THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

A comprehensive framework for future broadband policy: Assessing the EU initiatives

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A COMPREHENSIVE FRAMEWORK FOR FUTURE BROADBAND POLICY:
ASSESSING THE EU INITIATIVES

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Abstract

For more than two decades, broadband has been recognized in the EU as having great benefits for economic and social development. This recognition is evident in the first EU policy document on the telecommunications market – the 1987 Green Paper – which assumed that harmonization and liberalization through competition mechanisms could be used as tools to bring all those benefits to European citizens. Although the policy emphasized competition mechanisms in the years that followed, many additional instruments were developed and implemented in order to make broadband available to all European citizens. Some of the instruments can be seen in the form of directives, and some in the many policy strategies. All of them make a considerable contribution to the growth of broadband deployment in the EU. However, the importance of broadband infrastructures is furthermore elevated in the context of an emerging information society representing a fundamental transformation of social and economic structures resulting from innovation in information and communication technologies. With globalization, the policy impetus for broadband has shifted towards a means to increase the competitiveness of a nation or region. In addition, concerns of sustainability have emerged as a central issue for the long-run development of modern societies, and questions have been raised about the role of broadband in this context. This changing emphasis, due to globalization, competitiveness, and sustainability, impacts the design of policy instruments. A question can be raised as to which instruments can serve a new concept for future broadband policy.

This thesis aims to propose a conceptual framework for broadband policy that takes into account both traditional and new aspects of telecommunications sector in an information society by observing the empirical world, and analyzing literature and empirical studies. Particularly, this thesis presents an evolutionary concept for broadband policy in the EU by providing a model for integrating the related broadband policy instruments. A timeline of all the instruments and initiatives that are being implemented is explored. This evolution is analyzed to see what kind of future model is applicable to an information society when broadband policy is based on a perspective of globalization, regional competitiveness, and sustainability. The analysis addresses how well the existing instruments are applicable to a new concept of broadband policy and what the needs are for a new policy framework.

Keywords: broadband policy, sector agenda, strategic agenda, information society, the EU

Appended papers

Paper 1 Broadband universal service: a future path for Europe?
Bohlin, E., & Teppayayon, O. (2009)
International Journal of Management and Network Economics, 1(3), 275-298.

Paper 2 Will broadband networks make the world greener? Evaluating pros and cons of broadband development
Teppayayon, O., Bohlin, E., & Forge, S. (2009)
Communications & Strategies, 76, 19-38.

Paper 3 Functional separation in Swedish broadband market: next step of improving competition?
Teppayayon, O., & Bohlin, E. (2010)
Telecommunications Policy, 34(7), 375-383.

Paper 4 Broadband universal service in Europe: a review of policy consultations 2005-2010
Teppayayon, O., & Bohlin, E. (2010)
Communications & Strategies, 80, 21-42

Paper 5 Challenges of fibre-based infrastructure: a review of the NGA debate in Europe
Teppayayon, O., & Bohlin, E. (2011)
International Journal of Management and Network Economics, 2(2), 150-176.

Paper 6 Government intervention: Why is competition not sufficient for broadband deployment?
Teppayayon, O., & Bohlin, E. (2009)
Paper presented at the 37th TPRC Conference, 25-27 September, George Mason University, Arlington, VA, USA.

Paper 7 Broadband policy for the future: building upon conceptual framework
Teppayayon, O., & Bohlin, E. (2010)
Submitted to *Telecommunications Policy*.

Paper 8 Evolution of the EU broadband policy: towards an integrated framework?
Teppayayon, O., & Bohlin, E. (2012)
Paper presented at the PTC'12, to be submitted to *Info*.

Paper 9 Telecommunications networks and sustainable society: a new perspective of broadband policy
Teppayayon, O., & Bohlin, E. (2012)
Paper presented at the Regional ITS India Conference, 22-24 February 2012, Delhi, India, to be submitted to Telecommunications Policy (special issue).

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Orada Teppayayon

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List of abbreviations

ADSL	Asymmetric Digital Subscriber Line
CO_2	Carbon Dioxide
xDSL	x (any type of) Digital Subscriber Line
EEC	European Economic Community
ESPRIT	European Strategic Program on Research in Information Technology
EU	European Union
FTTH	Fibre to the Home
FTTx	Fibre to the x (x = anything)
GDP	Gross Domestic Product
ICT	Information and Communication Technology
ISDN	Integrated Services Digital Network
IT	Information Technology
ITU	International Telecommunication Union
Kbps	Kilobits per Second
LLU	Local Loop Unbundling
LTE	Long Term Evolution
Mpbs	Megabits per Second
NII	National Information Infrastructure
NGA	Next Generation Access Networks
NRAs	National Regulatory Agencies
OECD	Organisation for Economic Co-operation and Development
ONP	Open Telecommunications Network Provision
PLC	Power Line Communication
POTS	Plain Old Telephone Service
PPP	Public Private Partnership
PTTs	Post, Telephone and Telegraph Administrations
RACE	Research in Advanced Communications for Europe

R&D	Research and Development
USO	Universal Service Obligation
WTO	World Trade Organization

1. Introduction

This thesis is about a new perspective in viewing broadband policy. It is a study that reveals the importance of broadband infrastructures from both broad societal concerns and narrow industry interests. A new conceptual framework for broadband policy is also proposed. The empirical context of the research is the development of the European Union (EU) telecommunications polices and initiatives. The timeline of the analysis covers 24 years of development, starting from the first policy initiated in 1987, by which the telecommunications market was integrated into the single market policy by the European Commission, until the year 2011.

1.1. Background

Back at the end of the 19th century when the telephone system was first invented, no one could have imagined how far-reaching the effects of the changes of this new, innovative technology would be on society and the economics of the world. Even though the technological revolution had a profound effect on society for a hundred years, since the industrial revolution in the 18th century (Bell, 1999), no technology has been able to compress time and space the way the telecommunications system has. It compresses time by enabling synchronization of many different human activities, and space by allowing people to communicate over great distances (Tomlinson, 2010). It also facilitates a large number of transactions and brings in many aspects beyond the physical boundaries of countries. These new phenomena would not be possible without the technological development of the telecommunications system. This encompasses many dynamic changes in the industry, not only in market development but also in advantages to consumers and the evolution of policies, rules and regulations in this sector. Today, the benefits of having good and fast telecommunications infrastructures are not limited to providing better communications services to users but also contribute to the social and economic developments of a society.

1.1.1. The developments of telecommunications technologies

Since the industrial revolution in the 18th century, society has faced three major technological revolutions that have had dramatic social and economic effects on industrialization. The first technological revolution was the invention of steam engines and railroads and the growth of the iron industry, which took place in Britain before spreading effectively to the other European countries (McNeese, 2000). The second technological revolution, just a hundred years ago, can be identified by two innovations: electricity and chemistry. Electricity, in particular, enhanced a new form of power that could be transmitted hundreds of miles, transforming voice into electric signals to create telephone and radio. This revolution brought about tremendous progress in the field of communications, beginning with the invention of the telegraph in the mid-19th century, and followed by the invention of the telephone, which was patented in the USA, in 1876 (McNeese, 2000). The third technological revolution was built on four innovations: the change of all mechanical and electrical systems to electronics, miniaturization, digitalization and software (Bell, 1999).

Of these three revolutions, the last two have contributed greatly to the changes in telecommunications networks. When the telephone was invented, the system was the plain old telephone service (POTS), the voice-grade telephone service that remains the basic form of residential and small business service connection to other telephone networks. During that time, voice communications could be transmitted over a copper line to people living far away. Later, POTS also allowed for data transmission through dial-up technology, so-called narrowband, at a transmission rate of 56 kbps.

The development of data transmission technologies through copper line and fibre optics in the late 20th century, such as the integrated services digital network (ISDN), digital subscriber line (xDSL) and FTTx, has increased the data transmission capacity to beyond 56 kbps. Data services have become important and broadband has become familiar to the public. Today, there are many choices of technology that allow for broadband connections, not only through copper line technology, such as xDSL, cable modem and power line communication (PLC), but also through fibre optics and mobile technology.

1.1.2. An emergence of the telecommunications regulatory framework

Along with technological development, the industry structure and regulatory framework in this sector have changed over time. In the early era of the telephone industry (during the POTS period), the attitude that the ideal condition for a telephone service was a complete monopoly prevailed (Stehman, 1925; Brock, 1981; Noam, 1992; Bauer, 2010a) because it was believed that increasing returns to scale could best be obtained by a single firm supply (Fransman, 2003). The natural monopoly regime was applied to the telephone industry in most countries and the monopolistic firm was regulated through several kinds of price regulations and a universal service regime (Mueller, 1989).

Competition was introduced into the telecommunications market, for example, in the USA in the 1970s (Brock, 1981) and the EU in the 1980s (EC, 1987; Noam, 1992). During the transition period from monopoly structure to competition, many regulatory regimes were implemented, for example, an interconnection regime, an access regime and a licensing regime. Even though there are many positive effects of competition such as price reduction, effective resource allocation and quality of service improvement, the drawbacks of competition can also be seen, for example, in uneven development due to low investment in unprofitable areas. When broadband connectivity is widely accepted as being strategically important to all countries because of its contribution to economic growth in all sectors and its enhancement of social and cultural development and facilitation of innovation, policies and measures, including support for programs for remote areas, will be initiated in most countries around the world with the aim of encouraging broadband deployment.

Three approaches that are elaborated more in later chapters have been deployed in many countries around the world to encourage broadband penetration: a government approach, a market approach and a regulatory approach. Firstly, in the government approach, actions are mostly taken by the government though in many different forms. The most aggressive strategies of this type are government investment and state-aid policy. In Sweden, for example, government funding for broadband expansion has been stipulated by laws according to which the government undertakes special responsibility to stimulate broadband expansion in rural areas where the public interest is not satisfied by market-oriented forces. Under this approach, several kinds of public interventions can be seen, ranging from the allocating of a national budget for broadband infrastructure construction, operation and public-private partnerships to subsidization for broadband services. It is interesting to note that the growth of broadband penetration in countries that have implemented this approach, such as Sweden, Korea, and, recently, Australia, can also be seen over time.

Secondly, in the telecommunications regulatory approach, which can be in the form of both ex-ante and ex-post regulation, the primary objectives are to encourage competition in the broadband market and remove barriers to entry. These mechanisms are active at both national and international level. At international level, the European Union, a supra-national organization, has introduced several regulatory frameworks to encourage broadband competition and deployment in Member States. The leading framework that targets broadband can be seen from local loop unbundling, functional

separation and recently the NGA framework. At national level, this dimension has been implemented by most of the national regulatory bodies around the world, such as Ofcom in the UK, ARCEP in France, etc., and in some cases it is enforced by the competition authorities of the respective countries.

Lastly, the market approach is the dimension that can now be seen in many countries as a leading policy under which private investment is achieved as a result of liberalization and technological development. Japan, for example, relied heavily on competition in the broadband market in the early era of broadband development (InfoCom, 2002). This dimension also links to the actions taken by the telecommunications regulatory body (in the second dimension) in terms of balancing competition in the market.

1.1.3. An emergence of information society initiative

The publication that pioneered the information society thesis was *The Production and Distribution of Knowledge in the United States* by Fritz Machlup in 1962 (Duff, Craig, & McNeill, 1996; Ducatel, Webster, & Hermann, 2000). The concept of information society had been endorsed by many theorists. Among them, Daniel Bell is best known for his charaterization of the information society in his theory of *post-industrialism,* which was published in 1970s (the details of the concept will be provided in Chapter 6). Different perspectives on the information society were developed later on. However, the most common definition of the information society places emphasis upon spectacular technological innovation (Webster, 1995), in particular with the spread of broadband technologies.

