
Role of public organisations in the creation of new broadband access infrastructures

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Synopsis: Which roles may a public organisation play in the creation of new broadband access infrastructures? The main discussion issues about the roles of public organisations in relation to regulation and market distortion principles are given. Based upon some public policies and principles, the general requirements in making choices related to infrastructure in a specific broadband project are presented. The issues about the way how governments may fulfil the general requirements are presented. Examples and cases are related to the situation in the Netherlands

Keywords: *broadband access, infrastructure, policy, role, requirement, government*



Abstract

This white paper is concerned with the roles a public or governmental organisation (EU, national or local) may play in the creation of new broadband access infrastructures. First the most important policies and principles are summarised forming the base of a possible public role. Secondly the different roles of public organisations are analysed. Thirdly the general requirements for the selection of technological choices in a broadband project are presented which may follow from these policies and principles. These requirements may be useful in analysing options for architectures, technologies or business models in a specific broadband project. We discuss the risks and the challenges of the roles of public organisations with respect to the general requirements and principle of “no market distortion”. We also discuss some of the barriers of today’s regulatory situation in the evolution of broadband (with special attention for Fiber-to-the-Home) infrastructure. Examples and cases are related to the situation in the Netherlands.

Preface

The B@HOME project is part of the Freeband Communication programme, which aims at the generation of public knowledge in advanced telecommunication (technology and applications). Freeband is based on the vision of 4G networks and services. It specifically aims at establishing, maintaining and reinforcing the Dutch knowledge position at the international forefront of scientific and technological developments, addressing the most urgent needs for research and novel applications in the present unfolding of new technology. Freeband comprises more than 25 organisations, including all-important technology providers and many representative end-user organisations. The Dutch Ministry of Economic Affairs is co-funding this programme as part of the BSIK plan.

The vision for Freeband for 2010 is to consider communication and information transfer from the perspective of the user, not the provider. The communication infrastructure will become transparent and abundant in all its layers.

B@Home's scope is future broadband services for the residential user, with a focus on the entertainment domain. The objectives of the project are to develop new business models as well as architectures capable of plug-and-play service delivery to the end-user.

The knowledge and experience gained in the project will be used to implement a demonstrator to show some of the future advanced services. In B@Home, Lucent Technologies, Philips Research, LogicaCMG, the Technical University of Eindhoven, Erasmus University of Rotterdam and TNO work together to achieve these results. The project started on July 1st, 2004 and has a duration of four years. After two years, the first demonstrator will be presented.

This white paper is the first result of activity T0.3 "Integrated Broadband @ Home overview", producing white paper documents describing the main results and open activities of the project [B@Home](#) and related projects.

This white paper is meant for open discussion. Please send your comment and opinion to the author's e-mail address: jan.burgmeijer@tno.nl.

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1 Introduction

The Netherlands holds a rather unique position, having a total broadband penetration amongst households being among the highest in Europe. The Dutch government has the aim to hold this strong position [1].

In the broadband policy, “broadband” is defined in terms of its functionality: Broadband is a continuously available connection suitable for good quality audio-visual applications and the exchange of large data files [1]. We make a distinction between “narrowband” (bitrates below or equal to 128 kbit/s), “midband-broadband” (bitrates between 128 kbit/s and 10 Mbit/s) and “super-broadband” (bitrates higher than 10 Mbit/s). Typical examples of narrowband are: PSTN and ISDN dial-in connections. Typical examples of midband-broadband are the current ADSL and Hybrid Fibre Coax offerings. Typical examples of Super-broadband are: VDSL, Cable Ethernet and Fiber-to-the-Home. Fiber-to-the-Home (FttH) is the only technology able to offer more than 1 Gbit/s. This is the reason that municipalities and public organisations consider FttH as the most future proof technology. However current broadband providers are walking the evolutionary path from narrowband to midband-broadband and further to super-broadband. This is because FttH requires in most cases huge investment with pay-back periods too high for the current investment climate. The current providers also want to exploit their assets in cable and copper infrastructures as long as is economically possible.

In the revolutionary scenario towards Fiber-to-the-Home, many municipalities and public corporations are playing an active and stimulating role. These public organisations are co-operating with private organisations to implement their FttH pilot projects; they are stimulating broadband on the supply side by the creation of new infrastructures. Public organisations may also play a stimulating role on the demand side of broadband, e.g. stimulating the use of broadband applications. This paper will be focused on the first role, because this role is discussed heavily nowadays in the Netherlands and more clarity is needed. The paper is not an in-depth scientific paper, but more a discussion paper with some observations from the author. The arguments will be built up along the following line of questions.

- *What is the policy of European and national government towards these local initiatives?*
- *What are possible roles of governments (EU, national and local) in the creation of new broadband access infrastructure?*
- *What are the general requirements of public interest on the selection of the technology and architecture of the new broadband access infrastructure?*

The discussion will be focused on the following themes:

- *The EC directives and national regulation with respect to Fiber-to-the-Home*
- *Roles of public organisations with a risk for market distortion*
- *How to fulfil the general requirements*

The discussion of the role of public organisations in the creation of new infrastructures is very actual and interesting in the Netherlands. The content of this paper was originated from other projects related to B@Home. It gives a relevant contribution to the aim of task 0.3 “Integrated overview of Broadband @ Home”. The paper is relevant to the current discussions about the policy of Dutch government related to broadband, e.g. discussions about The Reference Model for broadband, one of the recommendations of the Dutch “Impuls Commissie” [7].

The paper is also relevant for further study in B@Home, especially on the following themes:

- *Role of public organisations in the creation of service architectures*
- *General requirements related to governmental policies on new service architectures*
- *Role of public organisations in the development of new applications and services in the public sectors entertainment, health care, education, mobility and security.*

2 Policies and principles of governments

2.1 European Policy and principles

The European Council in its e-Europe 2005 Action Plan [2] sets out a strategy to make broadband infrastructure widely available to businesses and citizens throughout the European territory at affordable prices. It also outlines the need to develop adequate content and services, with particular emphasis on public administrations (e-government), a dynamic business environment (e-business), health services (e-health) and education (e-learning). Subsequently, the Spring European Council of March 2003 called upon Member States to put their national broadband strategies in place by the end of 2003 [3].

Europe has the ambition of *broadband to all* to fulfil:

- *High total penetration of broadband connections*
- *Coverage in under-served areas*
- *Consumers' confidence in terms of quality and security;*
- *Broadband access at affordable prices*

The first question that follows is: Should the EC stimulate infrastructure development (“push”) or broadband service development (“pull”) ? The EC does not give a clear preference to either “push” or “pull” of the broadband developments, although it gives restrictions to push mechanisms. In the Lisbon agenda this duality was stated as: The European broadband policy has two clear priorities:

1. *To ensure the rollout of broadband infrastructure throughout the Union.*
2. *To stimulate development and use of broadband services.*

As an example of this second priority, the EC states that a clear role of government is *aggregating demand of public parties and co-ordinating government initiatives for broadband services (e-government)*.

