Public Sector Reform Using Information Technologies:

Transforming Policy Into Practice

Thanos Papadopoulos
University of Southampton, UK

Panagiotis Kanellis
Ernst & Young, Greece

Information Science
REFERENCE

Senior Editorial Director: Kristin Klinger
Director of Book Publications: Julia Mosemann
Editorial Director: Lindsay Johnston
Acquisitions Editor: Erika Carter
Development Editor: Michael Killian
Production Editor: Sean Woznicki
Typesetter: Christen Croley
Print Coordinator: Jamie Snavely
Cover Design: Nick Newcomer

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Public sector reform using information technologies: transforming policy into practice / Thanos Papadopoulos and Panagiotis Kanellis, editors.
p. cm.
Includes bibliographical references and index.
Summary: “This book offers an analytical, interdisciplinary examination of electronic governance implementation from theoretical and practical perspectives, for researchers in fields like computer science, information systems, and sociology, and practitioners in policy formulation, implementation, and IT and systems deployment”--Provided by publisher.
ISBN 978-1-60960-839-2 (hardcover) -- ISBN 978-1-60960-840-8 (ebook) -- ISBN 978-1-60960-841-5 (print & perpetual access) 1. Online social networks. 2. Internet in public administration. 3. Public administration--Technological innovations. I. Papadopoulos, Thanos. II. Kanellis, Panagiotis, 1967-
HM742.P83 2012
352.3’80285--dc22
2011011411

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 17
Broadband Infrastructures as a Common Service and the Role of Local Governments

Christos Bouras
University of Patras, Greece

Petros Ganos
Municipality of Patras, Greece

Vaggelis Kapoulas
Research Academic Computer Technology Institute, Greece

ABSTRACT

Broadband infrastructure is widely viewed as a major development driver. In addition, access to broadband networks is considered by many as a common service to be offered to all. This chapter presents interesting national strategies as well as practices and initiatives of municipalities for to broadband and next generation access networks. It, also, presents five scenarios for business models showing the way in which public agencies and the private sector may work together to offer fibre-to-the-home. Finally, it presents a case study of a Greek inter-municipal company emphasizing to the operating environment, the technical and economic factors, the results of financial analysis, and the assessment of sustainability.

INTRODUCTION

This chapter focuses on the role of the Local Governments/Authorities in the development of open access broadband infrastructures and their involvement in the management, operation, maintenance and expansion of the broadband networks. This role is emphasized through the concise presentation of most important national strategies and practices/initiatives of various municipalities. In addition five selected scenarios for business models on municipal broadband infrastructure exploitation are briefly described. A considerable part of this chapter is dedicated to the presentation of a Greek inter-municipal company which has as main task the holding, management, maintenance and expansion of passive equipment of broadband

DOI: 10.4018/978-1-60960-839-2.ch017

metropolitan networks installed in 24 participating Greek municipalities.

The term "broadband" means an advanced and innovative environment, from a social and technological view, which consists of fast network connections and appropriate network infrastructure for the development of new applications and services. Broadband in simple terms means a constant connection to the Internet without complicated settings, high speed (10-100 times the conventional connection) for new applications and reliable digital connections with guaranteed and consistent high performance. The provision of broadband services is now a key factor for improving the quality of life, education and economy. According to the i2010 (European Information Society 2010) initiative, broadband access is intended to stimulate the development of services, applications and content while providing a safe speed broadband access to Internet, modern online public services, electronic government (e-government), electronic learning services (e-learning), electronic health services (e-health), dynamic environment for electronic business (e-business), secure information infrastructure, mass availability of broadband access at competitive prices, benchmarking progress and dissemination of good practices.

The importance of broadband infrastructure is internationally confirmed by the activation of various advanced countries, which take initiatives to develop appropriate broadband infrastructure, adapt an alternative way to develop their economy and overcome any "technological blockades" of their citizens (Chlamtac, Gumaste, & Szabo, 2005). Next Generation Networks (NGNs) and Broadband infrastructure in general is a key element in the provisioning of e-government services to all citizens, which are both means and targets for the public sector reform. In addition the access to broadband infrastructure is increasingly recognized as a public good (common) and the local and national governments have the task of ensuring its proper and wide deployment.

Apart from providing basic services to citizens and businesses, a lot of local authorities have embraced the provision of broadband services to the list of their strategies as a means to the development of the local economy. There are various reasons and motives for which the local government decided to invest in broadband, whether to develop networks or provide services. The most important are: promotion of economic development, revenue increase of the municipality, services in remote and rural areas, e-government services, public security services, applications that make efficient routine services provided by municipalities (e.g. GIS) and projection of the municipal authority activities.

In general, a large number of Broadband Metropolitan Area Networks (BMAN) has been developed in municipalities along different parts of the globe, using the fibre optic technology as the "communication avenue" for the next decades. But to fully exploit the optic infrastructure and the benefits offered by broadband services, there is an urgent need for the creation of a group of cooperating partners allowing neutral management of broadband infrastructure, so as to ensure maintenance, expansion and most of all sustainability of these networks. Local governments internationally take a series of initiatives to provide broadband infrastructure, mainly optical fibre to each building. These initiatives address the broadband as a common and aim to ensure the connection of all buildings with fibre (FTTx), regardless of geographical distribution. The general term Fibre-to-the-x (FTTx), describes any architecture that uses fiber optics to replace part or all of the copper or other technologies to the local loop, and even to the buildings or homes (as is the case for FTTB and FTTH respectively). There are several variants such as FTTC: Fibre-to-the-Curb or Fibre-to-the-Cabinet where the optical fibre reaches up to the street cabinet that is near the subscribers' premises (typically approx up to 300m from the premises), FTTB: Fibre-to-the-Building, where the fibre reaches the

entrance or boundary of a building, and FTTH: Fibre-to-the-Home, where the fibre reaches the individual homes /apartments of the subscribers. FTTP: Fibre-to-the-Premises is used as a blanket for FTTH and FTTB. (FTTH Council, 2009) has definitions for FTTH and FTTB, but no formal definitions for other variants of FTTx.

The chapter is organised as follows: Section 2 presents the broadband infrastructure as a common and the role of the local governments in supporting this common for the public good; Section 3 presents the national strategies of various countries to develop broadband infrastructures and international practices/initiatives undertaken by local authorities; Section 4 briefly presents the business models that can be used for the optimal exploitation of the Broadband Metropolitan Area Networks by local authorities; Section 5 presents the pertinent activities taken by a consortium of municipalities in Southwest Greece as a case study.

BROADBAND AS A COMMON (COMMODITY)

The recent times, a movement is growing for the protection and support the commons of the 21st century. The commons, seen as an economic sector, complements corporations and their commercial economic activity, and come to a balance with them (Tomales Bay Institute). Therefore, it is expected that in the long run economies will be influenced by the proper management, use and evolution of the commons. An active commons sector can help with the reduction of inequalities and contribute to the improvement of the quality of life.

The New Commodities of the 21st Century

When referring to the commodities, most people only think about the traditional commons, usually offered by nature, such as air, water, forests, meadows, beaches, public spaces etc.

However in our era, there are also new goods, made possible by the evolution and use technology, that a growing movement thinks that can and should be considered as commons, see e.g. (Berra, 2006). Examples are the free distribution of the results of creative works, software, digital content, infrastructure to provide access to the Internet etc. The recent years broadband infrastructures, Wi-Fi access, access to fibre-to-the-home/building (FTTH/B) infrastructures, and use of the frequencies reallocated by the transition to digital television for public wireless networking (i.e. unlicensed use of the freed "white space") have been added to the list of the new commons.