Until early 1980s there was a growing recognition of the convergence taking place between computing and communications to form information and communication technologies (ICT). During this period, a number of influential policy statements and initiatives were introduced by governments. The information society was adopted as a political policy in 1990s in many countries under different names; *the National Information Infrastructure: Agenda for Action* in the United States in 1993, the *Establishment of High-Performance Info-Communications Infrastructure* in Japan in 1994, the *EU and the Global Information Society* (Bangemann Report) in 1994, which was implemented as *the Information Society for All* in the EU in 1999. Those policies came with different emphasis. The NII of the United States, for example, focused on information and knowledge development and accessibility whereby infrastructure was clearly viewed as something to be deployed by private firms. Meanwhile, the EU had similarities to the NII (Ducatel et al., 2000). In contrast, the policy of Japan focused on the deployment of high-performance infrastructure, in particular fibre optics, information and knowledge development, and environmental protection issues. Since then, new policies and initiatives have been developed or introduced over time in many countries in order to move towards an information society.

1.1.4. The challenges of the telecommunications sector

Natural disasters around the world, such as Hurricane Katrina in 2005 in the United States, the earthquake and tsunami on northeast coast of Japan in 2011, the tsunami in Phuket, Thailand in 2004 and the severe flooding in Bangkok, Thailand in 2011, as well as the giant snow storm in Eastern Europe in 2012 have compelled people and governments everywhere to think more seriously about planet Earth, our global system. Having a good and efficient telecommunications infrastructure not only satisfies the demands for bandwidth from the business sector and individual users, but also contributes to the long-term development of a country. Available, accessible and usable telecommunications infrastructures are necessary before and during disasters.

The growing concern over environmental issues is resulting in increasing awareness of the impact that humans and their activities have on the Earth and is leading to calls for sustainability through information technologies (IT). In recent years, the term “Green IT” has begun to be used to describe a field at the juncture of the growing concern over environmental issues and the use of IT, itself. The rapid growth and acceptance of IT worldwide suggests that this may be a fruitful area in which to seek possibilities for environmental change, as green IT can help reduce the impact of e-waste, enable sustainable interaction design and decrease energy consumption by computational systems (Tomlinson, 2010).

However, a growing concern is that high energy consumption and high CO_2 emissions will result from high connectivity and utilization of telecommunications networks. This issue suggests that sooner or later the issue of sustainability in telecommunications networks will be an important one. Nevertheless, the current regulatory and policy model in telecommunications sector is not designed for this new challenge.

From another viewpoint, the telecommunications infrastructures can also improve the effectiveness of business transactions in other sectors such as transport and health care. In all or part, the growth of telecommunications infrastructure and its utilization are a factor in the measurement of the competitiveness of a country. Observations can be made in several competitiveness indices countries that rank high in terms of competitiveness have a high level of penetration in the telecommunications infrastructure, and how it diffuses and contributes to development in other sectors.

1.1.5. The evolution of telecommunications regulatory and policy in the EU

The EU shared the same line of development in the telecommunications regulatory regime as was prevalent throughout the world. For a century, telephony in countries throughout Europe had featured a ubiquitous, centralized, hierarchical network operated by a monopolist (Noam, 1992). When the telecommunications infrastructure and services were viewed as a natural monopoly, the Post, Telephone and Telegraph administrations (PTTs) operated the national telecommunications infrastructures and maintained special and exclusive rights over the supply of telecommunications services (Goodman, 2005). Since the 1970s, telecommunications networks and services in the European Community have been reformed by a number of exogenous factors, such as technological and economic developments, among them the breaking down of cartels and cross-subsidies (Noam, 1992; Michalis, 2007).

For more than two decades, since 1987, broadband has been recognized as providing great benefits to economic and social development. This recognition is evident in the first EU policy document on the telecommunications market – the 1987 Green Paper – which assumed that harmonization and liberalization through a competition mechanism could be used as tools to bring all those benefits to European citizens (EC, 1987). Building on the Green Paper in 1987 (EC, 1987), the 1990 Service Directive mandated that Member States withdraw all special or exclusive rights to the supply telecommunications services other than voice telephony. An exception was made for voice telephony to safeguard the financial stability of the incumbent providers (van Eijk, 2004). In addition to the Service Directive, the 1990 ONP Directive introduced harmonized principles and conditions for open network provision. With this directive, access to networks and services could not be restricted except for reasons of general public interest.

Although, in the following years, the policy emphasized the competition mechanism, many additional instruments were developed and implemented in order to make broadband available to all European citizens. Some of these instruments are in the form of directives, while others are structured as many

policy strategies. All of them make a considerable contribution to the growth of broadband deployment in the EU. However, with globalization, the policy impetus for broadband has shifted towards a means to increase the competitiveness of a nation or region. In addition, the environmental issue is of growing concern to the public. This changing emphasis due to globalization, competitiveness and sustainability impacts the design of policy instruments. Whether the EU can elaborate on all the issues surrounding the development of telecommunications is the main focus of this research and will be analysed further in this thesis

1.1.6. Notes on terminology

Some words are crucial to the idea building in this thesis. In order to have the same understanding, those terms are provided below.

Broadband	refers to a service or system with the ability to receive (and in some cases transmit) information at high rates of speed, running from 128 Kbps.
Broadband policy	refers to an overall strategy embracing the general goals and acceptable procedures for broadband development.
Competitiveness	refers to a set of institutions, policies and factors that can facilitate a country capability to compete with other countries
Convergence	refers to the ability of different network platforms, such as, computing, communications and media, to carry essentially similar kinds of services (EC, 1997).
Information society	refers to a transformation of the social and economic structure as a result of technological innovation in information and communication technologies. (Note: throughout this thesis, this terminology is then interchangeable to ‘post-industrial society’ or ‘network society’. The differences of terminologies come from the fact that they are developed by different authors)
Regulatory framework	refers to a set of telecommunications regulations being implemented to regulate the telecommunications industry.
Sector agenda	refers to an underlying plan for the telecommunication sector, set by policy makers at sector level. Its primarily aim is to make telecommunications infrastructures available, accessible, and affordable.
Strategic agenda	refers to a national or regional strategy setting for country development. This type of strategy is usually achievable by the involvement of many sectors.
Sustainability	refers to an integration of economy, environment and social well-being in an assessment of societal outcomes.
Sustainable development	refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission, 1987).

Telecommunications policy	refers to an overall strategy embracing the general goals and acceptable procedures for the development in the telecommunications sector
Telecommunications sector	refers to a part of the economy that provides the transmission of voice and data over distances, through wire and wireless technologies.

1.2. The aims and research questions

The development of telecommunications technologies, in particular broadband, leads to the changes of social and economic structure whereby telecommunications infrastructures become an important platform for information and knowledge distribution. Along with technological development, the industry structure and regulatory framework in this sector have changed over time from monopoly to a competition mechanism in order to increase efficiency in the telecommunications sector. The EU, particularly, has emphasized the competition mechanism as a main policy for the telecommunications sector for more than two decades. The coming of the information society as a result of technological convergence and demand change has increased the importance of telecommunications infrastructures. They are expected not only to be a solution for meeting the demands of the sector, but also a means to realizing the efficiency and security goals of a country. Whether or not these new expectations can be achieved with the existing telecommunications regulatory framework is worth investigation.

Therefore, there are two main aims of this thesis.

Firstly, this thesis proposes for the first time a conceptual framework for broadband policy that takes into account both traditional and new aspects of telecommunications in an information society environment.

Secondly, this thesis examines the possible benefits of the proposed framework. This is done via an analysis of EU broadband polices from the proposed framework viewpoint. This analysis is based on the conceptual framework which is proposed in this thesis. The timeline of the analysis covers 24 years of development, starting from the first policy initiated in 1987 by which the telecommunications market was integrated into the single market of the European Commission, until the year 2011.

The background mentioned in previous sections suggests that telecommunications infrastructure is not only important to the telecommunications industry itself, but also to social and economic development as a whole. It can be seen that much policy research focuses mainly on the existing EU regulatory framework as to how effective the mechanisms under the present policy framework are. The contributions of the telecommunications infrastructures are not limited only to growth and penetration in its sector. Rather, from a broader social perspective, the utilization of the networks and a sustainable society are also important. Those contributions lead to the issue whether or not the existing policy structure is able to deal with the emerging environment in an information society. Therefore, the first research question is formulated:

RQ 1:

How is the existing broadband policy applicable to an information society?

Moving towards an information society places emphasis on telecommunications networks, in particular how these networks can be utilized or contribute to the development of other sectors. The focus of broadband importance nowadays is the highlight of contributions to social and economic developments in a broader sense. Therefore, if the existing policy mechanisms cannot facilitate this change of perspective, the issue to be discussed and investigated is whether or not there are any other perspectives or aspects of broadband policy to be considered. Hence, the second research question is formulated:

RQ 2:

How can a broadband policy be formulated to consider the new challenges of the telecommunications sector in an information society?

These two research questions are formulated in connection with the first purpose of the thesis. The two research questions are analyzed with explorative information by studying the challenges of broadband from different aspects in order to see whether or not a framework or concept can be constructed as a tool to assess broadband policy as a foundation for the future development of a country.

In the EU, broadband policies and initiative have been implemented since 1987, and the information society initiative has been introduced in 1990s. It is important to investigate all those policies and initiatives in order to see how the telecommunication policy at the EU level has responded to the emerging environments of an information society. Therefore, the third research question is constructed as follows:

RQ 3:

To what extent have the EU broadband policies addressed the new challenges of the telecommunications sector in an information society?

Nine sub-studies have been conducted to support this thesis. Though these studies have different focuses in terms of the issues to be discussed, each one is linked to the aims and research questions of the thesis (see Figure 1). The relationships among them are shown in later chapters.