The second question is: Should the EC stimulate by intervention of European and national governments or should it stimulate the role of competition? The second question has got a very clear answer: *Government policies should emphasise the role of competition in stimulating broadband development and diffusion and should avoid direct intervention in the broadband market which risks distorting market mechanisms* [4].

This clear answer was based on the experience of the explosive growth of broadband access infrastructures in Europe in the past decade; the existence of competition has helped to stimulate the development and diffusion of DSL and cable modem technologies and provide the incentive to reduce prices and improve end-user quality. There is a positive correlation between the diffusion of both DSL and Cable infrastructures in a state and the total penetration of broadband connections to consumers in that state. This has become a guiding principle for European government called *Facility based competition*.

Funding from public sources should be restricted. Especially the funding of actions in the market on the supply side is restricted. This is based on the general principle of *no state aid*. If national governments want to fund project with public sources this has to be notified to the EC; there is a simplified framework available for this notification [3, annex 1].

The EC has formulated guidelines to help those regions who wish to co-finance investments through structural funds in the electronic communications sector. The European Regional Development Fund (ERDF) is the main financial instrument in support of EU cohesion and regional policy. The guidelines set out the criteria of ERDF support, especially for broadband, in particular in *rural and remote areas of geographic isolation and low population density* [3].

Structural funds should support regions in strengthening the demand side of the Information Society, especially the capacity of firms and institutions to effectively use ICT. Approaches are for example: aggregation of demand in the public sector, in clusters of the private sector, developing content and raising digital skills.

New infrastructure may be supported through structural funds in eligible regions, especially in rural and remote areas. The main criteria for infrastructure interventions under structural funds are:

- *Investments should be targeted towards areas that have insufficient commercial incentives to provide adequate infrastructure.*
- *Technology neutral, not favouring a priori any particular technology. Choices of technology must be clearly justified on a cost/benefit analysis.*
- *Open access. Support should be limited to infrastructure and equipment which is open to all operators and service providers.*

Infrastructure projects, subsidised by government, should follow a number of key implementation rules:

- *Contracts should be awarded through open calls for tender.*
- *Financing should be limited to the necessary amounts of resources for the provision of the service.*
- *The subsidised infrastructure can be owned by a public authority, a private entity which provides co-funding, or by a public-private entity. Rules exist in each case about the choices of the private undertaking, the suppliers, the infrastructure manager and about the open access to the infrastructure.*
- *Operators will have to develop a transparent cost accounting system.*

2.2 Dutch national broadband policy

In the Netherlands, a group representing the market parties, called the National Broadband Expert Group has made a broad range of recommendations to the cabinet for achieving a national lead in the field of

broadband infrastructures and applications [5]. These recommendations were only partly accepted by the Dutch Cabinet; the role of market and local initiatives was strongly emphasized instead of intervention by the central government. Municipalities, public organisations and some private companies in the Netherlands have taken the lead in the development of broadband infrastructures. A number of municipalities have started pilot projects, financed and stimulated by the ministry of Economical Affairs [6]. Other municipalities have used their own financial resources to start broadband projects.

In May 2004 the Dutch Cabinet formulated its national strategy for achieving the targets of e-Europe 2005; the national policy document on broadband was called “The Broadband Paper; a question of pace and better utilisation” [1].

The ambition of the Dutch government was formulated as: “Nederland Breedband Land”; a leading position of the Netherlands in Europe and world-wide regarding broadband development.

The same dual policy is chosen as in eEurope: stimulating both broadband services as broadband infrastructures. The first however gets more emphasize, because the Netherlands scores below the European average with regard to the use of services, while the position of the Netherlands with respect to broadband infrastructures is already strong.

The policy principles (besides the general EU policy principles) of the Dutch Broadband Paper [1] are:

- *Promotion of competition primarily at the level of services; Networks will operate far less in competition with each other and more as complementary activities as a result of convergence and the formation of horizontal layers in the business models.*
- *Creating the right conditions and improving the functioning of the broadband market. The development of broadband requires simultaneous development of infrastructure and services.*
- *The installation of the new generation broadband infrastructures will take place gradually. This could lead to administrative and technological fragmentation. Central government intervention is required to minimise any negative consequences of fragmentation as far as possible.*
- *Public organisations, like municipalities and housing corporations, can play an important role in the development of broadband. However market distortions should be avoided. Uniform government action is required.*
- *The new Telecommunications Act and the Open Network Provision regime are used as a framework for regulating the broadband market. The government takes account of market developments that could lead to natural (regional) monopolies of new broadband networks.*

A number of 14 Actions are started, based on the roles the Dutch government wants to fulfil. This comes back in the chapters to follow.

A Broadband Impulse Committee was installed by the ministry to steer the development of broadband policy. The committee has given its advice on the basis of a dialogue with the market. Impulses should be given in 4 areas:

- *A programmatic impulse in 4 social sectors: Care, Safety, Education and Mobility. Emphasis on application projects. A strong co-operation between organisations active in the same sectors.*
- *The 4 greatest municipalities (G4) should give direction in the development of infrastructure, applications and business models (Connecting the Dots).*
- *A financial impulse should be given. A contingency fund (“Garantiefonds”) for infrastructural development stimulating private investments and a stimulation fund (“Stimuleringsfonds”) for application development.*
- *A national governance impulse. A national “reference model Broadband”, containing elements on standardisation and a minimum set of general requirements regarding the development of new infrastructure on different network layers. The national “Reference-model Broadband” should be embedded in a new institution “National Governance Organisation Broadband”. The working group is called: E NORM.*

New broadband projects should obey the requirements of the reference model broadband to be able to get finance from the contingency fund for infrastructure development. Doing this, fragmentation will be avoided. The risk of fragmentation in the infrastructure is present at two levels: between technologies of the infrastructure or between infrastructures and applications. This has been worked out in the annex of [7]. In Chapter 4 we will come back to this.

2.3 Market regulation

To regulate a proper functioning of the market of electronic communications, the EC makes directives for the work of the National Regulatory Authorities (NRA), like OPTA in the Netherlands. The objective of these new directives is to stimulate investments, to create only regulation if necessary, to be less telecom specific and to get more general competition regulation. The method of the NRA is illustrated in figure 1.