True to this new way of thinking, several local and regional administrations, organisation and even groups of individuals have gone on and implemented open access wireless (Wi-Fi) networks in numerous cities around the world.

Broadband Access and Broadband Infrastructures as a Common

Broadband is considered by several nations (especially the developed ones) as the infrastructure of the 21st century. This pertains to the effects that broadband has and the advantages it offers on education, development, economy, public administration, research, innovation, leisure, and in general on all those aspects that constitute the well fare and progress of a community.

Given that almost everybody recognises the opportunities broadband offers and the benefits it brings, it is not unexpected that many formed the opinion that the access to broadband infrastructures should be a common and it should be offered to all citizens.

Broadband has often been seen as the roads, the canals, the railroads and the interstate highways of the Information Age, and its foreseen impact has often been compared to the impact of electricity and the electric grid deployment.

The Role of Local Governments

Although, a large number of local governments wireless deployed municipal networks to offered broadband access to their citizens, wireless networks cannot offer very high capacity in a large scale, cannot support all the forthcoming broadband services (such as high definition IPTV), and are not suitable for a true broadband experience.

Therefore, a need arises to have modern infrastructures that can scale to large numbers while still providing adequate capacity to each home/building not only for today's but also for tomorrow's applications. This infrastructure is fibre-to-the-home/building (FTTH/B).

Deploying an FTTH/B access network is not an easy task, and for some cases it is not economically viable. This is the reason that the private telecommunication companies has not yet undertook such tasks in large scales (and when they did it was only for specific areas where the task was deemed viable).

However, as already mentioned, FTTH/B is increasingly seen by local governments as an infrastructure that must be build for all and as an opportunity that cannot be missed, both because the infrastructure can be considered as common and because it is a means for economic development.

In places where building an FTTx infrastructure with wide coverage is not seen as viable and the private sector is reluctant to invest, there is a clear role for the local government to support and facilitate, and possibly (co-)invest in the deployment of such networks.

That does not mean, of course, that local governments should be elevated to telecom operators. Their role only lies in facilitating the deployment of open access infrastructure and ensuring that all can use them to offer telecommunication services.

There are several ways that local government can be involved in the deployment of FTTH/B networks, ranging from just enabling and facilitating other to do it to building and a totally public network. But in most cases a more balanced approach is used where the public and private sector partner to build the FTTH/B infrastructure.

INTERNATIONAL EXPERIENCE AND PRACTICES/INITIATIVES

National Strategies for Broadband

The importance of Broadband internationally is affirmed from the initiatives and activities of various countries to develop broadband infrastructures. Several countries start to treat broadband infrastructures as a utility (which pertains to the view that broadband infrastructures should be considered a common).

In several developed countries the deployment of high-speed broadband infrastructures is a main strategic target, and there are provisions both for the regulatory frame work and for the co-finance of the various plans and initiatives. An indicative list of summaries of the strategies for various countries follows.

The federal government of the United States of America stimulates the development of broadband infrastructures at a federal level, by loans and grants for broadband infrastructure projects in rural areas, and grants to fund broadband infrastructure, public computer centres and sustainable broadband adoption projects.

In Canada, as part of the Economic Action Plan, there is funding for strategy to deploy broadband coverage to as much un-served or under-served households, as possible (Canada's Economic Action Plan). The scope of the plan is to extend broadband coverage to all underserved communities, and the financing approach is to encourage the private sector to develop rural broadband infrastructure (Qiang 2009).

The Australian Government announced a project of AU$ 43bn to build a FTTP (fibre-to-the-premises) network to 90% of the country's buildings (Australia's broadband plan). To this

end Australian Government established NBN Co Limited to design, build and operate the wholesale-only National Broadband Network (NBN). The NBN will provide the infrastructure that will allow wholesale and retail service providers to deliver advanced digital services. NBN will be a wholesale-only, open-access network, and it provide equal, wholesale access, to all retailers. Australia invites the private sector to participate in NBN, but private ownership is apped at 49%. The plan is to connect 90% of all Australian premises with fibre and the rset 10% with next generation wireless and satellite networks (Qiang 2009). In June 20101 NBN and Telstra (the incumbent telecommunication provider) reached an agreement that Telstra would provide NBN access to its facilities, and Telstra's traffic will progressively migrate onto the National Broadband Network (subject to regulatory approval). This agreement can maximise the use of existing infrastructure and accelerate the roll out of the NBN, and means that Telstra is likely to become NBN Co's largest customer providing greater certainty about the future of NBN.

The New Zealand intents to invest NZ$ 1,5bn (apart from the private investments) to build a FFTP network, that would cover 75% of the country (New Zealand Government, 2009).

In South Korea there is a mid- to long-term plan to develop the Broadband Convergence Network (BcN) with 1Gbit/s for wired connections (Korea Communication Commission). The plan aims to help South Korea strengthen its position as one of the world leading countries in IT, by increasing broadband speeds ten-fold by year 2012 (Qiang 2009).

France, with its plan France Numérique 2012 (Digital France 2012), aims at equipping all house holds with Internet connections, while telecommunication suppliers offer FTTH solutions in urban areas (Preparing 'Digital France 2012'). France has a developed regulatory setting for the provision of access to fibre optic cables, and has been the first European country to adopt rules for fibre optic cables in buildings (Bourreau, Cambini & Hoernig, 2010). In ARCEP (2008) duct access is imposed on the incumbent operator, while in ARCEP (2009) the conditions of access to fibre inside buildings in very dense areas is detailed. France has put a strong focus on very dense areas hoping for a development of competition in infrastructure (Bourreau, Cambini & Hoernig, 2010). For the rural and suburban areas there are concerns; either that the areas will not be covered with fibre, or that there will be duplication of networks with viability. Recently the French government launched a consultation on a national program for high-speed broadband (DGCIS 2010) and plans to spend 2 billion Euros to accelerate fibre deployment. Public support is envisioned in two forms: Through public loans for projects in "viable" zones, and through direct state aid for "less viable" zones (Bourreau, Cambini & Hoernig, 2010).

In Germany, Deutsche Telecom rolled out fibre to the street cabinets to offer VDSL service to large German cities. Initially, the relevant regulatory authority (Bundesnetzagentur) did not want to force Deutsche Telecom to allow access to its fibre access network to competitors. However, the European commission, filed an action against Germany which required that Bundesnetzagentur mandate subsidiary access to ducts (and when space in the ducts is not available, to unused dark fibre) so that competitors can roll out their own fibre network. Deutsche Telecom attributes its hesitation to roll out additional fibre network to this mandates subsidiary access (Czernich, et al. 2009). However, the federal government of Germany, with its Breitbandstrategie (Broadband strategy), calls for 50 Mbit/s connections to 75% of the population by the end of 2014 (Breitbandstrategie).

In the United Kingdom, the Digital Britain report set the objective of broadband connections to all house holds, of at least 2 Mbit/s by the end of 2012 (Digital Britain – the report). In mid 2008 British Telecom announced that it will roll out

FTTC for 7-10 million households by 2012 (Ofcom 2008). Ofcom, the relevant regulatory authority, considers British Telecom obliged to provide access to the copper wire at the street cabinet, where it deploys FTTC, and obligates it to allow fibre or wavelength unbundling, or duct access whet it deploys FTTH (Czernich, et al. 2009).

Finland has become the first country in the world to make broadband a legal right for every citizen. From July 1st 2010, every Finn will have the right to access to a 1Mbps broadband connection. The Finnish law means that all telecommunications companies will be obliged to provide all residents with broadband lines that can run at a minimum 1Mbps speed. Finland has plans to connect everyone to a 100Mbps connection by 2016, and it plans to foot one-third of the cost of building a fibre optic network in areas that are underserved (Qiang 2009).