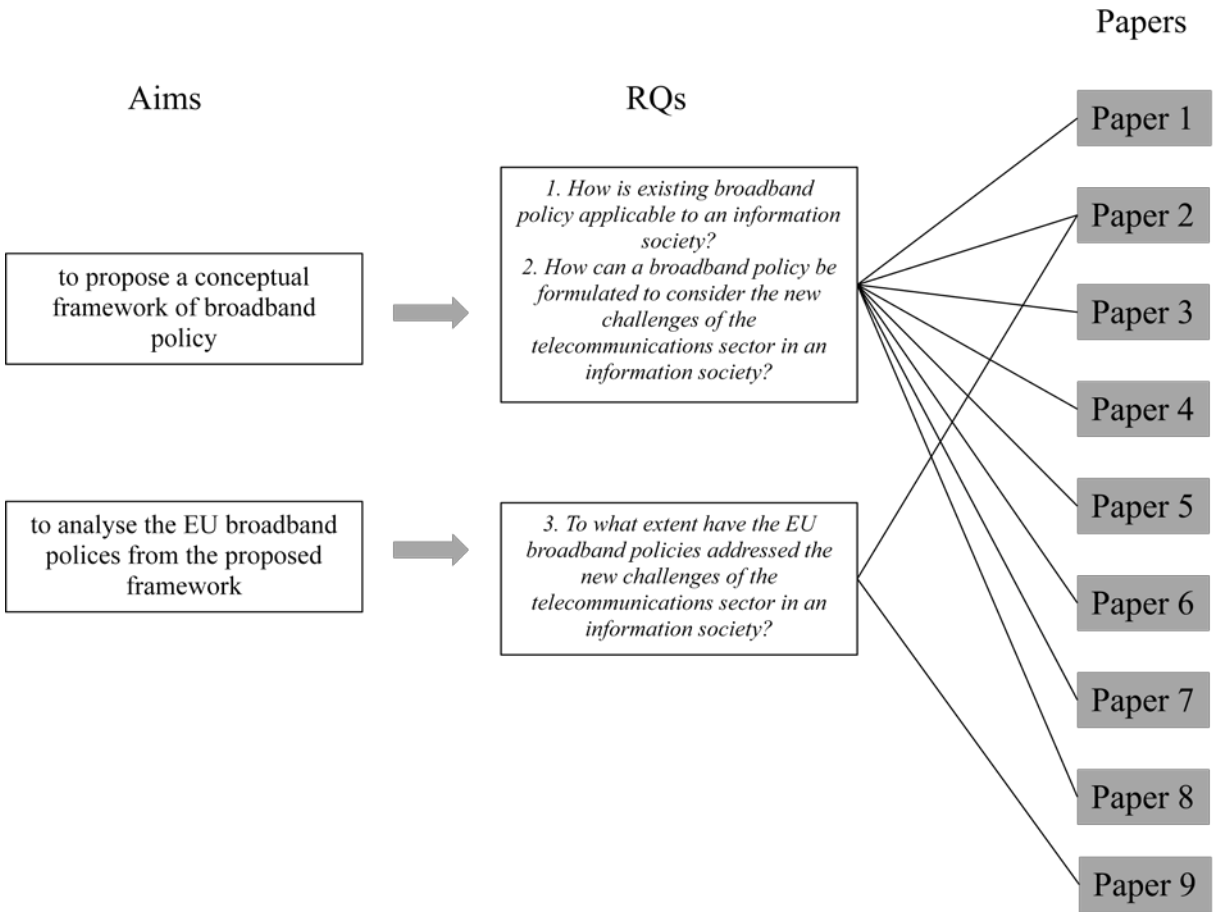

Figure 1 The linkage between research aims, research questions and the appended papers

1.3. The structure of the thesis and summary of the appended papers

While nine sub-studies (Appendices 1-9) are attached to the thesis, its structure is self-contained, explaining the linkages between the ideas surrounding broadband policy. The structure of the thesis is organized as follows:

Table 1 Structure of the thesis

Chapter	Title	Appended papers	Main idea
1	Introduction		To introduce problem areas and motivations
2	Data and methodology		
3	Development of telecommunications sector - Telecommunications sector: The ongoing development - Evolution of telecommunications policies in the EU	Paper 1,3,4,5,6, 7, 9	To observe the structure of the telecommunications industry in relation to both existing and emerging issues surrounding telecommunications To investigate the evolution of broadband policy and initiatives in the EU To explore academic research on broadband policy

4	Challenges of the telecommunications sector	Paper 2, 9	To explore emerging environments of telecommunications sector, namely competitiveness and sustainability.
5	Theoretical foundations - The policy cycle - The four levels of social analysis by Williamson - The theory of post-industrial society and the network society	Paper 7, 8	To explain theories relating to broadband policy and information society. The four theories will be used as overarching theory of the proposed framework
6	A comprehensive framework for broadband policy	Paper 7, 8	To propose the conceptual framework which is built upon the issues raised in the previous sections
7	Analysis on the EU		To analyse the EU initiatives by using the proposed framework and to conclude the main idea of the research
8	Conclusions, policy implications and future research		To conclude the findings of the thesis and provide policy implications and directions for future research

As mentioned earlier, this thesis includes by nine sub-studies. Each sub-study was conducted to analyse or to explore some specific issue. Therefore, it is important to summarize the main study of each paper in order to understand how those issues can be linked to the thesis, which is explained in later chapters. The papers are arranged chronologically in order to show the evolution of conceptual development, with published articles listed first (1-5) and conference papers later (8-9).

1.3.1. Summary of Paper 1

Title: Broadband universal service: a future path for Europe?

Main idea: The aim of the paper is to analyze the possibility and efforts of the EU to include broadband in the scope of the universal service framework. This paper provides an overview of the current state and trends of universal service with focus on broadband access in the European Union. In particular, a historical overview is given of the universal service legislation and various policies initiatives in the EU, emphasising that future broadband universal service has long-standing antecedents, going back to the 1980s. However, broadening the scope of universal service has many different contexts to be considered such as majority criteria, costs, market competition. Thus, balancing between contexts must be done carefully.

1.3.2. Summary of Paper 2

Title: Will broadband networks make the world greener? Evaluating pros and cons of broadband development

Main idea: This paper provides a review of how government policy, in particular by the EU and Japan, are moving towards the transition to sustainability by utilizing ICT, as well as an evaluation of the pros and cons of broadband development. There are many complex effects on sustainability due to ICT. Since ICT can have environmental effects both as enabling energy efficiency and causing rebound effects, the policies should respond to both direct and indirect effects. To facilitate policy

analysis and recommendations, this paper categorizes ICT impacts by five orders of aggregation. These five orders of aggregation may contribute both positively and negatively to sustainability, and each level will need targeted policies. The five orders of aggregation suggest a comprehensive and long term view of policy development, encompassing even policies that seek to improve the quality of decision making in our societies, by utilizing ICTs.

1.3.3. Summary of Paper 3

Title: Functional separation in Swedish broadband market: next step of improving competition?

Main idea: The aim of the paper is to examine broadband competition problems and addresses the recent regulatory tool – functional separation - which is implemented in several countries, i.e. the UK, Italy, and Sweden, and in a discussion at the EU level. It has been suggested that functional separation can be an effective policy for increasing competition in broadband markets under certain circumstances. Sweden has implemented functional separation by amending the Swedish Telecommunications Act in 2008 to include mandatory functional separation as one of the powers of the PTS, the Swedish telecommunications regulator. Although TeliaSonera, the incumbent fixed line operator, decided to voluntarily separate part of their business, the amendments to the law were debated with arguments similar to the debates in the EU following the new regulatory framework implemented in 2009.

1.3.4. Summary of Paper 4

Title: Broadband universal service in Europe: a review of policy consultations 2005-2010

Main idea: this paper provides an analytical survey of the current state and trends of universal service with focus on broadband access in the European Union. From the study, the discussion on broadening the scope of the Universal Service Directive (USD) to include broadband has been raised since the first periodical review in 2005, and also in the second periodical review in 2008. Both reviews came with the preliminary conclusion that broadband has not yet reached the majority of people, implying that the conditions of the USD for expanding the scope of universal service were not yet fulfilled. The paper concludes that the achievement of universal broadband requires a more holistic policy approach across a range of market drivers including both encouraging supply and addressing demand-side barriers. At the same time, if broadband universal service is to be implemented as another tool to ensure that all EU citizens have access to essential communication services, the universal service scheme itself may need to be re-designed so that any competition distortion can be avoided.

1.3.5. Summary of Paper 5

Title: Challenges of fibre-based infrastructure: a review of the NGA debate in Europe

Main idea: The papers points out that, currently, most countries in the EU have a high ranking for the broadband penetration rate compared with the rest of the world, but most of these rankings are based on DSL technology. The challenges of higher bandwidth requirements by users and a very low percentage of fibre infrastructures are creating a major concern for the EU as these could be major obstacles to moving towards an information society and lower the competitiveness of the region. In the EU, the NGA Recommendation was issued as a tool to serve the objective to encourage investment. It extends the current model of regulation, in particular the local loop unbundling regime, to the new networks but has a renewed emphasis on the sharing of passive infrastructures, with greater emphasis

on geographic differences. The paper concludes that the current model of the EU regulations is designed to maintain competition in the telecommunications market and serves to maintain competition in the market, the sector agenda, and encourage investment, the strategic agenda, creating ambiguity in the new NGA Recommendation.

1.3.6. Summary of Paper 6

Title: Government intervention: why is competition not sufficient for broadband deployment?

Main idea: The aim of the paper is to evaluate the role of government in different countries regarding broadband development. The papers discusses that there is a multitude of sources and instruments for government to influence broadband uptake, and one needs a contextual understanding of what issue is the most important for each country. The discussion has illustrated the major instruments for broadband deployment. Individually or in combination they underlie most major broadband deployments, which are themselves of several different types. Analysis may help to clarify and focus the situation and thereby help policy makers reach more effective results. However, observations are made in the broadband phenomenon showing that the telecommunications market has been liberalized for a number of years with the leading idea of market competition, and when broadband has been targeted, policies seem to step back to the first era of telecommunications market led by government.

1.3.7. Summary of Paper 7

Title: Broadband policy for the future: building upon conceptual framework

Main idea: The paper proposes two perspectives of broadband policy, namely sector agenda and strategic agenda. It points out that changing from monopoly to competition took nearly a century but the changing had a big impact to the whole system of telecommunications sector, in particular broadband. However, future of broadband policy is not only impacted by the changing of regulatory structure, but also impact by other issues such as globalization or sustainability. Those new issues will increase the level of complexity for broadband policy. The traditional broadband policy deals only to the sector agenda which is to increase penetration within a country. Therefore, it must be easier to place some specific mechanisms to solve some problems such as lacking of infrastructure or high price. Once broadband has been concerned as strategic importance of a country, such as competitiveness or sustainability, the policy may go beyond the telecommunications sector itself, and that require great effort and collaborations.

1.3.8. Summary of Paper 8

Title: Evolution of the EU broadband policy: towards an integrated framework?

Main idea: The paper addresses the issue of changing perspectives of broadband policy if broadband is viewed as an important strategy for future development. In this regard, broadband policy should be viewed from two main perspectives. The first perspective is called the sector agenda, which is based on the ongoing development tools and strategies aimed at to increasing broadband growth. The second perspective is called the strategic agenda which views broadband policy in terms of long term development in order to promote competitiveness in the global market. Those two perspectives should be integrated into broadband policy for the purpose of future development. Upon examination, some observations can be made about the EU broadband policy implemented during these twenty years. The EU policy has been successful from a sector agenda viewpoint by increasing broadband penetration

during this period. However, the EU's success may not be able to be sustained from the strategic agenda prospective because of new technological development and the new movement toward the globalization of post-industrial society or network society.

1.3.9. Summary of Paper 9

Title: Telecommunications networks and sustainable society: a new perspective of broadband policy

Main idea: This paper presents a theoretical concept of broadband policy by providing a model to integrate the related broadband policy instruments. A timeline of all instruments and initiatives being implemented is explored. This evolution is analyzed in order to see what kind of future model is applicable when broadband policy has to move beyond the traditional regulatory structure to a new changing environment i.e. sustainability. The analysis addresses how well the existing instruments can serve a new concept of broadband policy and what the needs are for new policy instruments.

1.4. Delimitations

This thesis proposes a conceptual framework from the explorations and observations of the ongoing situations. The purpose of the framework is not to provide predictions for the future, nor solutions. Instead, it is to raise government awareness and concern about the social structure changing as a result of telecommunications development.

In addition, it is important to note some limitations of this thesis:

- The thesis does not intend to evaluate policy implementation by using quantitative research methodology or mathematical models. As explained later in Chapter 2, this thesis uses a qualitative methodology, although some statistical data are used to support the discussions.

- The thesis mainly focuses on broadband policy in infrastructure deployment, particularly fixed broadband networks., In other words, it emphasizes the supply side, and not the adoption or usage side.

- The thesis does not cover the technology infrastructure needed for wireless communication though that is an important infrastructure. Since wireless infrastructures have different paths of development and policy instruments, this requires another set of discussions.

- The thesis does not evaluate whether each policy or measure is good or bad. Rather, the discussion concerns the relationship between the existing broadband policy and the emerging environments of an information policy.