The market definitions are technology neutral and should be done by the NRA. The EC has given recommendations for 7 retail product-markets and 11 wholesale product-markets. The list of product-markets will be revisioned on a periodic base. For this white paper about broadband services, the current two most relevant wholesale product-markets regarded broadband services are:

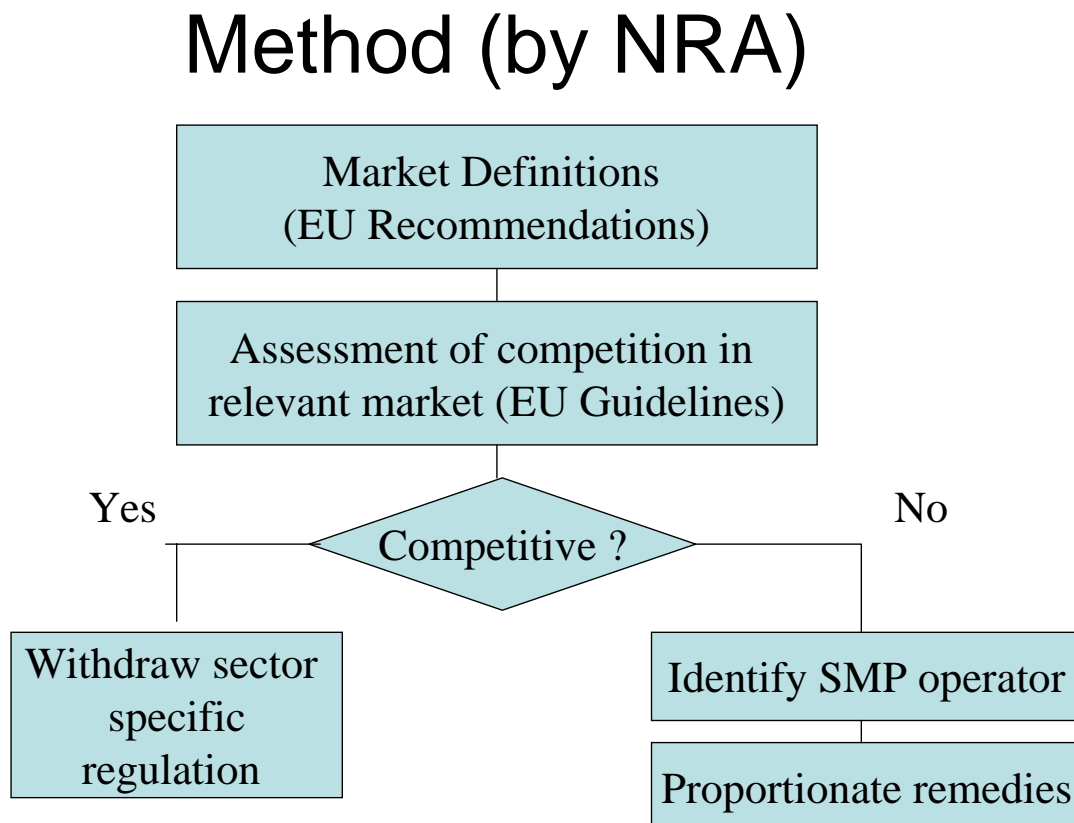
1. *Access to local loops (local loop unbundling and subnets) for broadband and voice services*
2. *Broadband services (like bitstream access)*

If broadcasting services (TV and radio) are involved as well, a third market may be relevant:

3. *Broadcast transmission services for delivering content to end-users*

The assessment of competition in these markets deals about the following question: Does competition work? Is there dominance or joint dominance? Dominance may be restricted to a geographical region or there is more homogeneous competition.

Figure 1: Method of the National Regulatory Authority (NRA) for market regulation.



If competition exists, the sector specific regulation should be withdrawn. If there is dominance by a market party, this party has “significant market power” (SMP); to be identified by the NRA. Normally this SMP has a market share of more than 50%. There may be a leverage of market power, e.g. SMP on infrastructure may lead to a SMP on the downstream service market; horizontal leverage is also possible, e.g. between telephony and ADSL services.

Having identified a SMP in a market, the NRA should impose proportionate remedies. This regulation is “ex ante” (beforehand). Possible ex ante regulation is:

1. *Transparency and non-discrimination*
2. *accounting separation*
3. *cost orientation (prohibiting excessive pricing)*
4. *access obligation (like unbundling, wholesale services, collocation)*

5. *no cross-subsidisation (between products of different markets)*

The ex ante regulation should always be technology-neutral and stimulate investments; it may make differences between emerging and replicable markets. Consultations with market parties are necessary before the regulation is introduced. This whole process will be delicate and time-consuming [17].

2.4 Policy and implementation strategies of some Dutch municipalities

The objectives of the policies of Dutch municipalities are very similar. Broadband may have a positive impact on local and regional objectives on economic, societal and cultural areas. Broadband may stimulate the establishment of new businesses and institutions. Broadband may stimulate employment in the ICT sector and in sectors depending on ICT. Broadband supports the “knowledge economy”; municipalities like to position their city as “knowledge city”. The expectations of the societal effects of broadband are also high. In municipalities like Appingedam there is concern about the high rate of elderly people and the care they need; broadband enables a change in home-care to more self-care and integration of care from different disciplines.

The implementation strategies of the Dutch municipalities are very different. Differences occur in the chosen business model, the reach of the pilot within the municipality and the speed in which the implementation is done. We will give some examples, but we will not make an in-depth case analysis.

2.4.1 Amsterdam

For the municipality of Amsterdam the preferred technology for broadband is fibre. Copper and coax are considered to be at the end of their life-cycle. Action should be taken, because the incumbent operators are too reluctant to invest in fibre and the implementation of Fibre to the Home (FttH) takes between 5 and 7 years.

The municipality will take a stake of 20% in the utility company owning and exploiting the passive layer (fibre) network. Other participants of this utility PPP are housing companies and private parties. The active layer should be owned and operated by a private company. This role is recently tendered in the market. After a private consortium for the active layer has been chosen, the implementation of the passive layer (digging) will be started as well. The FttH project in Amsterdam is called “Citynet”, it concerns all the 450.000 private homes in Amsterdam. The total project will cost about 800 MEuro (between 1500 and 2000 Euro per connection). The first phase of the project is in Zeeburg / Amsterdam Oost with 40.000 connections to be made. The municipality of Amsterdam will invest 6 MEuro (about 10%) in this first phase [20]. The discussion deals about the question if the Amsterdam municipality distorts the market with this investment with public money (see also chapter 5.2).

2.4.2 The Hague

The implementation in The Hague is lagging behind Amsterdam. The plans of the municipality of The Hague are presented in a report [15]. The choice for Fibre-to-the-Home is made using similar arguments as Amsterdam. The main action is the stimulation of the co-operation between incumbent parties (telephony network operator KPN and cable operator CASEMA). This should be done by forming a public-private partnership between these incumbent parties and some public organisations and the municipality. This PPP will own the current passive layers (copper and cable) as well as the new passive layer (fibre). The municipality will invest in this utility company with a minority stake of 10%. The role of the municipality is to guarantee the openness and transparency of the network and to make market competition work better. The municipality already has a role in the stimulation of the use and the development of new services and applications. The public organisations (e.g. schools and government buildings) may become a launching customer for new services.