In Greece, the government studies the feasibility of co-funding (in a public-private partnership scheme) an FTTH access network that could cover up 2 million households in the (if not all) major cities (more than 50) of the country (Strategy for electronic communications and new technologies 2008 - 2013).

The Netherlands has a well developed broadband access market. There is strong infrastructure competition between the dominant telephony provider and the cable providers which reach more than 94% of the households (Czernich, et al. 2009, Kirsch & von Hirschhausen 2008). The incumbent operator (KPN) had plans to replace part of its network with fibre rolled out to street cabinets or to homes. The regulatory authority (OPTA) imposed regulatory obligation to KPN so that competitors would not lose interconnection. Also, with interventions in the regulatory framework, it encourages investments for FTTH networks that would cover all country (OPTA 2008).

Portugal took steps to regulate duct (and other infrastructure able to carry fibre) access by imposing it to all telecom operators as well as other public and owned by the state entities. This way it significantly increased the number of ducts available to telecom operators for fibre deployment. In addition Portugal in order to facilitate fibre deployment in the rural interior of the country launched public contest for subsidies for the construction and operation of "open" Next Generation Networks (NGNs) in a number of different regions. The novelty of the competition is that he winners in each region will have to apply for state aid (with a significant part handed out by the EU). This allowed the contest to progress while the guideline for the state aid procedures where still under consultation. However, the rules of the contest conform to the state aid legality as outlined in the EC's guidelines. Furthermore, the Portuguese state committed itself to the creation of a 800 million Euros credit line for NGN construction as part of agreement with telecom operators to invest 1 billion Euros and help combat the economic crisis (Bourreau, Cambini & Hoernig, 2010).

Italy does not seem to have a clear national strategy for the deployment of NGNs, as the Italian government facing problem with the deficit, has suspended its commitment to provide subsidies to spur investment in broadband connections. As a result many Italian telecom operators turned to signing agreements with local governments and municipalities to extend broadband coverage in areas where the return on investment is considered low or non-existent (Bourreau, Cambini & Hoernig, 2010).

It should be noted that, similarly to what Katz (2000) argues, applying different policies strategies to different countries and/or areas may allow policy makers to understand what works and what does not. Bourreau, Cambini & Hoernig (2010) argue that this kind of "experimentation" is called for and it might be efficient to allow different countries to follow different routes in the early phases of the deployment of large scale fibre networks.

Most countries with a high broadband penetration rate focus on the preservation and increase of

this rate, but mostly on the increase of the quality and the speed of the broadband connections (e.g. by focusing on fibre optic connections) and the increase of the coverage to up to the whole population of the country.

The European Union is considering making high-speed Internet access compulsory; i.e. obliging member states to provide or ensure nation wide broadband coverage. This line of thinking come from the fact that existing infrastructure in the countryside does not provide as wide coverage as in urban areas.

Both as part of the above considerations, an as part of the Economic Recovery Plan, the EU wants to effectively involve the local and regional authorities in the deployment of new broadband infrastructures as to ensure that no community in rural areas is left behind.

In addition, in several countries, independent of the national strategy for the deployment of NGNs and fibre optic infrastructure there is an involvement of the regional and local authorities in relevant issues; either in developing the policy and strategy to be adopted (especially in rural and suburban areas), or in seeking subsidies, or in forming partnerships with telecom operators, etc.

Therefore, not only there is a role for the local governments in the plans to deploy broadband infrastructures, but the local governments are actually expected to assume this role and pursue their plans to offer access to broadband infrastructure to their citizens.

Broadband Practices and Initiatives of Various Municipalities

This section describes some example practices and initiatives, undertaken by some municipalities (with or without the involvement of private entities), both in European and international level, which are aimed at deploying and exploiting fibre optic network infrastructure.

A lot of municipalities all over the world have already recognised their role in the broadband scene and have already been involved in the successful deployment of high speed optical networks. Their practices now constitute examples that may be followed by other municipalities. Several other municipalities are deploying or expanding their broadband infrastructures and a sufficient number of them are planning to do so. As all the cases are numerous to present here, we mention only a few representative cases that attracted a lot of attention.

Stockholm – Stokab

Stokab is a fibre optic network deployed in the area of the municipality of Stockholm. Stokab was built by the company group Stockholms Stadshus AB, owned by the City of Stockholm (Dobers, 1999; Stokab in english).

The development of the fibre-optic network was started in 1994 in the commercial districts of inner-city Stockholm, and was thereafter extended to the major industrial areas of Stockholm. Now, there are interurban networks to all municipalities in the County of Stockholm, to Uppsala, parts of the archipelago, to some of the municipalities in the Mälar region via Mälarringen and also to Gotland. This network comprises 5,600 kilometres of cable and in total 1,200,000 kilometres of fibre (Stokab in english - The infrastructure).

The company is competition-neutral and provides a network that is open to all players on equal terms (Stokab in english - About Stokab).

Amsterdam

The local authorities in the city of Amsterdam realised, early enough, that the existing communication networks were not enough to satisfy the ever increasing telecommunication demands of the citizens. In 2000, some low-income housing complexes in the city connected to the fiber optic network that was developed by a Swedish company. Then there was the fact that, whereas previously these buildings attracted mainly foreign immigrants, after connecting with FTTH

network, they became an attraction for young professionals. Following that observation, the city realised the importance of the fibre optic network infrastructure. When the negotiations with telecommunication providers were fruitless, the city of Amsterdam proceeded to the formation of a public-private partnership, called GNA, to build a fibre optic network (Citynet Amsterdam; Sadowski, Nucciarelli, & Rooij, 2009).

The city of Amsterdam participates in the first phase of the deployment of the network with 20% of the budget. The network has open access architecture and the consortium GNA does not fix the retail prices, because it uses only the passive part of the network. Each provider will determine retail prices and features of the services provided to households and businesses. According to the design, the network will connect the total of 420,000 homes in the city and all businesses. In mid-2009 the second phase of the network began, covering 100,000 optic connections.

LocalRet

LocalRet (or Local Network for Catalonian Municipalities) is a consortium of municipalities, created in 1998, aiming at providing cable TV services to 800 municipalities in Catalonia. Since then its aim changed to include the deployment of broadband infrastructures.

The main aim is to create the necessary network infrastructure by the public sector and maintain this network infrastructure as the property of the public sector. The role of the involved authorities (LocalRet) is to create an organisation to manage this project and to promote broadband in Catalonia.

The government of Catalonia has the necessary resources to build the network even without the help of the central Spanish government. Once completed, the network will provide open access to all at competitive (cost-oriented) prices. The plan is to initially offer only passive network connections (dark fibre); other communication services will be also offered later (Cook Network Consultants 2005).

Wien

According to the plan for the Fiber to the Premises (FTTP) infrastructure in the city of Wien (Broadband Properties; FTTH in Vienna to all households), there will be connections of 1 Gbit/s to 1 million households. The project, which has already started, is implemented by a consortium of the municipality of Wien with Wienstrom (energy provider) and Wienkanal (cable provider). The consortium does not aim at creating a monopoly, but rather an open network where all service providers will have access on equal terms.

Interestingly, where in other cities the fibre-optic network is built as GPON (Gigabit Passive Optical Network), and the capacity of one fibre cable is shared between several households, the network in Wien uses one separate fibre connection per households and implements active Ethernet infrastructure.