2. Methodology

This chapter contains methodological considerations related to this thesis and the underlying studies. In order to do so, four main topics are explained in this chapter: research strategy, data collection methods, data analysis methods, and research design (see Figure 2).

2.1. Research strategy

The whole structure of the thesis is shaped by qualitative research methodology which, in particular, focuses on grounded theory concepts. Though many books take different starting points and take different approaches to grounded theory or elements in this methodology, the key components remain. Many components of grounded theory can be discussed, but the main one which determines the research methodology of this thesis is that grounded theory arises from a spiral of cycles of data collection, analysis, and theoretical categorization, where resulting theory is developed inductively *from* data rather than tested *by* data (Flick, 2009).

Grounded theory is related to the system combining or abductive approach of Dubois and Gadde (2002). As noted by them, the main characteristic of system combining is a continuous movement between an empirical world and a model world which is particularly useful for development of new theory. In systematic combining, the evolving framework is a cornerstone. With broadband, both the empirical world and the model world are interrelated when policy has to be formulated. The emergence of a broadband agenda can result in various issues in terms of policy development because matching theory and reality can be taken in various directions. The sector agenda which is elaborated in Chapter 3 of the thesis is a good illustration of this characteristic: while categorization based on some theories can be made, a pattern for every country is difficult to generate in reality due to the varying factors involved.

Meanwhile, broadband is acquiring the importance of becoming a strategic agenda in a country. It can be seen in Chapter 4 that, apart from the sector agenda, broadband has a potential to be a strategic agenda with a capability of contributing to future development. Therefore, most data collection activities in this chapter are directed towards the search for specific data, where empirical data are presented to support the proposed framework in Chapter 3 and Chapter 4. Hence, the research strategy of this thesis can be depicted as in Figure 3, which is adapted from the system combining of Dubois and Gadde (2002).

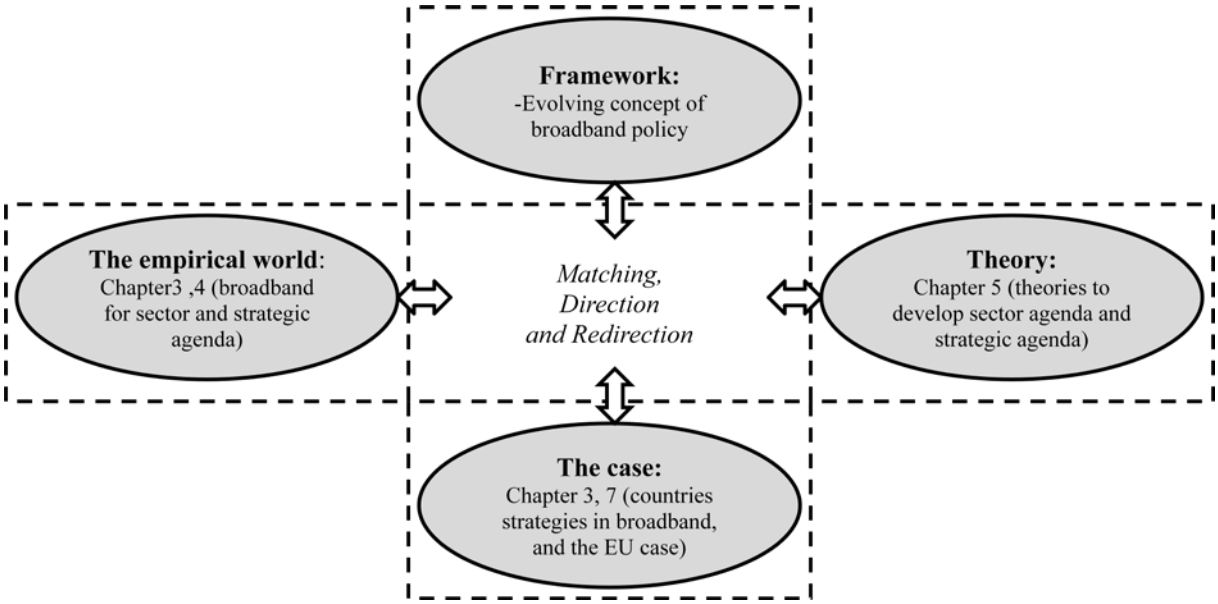

Figure 2 Research strategy of the thesis
(adapted from Dubois & Gadde, 2002)

In terms of knowledge construction, the thesis is based on interpretivism in epistemology. According to Bryman and Bell (2007), an epistemological issue concerns the question of what is regarded as acceptable knowledge in a discipline, or the ground of knowledge. In contrast to positivism, which seeks to explain and predict what happens in the social world by searching for regularities and causal relationships, this thesis is guided by interpretivism which seeks to understand the social world from the point of view of individuals who are directly involved in the activities which are to be studied (Burrell & Morgan, 1989). In this sense, the thesis does not present the causal relationships between different approaches. Some argumentation based on statistical data explaining certain features of broadband are presented, however, in order to see how approaches complement each other. Rather, the research tries to understand the importance of broadband phenomena in a country, and this leads to an understanding of why broadband policy is important.

As for ontological considerations, the thesis is based on constructivism. Questions of social ontology are concerned with the nature of social entities. The central point of orientation here is the question of whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can be considered social constructions built up from the perceptions and actions of social actors (Bryman & Bell, 2007). From this point of view, the research is an explorative study which takes broadband policy as a meaningful tool for a country but from the researcher's point of view, not limited to the facts. Moreover, the proposed framework draws upon the data collection and analysis.

2.2. Overview of research methodologies of the appended papers

Nine papers were included within the scope this thesis. Each paper employs different methodology and data collection. Overviews of each paper regarding to research methodologies are summarized in Table 2. Details of each method are provided in next sections.

Table 2 Summary on research methodologies of the appended papers

Theme of papers	Data sources	Data analysis	Research design	Countries in focus
Paper 1 Broadband universal service: A future path for Europe				
Investigate an evolution of universal service regime in the EU (sector agenda)	Archival documents of the European Commission; contributions from stakeholders in 2005 public consultation in 2005 (77 contributions in the EU database)	Hermeneutic analysis	Retrospective study	The EU
Paper 2 Will broadband networks make the world greener? Evaluating pros and cons of broadband development				
Explore an emerging issue on energy consumption in broadband technology and government initiatives (strategic agenda)	Archival documents of the European Commission and Japanese government; access to e-journal database	Content analysis	Comparative study / Snapshot study	The EU and Japan
Paper 3 Functional separation in Swedish broadband market: Next step of improving competition?				
Investigate the discussions over an introduction of functional separation in Sweden (sector agenda)	Archival documents of the Swedish government; newspaper	Content analysis	Case study	Sweden
Paper 4 Broadband universal service in Europe: A review of policy consultations 2005-2010				
Analyze the development of broadband universal service in the EU (sector agenda)	Archival documents of the European Commission; contributions from stakeholders in 2010 public consultation (118 contributions in the EU database)	Hermeneutic analysis	Comparative study / Retrospective study	The EU
Paper 5 Challenges of fibre-based infrastructure: A review of the NGA debate in Europe				
Investigate views from stakeholders on NGA consultations in 2008 and 2009 (sector agenda and strategic agenda)	Archival documents of the European Commission; contributions from stakeholders in public consultations in 2008 and 2009 (75 contributions in 2008, 82 contributions in 2009 in the EU database); access to e-journal database	Content analysis	Retrospective study	The EU
Paper 6 Government intervention: Why is competition not sufficient for broadband deployment?				
Explore government investment or funding in broadband infrastructure deployment (sector agenda)	Data from the European Commission website, PTS website, ARCEP website	Content analysis	Comparative study/ Snapshot study	The EU, the UK, France, Sweden
Paper 7 Broadband policy for the future: Building upon conceptual framework				
Explore different initiatives taken by the EU and Japanese government (sector agenda and strategic agenda)	Archival documents of the European Commission; interviews	Content analysis	Longitudinal study / Comparative study	The EU, Japan

Theme of papers	Data sources	Data analysis	Research design	Countries in focus
Paper 8 Evolution of the EU broadband policy: Towards an integrated framework?				
Investigate evolution of broadband regulatory and policy concept in the EU (sector agenda and strategic agenda)	Archival documents of the European Commission; access to e-journal database	Hermeneutic analysis	Case study / Longitudinal study	The EU
Paper 9 Telecommunications networks and sustainable society: A new perspective of broadband policy				
Investigate evolution of broadband regulatory and policy concept in general (sector agenda and strategic agenda)	Access to e-journal database; related research by academicians	Hermeneutic analysis	Longitudinal study	No country in particular

2.2.1. Data collection methods

Though data collection methods relate to research strategy, many kinds of data collection can be undertaken when conducting research. According to Bryman and Bell (2007), the main research methods are the following: a) ethnography/participant observation, b) qualitative interviewing, c) focus groups, d) language-based approaches to the collection of qualitative data, such as discourse and conversation analysis, and e) collection and qualitative analysis of texts and documents. Each method has both pros and cons, and some methods are very popular in qualitative methodology – for example, interviews or observations because they provide primary data.

Even though interviews were conducted in Paper 7, they are not the main data sources of the thesis. The main data source of this thesis is dependent on secondary data sources, in particular archival documents from government websites or printed materials. The thesis has appended with nine sub-studies, the data collection methods of the each study are summarized in Table 2.

In this thesis, the collection and qualitative analysis of texts and documents is chosen as the main data collection method and supplemented by semi-structured interview for some papers. The justification for choosing this data collection method is related to the research topic, which mainly focuses on government policies – at either national or international level in broadband development. This research is not about a small unit of business, such as a single company or group of companies, but rather deals with the development of a whole country, which the data should represent on a more general level. In addition, as mentioned earlier, interviews and observations have some limitations to be faced in this research, because it is hard to get into discussion with high-level persons in government.

Regarding the chosen method, it is important to note that documentary sources which have been, or can be, used in this thesis are public documents, official documents, academic journals, and mass media outputs. These documents have a high degree of reliability, and as noted by Bryman and Bell (2007), have not been produced at the request of a business researcher – instead, the objects that are the focus of this method are simply ‘out there’ waiting to be assembled and analyzed.

2.2.2. Data analysis methods

In line with the research strategy presented in Section 2.1, the interpretation of data in this thesis is based on content analysis and hermeneutic analysis. Content analysis is employed in Papers 2, 3, 5, 6, 7, while hermeneutic analysis is employed in Papers 1, 4, 8, 9.

As for content analysis, it is one of the classical procedures for analyzing textual material no matter where the material comes from. Above all, and contrary to other approaches, the goal of content analysis is to reduce the material (Flick, 2009). This should be suitable with the present research topic, broadband policy, because there are many materials from many sources relating to broadband policy development in a given country. Sometimes, most of them explain the same situation. Therefore, this approach mainly suits a reductive analysis of large masses of text. However, the weakness of this approach is that categorization of text based on theories may obscure the view of the contents rather than facilitating analysis of the text in its depth and underlying meanings (Flick, 2009). Therefore another method, hermeneutic analysis, is needed to make the research yield useful information.

Hermeneutics refers to an approach that was originally devised in relation to the understanding or interpretation of texts, and of theological texts in particular. It has been influential in the general formulation of interpretivism as an epistemology (Bryman & Bell, 2007). The central idea behind hermeneutics is that the analyst of a text must seek to bring out the meanings of a text from the perspective of its author. This will entail attention to the social and historical context within which the text was produced. As for data collected in this research, to understand the rationale behind each broadband policy, many texts and documents need to be carefully analyzed in order to find strategies behind them. Sometimes, interpretation cannot be made from the documents themselves; rather, documents from many other sources are needed. In addition, for some issues discussed in the thesis, especially Chapter 4, the meaning of the issues should be based very much on the perspective of the authors. Therefore, this kind of data analysis is applied to the research.