2.4.3 Tilburg

In the Tilburg the foundation Tilburg OnderWijs Net (TOWN) is active [22]. This is a demand aggregation initiative. It is primarily directed towards educational institutes. A GigaMAN fibre backbone ring has been built which is owned by TOWN. The GigaMAN project was tendered public. This is an example of a *customer owned network*. There are 117 locations along the ring, which are connected [16], total cost is 3,3 MEuro, this is equal to 28,5 kEuro per connection. In the near future cultural and care institutes and businesses will be connected. Although GigaMAN projects are restricted to the passive optical layers, the TOWN foundation will also be involved in the active layers and in several broadband services.

2.4.4 Almere

Almere has written its policy regarding ICT in their I-visie [22]. Almere has implemented three independent layers of the business model. Fibre is regarded as a utility; the municipality wants to invest in the passive layer of the FttH network. The utility company is named the "Almere Fiber Company (AFCo)". The active layer is exploited by a private company (First Mile Ventures) and the service layer by a private company (UNET). Further the role of the government is in demand aggregation for institutes and businesses. The Almere Fibre Pilot will have 2200 connections; consumers and businesses.

2.4.5 Nuenen

In Nuenen a cooperative model is used; the inhabitants, businesses and foundations are members of a co-operation owning the passive and the active layer of the fibre to the home network. The co-operation is

called: "Ons Net" (our network). This co-operation also offers a Triple Play service package; Fast Internet (10 MBit/s) and (in the near future) local telephony, radio and television. It offers also some societal services in the sectors care, safety, education, sport and religion. The penetration factor of this broadband project is very high; from the start the penetration was 97%. Households giving permission of installing the Customer Premises Equipment (CPE) are connected for 1 year for free. This is partly due to the government subsidy; A national government demand incentive subsidy for consumers, focused on the Eindhoven region, ("Kenniswijk"). At the end of 2004 all the houses in Nuenen (7.500) will be covered. Further industrial estates and small and medium enterprises are connected. After the first year of free connection, participants have to pay for their connection and the challenge of the project is to keep the penetration factor as high as possible.

2.4.6 Appingedam

The FttH project in this rural city in the north of the Netherlands is called: "Damsternet" [16]. The municipality has a share in the utility company (called "Damsternuts") owning and exploiting the passive layer. This is necessary to close the business case; Commercial banks are not prepared to provide enough money for an acceptable rent rate. The role of the municipality should diminish and disappear at the long term. Further, the municipality has a stimulating role in the active layer and in the development of new services. The EC has asked the Dutch government to make a notification to the EC in order to investigate whether the municipality has followed the EC guidelines regarding State Aid and open tendering.

3 Different roles of governments and local public organisations

Depending on their policy and ambition, central governments, municipalities and public organisations can take different roles in ICT infrastructure related projects. These roles were analysed already in several policy documents [4, 5, 8, 11, 13, 15, 16, 20, 21]. Our analysis combines these earlier results. We might see the following roles to materialise, displayed in ascending order of level of direct financial involvement:

3.1 Policy maker, legislator and regulator

European and national government are active in making policies for broadband, as is illustrated in the preceding chapter. The European Commission has introduced a framework for national telecommunication acts, to be realised by the national governments. The national government stimulates the use of ICT and makes rules for the use of scarce resources. Among others, rules are made for:

- *the use of radio spectrum,*
- *the harming effects of radiation,*
- *the rights of way (digging),*
- *numbering plans for telephony,*
- *interconnection and open access,*
- *Legal interception of telephony.*

To regulate a proper functioning of the market of electronic communications, the EC make directives for the work of the National Regulatory Authorities (NRA), like OPTA in the Netherlands. This was illustrated in Chapter 2.3

3.2 Knowledge developer and disseminator

On the European level we have knowledge development programmes with a longer-term research character, like IST (framework programme) and ITEA and Celtic (both Eureka). On the national level we have Research programmes like Freeband [7]. The project B@Home is one of the projects in Freeband. Knowledge dissemination is an important objective of these programmes.

Nederland BreedbandLand (NBL) is a Public-Private Foundation in the Netherlands. Main objective is the finding of best practises in applying broadband in public sectors like care, safety, education and mobility. These best-practices are brought on a national scale by starting an application pilot. This will accelerate the use of broadband services in these sectors. Further it will introduce new requirements and develop

new knowledge on broadband infrastructures. This knowledge will be disseminated by symposia and a website.

Dissemination of experiences from local broadband projects in the Netherlands is done by e.g. Stedenlink [6], ISOC.NL [8], Kenniswijk [9], GigaPORT [12] and on a European scale by the FttH Council [19].

3.3 Supervisor on the supply side

Municipalities are giving permission for digging to several parties, having a licence from the NRA giving them rights of way. They have the aim to minimise the inconvenience by co-ordinating the digging and installing of ducts and cables for various utilities like electricity, water and telecommunications. Several municipalities fear chaos under the ground when several parties want to dig for fibre to the home. Central registration of all the cables and ducts for all utilities may be the solution, leading to a zoning plan for the underground. Another supervisor role may be to synchronise all the digging activities in time. This principle is sometimes referred to as *smart digging* (“*Slim Graafwerk*”) [8].

Municipalities may have a stimulating role by advising how to conform to certain rules and streamlining the formal and legal paperwork. This facilitating supervising role may be focused on the roll out of infrastructures by new entrants.

3.4 Stimulator on the demand side

Governments may support private parties on the demand side, by subsidising a promotional activity, a demonstration of an application of broadband or an application pilot. The stimulation may be directed towards the use of infrastructures or the use of services. The demand incentive scheme in the region of Eindhoven (Kenniswijk) has given consumers a subsidy when they sign a contract for taking a broadband connection with at least one service, e.g. Internet. Kenniswijk has also given subsidies to service providers allowing them to pilot about 80 innovative consumer applications of broadband in the Eindhoven region [9]

Broadband trials and projects in the Netherlands have been primarily on infrastructure [6]. It is the purpose of the Dutch government that in the years to come services will get more attention.

3.5 Demand aggregator or launching customer

Governments or public organisations may stimulate broadband by the aggregation of public sector demand and the demand of private parties. This may create a market sufficiently large to provide an incentive of private investments in regions where normally it may not be profitable [4]. In this case, new broadband

access infrastructure will be owned and operated by carriers, called broadband access network providers. The network is called a *Carrier owned network*.

In the Netherlands a demand aggregator role is fulfilled using a concept called GigaMAN, initiated by the SURFnet organisation [12]. SURFnet is the Dutch organisation for ICT services to educational institutes. GigaMAN stimulates the forming of managed dark fibre rings. The demand of several non-profit organizations is aggregated. The GigaMAN rings are connected to SURFnet POP's to get internet connectivity. The GigaMAN rings may be *carrier-owned*, *customer-owned* or *customer-owned for a defined period* (e.g. *indefeasible right of use for 30 years*). In the case of customer owned, the educational institutes are the owner of the network. In the case of carrier owned a network provider owns the network.