Utah: UTOPIA

The Utah Telecommunication Open Infrastructure Agency (UTOPIA) is a consortium of cities in Utah, USA, responsible for the deployment and operation of a FTTP network that connects all enterprises and households in the participating cities. The access provided is 1 Gbit/s for enterprises and 100 Mbit/s for households.

The network, UTOPIA Community MetroNet, is built in three phases, with the first phase concluding and the second phase beginning. The business model used is that of the open wholesale access. Several services providers have already been selected, and UTOPIA seeks to co-operate with other providers for offering retail services. UTOPIA does not dictate the prices for the retail services, as it is just a wholesale provider. Every retail service provider defines the characteristics of the service offered as well as the price. UTO-

Table 1. Characteristics of practices/initiatives for fibre optic infrastructures by some municipalities

Characteristics	Stokab	Amsterdam	LocalRet	Wien	UTOPIA
Local Government	X	X	X	X	
Private Sector		X			
Joint Venture		X	X		X
Dark Fiber Network	X	X	X	X	X
Last Mile Connections		X		X	X
Government Funding		X	X	X	X
Private Support		X			
Collocation Facilities	X		X		
Rental to telecom providers	X		X	X	X
Services Provision	X (municipal services)			X	

PIA financed the network with a loan to be paid back by the income of the network (UTOPIA Feasibility Study).

Review of Practices and Initiatives

The following table (Table 1) presents the characteristics of the cases discussed in this section.

The examples above indicate that there is a variety of approaches that a local government can follow in order to support the deploying of a high speed broadband network within its area. These approaches range from building a neutral infrastructure financed and owned by local government, to co-investing usually through the formation of public-private partnerships, to just mediating and facilitating the private sector to build the broadband infrastructure.

However, in most cases, the local governments form a kind of cooperation with the private sector. This happens because, in most cases, and especially in rural areas, such an investment is not justified for the private sector, and some public funding is needed. Similarly, in most cases the local government or the public sector in general, cannot dispose the whole fund for such a big project. Therefore, in most cases the way forward is to form a public-private partnership that can stand on the fund (both public and private) to build the infrastructure. In this case the partnership leases the infrastructure to network or service providers in order to balance the investment.

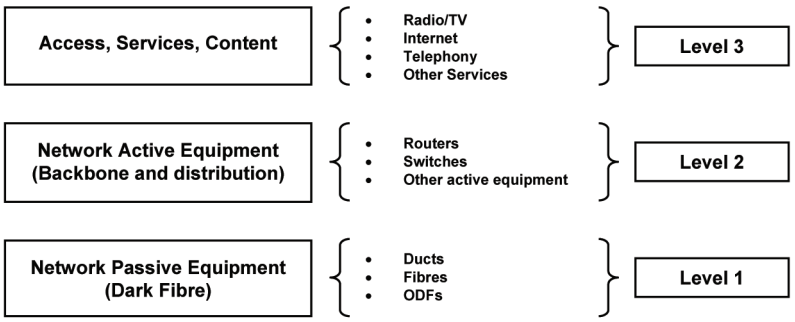
Also in most cases, the infrastructure is neutral, which means that it is available to reasonable price to all that request it, including service providers that may offer their services (including Internet access) to the citizens. This is usually a requirement for the building of the broadband infrastructure due to the public co-financing. In order to ensure fair competition, the infrastructure has to remain neutral and be offered at a cost-oriented rate to all.

BROADBAND BUSINESS MODELS

In literature, several business models for the exploitation of broadband infrastructure have been presented. Four representative papers with collected information are (Troulos, Merekoulias, & Maglaris, 2009; Kyriakidou, Chipouras, Katsianis, & Sphicopoulos, 2009; Alexiou, Bouras, Primpas, & Papagiannopoulos, 2008; Bouras, Gkamas, Theofilopoulos, & Tsiatsos, 2008). Figure 1 shows the three main levels of a well known business model (Hughes, 2003):

- The first level determines who (a private or public enterprise, etc.) exploits the net-

Figure 1. The basic levels of a business model



work's passive equipment (channels, optical fibres etc.).
- The second level determines who provides and exploits the active equipment of the network (switches, routers etc.).
- The third level determines who offers access to the network, the services and the content.

A table detailing the characteristics, advantages and disadvantages (with reference to Figure 1) of the main local and regional models for broadband deployment is given in (Bouras, Gkamas, Papagiannopoulos, Theofilopoulos, & Tsiatsos, 2009).

Scenarios for Business Models

Based on Figure 1 five scenarios for business models, that are presented in (Bouras, Gkamas, Theofilopoulos, & Tsiatsos, 2008), are briefly described. These scenarios show how public agencies and private providers of infrastructure, equipment and services may work together to benefit of the end user.

Scenario 1: Equal Access

The objective of this scenario is to ensure equal access to the passive network equipment. Specifically:

- At the first level the operating entity provides the passive network equipment in a cost-oriented manner to the provider of active equipment. Because of that, the entity must be a utility company or a municipal authority (in the form of a public, non-profit company).
- At the second level many providers are involved who offer the active network equipment.
- At the third level there are also many service providers who operate in competitive and offer broadband services to users.

Scenario 2: Full Public Control Through Public – Private Partnerships (PPPs)

This scenario involves the local government in all parts of the broadband network (passive infrastructure, active infrastructure and services). This ensures the State intervention and control at all levels, through State participation in joint ventures of public and private sector.

Scenario 3: Public-Private Partnerships – PPPs orchestrated

In this scenario a public - private consortium is created for the control of the passive network equipment and the provided services. In this

consortium, the local government is involved with a small percentage, usually less than 20%, while the other participants are private entities and companies. The active part of the network is owned and managed exclusively by a private company.

Scenario 4: Public Sector Telco

In this scenario the objective is the use of passive and active part of the network by a public utility. Specifically:

- In the first and second level a utility company or a municipal authority (in the form of a public, non-profit enterprise) operates, which provides the passive and active network equipment.
- The third level involves many private companies which operate competitively, offering broadband services to users.

Scenario 5: Sole Private Provider

In this model, the active network equipment, network management and services are provided by a single private provider. A public body (e.g. a municipality) owns the passive network equipment.

Business Model for the Greek Case

In (Bouras *et al.* 2009), the most appropriate business model for the effective exploitation of the broadband metropolitan area networks in Greece is proposed. According to this model, the network's passive equipment is proposed to be public, while competition exists among private companies in the two upper levels (services and active equipment). The main objectives of the proposed business model are the following:

- The passive network infrastructure may be used by a large number of service providers.
- The users have the choice of selecting one of the multiple service providers, according to their needs.
- Management of the infrastructure is performed by a neutral operator.
- Low operational expenditure (OPEX) and capital expenditure (CAPEX) are ensured.
- Financial viability of all parts of the infrastructure is secured.

Also in the same reference, table 3 shows the relevant stakeholders, roles, costs (Capital Expense - CAPEX and Operation Expense - OPEX) and the revenues in each layer (services, active network equipment and passive network equipment).

CASE STUDY OF A GREEK INTER-MUNICIPAL COMPANY

Operating Environment and Main Objectives

The need for broadband access in Greece is as given just as in other countries. The advantages of the spread and use of new technologies will be an essential tool for open and effective governance and the improvement of business competitiveness. Although considerable efforts have been made in recent years, Greece lags significantly in an advanced telecommunications infrastructure and provision of modern and advanced network services to its citizens. In Greece the provision of broadband services is now a key factor in improving the quality of life, education and economy. But to fully exploit the benefits offered by broadband services, it is necessary the installation of optic infrastructure and the construction of metropolitan broadband fibre optic networks.