2.2.3. Research design

The design of a qualitative study is the result of a series of decisions. It is not only the knowledge of interest in a study, but also the contextual conditions, that shape a study (Flick, 2009). Hence, research design is a plan for collecting and analyzing evidence that will make it possible for the investigator to answer whatever posed questions (Ragin, 1994). Each research design has its strengths and weaknesses. To conduct the studies, five research designs are employed; case study, longitudinal study, comparative study, snapshot study and retrospective study. Some studies combine different research designs due to the topic and evidences of the research. The research design of the appended papers is illustrated in Table 2.

A retrospective study is often used in biographical research in which retrospectively from the point in time when the research is carried out, certain events, and processes are analyzed with respect to their meaning for individual or collective life histories. This approach makes a consistent realization of a biographical perspective possible and allows a process perspective to be taken on order of events that have already begun or are even terminated (Flick, 009). This research design is used in Papers 1, 4, and 5 in order to analyze the history of broadband development of a nation, particularly, regulatory issues. Evaluating government broadband policy should start with the order of events which occurred in the past, in order to know the policy and the results that have emerged over time. However, there are some problems in doing so. The situation of current broadband penetration may be the result of a policy introduced in the past. Therefore, it is difficult to set the borderline between policies. Moreover, the perspective on the process is distilled from studying documents which have been produced, and it is difficult to include optional policies that could have developed.

To evaluate different government broadband policies properly, comparisons between countries should be made in order to ascertain the level of development of one country. Then a comparative study is applied to Papers 2, 4, 6, 7. Particular attention has been paid to the comparison between the EU and Japan on implementing different strategies. However, this design poses the problem w of how to select

the case in the group, and it is difficult to establish necessary standardization or constancy in the remaining conditions that are not the subject of the comparison. In a discussion of broadband penetration, each country has a different background of geographical, economic, demographic, or political conditions. Sometimes, it is hard to compare only the outcome or the growth figures. In addition, broadband penetration depends on both supply and demand; high penetration may be a result of both issues, which are hard to differentiate. Still, this design is useful despite its limitations.

The research design for Papers 3 and 8 is case study. The aim of case studies is the precise description or reconstruction of a case (Ragin & Becker 1992). The term 'case' in this research refers to countries or supranational entities, that is, Sweden in Paper 3 and the EU in Paper 8. Since a case study can capture the process under study in a very detailed and exact way (Flick, 2009), the research can then analyze broadband penetration and some specific strategies in a country by taking all relevant circumstances into account. However, it is difficult to select a case that permits more general conclusions. As mentioned, different countries have different backgrounds, and thus it is hard to make inferences about one country that can be applied generally.

The major parts of Papers 2 and 6 focus on snapshots. These are concerned with giving a description of circumstances at the time of the research into a particular issue (Flick, 2009). This design can also contribute to the development of some event over an extended period in order to capture or analyze this in parallel to its actual occurrence. It is seen that the issues which contribute to a strategic agenda in a country are developed and are useful at a particular point of time because the strategic agenda depends largely on a perspective which can be changed if relevant factors change, for example, related technology.

Longitudinal study is the research design used in Papers 7, 8, 9. It is a design that analyzes an interesting process or state at later points of data collection, and it is the most consistent way of analyzing developments and processes in their course (Flick, 2009). The strength of longitudinal studies is their ability to understand organizations as a way of providing data on the mechanisms and processes through which changes are created (Pettigrew, 1990). To analyze broadband policy under new environments of an information society requires time series evidence. The changing of an event at one point in time is not enough evidence of the existence of a new environment characterized as moving towards an information society. Hence, an analysis of telecommunications sector under an information society environment can only be done at a later stage of emerging events.

2.3. Reliability and validity

The value of qualitative research is a debatable issue even in methodology textbook discussion of how to assess qualitative research (Flick, 2009). However, this section discusses the classical criteria for assessing the procedure and results of qualitative research / reliability and validity.

Reliability

Reliability is concerned with the question of whether the results of a study are repeatable. This criterion is particularly at issue in connection with quantitative research (Bryman & Bell, 2007). However, Flick (2009) characterizes the discussion about reliability in qualitative research as coming down to the need for explication in two respects. First, the genesis of the data needs to be explicated in a way that makes it possible to differentiate between a statement of the subject, and the point at which the researcher's interpretation begins. Second, procedures in the field or interview and with the text need to be made explicit in training and rechecking in order to improve the comparability of the behaviour of different interviewers or observers.

The studies conducted are of two main categories: exploration of historical events and observations, and the ongoing development of the telecommunications sector. In terms of the genesis of the data, given that several papers are based upon historical development with most of data obtained from government websites, it should be possible to replicate the major findings, though different views of details can be seen. The formal documentation from government websites is often considered to be stable, unobtrusive and exact (Yin, 1994).

Though Denzau and North (1994) pointed out that individuals with different learning experiences will have different theories to interpret their environment, this thesis does not take any particular individual interpretation as a main part of the thesis. Rather, the thesis has mapped out all views from different individuals or institutions to the government policies in order to point out what has been missing or what the weaknesses of the existing policies are. Therefore, it can be reviewed by another person who would most likely to conduct research from a social science viewpoint.

Only one study of the appended papers, Paper 7, employed interviews,. The reliability of the interview data was rechecked by applying the same interview topic to different related institutions. Also, checking through government websites and internal data received from the involved person was done. Therefore, it is possible to repeat the findings from interviewed data.

Validity

Validity is concerned with the integrity of the conclusions that are generated from a piece of research. There are many types of validity criteria; internal validity, external validity, and ecological validity (Bryman & Bell, 2007). A brief clarification of each criterion and where the studies stand is included below:

Internal validity relates mainly to the issue of causality. It refers to how well the collected data match the reality that they seek to present. One way of doing this is to use different sources of data and then triangulate (Yin, 1994). Only one appended paper, Paper 7, described a study employing interviews. The reliability of the interview data was rechecked by applying the same interview topic to different related institutions. Also, checking through government websites and internal data received from the person involved was done. Hence, the data is validated through these methodologies. Another way of improving internal validity is to compare data with existing literature (Eisenhardt, 1989). A considerable literature review on related issues has been performed through e-journal database, such as, Scopus database, Wiley's online library, Elsevier database, as well as from textbooks. Therefore, a level of internal validity of the findings can be reached.

External validity concerns with the possibility that the results of a study can be generalized beyond the specific research context. It is often argued that case studies impose constraints upon the external validity of the findings, given the explicit focus on a certain event (Yin, 1994). The study that employed case study is Paper 3. Paper 3 was conducted to give an example of sector agenda instrument. The result of the study is not interpreted as a major instrument of telecommunications sector. All nine studies contribute different parts to the whole thesis, which is to develop a new broadband policy framework. Although, taken alone, none of them plays a significant role, but if one is lacking, the conclusion of the thesis cannot be drawn. Also the external validity of the thesis is validated when relating those studies to theory, and thereby the findings of the thesis may become general conclusions.

Ecological validity concerns with the question of whether or not social scientific findings are applicable to people's everyday lives or natural social setting (Bryman & Bell, 2007). Sector and

strategic agenda proposed in the thesis reach ecological validity. Emerging information society environments relate to people's everyday lives, in particular, sustainability. Global warming causing by greenhouse gases is a threat to all of use. Although the telecommunications sector is not a major factor in causing this, improving the situation through information and communications technologies is expected. The thesis does not provide all the solutions regarding sustainability, but it does point out some major concerns which are still lacking in the existing broadband policy as a next step that can contribute to better conditions for sustainability.

3. Development of the telecommunications sector

This chapter provides a basic understanding of the challenges facing the telecommunications sector from different perspectives. This chapter consists of two main parts. The first relates to the structure of telecommunications in general. The main idea is to explain the development of the telecommunications structure from the traditional structure to the current situation. Different initiatives to facilitate or encourage the deployment of broadband infrastructures are also addressed. In addition, this part addresses the new challenges of telecommunications. When telecommunications infrastructures are the basis for improvements in other sectors, the issues to be considered may go beyond the telecommunications industry itself. The second part provides empirical facts on the evolution of telecommunications regulatory frameworks and policy in the EU.

3.1. Development of the telecommunications sector

Information and telecommunications technology is attracting great attention from the public nowadays due to its huge effects on economic and societal development. With more than one hundred years of evolution, the structure of the telecommunications industry today has changed from the time the technology first came to the market. These changes can be divided into three main eras (see Figure 4). The first era was the old structure which is explained in Section 3.1.1. The second era is the existing structure which is explained in Section 3.1.2. The third era is the telecommunications sector as a national strategy, which is explained further in Chapter 4.

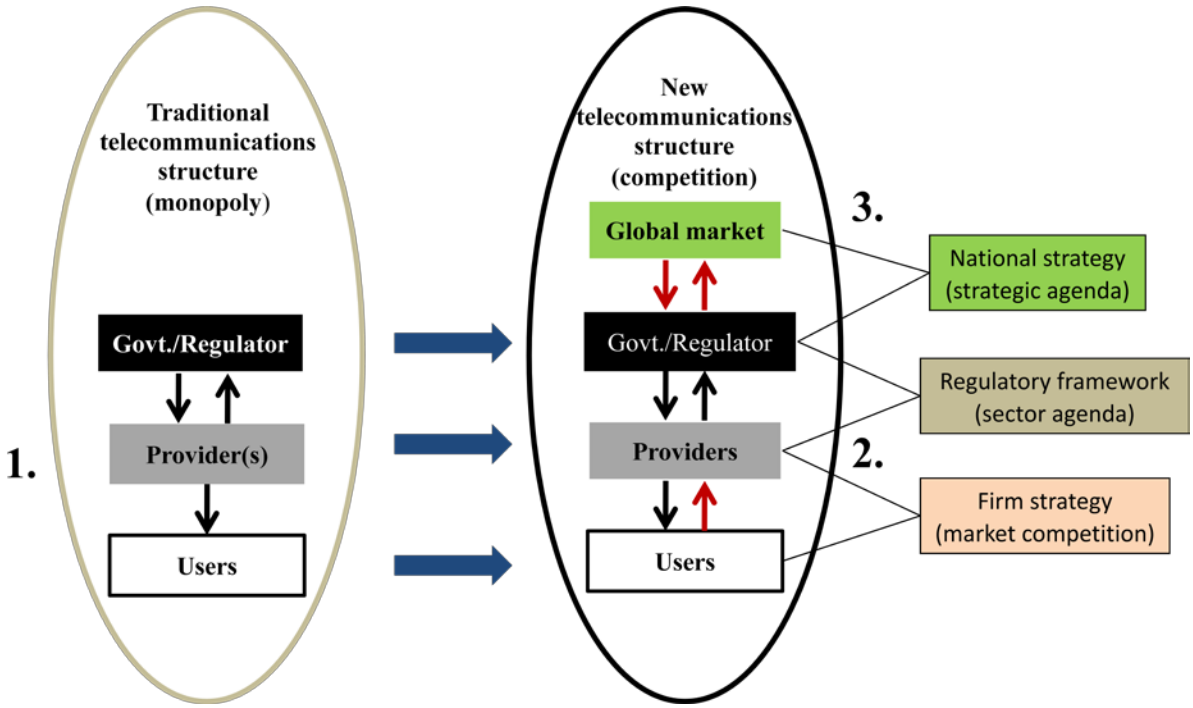

Figure 3 The changing structure of telecommunications

3.1.1. The old structure

The traditional telecommunications structure started at the time when the telephone system was first introduced into the market and continued until the 1970s. During this time, the natural monopoly

regime was applied to the telephone industry in most countries through either a privately or a publicly owned company.

