is, that telecommunications networks and services are not economically replicable and need to be provided by the public.

All of these models assume however that at least one infrastructure is already in place. In the case of next generation access networks we are facing a situation where no infrastructure is available. In order to apply the regulatory approaches mentioned above investment incen-

tives for at least one player need to be available. These investment incentives are highest in the monopoly carrier model. The disadvantage is that the goal of competition is not fulfilled. From a regulator's point of view regulatory holidays seem unlikely so that a player going this way faces the problem that he might build a structure which will be opened up in the same way as incumbent carriers' at the end of the 1990s. It comes as no surprise that there is much reluctance to invest. The models described above also refer to "owner" and "municipality". Whereas the municipality clearly is an element of the "public", owners may be public or private owners. However, even in case of private owners one can argue that their overall responsibility for e.g. a certain facility puts them in the place of a "quasi-public" institutions which should take care and responsibility of the development and value of the facility.

A balance needs to be struck between competition which is best fulfilled with the model on the left hand side and incentives for investment which is best fulfilled by monopoly, the model on the right hand side. The optimal solution might vary for different regions and different stages of the market evolution. The goal is to move as far to the left as possible provided more than one player invest in state-of-the-art infrastructure. The part of the network with monopoly like behaviour needs to be opened up by applying an open access policy. A further argument to consider is that the higher the requirements for infrastructure – or put another way – the more capital expenditure is needed, the more monopoly like the structure will appear. Since demand is derived from the general public, the government has means and an obligation to step in and move the model to the left hand side by taking some kind of investment risk and offering it via open access.

We conclude that different forces are at work, which determine the optimal model. Technological evolution will lead to decreasing prices, which eventually will allow a deeper level of competition. Surfacing concrete demand and willingness to pay also will lead to increased incentives to invest. The government has the means and responsibility to influence the models in order to achieve the optimal balance between competition and investment by also considering the public value of state-of-the-art telecommunications. Such an influence could be used by determining which types of models will be accepted from a regulatory perspective as they contain the possibility to achieve competition AND investment in parallel.

2.3 Conclusions

We derive the following conclusions:

- State-of-the-art telecommunications infrastructure involves fibre deployment in the access network, because this is the only medium suitable for offering future-proof bandwidth.
- International experience shows that reliance on the telecommunications market with its competitive nature might not be sufficient to achieve this state-of-the-art infrastructure. From an economic point of view, an evolved last mile which does no longer constitute a technical bottleneck will still represent an economic bottleneck. This is

backed up by the fact that all successful models mentioned above involve funding models, which also involve other stakeholders such as developers or state/municipal governments (or the public sector in general).

- The move from monopoly to competition and technological acceleration has implied a large degree of market, regulatory and investment uncertainties which may lead to a sub-optimal amount of infrastructure investment.
- The deployment of fibre demonstrates that the vertical integration of networks and services is being broken up and that different horizontal layers of passive and active infrastructure can be provided by different players. This impacts the design of future business models and also has a significant impact on the investment incentives of different types of players.
- Full infrastructure competition in fibre networks may not be realized only through market forces. Therefore, public intervention and support may be helpful to overcome the reluctance to invest. Such support should be technology and competitively neutral. Therefore, our main finding is that for fibre infrastructure to be implemented, markets AND institutions have an important role to play.

Concluding we would like to state that competition and investment represents some kind of dichotomy. This means that a balance needs to be struck between these two conflicting goals.

3. PPP: practical importance and implementation. The case of telecommunications and for fibre rollout

3.1 Ideas behind PPP

The primary idea behind PPP is that the public sector has limited financial resources and furthermore is limited in raising debt and borrowing money from the capital markets, amongst others to fulfil all its duties regarding the provision of public services in the fields of all types of infrastructures, e.g. roads, railways, airports, gas and water, education, environment and health. Taking into account the aforementioned aspects, PPP refers to forms of cooperation between the public sector and private businesses which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service.