Large cities of Greece have approved proposals in the Operational Program "Information Society" through the calls 93, 145 and 195, for building metropolitan broadband fibre optic networks

with the basic objective of linking the buildings of public interest (Bouras, Papagiannopoulos, Katsikas, & Gritzalis, 2008). The need to establish and operate a new regional form for the proper operation and further development of metropolitan networks in Greek regions main stems from the fact that the developed broadband infrastructure in these areas are diffused and have no interconnection. These networks are essentially independent islets of fibre infrastructure, thereby creating both an unattractive business model and also limited possibilities for future use. The issue that deserves special attention is the way of use and further development of these metropolitan fibre optic networks. The proposal to establish an inter-municipal company faces the broadband as an infrastructure, which means that it should be offered as a public good, without any exclusion. A key to the success of this proposal is the local government (Bouras *et al.*, 2007).

On the initiative of the Municipality of Patras an Inter-municipal Company of Broadband Network of Southwest Greece (summary IBC: Inter-municipal Broadband Company) was created to support broadband infrastructure that was developed throughout the southwest axis of Greece and especially in the regions of Western Greece, Ionian Islands, Epirus and Peloponnesus. Figure 2 shows a map of the 24 participating municipalities.

The task of IBC is the holding, management, maintenance and expansion (in various stages) of passive equipment (physical layer) of broadband metropolitan networks of 24 participating municipalities. The IBC has a dual role:

- The supervision of management and maintenance of the network
- The supervision and planning of network expansion

The company's foundation has obvious advantages that have to do with central planning in relation to the maintenance, operation and expansion of networks in the wider area of Southwest Greece. Therefore, with this approach, competition among telecommunications providers and service providers ensures benefit to the consumer. Telecommunications providers will have available cheap passive infrastructure on equal terms. The provision of passive infrastructure reduces costs in the required initial investment, resulting in greater number of active telecommunications providers. Competition among service providers is ensured by the fact that they have the option to choose between telecommunications providers as a platform for their services. The construction of metropolitan fibre optic networks in conjunction with the disposal of broadband services is expected to promote healthy competition in bodies, companies and businesses. In particular, the expected indirect effects are:

- Improvement of the functionality of public sector and particularly in the areas of health, education and public administration.
- Stimulation of competition and growth of entrepreneurship in the region.
- Reduction of the factors discouraging investment in the region by private companies.

IBC has an organizational scheme which allows centrally monitoring of fibre optic networks and also the provision some of the company activities as a sub-contract (outsourcing) to legal entities of public or private sector. The funding sources of the proposed company could be found among private investment, the NSRF (National Strategic Reference Framework) and the Greek development law. Also another funding source can be Standard Innovative Development Projects which will be exploited through Global Grants (www.ggea.gr/globalgrants).

The long term goal of IBC is the global creation of broadband infrastructure. In particular:

- The interconnection of broadband networks that were created under the calls 93,

Figure 2. Municipalities participating in the IBC

145 and 195 in the region of Southwest Greece.

- The expansion of broadband networks created under the calls 93, 145 and 195 in Southwest Greece with a view to providing fibre to the final user (Fibre To The x - FTTx).
- The provision of broadband access with Wi-Fi, WiMax technologies for remote users.

TECHNO-ECONOMIC STUDY

The Patras Municipality, which is the third largest city of Greece and the owner of the longest fibre optic network (through the above calls), commissioned the University of Patras to prepare a techno-economic study. The ultimate goal of this study is to find the optimal business model to ensure the sustainability of the metropolitan networks and fully exploit the offered possibilities. In the

following paragraphs an executive summary and major results of this study are presented.

In the four Greek regions considered in the study, a major infrastructure of metropolitan broadband fibre optic networks has already been developed in 24 municipalities. The total length of routes is 376.157 km. In the regions of these municipalities the indexes of use the Internet and broadband penetration are in general lower than the national averages, while in the considered 24 urban areas these indexes are higher than the ones of the corresponding region. Also in these urban areas optical fibre infrastructures have been developed by various private telecommunication companies (OTE, OTEGlobe, HoL, Tellas etc.).

For the involvement of local authorities in the development of broadband infrastructure, there are many business models (Bouras, Gkamas, Papagiannopoulos, Theofilopoulos, & Tsiatsos, 2009). But in no way the purpose of local authorities should be to become a telecommunications provider. The ultimate objective of the local government regarding its involvement in the provision of broadband services should be the creation of an open competitive environment in which access and services will be offered by many providers. This reduces the cost of provided services for citizens and businesses and promotes the development of advanced and high quality services. The investment in the passive infrastructure of a network is long and, although it requires large capital investment at the beginning, has long life-cycle of the order of twenty years. It can be considered a low risk investment with a payback period of 15 to 20 years.

Regarding the technological side and having regard to long-term planning to cover all citizens, broadband infrastructure that can meet the demands of the future is the one of optical fibre based on architecture FTTH (or temporarily FTTB) and specially the architecture Point – to – Point. This architecture authorizes the activation of many service providers and thus creates competition in service provision. Another advantage of such infrastructure is its relatively easy expandability.

In Greece, there are some initiatives to public sector involvement in Next Generation Access Networks. It is remarkable the Greek State plan to create FTTH network in two million households. Also the proposal of the Central Union of Municipalities and Communities indicates the immediate integration and operation of fibre optic networks of local authorities. In this context, regional forms have been created by municipalities trying to promote the utilization of their optical infrastructure. Four initiatives are these of the Municipalities of Central Greece, the Municipalities of Kriti and Aegean Sea, the Municipalities of East Macedonia and Thraki and the 24 Municipalities of Western Greece, Epirus, Ionian Islands, and Peloponnesus. At the same time throughout the Greek territory, there are two large public networks, SYZEFXIS and Greek School Network. SYZEFXIS (www.syzefxis.gov.gr) is a project of Greek Ministry of the Interior, Public Administration and Decentralization, which aims at the development and updating of Public Sector's telecom infrastructure. It's about a core and access network for the Public Sector's organizations aiming to satisfy all their needs for communication through Telephony (telephone communication between organizations), Data (PC's communication - Internet) and Video (teleconference - training). The Greek School Network (GSN - www.sch.gr) is the educational intranet of the Ministry of Education and Religious Affairs (www.ypepth.gr), which interlinks all schools and provides basic and advanced telematics' services. Thus, it contributes to the creation of a new generation of educational communities, which takes advantage of the new Informatics' and Communication Technologies in the educational procedure. These two networks have many common physical points with the Metropolitan Broadband Networks, while optic infrastructure covers additional points of public interest. Therefore, these two large public networks can be extended

and improve their provided services by the use of the municipal optic infrastructure.

SUMMARY AND RESULTS OF FINANCIAL ANALYSIS

For the financial analysis some initial considerations - assumptions were used that are considered necessary for the calculations. These are the following:

- The construction cost of the optical fibre network per kilometre is equal to 50,000 €/km.
- The maintenance cost of the optical fibre network per kilometre is equal to 2% of construction cost per kilometre thus equal to 1,000 €/km.
- The average length of the optical loop (from network distributor to telecommunications centre) is equal to 1.3 km.
- Assuming that at least two providers will undertake action in the local area and request the use of the network, the estimated average number of optical pairs rented per cable is equal to 1.5.
- The period of depreciation is equal to 25 years.
- The fixed charge for the provision of any new connection is equal to 1.500 €.

Also the following data are taken into account:

- The total population of the involved 24 municipalities is equal to 729,770.
- The total of the public sector points for the 24 municipalities is 629, while 598 connections will gradually be activated (relocation of some public points).
- The total of the educational and research points for the 24 municipalities is 418.
- The total length of the optical infrastructure for the 24 municipalities is 376.157 km.