In the United States and Canada, for example, the market was dominated by privately owned companies that were subject to municipal oversight during the late nineteenth century and to regulation by state and federal agencies from the beginning of the twentieth century (Bauer, 2010a). In contrast, telephone and telegraph development took place with much greater government involvement in Europe than it did in the United States. In most countries, private companies played an initial role but were eventually absorbed into a government monopoly (Brock, 1981; Noam, 1992). During the monopolistic period, the monopoly provider was regulated through a universal service regime (Mueller, 1989).

Along with the technological development of broadband technology, such as ISDN, being introduced into the telecommunications market in the 1980s, there has been a transition from the traditional telecommunications structure to the new structure, and the concept of market competition has also been introduced into the telecommunications sector.

During the late 1980s, within a relatively brief period of little more than a decade, the European Commission led the way to abandoning monopolies and replacing them with a more openly competitive market structure (Michalis, 2006). As in the United States, terminal equipment, value-added services and mobile communications were successively opened to new entrants (Bauer, 2010a).

External regulation by specialized agencies was considered a more efficient institutional arrangement than a state monopoly (or at least a second-best necessity during the transition from monopoly to competition). As PTTs were gradually privatized, countries that had historically opted for state ownership, such as European nations, therefore established independent regulatory agencies to oversee the reorganized incumbent service providers. The owner-operators state gradually transformed into a regulatory state (Jessop and Majone as cited in Bauer 2010a).

Throughout most of the twentieth century, state ownership and government regulation were considered alternative, mutually exclusive, forms of public control of sectors deemed to be of critical importance to the economy and society. This situation started to change in the beginning of the 1970s as weaknesses in the state-owned postal, telephone and telegraph companies (PTTs) in providing efficient information and communication infrastructures became noticeable. At the same time, trust in the ability of government agencies to regulate monopolies successfully started to fade and made room for a stronger belief in deregulation and the superiority of market organization and competition (Bauer, 2010a).

3.1.2. The transition from the old structure to the existing structure

The new environment introduced competition into the telecommunications market. This clearly separated the relationship between the government, the providers and the users, but also created a more complex structure. As competition is the underlying principle of the telecommunications market, the role of the regulators is not only to remove the barrier to entry for new entrants but also to maintain competition in the market, and deal with the problem of market dominance. At the same time, when the demand for telecommunications increases, the resulting increase in network capacity coupled with the responsibility to make telecommunications services accessible, available and affordable throughout the respective countries make the role of the regulators even more challenging.

During this stage, as broadband becomes more important to the development of the social economics of countries, many initiatives are implemented around the world in order to meet all the expectations of firms and users, and these initiatives are the tools to serve the sector agenda.

As elaborated in Papers 5, 7, 8, and 9, three different approaches are being used by countries around the world to reach the sector agenda. These are the government approach, the market approach and the regulatory approach (see Figure 5).

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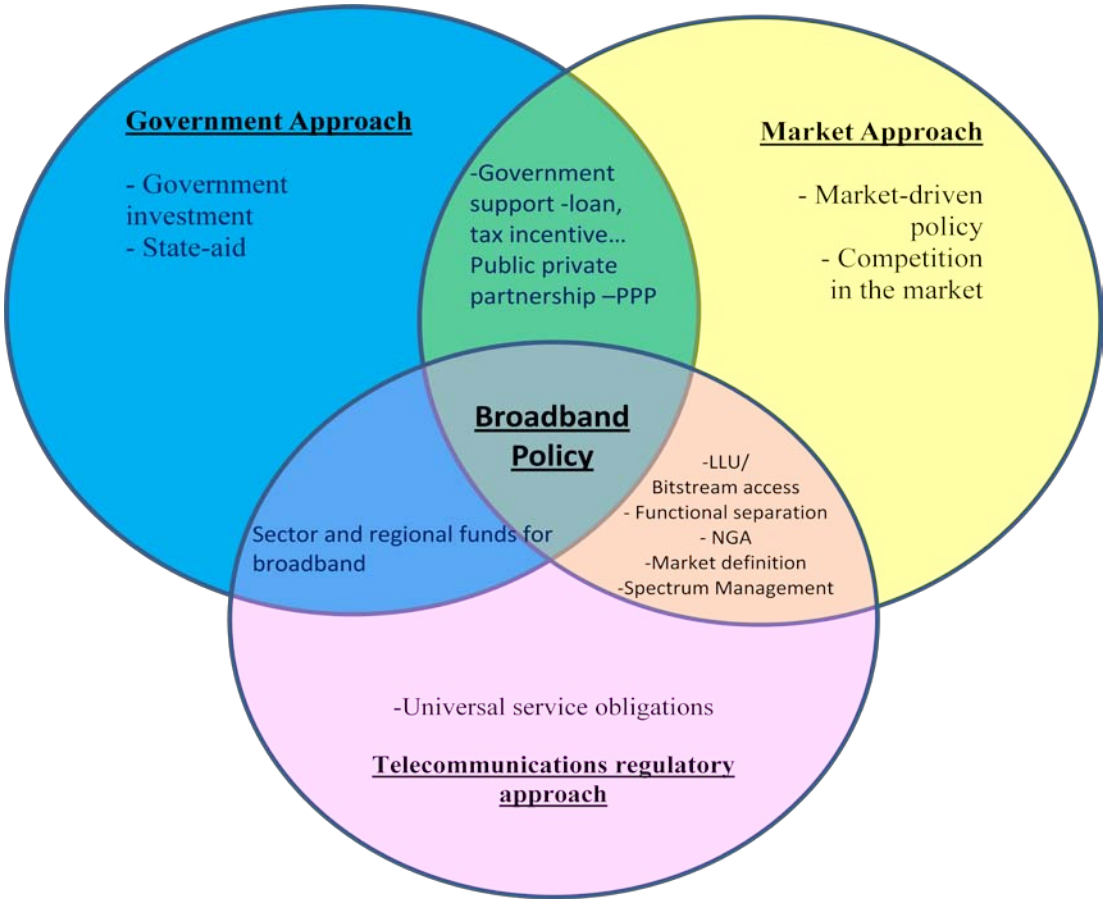


Figure 4 Three approaches of broadband initiatives

a) The government approach

This approach is taken in many different forms by governments. The most aggressive strategies of this type are government investment in telecommunications infrastructures through the budget. The leading countries that have implemented this strategy are Sweden, South Korea and, recently, Australia.

In Sweden, government funding for IT infrastructure expansion to rural areas was backed by laws authorizing funding based on six-year support during 2001-2006 totalling 5.2 BSEK to aid municipalities in rural areas with the expansion of three distinct layers of broadband infrastructure technologies. This was also the case in South Korea where USD 24 billion were spent during the Korean Information Infrastructure-Government phase in the late 1990s (Berkman, 2010). From 1995 to 2000, a nationwide backbone comprising a 155 Mbp-40 Gbp backbone network was established in 144 cities with the objective of upgrading it to Terabps (Lee & Chan-Olmsted, 2004). The latest

country to follow this strategy is Australia. In 2009, the Australian government has initiated the National Broadband Network (NBN) project to invest up to AUD 36bn (USD 37bn) on building a nation-wide fibre broadband network aiming to cover 93% of Australia by 2020 (Li, 2012).

A more modest version of this approach can be observed when the government acts as a supporter or facilitator. The government investment is only made to complement market functioning in geographic areas where there is a lack of broadband infrastructures where there is little incentive for private investment, mainly due to the high fixed cost of deploying infrastructures and the low revenues associated with these areas (Cava-Ferreruela, 2008). Actions of this type taken by governments can therefore be carried out in many different ways, such as providing financial support or incentives to private telecommunications providers or collaborating with those providers to roll out broadband infrastructure. There are several kinds of financial support or incentives for private firms, including low-interest loans, tax incentives, government subsidies and investment incentives. This type of support can be seen in the case of South Korea and Japan. In South Korea, 1.76 billion USD in low-cost loans was spent by the government to support broadband infrastructure (Berkman, 2010).

Another type of government approach that could relate to the telecommunications regulatory framework is the public-private partnership (PPP). PPPs have been implemented in many countries including Sweden, Spain, France, etc. For example, in Sweden, a PPP project known as SkåNet was launched in 2002 in the province of Skåne as a collaborative effort between municipalities and private companies. Tele2 has undertaken to build, own and operate most of the fibre network, but the network is open to all players on equal terms.

The government approach is justified on the basis of market imperfections and inequalities in society. However, this approach has both its advantages and disadvantages. The main advantage is naturally to address market failure and achieve distributional policy. The effectiveness of government programmes that have stimulated broadband supply by public funding, especially to increase coverage in areas where market forces do not deliver the required investment, is also recognized by the ITU (2003). The disadvantages of the approach are apparent if it is not implemented proportionately (Papadias, Riedl, & Westerhof, 2006) and can distort competition, crowd out the market and duplicate investment.

b) The market approach

The market approach relies on competition in the market, can be both inter-platform or intra-platform competition. It is recognized that competition can yield the most benefits to the users in terms of price, quality of service, resource allocation, etc. Fortunately, in the broadband era, the market for retail broadband communication services differs from the markets for local telephony in an important respect: it is emerging in an environment of competition rather than monopoly. Unlike the telephone network (which began as a patent monopoly and, after a brief period of competition, reached maturity as a regulated natural monopoly), every broadband provider has faced actual or imminent competition from the beginning. Broadband in its current early state thus seems more analogous to wireless telephony, which was born as a duopoly, than to voice telephony (Shelanski, 2002).

This approach now seems to be the underlying principle for regulating the telecommunications market in many countries, including some that have implemented this approach (e.g. Japan, the United States and Finland). Japan, for example, has now become a world leader in fibre-optic networks as a result of the competition mechanism in the broadband market during the early era of broadband development (InfoCom, 2002). Another example is Finland (Eskelines, Frank, & Hirvonen, 2008).

The market approach, too, has its advantages and disadvantages. The advantages are that this approach encourages private investment, in particular when demand for telecommunications services is increasing. It also facilitates market innovation when firms need to find strategies to induce new customers while still retaining their existing customers. Firms have now introduced several strategies into the market such as bundled services and new application developments. The disadvantages of this approach are often due to the imperfections inherent in real-world market behaviour. Situations of cream skimming and anti-competitive behaviour may arise if the regulators fail to do their job properly.

c) The regulatory approach

The telecommunications regulatory approach is active at national and international levels. At international level, the European Union, a supra-national organization, has introduced several regulatory frameworks to encourage broadband competition and deployment in Member States. The leading framework that targets broadband can be seen from the proposal to include broadband in the scope of universal service, local loop unbundling, functional separation and, recently, the NGA Recommendation. At national level, this dimension has been implemented by most of the national regulatory bodies around the world such as Ofcom in the UK, ARCEP in France, etc. The current ongoing regulations for broadband service are open access regimes, universal service and functional separation.