According to the green paper of the European Commission the following elements normally characterise PPPs:

- a (relatively) long duration of the relationship between the public partner and the private partner;
- the funding of the project occurs from the private sector, at least partly and public funds - in some cases rather substantial - may be added to the private funds;
- the important role of the private partner, who participates at different stages in the project; e.g. design, completion, implementation, funding;
- the role of the public partner that is driven by defining the objectives to be attained in terms of public interest;
- the transfer of risks and/or the distribution of risks between the public and the private partner, whereas the precise distribution of risk is determined case by case, according to the respective ability of the parties concerned to assess, control and cope with this risk.¹⁸

and furthermore the following elements usually constitute a PPP project:

- the need of the public sector to utilise private sector management and experience;
- to recognise that both partners have certain advantages relative to the other in the performance of specific tasks.¹⁹

¹⁸ Green Paper on Public Private Partnerships and community law on public contracts and concessions, Commission of European Communities, Brussels 2004, p. 3.

¹⁹ Abadie, R. and Howcraft, A.A., Developing Public Private Partnership in New Europe, PricewaterhouseCoopers 2004, p. 9.

Literature review leads us to conclude that there is no commonly accepted definition of public private partnerships across Europe and beyond. However, the above mentioned characteristics are widely accepted.

3.2 Examples in the telecommunications industry

The analysis that has been conducted for this paper shows that a lot of PPP projects regarding the deployment of telecommunications networks have been executed in several countries throughout Europe and in other regions. Therefore, this section can only show a small selection of projects thereby highlighting such ideas and examples which are characterized by some kind of different features in the way the projects are organized, financed or implemented. Except for (incumbent) telecommunications operators who may review their investment strategy and move to fibre based network topology, there are also other market players who consider such moves. We have identified that these can be the local municipalities/cities, other utilities (such as power, gas or water providers), independent companies entering the communications market from a completely different angle as well as housing companies or construction companies. In the following some of the projects with its key facts are going to be introduced.

One of the first and best-know project is **Stokab in Stockholm**, the capital of Sweden. Stokab was founded in 1994 and is 100% owned by the company group Stockholms Stadshus AB, which is in turn owned by the City of Stockholm. Stokab's core tasks are to provide an operator-neutral basis (dark fibre) for IT infrastructure in the Stockholm region and to lease out fibre optic connections. The company provides a physical network that is open to all players and service providers respectively on equal terms, for the delivery of services to their end-users. In addition, Stokab collaborates with other players to facilitate the rollout of infrastructure for wireless communication and drives development of the broadband market in the Stockholm region. Furthermore Stokab allows public agencies, businesses, property owners and organizations to meet their data and telecommunication needs through dedicated networks.²⁰ Stokab is deploying a FTTH network in cooperation with the cities housing companies containing the following key indicators:

- FTTH rollout to 95.000 households over 2 years (2007 –2009),
- Stokab connects each building to the network,
- the housing companies build and own the in-house network that equips each apartment with fibre,
- the housing companies engage a communication-operator that offers the services to the tenants from a number of suppliers at their own choice, and

²⁰ http://www.stokab.se/upload/Dokument/Company%20brochure%20Stokab_2005.pdf

- parallel to this expansion of fibre private house owners and tenant-owners are offered fibre connection of their houses.²¹

One could discuss whether the Stokab project can be defined as a pure PPP. At the end it is an open access network, one can say a public good owned by the public partner that offers its services to private partners - network operators and service providers - providing telecommunications services to residential and business customers. In any case, the public intervention has led to a lowering of risk for communication operators who wish to offer these services.

Another huge PPP project is the **CityNet of Amsterdam**. In 2003 the city decided to go for a Private Public Partnership, with minimal municipal investments, only in the passive layer. CityNet is a fibre-to-the-home/premise deployment to deliver high-speed symmetrical broadband access based on open network principles. The legal entity to build the network is Glasvezernet Amsterdam BV (GNA), which is owned one-third by Amsterdam's City Council, one-third by five large Amsterdam housing corporations and one-third by ING Real Estate Investment Management. The network deployment costs are 18 million Euros shared between all partners.