3.6 Governmental infrastructure investments

There are 5 possible objectives for a government or municipality to invest in broadband access infrastructure; depending on which objective is dominant the role of the governmental organisation is different [21].

3.6.1 Taking away the risky financial threshold

The government may provide funds for direct investment. It may supply a *government-backed loan* or finance projects from a *contingency fund* ("Garantiefonds") for stimulating private investments in infrastructural development.

3.6.2 Investing in under-served areas

A reason for governments to invest in infrastructure may be their concern for *under-served areas* (rural areas, poor urban areas), where no private investor is prepared to build a network. The investment costs are too high related to the expected revenues. Governments are tending to do this to prevent a *digital divide*. In some densely populated countries (like Belgium, Denmark and the Netherlands) the coverage of midband-broadband is already good enough; no plans to use public funds to bring broadband to under-served areas. In some other European countries (Greece, Spain, Ireland), the government invest money through Public Private Partnerships to bring midband-broadband to under-served areas [10]. The question whether there will exist under-served areas for super-broadband is yet too early.

The future technological improvement might reduce or eliminate existing perceived digital divides; e.g. extension of DSL technologies to subscribers more than 5 km from a local exchange. As many unpopulated areas usually have only one infrastructure provider (the incumbent), any government initiatives tend to work with the incumbent and create or reinforce a de facto local monopoly [4].

3.6.3 Connecting Public Buildings

The government may feel the need of connecting government buildings or public buildings. The demand of broadband connectivity from these institutes is potentially high, but the possibilities of leasing a broadband connection may be a problem. This situation is similar to the *demand aggregator* role of government, however in this case there is still no private investor willing to build a broadband access network. The government may take the initiative to invest and a *government owned network* may be built. If a municipality owns such a network, we have a municipality or city owned network.

Municipality owned networks are not very common in the Netherlands. This is because the good coverage of broadband networks like ADSL over copper, Hybrid Fiber Coax and Fibre backbone rings. An example of an optical fibre network connecting governmental buildings is “De Haagse Ring” (The metro ring of The Hague) [26].

In the US there are several cities that have attempted to build and own broadband networks; but the costs and financial risks, to be paid by taxpayers, are relatively high. In general public provision of services tends to be less efficient in the long run than private provision. Because of large economies of scale, the telecommunications industry is dominated by large (international) companies who are able to offer competition from the moment that this is commercially interesting. At that moment city officials would have to be prepared to quickly sell the network; but municipal entities are generally not able to act quickly enough [23].

3.6.4 Investing in the public backbone network (neutral networks)

Another new public utility is a *dark fibre* network for the metropolitan networks (MAN). These networks are called *neutral networks*; the government stimulates private investors making the final connection with the user in apartments. In Sweden these roles are filled in by Stokab and B2 respectively. In this case the government does not connect direct users but has a *wholesale offering* to private companies [11]. Another name is “*public backbone network*” [21]. In the Netherlands some municipalities follow the GigaMAN model, originally set up for connecting educational institutes. This model can be extended to other institutes as well. In Tilburg the GigaMAN project has been extended to non-educational institutes and also from the passive layer into the active layer and broadband services.

3.6.5 Investing in the natural monopoly part of the network (public utility)

Government already plays a dominant role as a builder of public utilities, like water and electricity. They may regard parts of the broadband access infrastructure as a similar public utility in which they see a role for themselves. One reason to do this may be the conviction that fiber to the home introduction will lead to

a *natural monopoly*. This means: the first party having a fiber-to-the home network in a region will become a monopolist in a natural way because this first provider will take initially the greatest part of the market. A second party, investing in a fiber-to-the-home network in the same region, will have a hard job to get a market-share which is high enough to get enough return on his investment .

The idea about public utility investment is strongest for the passive layer of the fiber-to-the-home business model. This passive layer has a long depreciation period; e.g. 25 years, comparable with real estate. The argument about the natural monopoly seems to be the strongest for this layer: there will be not more than one fiber cable buried in my garden and coming into my house. In most cases (e.g. the broadband plans for Amsterdam, Appingedam, Den Haag) the municipality has a minor share in the utility company owning and exploiting the passive layer. When an investment is made in a new venture together with private companies, a Public Private Partnership (PPP) is formed. Alternative to government investments or PPP's are the investments of co-operations of house owners (e.g. the Nuenen case).

Role	EU	National	Municipality	Local; PPP
<i>Policy maker</i>	<i>European policies; eEurope 2005</i>	<i>National Policy; Guidelines</i>	<i>Policy of municipality</i>	-
<i>Legislator / regulator</i>	<i>Framework Electronic Communication</i>	<i>Telecom Act; NRA-SMP Spectrum licence</i>	<i>Rights of Way;</i>	-
<i>Knowledge developer and disseminator</i>	<i>IST, Eureka research programmes</i>	<i>Sectoral development, like Nederland BreedbandLand</i>	<i>Dissemination of local experience via e.g. Stedenlink</i>	-
<i>Supervisor on the supply side</i>		<i>National Agency for Supervision (Agentschap Telecom)</i>	<i>Central registration of cable and ducts; Smart Digging</i>	
<i>Stimulator on the demand side</i>		<i>Kenniswijk; Demand incentive scheme</i>		
<i>Demand aggregator, Launching customer;</i>		<i>Combining the demand of national public buildings</i>	<i>Combining the demand of local public buildings</i>	<i>Combining the demand of public and private parties</i>
<i>Government Investor</i>	<i>EC Regional Funds</i>	<i>Investments in under-served areas. Contingency Fund</i>	<i>Government and city networks. New public utilities. Co-funding.</i>	<i>Public Private Partnership for customer owned network and neutral networks</i>

TABLE 1: OVERVIEW OF GOVERNMENTAL ROLES AT DIFFERENT LEVELS

4 General requirements on new broadband infrastructures

In the preceding chapters we discussed the policies of governments and their possible roles in the creation of new broadband access infrastructures. In this chapter we will give an answer to the question: What are the general requirements of public interest on the selection of the technologies and the architecture of the new broadband access infrastructure?

We will formulate a framework of general requirements, based on the policy principles given in chapter 2 or formulated in a number of policy papers. The general requirements may be used to accept or reject certain technological or architectural options of broadband access infrastructures. In the list of requirements to follow we will give examples of some of the consequences of the stated general requirement on some well known infrastructural options. The infrastructural options themselves are not included in this paper; they will be subject of a new white paper in this project. However, a first version of the list of infrastructure options is included in our earlier paper [13].