Open access regimes require telecommunications providers, mostly incumbents, to make various parts of their networks or services available to their competitors, usually at regulated rates, so that competitors can begin to compete using these components as parts of their service without having to replicate the full investment that the incumbent originally made. There are various types of access, namely: unbundled local loop, shared access, bitstream access and wholesale. As shown by the literature in Section 2, open access policy and unbundling, in particular, played an important role in facilitating competitive entry into national markets of most of the countries in the EU, Japan New Zealand and others. In many cases, even where facilities-based alternatives were available, unbundling-based entrants played an important catalytic role in the competitive market. In some cases, competition introduced through open access has driven investment and improvement in terms of speeds, technological progression, reduced prices and service innovations. Open access policies have also contributed to the success of many of the top performers during the first broadband transition and, as a result, they are now at the core of future planning processes in Europe and Japan (Berkman, 2010). Moreover, the study by Garcia-Murillo (2005) shows that unbundling an incumbent's infrastructure results in substantial improvements in broadband deployment for middle-income countries. This means that governments in less-developed countries can promote the deployment of broadband networks by fostering competition and requiring unbundling of local loops. Unbundling allows other carriers to enter the market, and pressure from competition should force all carriers to provide enhanced services.

Universal service is one of the principles that have long been rooted in telecommunications regulatory development. Although the main objective of open access policy, in particular unbundling of the local loop, is to foster competition in order to yield all the benefits to everyone, low urbanization levels and consequently a high cost of network deployment per user appear to be the main constraints in building a network. Telecommunications reform, together with technological development, brings competition into markets where penetration has increased and the increased coverage may not benefit consumers at all income levels (Clarke & Walsten, 2002). The universal service regime is therefore implemented to guarantee that all citizens can enjoy the benefits of at least basic telecommunications service under the

principles of accessibility, affordability and availability. Details of this regime, which are being discussed in the EU, are provided in Papers 1 and 4.

Functional separation is increasingly being adopted or considered, in an effort to achieve open access to the next-generation transition in many countries such as the UK, New Zealand, Sweden, the Netherlands, Italy and Australia. The justification for this regime arises when the market is viewed as unable to deal with particular structural and/or behavioural problems. As the structure of the telecommunications market emerged in the form of a monopoly, vertically integrated between upstream and downstream elements, integration may be problematic, especially as a vertically integrated firm has the means and motive to practise non-price discrimination in the activity in which it is dominant in order to weaken or eliminate competitors in potentially competitive activities (Cave & Doyle, 2007). Details of this regime are discussed in Paper 3.

The telecommunications regulatory approach, in particular local loop unbundling regulation, is recognized as a successful initiative in terms of increasing broadband penetration in the EU. Nonetheless, this approach also has advantages and disadvantages. The advantages of having regulations in place are that they reduce regulatory uncertainty and prevent discriminatory practices. The disadvantages are that the regulations may discourage investment if they are too strict and cannot respond to immediate changes in the market. An example of the discussions regarding advantages and disadvantages of implementing regulations could be seen in the launch of the NGA recommendation in the EU, which is described in detail in Paper 5.

The three-dimensional approach above suggests that there are many instruments can be implemented for broadband penetration. However, this approach is not about the choices to be made because, in practice, governments have implemented several instruments in parallel, with different emphasis, to increase broadband penetration. Table 8 gives some examples on different instruments that were implemented in different countries. The countries chosen are those with a very high penetration rate.

Table 3 Regulatory instrument implementation in practice
(Source: Compiled by author)

Countries	Public investment	Regulations	PPP	Market competition	Low interest loan	Tax reduction
Denmark	-	++	+	+++	n/a	n/a
France	-	+++	++	+	n/a	n/a
Japan	n/a	++	n/a	+++	+++	+++
South Korea	n/a	++	n/a	++	+++	n/a
Netherlands	n/a	++	++	++	n/a	n/a
Sweden	+++	++	++	++	n/a	+
Switzerland	n/a	++	+	+++	+	n/a
USA	n/a	++	+	+++	n/a	n/a

Note: +++ Plays a major role in government policy
++ Implements, but does not play a major role in government policy
+ Implements but does not emphasize
- Not used at all
n/a Data not available

The above table suggests that there is no perfect instrument to increase national broadband penetration. Which instrument is suitable for a country depends on many factors, including that country's economic and social structure, as well as the size of its economy (Symeou, 2011), economic level

(Cava-Ferreruela & Alabau-Munoz, 2006), population and GDP per capita (Garcia-Murillo, 2005), and socioeconomic status (Trkman, Blazic, & Turk, 2008) .

3.2. Evolution of telecommunications policy in the EU

In telecommunications sector, the EU and its Member States, which are countries with a more centralized political system, show a greater ability of policy-makers to effectively transform industry structure (Bauer, 2004).

The evolution of telecommunications developments in the EU can be viewed in two major periods. In the first period, which extended to 1987, the telecommunications sector was an issue at national level or related to industrial policy. The second period started in 1987 when the telecommunications sector was integrated into the single market policy of the European Commission. Although the main objective of this paper is to analyse the developments of telecommunications policy in the EU since 1987, it is useful to address the previous situation.

In order to address systematically the evolution of broadband policies and regulations in the EU, the development of telecommunications can be divided into four main stages (see Figure. 5).

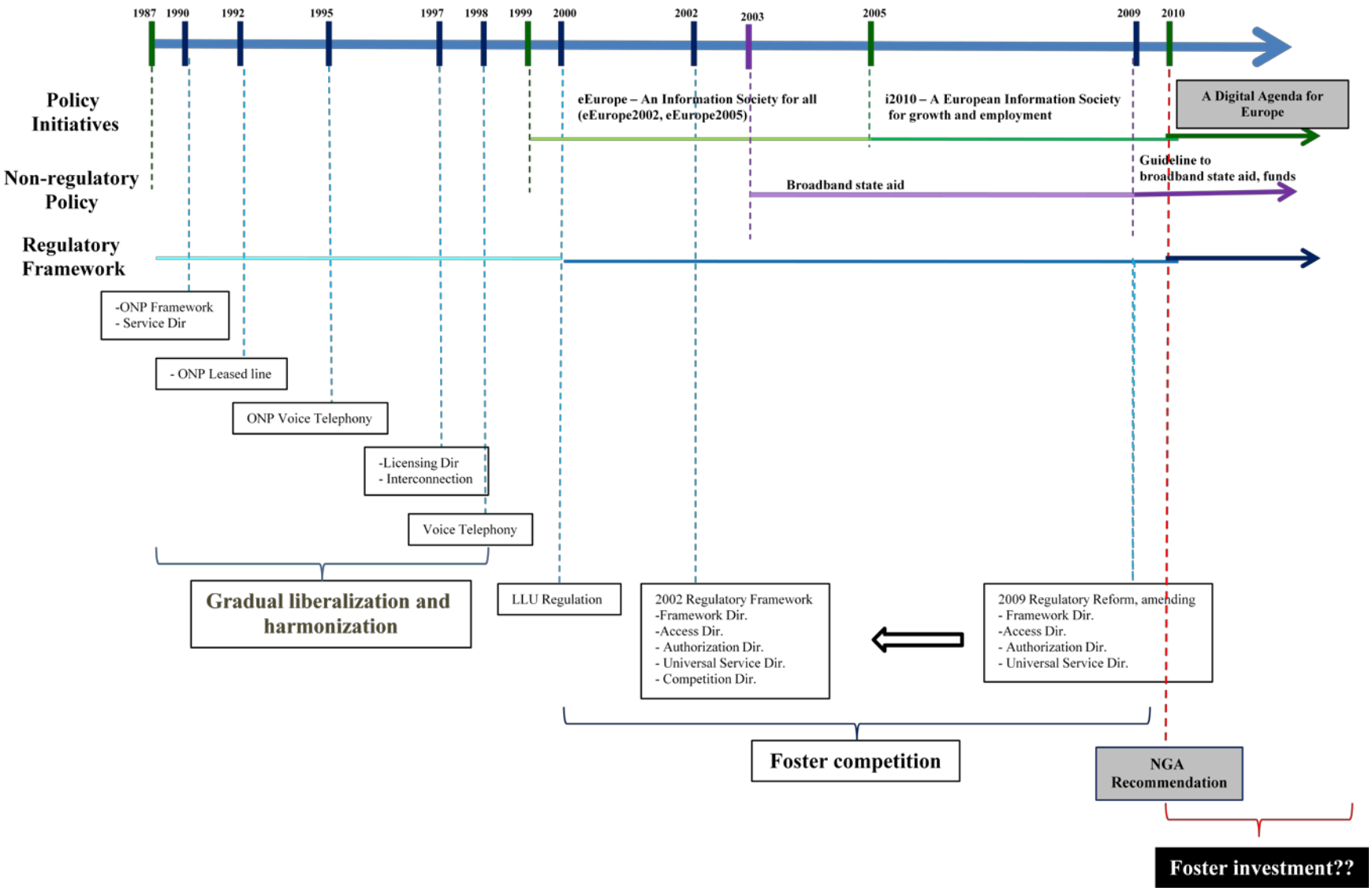


Figure 5 The evolution of telecommunications policy framework in the EU

3.2.1 Development before 1987: a national agenda

For most of the twentieth century, telecommunications throughout Europe had been a state funded, ubiquitous, centralized, hierarchical network operated by state-owned monopolists. The only exceptions were Italy and Spain where mixed public-private and fully private firms offered services (Noam, 1992; Bauer, 2010a). During this period, the Post, Telephone and Telegraph administrations (PTTs) operated the national telecommunications infrastructures and maintained special and exclusive rights over the supply of telecommunications services and equipments (Noam, 1992; Goodman, 2005). The main policies were set by technical experts, who largely stood beyond public scrutiny. The arrangement served the important goal of interconnecting society and operated as a mechanism of redistribution. Also, during this time, there was no involvement from the EU (previously EEC) in this field. The telecommunications policy was purely national and the concept of a European internal market in telecommunications was generally absent from economic, legal or political consciousness (Solomon & Walker, 1996).

Although the traditional monopoly system operated to the economic advantage of equipment firms, the monopoly followed the concepts of public service: universal, accessible, affordable and redistributive. As a public service, telephony was outside the mechanism of the market, even in otherwise free market countries. Any change to this status was bound to be controversial (Noam, 1992). Since the 1970s, telecommunications networks and services in the European Community have been reformed by a number of exogenous factors, such as technological and economic developments (Goodman, 2005), among them the breaking down of cartels and cross-subsidies (Noam, 1992).

In the late 1907s and early 1980s, the realisation that telecommunications infrastructures and services were becoming a decisive factor in determining national competitiveness suggested that new thinking and structures needed to be introduced into the industry (EC, 1984; Solomon & Walker, 1996).

3.2.2. Development during the years 1987-1999: gradual liberalization and harmonization

During the late 1980s, Europe, stirred by a sense that its telecommunications industry was falling behind that of the USA and a few emerging nations in Asia, embarked on an ambitious programme of market structure and regulatory reform. National fragmentation was also seen as a major obstacle to the integration of the European market (Bauer, 2010a).

Under the leadership of the European Commission, over more than a decade, monopolies were abandoned and replaced by a more openly competitive market structure (Michalis, 2006). In the early the 1980s, the European Commission, Council and Parliament began to harmonize national policies to liberalize national and trans-European markets and introduce transparent regulation, and, in 1987, the Green Paper on the development of the common market for telecommunications services and equipment was issued. It was the first major initiative in telecommunications by the European Commission. A two-pronged strategy, liberalization and re-regulation or harmonization, was introduced to the European market. At that time, a broadband vision had already been declared in the 1987 Green Paper, before broadband penetration was recorded. The vision referred to narrowband and broadband as prerequisites for future efficient national, community-wide and worldwide communications, essential to future economic and social development as well as emergency and security purposes. Member States were to ensure that the new digital narrowband and broadband infrastructure would be provided in all Member States within reasonably similar timeframes (EC, 1987).