The construction of the network which means digging trenches and laying the fibre has been awarded to Van den Berg Infrastructuuren (BAM) and Draka Comteq Telecom. BBned, a subsidiary of Telecom Italia, was picked to operate the network, e.g. lit the fibre and provide backbone connectivity. As CityNet is designed as an open networks initiative, BBned is required to support all services from third-party providers without discrimination.²²

In 1999, the municipality owned Burlington Electric Department (BED) of the city of **Burlington** (USA) started a co-operation with Aptus Networks to build a citywide fibre-to-the-home network. The initial investment was \$ 2.6 million for the fibre optics system that was partially owned by the city holding 55% and Verizon holding the residual. The first phase of this four phase project connected government offices with Internet and voice services. Phase two added a few, carefully selected, large businesses to the network.

As an operator Burlington Telecom was established a company that currently operates two separate networks. Firstly the "City Network" which is specifically designed to serve a small number of extremely high-use sites, e.g. the City Government's own sites and furthermore sites belonging to organizations like the State of Vermont and Community Health Care of Burlington. Secondly the company operates the "Universal Network" which is designed to pass and serve every premise in the City. In the long term the operator will not mind being driven out of the service provider business as it is ultimately focused on the transport layer.

²¹ <http://www.oecd.org/dataoecd/35/57/40460908.pdf>

²² <http://www.localret.es/localretnews/bandaampla/num3/docs/etcnamsterdam.pdf>

By mid-2006, Burlington Telecom had over 350 customers, as of August 2007, it had 1,800 subscribers and was increasing every week. On the expenses side of the equation are more than \$2 million in debt servicing and \$2 million in operating costs each year. Burlington Telecom projects an overall positive revenue flow by 2009.

But Europe and the US are not centres of such activities. **Aurora** is the first Australian project that brings together State and local governments and a developer to test a model to make FTTH services available on a widespread basis. In 2005 Victorian Government agencies VicUrban and Multimedia Victoria set about finding a strategy for transforming the empty conduit network into an advanced broadband network delivering a rich array of content and services. VicUrban's Request for Tender attracted six FTTH solutions from a range of vendors. A contract was ultimately awarded to Victorian-based IP System Limited. As a result property buyers in a green field estate (Aurora) will have access to the FTTH based broadband services.

The approach contains that the developer of Aurora funds the capital cost of the network, adding only marginally to the expense of preparing habitable land. The costs are recovered in the selling price of land. In exchange for the desired outcome, VicUrban indicated its willingness to support the project e.g. in terms of access to pit-and-pipes, providing locations for equipment, marketing the solution to all property buyers and regarding funding activities.²³

All infrastructure solutions proposed satisfied the key objective of taking fibre all the way to the home to ensure abundant capacity for the future. VicUrban had agreed with all builders in Aurora that they would contribute \$800 towards the cost of a FTTH outcome. For the purpose of commenting on the results, it is useful to exclude this contribution and the impact of Broadband Connect. When this is done, the cost per lot to VicUrban (expressed in terms of net present value at a discount rate of 10 per cent) and based on the full 8,000 home deployment) for all solutions tendered fell within the range – \$1,500 plus or minus \$415. This includes the cost of providing a six-month period of free Internet connection.

It has to be noted that all of the results are negative. This reflects the reality that it requires a contribution from the developer to procure an advanced services and infrastructure solution.

The examples show that several cities and municipalities on a worldwide scale co-operate with local and/or private partners within PPPs to deploy their own fibre optics network. In general quite different, all of the respective models have in common to use the particular strengths of each of the partners to act successfully. Building their own fibre optics network a city or municipality invests in their future because of realising a sustainable communications infrastructure for residential and in particular for. Investors are realising a long term investment with if applicable lower earnings on the one hand but on the other hand got more reliability because of the participation of the municipality.