Based on these initial considerations and assumptions the following initial variables can be calculated:

- The construction cost of the optical loop (from network distributor to telecommunications centre) is equal to 50,000 € / km x 1.3 km = 65,000 €.
- The annual construction cost of the optical loop is equal to 65,000 € / 25 years = 2,600 €.
- The total annual cost or equivalently charge (construction and maintenance) of the optical loop is equal to (2,600 € + 1,000 €) / 1.5 = 2,400 €.
- The total monthly cost or equivalently charge of the optical loop is equal to 3,600 € / 1.5 / 12 = 200 €.

The financial analysis was based on the above assumptions leading to the calculation of basic critical operation elements of IBC for five years, which are shown in the following table (Table 2).

Figure 3 shows the cash flow of IBC.

The above analysis results that the IBC shows positive financial flows from the year 2014. The above does not mean that the IBC will be profitable by the year 2014 as there are negative financial flows in previous years which have to be covered. But it means that, IBC with positive financial flows from 2014 onwards may reach the point where the total (cumulative) income will be equal to the total (cumulative) cost (break-even point). Therefore, although the creation of the IBC does not seem attractive in the short term, the analysis shows that there is a basis for its sustainability.

However, the above analysis focused on basic initial assumptions such as the fact that at least two providers operating in the region will be in-

Table 2. Basic financial elements for the operation of IBC

	2010	2011	2012	2013	2014
Revenue	**629.601 €**	**877.988 €**	**1.052.315 €**	**1.162.785 €**	**1.245.331 €**
Marketing costs	12.592 €	17.560 €	21.046 €	23.256 €	24.907 €
Selling, General and Administrative Expenses (SG & A)	614.372 €	624.985 €	675.436 €	723.742 €	731.095 €
Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA)	**2.637 €**	**235.444 €**	**355.832 €**	**415.787 €**	**489.329 €**
Depreciation	403.584 €	597.127 €	831.324 €	579.500 €	521.832 €
Earnings Before Interest and Taxes (EBIT)	-400.948 €	-361.684 €	-475.492 €	-163.713 €	-32.503 €

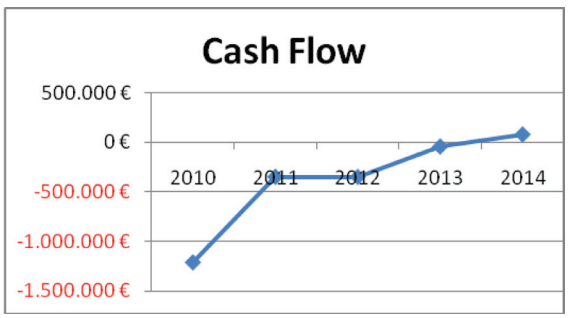
terested to purchase pairs of optical fibre. Also, we considered that some of the connections to be requested will require constructions of network expansion. Cases such as these affect the process of the company and its results.

The main objective of the business plan was to keep the company operating costs low. However, the revenue guarantee is a parameter which sets the project in risk. This concerns the demand from private providers and the accounting or actual income from the public bodies. To make the whole project much more attractive, company costs have to be reduced, while revenue has to be increased. One way to achieve this is through scale economy if the range of metropolitan fibre optic networks is not limited to those considered in the present study (Western Greece, Epirus, Ionian Islands and Peloponnesus). The management of many more networks would allow first the distribution of less construction costs per km and second the negotiation in better terms of maintenance cost which could be reduced to 1.5% or even lower (by 2% estimated in this study). Also, the overall discussions and negotiations with providers for the use of broadband metropolitan optical fibre networks would be done in better terms. These negotiations could lead to initial agreements that would allow more precise calculation of the connections, removing the uncertainty that put the initial assumptions and the possible redefinition of the cost of each connection at most attractive price. The last would increase the possible sales to other stakeholders.

ASSESSMENT OF SUSTAINABILITY

The implementation of fibre optic networks results in different risks, which may be economic and/or technological. To study the economic risks, the

Figure 3. The cash flow of IBC



implementation of the network has to be separated into two sections, the implementation of passive optical network infrastructure (the subject of the IBC) and the implementation of active network equipment and services which, according to the business model proposed for the IBC, will provide competition from other private companies.

The implementation of passive infrastructure likes enough to the establishment of public good infrastructure (such as water supply or electricity). It is a long term investment, which requires large capital investment at the beginning of the project and has a long lifecycle. A typical lifecycle of a passive infrastructure is at least 20 years and can be considered an investment, which will be repaid over 15-20 years. The creation of a passive optical network infrastructure is considered as a public good and for that reason it should be supervised to ensure global access and low cost to end-users. To ensure this, the building process of broadband infrastructure usually receives support from the government (as in the calls of Operational Programs) and especially through the financing of infrastructure in areas which are expected to be not profitable or low profit. These infrastructures are considered low-risk financial investments (in terms of investment in active equipment and services) and are attractive to investors who are interested in long-term safe investment.

On the other side, the investment in active broadband equipment and services is a high tech investment with significantly lower life-cycle (around 5-7 years). This investment adds value to citizens and businesses and enables higher profits, but the financial risk is significantly greater than the implementation of passive infrastructure. Therefore, the loans that finance the installation of active equipment and development services are considerably more expensive.

The above reinforce the policy followed by the IBC in which the management of passive infrastructure is separated by the active equipment and development of services. With this practice, lower cost is provided and the financial risk is shared among large (for the active equipment and services) and low (for the passive infrastructure).

The disadvantages and potential risks of the policy of IBC include the fact that substantial investment by network providers and internet service providers for the provision of related services are required. Given that the investment required by the providers is a relatively risky, this may lead to the fact that some metropolitan optical networks may not be considered particularly attractive by the providers. The above fact may lead to a situation where some metropolitan optical networks (especially in small towns) will attract a few providers (so there will be low competition), or, at worst, none provider. To address the above risk, promotion of broadband services should be increased to the citizens, to make clear the advantages and to increase the demand for broadband services. These, in synergy with the fact that the IBC will provide its infrastructure with a cost-oriented manner (resulting in the provision of services to citizens in a low cost), will boost the demand for broadband services and attract a sufficient number of providers in the metropolitan optical networks supported by the IBC.

A significant risk is the further consolidation in the telecommunications sector. Today, several providers are active, but their presence in the remote areas is lower than the big cities. The basic assumption for generating revenue to IBC from customers - service providers is that during the five years period more than two service practitioners in the IBC's area should be active, who will be interested to use fibre pairs of the IBC. Risk also exists on the revenue expected from the connection of government agencies which are estimated to 50% of the total revenue of the IBC. In case that such income is accounting and is not collected at all or collected with delay, the operation of the company is compromised. Another risk is that the IBC should gain experienced and skilful staff in technology and promotion issues of broadband infrastructure. The above risk will be addressed by attracting capable managers in the human

resources of the IBC and the use of outsourcing policy in fields where the IBC can not handle alone (for example, the network maintenance).

Having therefore a key objective to reduce the costs of IBC, applying a national business model under the auspices of Central Union of Municipalities and Communities would contribute significantly to sustainability. By applying such a model the conditions for reducing the costs to the levels of management, maintenance and expansion of the network are created and significant economies of scale can be achieved. In addition to this solution better conditions are created for the expansion of existing networks, the links between the MAN and the links between MAN and other broadband networks.

CONCLUSION

The purpose of this chapter was to highlight the broadband infrastructures as a common and focus the important role of local governments in the development and use of municipal fiber optic networks. The ultimate objective of the local government regarding its involvement in the provision of broadband services is the creation of an open competitive environment, in which access and services are offered by many providers, thereby reducing the cost of services for citizens and businesses, while developing advanced, high-quality services. Depending on the prevailing conditions, the local authorities have to engage actively to achieve this goal while ensuring cost-oriented operation of infrastructure.