4.1 Coverage and penetration

Coverage (or Reach) deals with the total number of households in a geographical area, which can potentially be served by the access infrastructure. Penetration deals with the total number of subscribers that actually is connected within this area. If given as penetration factor the penetration is divided by the total number of households in the geographical area.

The policy of the European countries is stated in short as: “*broadband to all*”: the coverage of broadband should be as high as possible. Broadband should be available even in rural and remote areas of geographic isolation and low population density. In the areas covered by broadband, the penetration should be as high as possible. At this moment this requirement is used for midband-broadband. In the future the requirement may come valid for super-broadband (see introduction for the definitions).

What does this requirement mean for the broadband technologies used? The coverage should be enough to economically cover the needed distance between user and the first aggregation point in the access network. Restrictions in coverage may be related to the distance to the central office (telephony exchange) in case of xDSL, or more general the service node or remote node (hub) with most of the other technologies. If the technology used in “the last mile” is not able to bridge the distance, it is possible to use a broadband (fiber) feeder network, resulting in a hybrid access-infrastructure.

Technologies may have restrictions regarding the level of penetration. Some optical and wireless technologies require line-of-sight between the client and the (radio, optical) antenna mast. In rural areas

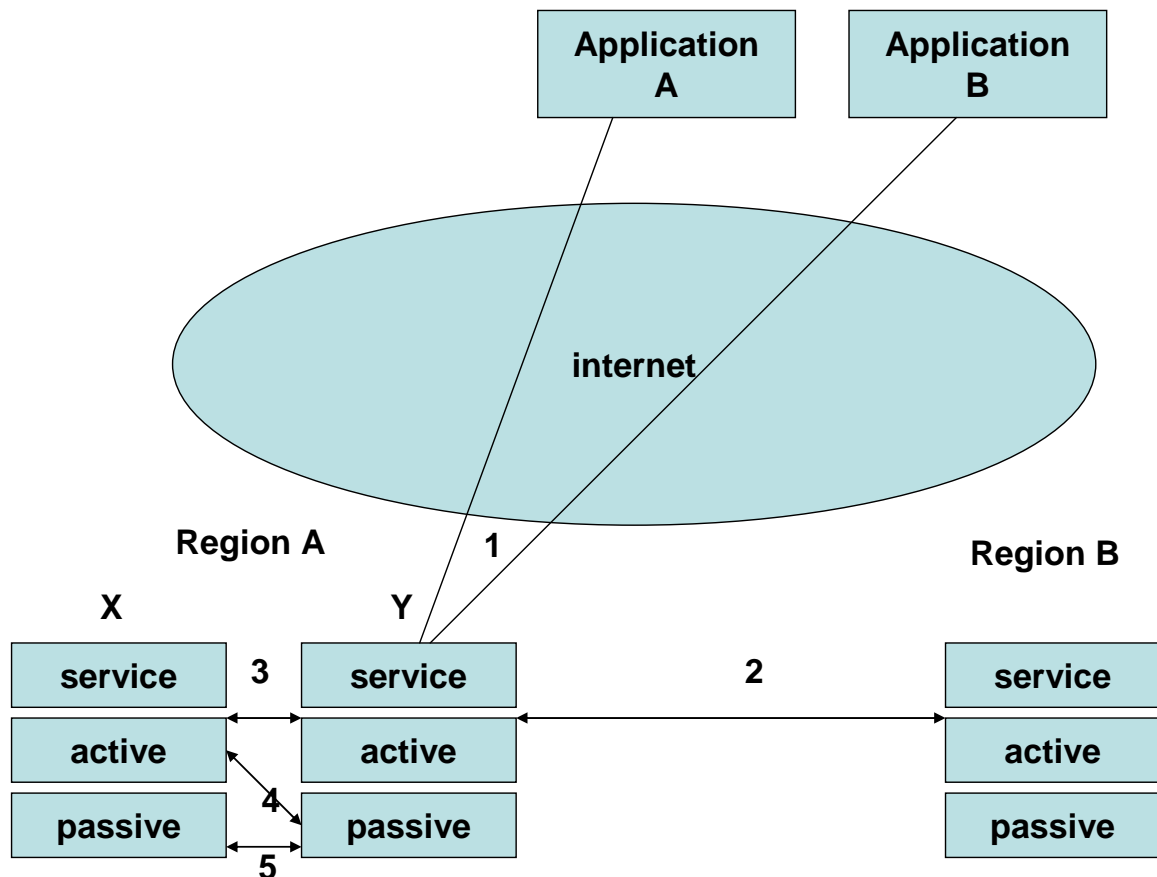
this is less restrictive than in urban areas. Using full copper technologies, the number of active xDSL subscribers connected within the same feeder cable has its limitations.

4.2 Service and Infrastructure Interoperability

The policy of *stimulating competition* between providers and the policy of *technology neutrality* are making interoperability an important risk. The general requirement is that connectivity within regions or between regions should be fully compatible on the network and service / application level. This general requirement may lead to a framework of more technical guidelines; guidelines are only effective if formulated on a national and preferably pan-national (European) scale. The Dutch Impulse Commission has understood this risk very well [7] and has introduced the Reference Model with some starting points to set up such a Reference Model.

In the situation of competition between more than one access technology and more than one provider, the requirement of no fragmentation is presented on five levels (figure 2).

Figure 2: The requirement of “interoperability” on 5 different levels



1. *Application interoperability: Users of an application A can use the same infrastructure as users of an application B*
2. *Network and service interoperability: Subscribers in region A can communicate without restrictions to subscribers in region B*
3. *Network and service interoperability: Subscribers connected by technology or provider X can communicate without restrictions to subscribers connected by technology or provider Y.*
4. *Infrastructure Interoperability: Active system X can be used on the passive system X and Y*
5. *Infrastructure Interoperability: Passive system X can be interconnected on a physical level with passive system Y*

Service or application interoperability is the most important requirement. It allows that service / application providers can reach a high economy of scale. Network interoperability is guaranteed on the level of IP connectivity. Infrastructure interoperability is normally not a requirement because it conflicts with the requirement of *technology neutrality*. Different infrastructures in regions or between regions are allowed and causes a facility based competition.

4.3 Open access

Once an access infrastructure is present in a certain region, it is more difficult for others to invest in a second overlaying network and attract new customers for this second network. This is especially of interest in the case of government having invested in a network in the past (copper or cable networks), being presently owned by an *incumbent operator*. Open access deals with the possibility of other operators using (a part of) the same network at the same time.