²³ <http://tinyurl.com/38d36u>

3.3 Interaction between the public and the private sector

Public private partnerships are cooperations between the state and private enterprises to realise a certain kind of infrastructure and/or services. Often it is characterized by a relationship with the aim of introducing private sector resources and/or expertise in order to help to provide and deliver public sector duties and services.²⁴ Considering appropriate issues and projects respectively PPPs can procure public investments less expensive than a traditionally procured investment without losing the responsibility for providing public services and their respective risks, due to a substantial privatisation. PPPs usually are less than a privatisation but more than a public procurement of services that are provided by private enterprises. They are long term contractual relationships representing the whole lifecycle of a project starting with the design followed by the deployment and the operations including maintenance and ending with the recovery of the public infrastructure or service. PPPs are coming to an edge where the interests of the partners are getting more complex or the risks tend to appear unforeseeable.

However, thinking about public private partnerships within telecommunications as one type of infrastructures a typical attribute of such a relationship is that both, the public and the private partner as well as all other involved parties, e.g. corporate finance should be aware of their strengths and core competencies to optimise the provision of the respective services.

Considering traffic, electricity, gas and water infrastructures municipalities are always playing the most important role regarding their availability for the public. Taking into consideration the level of privatisation as well as the competitive environment, some differences are obvious between the various infrastructures. While roads usually are privatised only in exceptional cases telecommunications infrastructures are in general competitively organised and almost completely privatised. In-between these two one may allocate the other infrastructures like electricity and water.

PPP cooperations between municipalities or cities and private investors regarding the deployment of fibre optics networks need to improve the design, the technical planning, the marketing and the business model, whereas the public sector can benefit from the private sector's management and operational experiences. Furthermore such cooperations in particular taking into account adequately the economic risk of these investments. From the perspective of a municipality, the risk of falling behind others within the regional competition because of lack of broadband access decrease if it is shared with private investors and enterprises respectively. From the perspective of a private enterprise, e.g. a network operator the partnership generates advantages regarding the deployment of the network by e.g. getting access to trenches, ducts or passive infrastructures which are much easier to provide by the

²⁴ Abadie, R. and Howcraft, A.A, Developing Public Private Partnership in New Europe, PricewaterhouseCoopers 2004, p. 9.

municipality. Furthermore the integration of local offers and for example the introduction of an electronic market place may help both partners to act successful.

A PPP project is determined by amongst others environmental analysis, looking for partners, bid invitations, contract management, project management and receipt of state aid as well. Several duties and responsibilities need to be assigned in a way that they are going to fulfilled according to the respective abilities and competencies. It is also necessary to share the risks between the partners appropriate to their capability to bear the risk. Taking the aforementioned into account the question regarding the respective roles arises. A distribution could occur as follows:

Public sector	Private enterprise
basic provision of infrastructures	contracting / building (construction) business
project developer	Operation of network
client / purchaser	investor / sponsor
shareholder / partner	(co-)financer
provision of personnel	service provider (on the network) – potentially one of many service providers
building permits / rights of way	

There is evidence that, if appropriate and thoroughly designed and projected, PPPs may provide significant improvements regarding the deployment of a broadband infrastructure also in remote areas and small municipalities. However, there should be no presumption that PPPs are a panacea or that they are appropriate and succeeds in all circumstances. PPPs are an approach which states and local authorities as well as private businesses and enterprises should consider in tackling the challenges of the provision of public infrastructures and services in case of financial limitations combined with a lack of alternatives from the private sector.²⁵

3.4 PPP design for fibre rollout

The PPP approach is generally driven by requirements regarding the necessity of build, enlargement and reconstruction of infrastructures of several kinds (traffic, health, education, environment) as well as public services (energy, gas, water, waste) governments are confronted with. In this context as mentioned above one has to take into account that the public

²⁵ Abadie, R. and Howcraft, A.A, Developing Public Private Partnership in New Europe, PricewaterhouseCoopers 2004, p. 3 and 8.

sector has limited financial resources and is restricted in its ability to raise funds, especially in Europe because of the Maastricht criteria.²⁶

To transform the basic idea of PPP to the deployment of broadband networks and fibre optic networks respectively one needs to move the responsibility of the public partner from the federal to a more state and/or local government level.