The installation of broadband infrastructure in a country is considered as a common that can lead to significant changes in both the public and private sectors. It is commonly accepted that the local authorities and government bodies focus on the creation of passive infrastructure to encourage the creation of broadband networks. Understanding the benefits, advantages and potential of the broadband, a summary of international experience is described. Several countries develop and adopt strategies and policies for broadband growth and expansion. Most of these efforts are initiatives of local government or based on public – private partnerships, which have shown successful best practices in developing and maintaining of municipal fibre optic networks, while the efforts of the private sector are a minority.

Also, five scenarios for broadband business models are briefly presented. The business model that draws much attention indicates that there is no relationship between the owners of the infrastructure (public sector) and the services provided to the subscribers by the services providers (private sector).

Finally in this chapter a case study of a Greek inter-municipal broadband company (IBC) is presented. IBC has been created to support broadband infrastructure that was developed throughout the southwest axis of Greece. The techno-economic study shows that IBC has to be active only in the operation, management, maintenance and expansion of passive equipment of broadband metropolitan networks. The results of the financial analysis show that having as a key objective to reduce the costs of the IBC, its sustainability depends on the application of a national business model which can perform significant economies of scale. The application of this model creates the preconditions for cost reduction in the levels of management and maintenance of the network. In addition, this solution creates the conditions for the expansion of existing networks, interlinking MAN and connecting MAN with other broadband networks.

REFERENCES

Alexiou, A., Bouras, C., Primpas, D., & Papagiannopoulos, J. (2008). Metropolitan broadband networks: Design and implementation aspects and business models. In *Global diffusion of broadband data transmission: Factors affecting the adoption, usage and economics of broadband* (pp. 196–210). Hershey, PA: IDEA Group Publishing.

ARCEP – Autorité de Régulation des Communications électroniques et des Postes. (2008). *Décision n° 2008-0835*. République Française. Retrieved July 1, 2010, from http:// www.arcep.fr /uploads/ tx_gsavis/ 08-0835.pdf

ARCEP – Autorité de Régulation des Communications électroniques et des Postes. (2009). *Décision n° 2009-1106*. République Française. Retrieved July 1, 2010, from http:// www.arcep.fr/ uploads/ tx_gsavis/ 09-1106.pdf

Berra, M. (2006, March 23-25). *New commons or IPR extension? The future of innovation*. IASCP Europe Regional Meeting: Building the European Common: from Open Fields to Open Source, Brescia, Italy. Retrieved March 1, 2010, from http:// iascpeurope.eco.unibs.it/ papers/ Berra.pdf

BMWI. (2010). *Breitbandstrategie*. Retrieved March 1, 2010, from http:// www.bmwi.de/ BMWi/ Navigation/ Technologie-und-Innovation/ Telekommunikation-und-Post/ breitbandstrategie,did=257532.html

Bouras, C., Gkamas, A., Papagiannopoulos, J., Theofilopoulos, G., & Tsiatsos, T. (2007). *Business models for broadband municipal optical networks: A proposed model for the Greek case*. The Twelfth IEEE Symposium on Computers and Communications, (pp. 727-732). Aveiro, Portugal.

Bouras, C., Gkamas, A., Papagiannopoulos, J., Theofilopoulos, G., & Tsiatsos, T. (2009). Broadband municipal optical networks in Greece: A suitable business model. *Journal of Telematics and Informatics*, *26*, 391–409. doi:10.1016/j.tele.2009.03.003

Bouras, C., Gkamas, A., Theofilopoulos, G., & Tsiatsos, T. (2008). Business models for municipal broadband networks. In Khosrow-Pour, M. (Ed.), *Encyclopedia of Information Science and Technology* (pp. 457–465). Hershey, PA: IGI Global. doi:10.4018/978-1-60566-026-4.ch076

Bouras, C., Papagiannopoulos, J., Katsikas, S., & Gritzalis, S. (2008). The status of broadband in western Greece: A study on the supply and the demand of broadband services for e-government promotion. [IJEG]. *International Journal of Electronic Governance*, *1*(3), 326–344. doi:10.1504/IJEG.2008.020453

Bourreau, M., Cambini, C., & Hoernig, S. (2010). *National FTTH plans in France Italy, and Portugal. Robert Schuman Centre for Advanced Studies, Florence School of Regulation European University Institute*. Florence, Italy: European University Press.

Broadband Properties. (2006). *Issues*. Retrieved July 2, 2010, from http:// www.broadbandproperties.com/ 2006issues/ mar06issues/ vienna_march.pdf

Chlamtac, I., Gumaste, A., & Szabo, C. (Eds.). (2005). *Broadband services business models and technologies for community networks*. John Wiley & Sons. doi:10.1002/0470022515

Citynet. (2010). *Citynet Amsterdam*. Retrieved June 28, 2010, from http://www.citynet.nl/

Cook Network Consultants. (2005). *Building regional open access fiber infrastructure in Catalonia* (Northeastern Spain). The COOK Report on Internet, September-October 2005. Retrieved March 1, 2010, from http:// www.cookreport.com/ catalonia.pdf

Czernich, N., & Engl, F. Falck, O., Kiessl, T., & Kretschmer, T. (2009). *Regulatory framework for next-generation access networks across Europe*. CESIfo Dice Report 1/2009.

DGCIS - Direction générale de la Compétitivité, de l'Industrie et des Services. (2010). *Consultation publique - Programme national très haut débit*. République Française. Retrieved July 1, 2010, from http:// www.telecom.gouv.fr/ fonds_documentaire/ consultations/ 10/ consthd.pdf

Digital Britain. (2010). *What we do: The report*. Retrieved March 1, 2010, from http:// www.culture.gov.uk/ what_we_do/ broadcasting/ 6216.aspx

Dobers, P. (1999). *Netting the information infrastructure of Stockholm*. Paper presented at the Conference of Managing the Big City, Göteborg University, Sweden.

Epractice. (2008). *Preparing Digital France 2012*. Retrieved March 1, 2010, from http:// www.epractice.eu/ en/ news/ 284991

European Commission. (2010). *European information society 2010.* Retrieved June 28, 2010, from http:// ec.europa.eu/ information_society/ eeurope/ i2010/ index_en.htm

FTTH Council. (2009). Definition of terms. (Revision Date: January 9th 2009). Retrieved August 4, 2010, from http:// www.ftthcouncil.eu/ documents studies/ FTTH-Definitions-Revision_January_2009.pdf

Government of Canada. (2010). *Canada's economic action plan*. Retrieved March 1, 2010, from http:// www.actionplan.gc.ca/ eng/ index.asp

Hughes, G. (2003) Local & regional models for broadband deployment. In *Proceedings of eEurope: Broadband Local & Regional Best Practises Workshop*. Retrieved August 4, 2010, from http:// ec.europa.eu/ information_society/ eeurope/ 2005/ doc/ all_about/ broadband/ bb_regional /g_hughes.ppt

Katz, M. (2000). Regulation: The next 1000 years. In R. M. Entman (Ed.), *Six degrees of competition: Correlating regulation with the telecommunications marketplace*. A Report of the Fourteenth Annual Aspen Institute Conference on Telecommunications Policy. The Aspen Institute, Washington.

Kirsch, F., & von Hirschhausen, C. (2008). Regulation of next generation networks: Structural separation, access regulation, or no regulation at all? *Communications & Strategies*, *69*, 63–85.