Open access may be given on the level of passive (physical) network, active network or services. There is the common European regulation framework, which requires this open access for several services [14]. According to the policy principles mentioned above the more general goal of interconnectivity and the possibility of free competition is being pursued. With the new framework for electronic communications networks open access is not an absolute requirement and interconnectivity and interoperability are more important. These requirements are part of the interoperability requirement (chapter 4.2)

For open access to passive (physical) networks the term *unbundling of the local loop* is often used. Unbundling of the local loop is realised in the Netherlands with regard to copper pair infrastructures. Dutch cable operators recently are stimulated in making steps in opening up their infrastructures. With regard to fibre infrastructures, unbundling is of special interest because the investment of a fibre infrastructure is expensive and fibre infrastructures have the possibility of carrying all basic services; TV, telephony and data. If the policy of the public organisation is to invest in the passive (optical) network, it is to be expected

that this fibre infrastructure should be open to more than one active operator [16]. Discussion and research are going on how this role of network operator on an unbundled passive fibre network may be fulfilled with an acceptable economic return.

4.4 Affordable price

The price citizens have to pay for their broadband connection should be affordable. Free market mechanisms with a number of competitors in place should work in order to let the consumer make his choice for an offering with an acceptable price / quality. Competition puts a downward pressure on the price, making it affordable for an increasing part of the population.

Competition is currently fierce in the market of midband broadband technologies; ADSL and Cable modem technologies. The price of broadband connectivity is affordable for a great part of Dutch population [1].

The cost of broadband connectivity is lower if the penetration in a certain region is higher. However, due to demand-price dependencies, the penetration will only be high enough if the price (and cost) is below a certain threshold. To break this situation, governments are willing to subsidise the price for a certain period, making it affordable for a larger part of the consumers. This has been done in The Dutch Smart Community pilot in the Eindhoven region, called "Kenniswijk" [9]. According to EC regulation this was only possible as a demand incentive subsidy and in the case of no preference for the technology to be used.

4.5 Consumers' confidence aspects

The consumers' confidence in terms of quality and security is essential in the European broadband policy. In the case of more and more essential services and applications coming available in an electronic way, the importance of guaranteeing this confidence will be obvious. Confidence is related to many aspects. For example: security and privacy, quality and availability.

Security aspects are an issue with technologies like WiFi. It is still relatively easy to get unauthorised access to a PC of a consumer having a wireless access station. New IEEE standards are under development to improve this security.

The availability of the broadband access infrastructure should be high. As the use and the economic and social importance of broadband infrastructure grow, the need for high availability will rise. The availability rates for internet access are traditionally lower than for e.g. fixed telephony (PSTN or ISDN) services. This lower availability is not longer allowed if more and more telephony services (using VoIP technology) are bundled on broadband and operational critical applications (both server and client parts) make use of the broadband access infrastructures.

Quality may be interpreted as having better operational qualifications and having a certain product interoperability (guaranteed by standardisation) and commercial availability.

4.6 Future proof and standardization

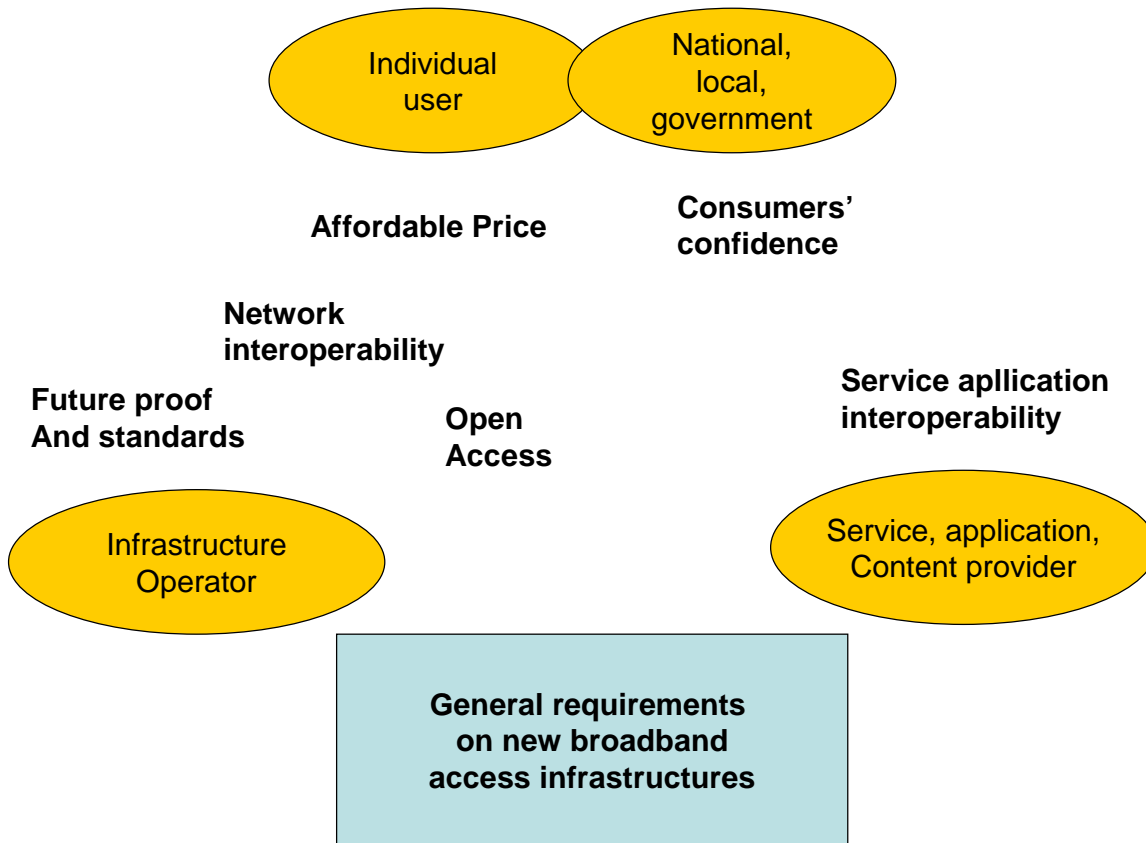
Investment in infrastructure has a long-term payback period. This is especially true for investments in fibre-to-the-home projects where pay-back periods of 15 years or more are to be expected. The economical and technical life-time of the infrastructure should be longer than the financial pay-back period.

Future proof often depends on the degree of standardisation and the acceptance of the standard by the users and the suppliers / operators. Many of the access technologies used are already standardised within ITU, IEEE or ETSI. The risk of taking a technology, which has its standardisation not finished, is that systems should be replaced on a shorter term by standardised and improved versions. The older systems are not interoperable anymore (see also chapter 4.2).

For fibre-to-the-home this is split into two parts. The active layers and the service platforms are expected to have short technical and economical life-times, like other electronic products as computers. The pay-back period of this part of the infrastructure should therefore be short as well. Future proof of the chosen technology is less critical. The passive optical layer (ducts, cables and other outside-plant utilities) should have a pay-back period of say 15 years. The technical life-time of the chosen passive optical technology and the chosen fibre network architecture should therefore be at least 15 years. The infrastructure should be able to support future growth in penetration, in use per subscriber and in possible future services. It is desired that the upgrade of the infrastructure by just changing the active components and by keeping the passive cable infrastructure in place is possible.