Significant investments are necessary for the deployment of fibre optic networks. Thus, a market driven solution, which means the provision of broadband access and broadband services by a privately owned network operator and/or service provider including the full financial coverage, is not feasible in all situations.

As mentioned above PPPs in the telecommunications sector are basically suitable to resolve the lack of broadband infrastructures in remote areas. To assess the suitability of PPPs some key aspects need to be taken into consideration.

Probably the most important aspect of PPPs is the funding of the respective project. Usually the funds of the municipalities are not applied for infrastructure development in the telecommunications sector. Given that and taking into account the need for an appropriate telecommunications infrastructure for broadband services in remote areas, alternative ways of financing such projects are required. Two options for additional financial resources are available in general. Firstly, within a PPP project private co-financing stands for the usual procedure to collect the necessary money. Furthermore, if the financial resources of the municipality and the private partner are insufficient, the local authority can apply for governmental support or grants from the EU, if available. Considering the application of state aid and EU grants the local authority must adhere to the EU grant regulations as well as the national fundamental principles of funding of local infrastructure projects by using state aid. Reviewing the European “funding landscape” one can identify in most of the member states national state aid programs to support the roll-out of future proof and sustainable broadband networks. Just to mention some:

- support for the development of broadband in the territory of Alto Adige (Italy),
- broadband access in underserved territories of Greece,
- public support to broadband, digital TV, mobile infrastructures in rural areas of Spain,
- broadband infrastructure in Lazdijai and Alytus (Lithuania), and
- broadband in rural areas of Bavaria, Saxony and Lower Saxony (Germany).

²⁶ In light of the current economic situation (“financial crisis”) several countries discuss measures to support the local economy. Infrastructure investment is one of these potential targets. Thus, the current situation could bring about exactly the financial means to fund such projects.

Concluding, alternative funding models of this kind can involve private or public investment. OECD for example mentions the possible roles of the government which would have an impact on “production” besides its role as stimulator and regulator²⁷.

Public private partnerships with regards to the broadband network deployment are co-operations between local authorities, municipalities or cities and private enterprises or organisations. Thus, a second aspect to examine is the model of PPPs, whereas according to the green paper of the EU it is proposed to make a general distinction between the following:

- PPPs of a purely contractual nature, in which the partnership between the public and the private sector is based solely on contractual links, and
- PPPs of an institutional nature, involving co-operation between the public and the private sector within a distinct entity.

This distinction is based on the observation that the diversity of PPP practices encountered in the Member States can be traced to these two major models.²⁸

The first model refers to a partnership based solely on contractual links between the different players. It covers a variety of set-ups where one or more tasks are assigned to the private partner, and which can include the design, funding, execution or exploitation of for example a fibre optic network or a (broadband) service.

In this context, one of the best-known models, often referred to as the “concessive model”, is characterised by the direct link that exists between the private partner and the final user: the private partner provides a service to the public, “in place of”, though under the control of, the public partner.

In other types of set-up, the private partner is called on to carry out and administer an infrastructure for the public authority (for example, an (telecommunications) infrastructure, a school or a hospital). The most typical example of this model is the PFI²⁹ set-up. In this model, the remuneration for the private partner does not take the form of charges paid by the users of the works or of the service, but of regular payments by the public partner.

The second model, institutionalised PPPs involve the establishment of an entity held jointly by the public partner and the private partner. The joint entity thus has the task of ensuring the delivery of a work or service for the benefit of the public. Public authorities sometimes have recourse to such structures, in particular for to administer public services at local level (for example, for water supply services or waste collection services).