Korea Communication Commission. (2010). *Important issues*. Retrieved March 1, 2010, from http:// eng.kcc.go.kr/ user.do?page=E02010100&dc=E02010100

Kyriakidou, V., Chipouras, A., Katsianis, D., & Sphicopoulos, T. (2009). Business models for municipal metro networks: Theoretical and financial analysis. In Chochliouros, I. P. (Ed.), *Optical access networks and advanced photonics: Technologies and deployment strategies*. Hershey, PA: IGI Global. doi:10.4018/978-1-60566-707-2.ch010

LocalRet. (2009). *Website*. Retrieved July 1, 2010, from http:// www.apd.cat/ media/ 888.pdf

New Zealand Government. (2009). *Broadband investment initiative.* Retrieved March 1, 2010, from http:// www.med.govt.nz/ upload/ 63958/ Final-broadband-initiative-consultation-document.pdf

Ofcom. (2008). *Delivering super-fast broadband in the UK*. London.

OPTA. (2008) *Policy rules: Tariff regulation for unbundled fibre access*. OPTA/AM/2008/202874. The Hague. Retrieved July 1, 2010 from http:// www.opta.nl/ en/ download/ publicatie/?id=2832

Qiang, C. Z.-W. (2009). *Broadband infrastructure investment in stimulus packages: Relevance for developing countries*. Washington, DC: World Bank.

RadioAustralia News. (2009). *Australia's broadband plan*. Retrieved March 1, 2010, from http:// www.radioaustralianews.net.au/ stories/ 200904/ 2538028.htm

Sadowski, B., Nucciarelli, A., & Rooij, M. (2009). Providing incentives for private investment in municipal broadband networks: Evidence from the Netherlands. [Elsevier B.V.]. *Telecommunications Policy*, *33*(10-11), 582–595. doi:10.1016/j.telpol.2009.08.005

Stokab in English. (2010). *Home*. Retrieved March 1, 2010, from http:// www.stokab.se/ templates/ startpress.aspx?id=1115

Stokab in English. (2010). *About Stokab*. Retrieved March 1, 2010, from http:// www.stokab.se/ templates/ StandardPage.aspx?id=306

Stokab in English. (2010). *The infrastructure*. Retrieved March 1, 2010, from http:// www.stokab.se/ templates/ StandardPage.aspx?id=775

Tomales Bay Institute. (2006). *The commons rising, a report to owners*. Retrieved August 30, 2007, from http:// onthecommons.org/ files/ Commons_Rising_06.pdf

Troulos, C., Merekoulias, V., & Maglaris, V. (2009). A business model for municipal FTTH/B networks: The case of rural Greece. *Info - The Journal of Policy, Regulation and Strategy for Telecommunications* [Emerald Group Publishing Limited.]. *Information and Media*, *12*(3), 73–89.

UTOPIA. (2003). Feasibility study, part II: Financial analysis, dynamic city Metronet advisors.

UTOPIA. (2010). *Utopianet.* Retrieved March 1, 2010, from http:// www.utopianet.org/

VoIP and ENUM. (2006). *FTTH in Vienna to all households*. Retrieved July 2, 2010, from http:// voipandenum.blogspot.com/ 2006/ 01/ ftth-in-vienna-to-all-households.html

YME. (2008). *Strategy for electronic communications and new technologies 2008 – 2013*. Retrieved March 1, 2010, from http:// www.yme.gr/ index.php?tid=21&aid=1532 (in Greek)

ADDITIONAL READING

Bouras, C., Alexiou, A., Kapoulas, V., Paraskevas, M., Scopoulis, I., & Papagiannopoulos, J. (2005, 7-8 October). Deployment of Broadband Infrastructure in the Region of Western Greece. *2nd IEEE/Great e-net International Workshop on Deployment Models and First/Last Mile Networking, 2*, pp. 1510-1515. Boston, MA, USA.

Burney, P., Parsons, S., & Green, J. (2000). Forecasting market demand for new telecommunications services: an introduction. *Telematics and Informatics*, *19*(3), 225–249. doi:10.1016/S0736-5853(01)00004-1

Cava-Ferreruela, I., & Alabau-Munoz, A. (2006). Broadband policy assessment: a cross-national empirical analysis. *Telecommunications Policy*, *30*(8–9), 445–463. doi:10.1016/j.telpol.2005.12.002

Choudrie, J., & Dwivedi, Y. K. (2006). Examining the socio-economic determinants of broadband adopters and non-adopters in the United Kingdom. In *Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06), 4*. p. 85a.

Ebusiness Forum. (2005). *Study about the Use of New Information and Telecommunication Technologies in Small and Medium-sized Enterprises*. Retrieved March 1, 2010, from http:// www.ebusinessforum.gr/

European Commission. (2004). *Challenges for Europe's Information Society Beyond 2005: Starting Point for a New EU Strategy*. EC communication, p. 757.

Government of Sweden (2006). *Broadband for Growth, Innovation and Competitiveness*. The Government and the Government Offices of Sweden, December 2006.

Greek Research and Technology Network – GRNET. (2005). *National Survey on New Technologies and the Information Society*. Retrieved March 1, 2010, from: http:// www.grnet.gr/

Henderson, A., Gentle, I., & Ball, E. (2005). WTO principles and telecommunications in developing nations: Challenges and consequences of accession. *Telecommunications Policy*, *29*(2–3), 205–221. doi:10.1016/j.telpol.2004.11.003

Höffler, F. (2007). Cost and benefits from infrastructure competition. Estimating Welfare Effects from Broadband Access Competition. *Telecommunications Policy*, *31*(6–7), 401–418. doi:10.1016/j.telpol.2007.05.004

Jones, R. (2006, 25–26 January). *Business Case Study for Municipal Networks – FTTH Project Funding*. FTTH Council Europe Conference 2006: Europe at the Speed of Light, Vienna.

Weis, G., Pink, F., & Kadrnoska, H. (2006, 25–26 January) *Fibre–Optic Technology in Vienna*, FTTH Council Europe Conference 2006: Europe at the Speed of Light, Vienna.

KEY TERMS AND DEFINITIONS

Broadband: An advanced and innovative environment, from a social and technological view, which consists of fast network connections and appropriate network infrastructure for the development of new applications and services.

Commons: Resources that are shared by a large number of individuals and resists sole ownership, i.e. they collectively owned.

Fibre-to-the-x (FTTx): Any architecture that uses fiber optics to replace part or all of the copper or other technologies to the local loop, and even to the buildings or homes. FTTx is a collective term for FFTC, FFTB, FTTH and/or FTTP.

Fiber-to-the-Building (FFTB): An architecture for fibre optic networks where the optica; fibre reaches the entrance or boundary of a building.

Fiber-to-the-Curb: or **Fiber-to-the-Cabinet (FFTC):** An architecture for fibre optic networks where the optical fibre reaches up to the street cabinet that is near the subscribers' premises (typically approx up to 300m from the premises).

Fiber-to-the-Home (FFTH): An architecture for fibre optic networks where the fibre reaches the individual homes /apartments of the subscribers

Fiber-to-the-Premises (FFTP): A term used as a blanket for FTTH and FTTB (FTTH/B is also used)

Next Generation Networks (NGNs): Next Generation Networks is a term to describe the networks that will be deployed over the next years. Their main characteristic is that one network achives very high transmission rates (using optical fibre technologies) and transports all information and services, including voice, video, TV, data etc.

Optical Fibre: An optical fibre is a flexible, glass or plastic fiber that carries light along its length. Optical fibres can be used as a medium for telecommunication and networking, and can achieve very high transmission rates.