For wireless technologies “future proof” is determined by standards and licenses. The use of the radio spectrum should be protected by governmental regulation, to protect investments made in transmitter/receiver equipment specific for a certain frequency band from interference by other radio sources.

Figure 3: Overview of general requirements on new broadband access infrastructures



5 Discussion

5.1 Discussion about EC directives and regulation with respect to Fiber to the Home (FTTH)

- Are super broadband services considered as a new product-market by the NRA, different from the existing midband broadband services? Super broadband services are supported e.g. by fiber-to-the-home and midband broadband services by xDSL and Hybrid Fiber Coax [1].
- Suppose super broadband services and midband broadband services are considered as belonging to the same product-market. In that case it will be less probable that one of the providers will be considered as “dominant” or having a “natural monopoly”. Only in the case that the super broadband infrastructure is a fibre-to-the-home infrastructure, invested with the aid of (local) governments, the regulation of open access may be used: e.g. unbundling of the local loop or the provision of wholesale bitstream access.
- Suppose super broadband services and midband broadband services are considered as separate product-markets, it is more probable that with the use of fiber-to-the-home, dominance (natural monopolies) will occur on the scale of neighborhoods or municipalities. Further in rural areas and under-served areas there will only be one investor; more than one private or public investor is too risky [18]. In these cases the assignment of a FttH operator, having dominance on a regional scale, as a SMP is very likely. This may imply remedies like unbundling of the fibre loop or the provision of wholesale bitstream access. And this may imply that investments in fibre to the home are less attractive for private investors.
- How likely is the situation in EU of FttH operators getting an unbundling requirement for their fibre loops? In the US, the FCC decided in February 2003 that there is no unbundling requirement for new build / greenfield FttH loops for both narrowband and broadband services if the legacy (copper) infrastructure is kept in place by the incumbent and a transmission path suitable for providing narrowband service should be available on the fibre network [27]. Should this followed by the European regulators as well [19] ?

5.2 Roles of government with a risk for market distortion

- The European Commission has asked the Dutch government clarity about the financial role of municipalities in fibre-to-the-home projects. The compliance of this information with articles 87 and 88 of the treaty of the EG regarding State Aid will be verified. The role which is under discussion is the municipalities taking a share in the “utility companies” which are investing in the passive optical

layer of fibre-to-the-home networks. These investments can be considered as “State Aid” if they give a false competition (market distortion) with other existing broadband access networks with (almost) the same functionality. Investments or participations of governments should be notified at the EC, although there are some exceptions to this rule [21]. There are currently no clear EC state aid guidelines available in case of public funding of FttH projects; this is to be justified on a case-by-case basis by the EU Commission

- The roles of governments as mentioned in chapter 2 are depending also on the geographical level. We observe differences on the EU, national, municipality and other local levels (Table 1). Possible conflicts of roles are given in table 2 .
- The legal role of municipalities is the role as supervisor on the supply side (e.g. giving right of way). If they also have a role as launching customer, demand aggregator or investor in their own networks, they may distort the market. A structural segregation of these roles is necessary.
- If municipalities are investor in their own networks, they may give access to their network to other citizens as well. These other citizens may pay a lower price for this access, because a large part of the fixed costs of the network are already paid by the municipality. This may distort the market, with lower cost and / or lower margins than private companies. These companies will not enter the market and a long-term government monopoly will be the consequence. This is normally unwanted in EU countries. Municipalities prefer to take only a minority part in a public-private partnership for the passive layer. In that case the role of the municipality as an investor is as small as possible and a conflict with the supervising role of the municipality is not to be expected.
- The role of the government as network investor may be in conflict with the interest of incumbent operators. This is mainly the case for the copper local loop operator (KPN) and the cable operators (members of VECAI). The demand for bandwidth for services will more or less increase in line with the supply of capacity of the cable infrastructure until at least 2008, and probably until after 2012 [24]. This is probably right also for xDSL infrastructures. Any new investment, partly subsidised by the government will distort market competition. In the plans for The Hague a proposal to solve this problem was given, but this was still not acceptable for the VECAI [15].
- The “Interdepartementale Commissie Marktwerking (ICM)” has given an advice to the Dutch government about Broadband and Market distortion [21]. It offers guidelines to public and private parties to implement broadband without distortion of the market; the Dutch Cabinet will give its view about this recommendation in November 2004.

Role	EU	National	Municipality	Local; PPS
<i>Policy maker</i>		<i>Low risk of conflicting roles</i>		-
<i>Legislator / regulator</i>				-
<i>Knowledge developer and disseminator</i>				-
<i>Supervisor on the supply side</i>				
<i>Stimulator on the demand side</i>				
<i>Demand aggregator, Launching customer;</i>		<i>Low risk of market distortion</i>		<i>To lower the risk of conflicting roles, municipalities take a minority share.</i>
<i>Taking away financial threshold</i>		<i>Low risk of market distortion</i>		
<i>Government Investor</i>	<i>Under-served areas: Low risk of market distortion</i>	<i>High risk of market distortion. Under-served areas: low risk of market distortion</i>		

TABLE 2: OVERVIEW OF GOVERNMENT RULES WITH A RISK OF MARKET DISTORTION

5.3 How to fulfil the general requirements

- If national governments don't take (or: are not allowed to take) an active role in the creation of new broadband access infrastructure, how can governments achieve the objective of *interoperability*, the use of *standards* and *open access*? These requirements may be contrary to the objective of private companies; to maximise the profit of the company. In some cases we see that companies use proprietary standards or different companies use different competing open standards. The reason companies are acting this way is that they don't want to pay high license costs of some (open or proprietary) standards and/or they think they have to protect their market for other competitors. *Self-regulation* may be the answer; if government don't take an active role; companies are sometimes prepared to make appointments about the use of the same standards

and the offering of open access to competitors. *Co-regulation* may be another alternative, if the companies make their appointments together with the regulator. The foundation “Nederland BreedbandLand” may take the role of self-regulation or co-regulation, providing guidelines for technological and architectural choices.

- In some cases the *affordable price* is an important objective for cities to start co-funding a fibre-to-the-home project. Example is: Appingedam. The prices of the triple play services offered by the existing providers were relatively high in this rural city. The municipality made a business case based on these high subscriber prices. When the plans of the municipality were accepted and they started to dig for laying the ducts, the incumbent provider (Essent) lowered its prices. This is typical for a market situation where several infrastructure options for broadband are already available and prices are falling down. *Affordable price* seems to be not a good justification for a governmental role in broadband access.
- New broadband projects should obey the requirements of the *reference model broadband* to be able to get finance from the contingency fund for infrastructure development [7]. The general requirements of Chapter 4 may be a good starting point for a detailed working out of this reference model for the most important technologies and architectures.

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