²⁷ See OECD 2008, p. 36.

²⁸ Green Paper on Public Private Partnerships and community law on public contracts and concessions, Commission of European Communities, Brussels 2004, p. 8.

²⁹ The term PFI refers to “Private Finance Initiative”, a programme of the British Government permitting the modernisation of the public infrastructure through recourse to private funding. The same model is used in other Member States, sometimes with major variants. For example, the PFI model inspired the development of the “Betreibermodell” in Germany.

Direct cooperation between the public partner and the private partner in a forum with a legal personality allows the public partner, through its presence in the body of shareholders and in the decision-making bodies of the joint entity, to retain a relatively high degree of control over the development of the projects, which it can adapt over time in the light of circumstances. It also allows the public partner to develop its own experience of running the service in question, while having recourse to the support of a private partner.

An institutionalised PPP can be put in place, either by creating an entity held jointly by the public sector and the private sector, or by the private sector taking control of an existing public undertaking.³⁰

In the aforementioned context one example for a special co-operation is the usage of the infrastructures provided by (municipal) utilities, meaning trenches and ducts usually used for public services like gas, water and sewage. These public infrastructures are going to be built, operated and maintained by the respective utility and are connected to every family home or multi dwelling unit. Considering the roll-out of a FTTH fibre optic network this model is a co-operation that appears highly practicable in cities as well as in remote areas.

The third important aspect with regard to the design of a PPP for a telecommunications infrastructure is the role of and the foundations laid by the public partner. This aspect comprises, e.g. the personnel support in terms of administration as well as providing permissions, ordinances and by-laws, furthermore the provision of rights of way and finally also support regarding the involvement of local (construction) businesses.

Thereby, one can look at possible government policies as supportive measures, taking into account the issue of funding if the market cannot provide a solution. This policy – in our view – again raises the question of the long-term effects of interventions of this kind on the competition in the market. Some elements to be considered are:

- “Regulatory interventions should be limited to the extent that they compensate for the market failure.
- When governments or local authorities subsidise new networks or participate in public-private partnerships these should result in open networks that foster competition.
- The public partner’s role in investing in physical infrastructures and provisioning services should be on a gradual scale with roughly the following steps:
 - Digging trenches and laying ducts, removing a significant part of the costs of rolling out a network.
 - Providing passive network infrastructure to which network providers can connect their active infrastructure.

³⁰ Green Paper on Public Private Partnerships and community law on public contracts and concessions, Commission of European Communities, Brussels 2004, p. 8 and p.18.

- Providing an active network over which others can provide their services.
- Providing services over the network to end-users.
- If governments are investing in networks and services, they should periodically evaluate whether there is still a necessity to do so and preferably state a fixed term at the start of the investment when the decision will be evaluated.”³¹

Besides the OECD the British Broadband Stakeholders Group has analysed models for efficient and effective public sector interventions in next generation access networks comprising demand side and supply side interventions.³²

As can be seen, there are various ways and different intensities for public sector support to network rollout. The solution chosen depends strongly on local market conditions and demand. It also requires finding the right balance. Public sector support and especially funding should not crowd out private sector investment. This may be highly critical for the development of a competitive market in general. Therefore, “soft” measures as described above may foster network rollout and investment in a better way without implying biases for any business model or technology.

3.5 The trigger for PPP for fibre rollout

Considering the deployment of a certain technology the current discussions lead to a common understanding that fibre optic networks are the only future proof and sustainable alternative. High investments are necessary for the respective network roll-out. Those investments are offering long-term benefits and advantages to the regions, the enterprises in these regions and to the residents who are getting the benefits of the newly deployed networks. But, to realise the former substantial financial resources need to be provided first, which in the end heavily depends on the profitability for the (private) investors. The profitability depends on the penetration, the usage und the density of population in the respective areas. Taking into account the latter a complete (nationwide) roll-out of fibre optic networks is unlikely.

A study conducted for the Saxon State Ministry of the Environment and Agriculture and the Saxon State Ministry for Economic Affairs and Labor has come to the result that, profitability of broadband infrastructure investments may be realized merely in municipalities with a minimum number of 500 inhabitants. Below this size the realisation of a stable business model appears questionable. At this stage of the issue the state and the public authorities are coming into play. And furthermore, besides remote municipalities a positive business

³¹ OECD (2008a): Development in Fibre Technologies and investment, pp. 40.

³² BROADBAND STAKEHOLDERS GROUP (2008): Models for efficient and effective public sector interventions in next-generation broadband access networks, Report by Analysys Mason Ltd. Commissioned by BSG, 9 June 2008

case for fibre optic networks isn't self-evident in huge cities with a dense population which is a reason for e.g. the PPP approach of the CityNet of Amsterdam.

Coming back to the so called "white spots" of the European broadband infrastructure map, the respective discussion regarding their elimination has uncovered market failure at least regarding the deployment of those infrastructures in remote areas. The operative point here is that, network operator and service provider are not willing to deploy or extend their networks because of lack of an acceptable profitability. Commissioner Reding confirmed this in a speech at the beginning of 2008:

"Point-to-point fibre deployment, meanwhile whilst the most conducive to providing un-bundled access for third parties, is rarely being deployed by private market investors. Certainly, this is due to its high cost, but it is also probably due to its openness. Where we do see it being used is in open access schemes initiated by municipalities, in cities such as Stockholm and Amsterdam. These schemes are local partnerships that take a pure "infrastructure utility" approach by building ducts and end to end dark fibre and then leasing access to service providers. Clearly by so doing these cities have created for their business and citizens a future proof network infrastructure and for the investors in the networks a very long term stable return on their investment given that ducts and dark fibre have a potential operating life of several decades."³³

Given that, some analysis' that have been done in the forefront of investment decisions show the following:

- The Amsterdam case was driven by the number of subscribers and the revenues per customer. Based on conservative presumptions a 40% take-up rate and € 25 per customer and month make the business case profitable, inter alia because of a thirty years lifetime of the fibre optics.
- Another study (by A.T. Kearney) comprising Athens and Thessaloniki in Greece has been calculated a break even point after 16 years, whereas 750,000 access lines need to be realised
- Even for small cities in the US (Monticello) and Australia (Whittlesea) business cases were calculated to justify the investments. At the end in both cities profitable solutions were found.

As a result it can be stated that investments in fibre optic networks generate benefits for both, the public and the private sector.

But, there are also some cases noted where investments are not profitable by themselves, caused only partially by the demand situation (low population, low penetration) but also by the unclear regulatory framework and the technological development. The latter in particular

³³ http://ec.europa.eu/commission_barroso/reding/docs/speeches/2008/brussels_20080114.pdf

makes it more difficult to finalise decisions regarding the investments and the selection of the used technology. In such a situation the public sector can and should support especially in the remote areas with a low population. One option is establishing a partnership between the public and the private sector – a public private partnership (PPP).

3.6 Criteria for success

The report of the Broadband Stakeholders Group identifies the following critical success factors regarding public sector interventions in next generation access networks also with respect to public private partnerships³⁴:

- not pre-empting the market unless there are good grounds to do so,
- using the open access network model,
- designing to minimise barriers to adoption,
- stimulating and aggregating demand,
- anticipating risks via detailed planning and
- compliance with state aid rules as well as support via other legal frameworks.

One of the most important criteria from our perspective is considering the open access network as the probably best solution for a future-proof and sustainable model whereof both the public and the private partner can benefit from. Implementing this solution it offers the municipality the option to decide by itself how to participate in the value added chain as well as regarding their investment level, if applicable. The latter highly depends on the financial resources of the municipality and the available subsidies and/or governmental grants. However, because of the clear horizontal separation the municipality can be engaged at three separated layers as there are:

- the provisioning of passive infrastructure such as ducts and dark fibre,
- the operation and maintenance of the network and
- the provisioning of services and applications.

But, even without a direct engagement of the municipality the open access model is a thinkable option for the private sector because of it can reduce the investment risk with respect to sunk costs. Furthermore in case of only operating and maintaining the network the private partner can decide with regard to the profitability about the wholesale conditions for service provider applying for the usage of the network.

³⁴ BROADBAND STAKEHOLDERS GROUP (2008): Models for efficient and effective public sector interventions in next-generation broadband access networks, Report by Analysys Mason Ltd. Commissioned by BSG, 9 June 2008

Another criterion for the success of the public participation at the provision of telecommunications infrastructures and services is a sound legal framework. This means in particular the national laws and by-laws regarding the permission of economic activities of local authorities and municipalities. For example Germany: to establish, to take over, to run, to extend or to participate in a business or a company is limited by state laws and furthermore controlled by a supervisory authority of the federal state.

Besides the national rules regarding economic activities of the public sector e.g. within public private partnerships the EU policy concerning PPPs is also important. The green paper of the EU can be seen as a framework regarding how PPPs interact with the EU legislation and regulations. This Green Paper discusses PPPs from the perspective of Community legislation on public contracts and concessions. Community law does not lay down any special rules covering the phenomenon of PPPs. It nonetheless remains true that any act, whether it be contractual or unilateral, whereby a public entity entrusts the provision of an economic activity to a third party must be examined in the light of the rules and principles resulting from the Treaty, particularly as regards the principles of freedom of establishment and freedom to provide services (Articles 43 and 49 of the EC Treaty), which encompass in particular the principles of transparency, equality of treatment, proportionality and mutual recognition.³⁵

A third success criterion from our perspective is the ratio between welfare economics of a society and the profitability of a single business like deploying and operating a telecommunications network. Considering that, the PPP approach is not the appropriate type of cooperation between the public and the private sector if the private partner mainly focuses on quick and high profits as well as shareholder value. The approach requires sustainable thinking on both sides the public and the private sector to be successful and gaining benefits in the long run.

³⁵ Green Paper on Public Private Partnerships and community law on public contracts and concessions, Commission of European Communities, Brussels 2004, p. 5.

4. Conclusions

This paper has demonstrated that the technical characteristics of classical telecommunications networks are outdated when it comes to new applications and new services which require more bandwidth. In many projects, commitment towards broadband in general and fibre optic networks have already been made. The rollout of these networks meets a number of difficulties with respect to the competitiveness of the market (and thus the difficulty to find an appropriate business model), the private investment under competitive circumstances, the market regulation etc. Therefore, the private sector may not be able to come forward with the investment alone. Additionally, we see the vertically integrated model of the provision of networks and services changing. With fibre rollout, different layers gain importance and various passive and active infrastructure / service layers can be provided by different operators. This leads to many different models in the projects which have been realized so far on a worldwide scale (e.g. dark fibre provision, open access etc.).

As the public sector “owns” some of the horizontal layers (e.g. manages the Rights-of-Way etc.) and has an economic interest that the region is not falling behind in competitiveness, this public sector will always have a certain interest to see these networks and services being provided – like a kind of “public good”: This brings private sector and public sector much closer together in the discussions regarding the realization of such projects and the application of Public Private Partnership Models (PPP). Several aspects have to be analyzed and observed and in some jurisdictions it is really difficult to enable the public sector to engage on this matter.

Considering PPP projects one can conclude that they are suitable to develop solutions for the deployment of broadband infrastructures particularly in remote areas. But, it needs to be pointed out with regard to the examples that their success highly depends on the regulatory, financial, legal and governmental environment as well as the willingness of both the public and the private sector to cooperate in a way where everyone can benefit. PPP's are one alternative with some potential but not the only one and they are not a panacea.

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