The main mechanisms implemented during the transition period from the national agenda to harmonization at EU level and from the natural monopoly to the liberalization process relied mainly on regulatory tools, starting with the 1990 Service Directive, which mandated Member States to withdraw all special and exclusive rights to the supply of telecommunications services other than voice telephony. An exception was made for voice telephony to safeguard the financial stability of the incumbent providers (van Eijk, 2004). In addition to the Service Directive, the 1990 ONP Directive was introduced to harmonize principles and conditions for open network provision. With this directive, access to networks and services could not be restricted except for reasons of general public interest. Many regulations were later put in place, such as the 1992 ONP Leased Line Directive, the 1995 ONP Voice Telephony Directive, the 1997 Licensing and Interconnection Directive, and the 1998 Voice Telephony Directive. All of these resulted in the gradual liberalization and harmonization of the EU telecommunications market.

Shaped by nearly 30 directives from the European Commission and the Council since 1988, terminal equipment, value-added services, mobile services, cable services and satellite services were liberalized. In 1998, the last remaining monopoly domain, entry into basic services and network infrastructure, was eliminated (Jordana, 2002). Nevertheless, during this time, there was no policy agenda being set by the European Commission.

3.2.3. Development during the years 1999-2009: fostering competition

The stage of liberalizing and harmonizing the telecommunications market in the EU took more than ten years from the first Green Paper being issued in 1987. By 1998, all market segments were fully liberalized, with regulation gradually shifting from retail to wholesale markets. However, the open access policy that was implemented as a result of the liberalization policy was not enough on its own to maintain competition in the broadband market, and it could not contribute much to broadband growth in the regions where there was still a gap within and among the EU countries. Many policies and regulations have therefore been initiated and implemented, starting in 1999, to cope with competition and broadband growth.

Beginning in the mid 1990s it was increasingly seen as a precondition for the development of a vibrant European “information society”. A first formulation of a European approach to the “Information Society” was expressed in the Delors Paper of 1993 (EC, 1993). At the centre of this paper was a concern for employment and international competitiveness of European businesses. However, the subsequent Bangemann Report (EC, 1994) marked a shift towards a more neo-liberal framework, advocating a withdrawal of the government and the increased involvement of the private sector as the main driver of the European Information Society (Bauer, 2002). Although broadband was recognized for its importance in the policy statement in 1987, the main policy that emphasized the first broadband development, “An Information Society for All”, was introduced in 1999. This political initiative was intended to accelerate positive change in the EU by aiming to ensure that the change towards the information society would be cohesive, integrated and open, so that the benefits of the information society could be accessible to all Europeans (EC, 1999). Together with “An Information Society for All”, the Lisbon Strategy, launched in Portugal in 2000, recognized the importance of ICT to growth in modern economies and opened the way for the launch of the first eEurope action plan in Feira in June 2000. Since that time, parts of the ICT sector have faced a slowdown, though the information society has continued to expand. The creation of a favourable environment for the spread of ICT remains an important responsibility for policymakers (Liikanen, 2005).

During this period, many policies were initiated at EU level to stimulate broadband coverage. Though the primary role of the market as the common approach to broadband deployment was recognized, many regulatory and non-regulatory policies were implemented. Among them the Local Loop Unbundling Regulation in 2000 was issued as a tool to foster broadband growth through competition mechanisms.

eEurope 2002 was introduced in 2001 in order to increase Internet connectivity in the EU. Under this new policy initiative, the adoption of digital technologies was considered a problem due to the fact that not even 5% of Internet users shopped online and only 10% interacted with the government online, even though the Internet penetration rate was about 40% of the population at that time (EC, 2001). The adoption of the regulatory framework for electronic communications was therefore given as one of the priority areas to be implemented. The new regulatory framework was issued in 2002 with the main objectives of promoting and sustaining an open and competitive European market for communications services and consolidating the internal market in a converging environment. It is important to note that the issue of having a high-speed infrastructure was also set as one of the priority areas, but it was directed as a primary task for the private sector to deploy the networks without any guidance except that Member States should work towards co-ordination of frequency allocations and promote interoperability.

In 2002, eEurope 2005 was proposed to stimulate the development of services, applications and content while speeding up the deployment of secure broadband Internet access (EC, 2002a). Under this policy agenda, the focus was on having wide availability of broadband access, and the use of the new regulatory framework for radio spectrum policy to guarantee frequency availability for wireless broadband services and support for broadband access in less-favoured areas were mentioned as main activities. Under the broad policy framework of eEurope 2005, there was no proposal for changing the regulatory structure. Instead, non-regulatory policies were put in place, such as the state aid mechanism for the deployment of broadband infrastructure in rural areas in 2003. Up until February 2010, almost 60 broadband projects were approved in compliance with the state aid rules.

i2010 was the last policy agenda for broadband issued at this stage. It was introduced in 2005 with the aims of coordinating the actions undertaken by Member States to facilitate digital convergence and respond to the challenges associated with the information society (EC, 2005). In order to foster an open and competitive internal market for the information society and the media, the first objective of i2010 was to establish a Single European Information Space offering affordable and secure high-bandwidth communications, rich and diverse content and digital services. Under this objective, the aim was to increase the speed of broadband services in Europe, therefore, the Community Guidelines for the application of state aid rules in relation to rapid deployment of broadband networks and the review of the regulatory framework for electronic communications were in addition issued in 2009.

3.2.4. Development from 2010 onwards: fostering investments

Policies, non-regulatory policies and regulations implemented in the third stage resulted in high broadband penetration in many EU countries. Although Europe may have some of the highest broadband penetration rates in the world, the rest of the world is catching up, and some countries have better quality networks. As the high growth rate of broadband deployment in the EU is largely based on DSL technology, this will make Europe less competitive in the long run (Kroes, 2010). The target for fast and ultra-fast Internet access was chosen because of the central role it will play in economic recovery and in providing a platform to support innovation throughout the economy, as electricity and transport have done in the past (EC, 2010a).

In 2010, a new initiative was therefore proposed by the European Commission under the Europe 2020 Strategy. Under this new strategy, one flagship initiative to promote "smart growth – an economy based on knowledge and innovation" is the Digital Agenda for Europe (EC, 2010b). Its aim is to deliver sustainable economic and social benefits from a Digital Single Market based on fast and ultra-fast Internet and interoperable applications, with broadband access for all by 2013, access for all at much higher Internet speeds (30 Mbp/s or above) by 2020, with 50% or more of European households subscribing to Internet connections above 100 Mbp/s (EC, 2010b).

Nevertheless, the deployment of this new fibre-based network requires substantial investment. The key is to stimulate investment in fast Internet access beyond the current market-driven level of development. Many strategies have been put forward, among them the NGA Recommendation. The NGA Recommendation has been issued to provide regulatory certainty to investors and foster competitive investment and innovation for the benefit of all parties involved and, ultimately, for consumers. At the same time, the NGA Recommendation attempts to build a continued, consistent approach to competition in telecommunications in line with previous legislation at EU level, especially on the LLU. The new NGA Recommendation has many aspects that need to be discussed, but the main focus of this paper is the role of the NGA Recommendation in the context of serving both the strategic agenda, in order to foster competitive investment and enhance national and regional competitiveness, and the sector agenda, in order to maintain competition in the telecommunications market.

At the same time, the issue of using the ICT sector in a key role to improve energy efficiency is mentioned. In so doing, the ICT sector should lead the way by reporting its own environmental performance by adopting a common measurement framework as a basis for setting targets to reduce energy use and greenhouse gas emissions of all processes involved in the production, distribution, use and disposal of ICT products and the delivery of ICT services together with cooperation between the ICT industry, other sectors and public authorities, in order to accelerate development and wide-scale roll-out of ICT-based solutions (EC, 2010c).

3.3. Research outlook

The literature shows that a considerable amount of research on the EU telecommunications policies has been conducted. This can be categorized into four main groups: research on the overall picture of telecommunications policy being adopted, research on specific regulatory tools or measures, comparative study between different implemented strategies, and research on a new perspective of telecommunications sector.

3.3.1. Literature focusing on telecommunications policy in general

Literature in this category focuses on an overview of the telecommunications sector when the information society initiatives were introduced in 1990s. Several concerns were raised in many articles as to how the Information Society initiative could succeed, and what the possible obstacles that would have to be faced.. A summary of those articles is presented in Table 4.

Table 4 Summary of literature on telecommunications policy

Research findings	Author(s)
The major problems for Europe are not at the bureaucratic level or at the level of awareness within the Community but relate to the conflict between the more protectionist measures Europeans defend in audiovisual matters and the more deregulatory proposals Europe makes in telecommunication matters	Burgelman & Pauwels, 1991

Whether or not the policy would succeed and yield all benefits to an economy depends on the role of governments. Apart from an expansion of the physical transmission capacity, comprehensively coordinated national and international policies by government and industry were essential. However, the rush to make commitments to promote the construction of information superhighways at the most rapid pace possible can only help the dominant supplier industries and countries in the short run.	Melody, 1996
It will be necessary for European regions to have a policy that guarantees a coherent development of basic networks, infrastructures and services	Albau, 1997
Government policy should not favour or disfavour any type of plan to provide these services; instead, government should act as a referee to ensure competitive service provision	Hundt & Rosston, 1998
The issues of the balance between technology and its impact on citizens in the information society era are important. Particular attention should be paid to the problems of illegal and harmful content, copyright, social inequalities, privacy and censorship, impact on democracy, and citizens' knowledge and acceptance of the information society.	Kofler, 1998
The issue of welfare state will arise again in the information society. ICT plays a crucial role on social contract due to the increasing economic performance of telecommunications and mass media services in terms of growth potential and the creation. This implies that the debate on the regulation of communication is not only important to guarantee equal access, as it was in the old context, but also is fundamental to the rise of the information society, as such.	Burgelman, 1999
The role of European institutions in defining a new policy was of key importance in fostering innovation in the Member States.	Schneider, 2002
Convergence-related policy should take into account: the development of markets and technology which is expected to be strongly dynamic in the foreseeable future; integration of sustainability with the information society concerns promises to be a fundamental research agenda, with important links to telecommunications policy research	Bohlin, 2003
Public policy and regulation can promote the positive outcome in the EU market by the pursuit of a strategy of regulatory disengagement. A deregulatory (or re-regulatory) package must take into account the possible continuing need to regulate access networks, while at the same time retaining investment incentives both for incumbents and new entrants	Cave, Prosperetti, & Doyle, 2006
Under the development of the information society, the scenario of public participation in the deployment of telecommunication networks reliant on public support will likely appear globally. Many digital policies (eInclusion, eHealth, eGovernment, and eParticipation) share the same basic axiom of preventing exclusion. Therefore, the relationship between public and private can (and should) be put in a wider, more social and citizen-centric context. Understanding these new relationships is key to the development of next-generation communications because they are no longer isolated from issues of general socio-economic welfare.	Gómez-Barroso & Feijoo, 2010

From the above articles, several implications can be drawn. Firstly, the role of government policies is important for the development of telecommunications sector. Secondly, government policy has increased importance in the information society era because many issues must be addressed, such as, innovation, market and competition, social impacts, digital divide, and technological development. Thirdly, the relationship between public and private entities will be broadening into more social and citizen-centric context.

3.3.2. Literature focusing on regulatory instruments

A number of studies regarding the implementations of regulations or some other measures have been conducted. A summary of this literature is presented in Table 5.

Table 5 Summary of literature on regulatory instruments

Research findings	Author(s)
Inter-platform competition is the main driver to stimulate broadband adoption in the EU. Also, lower unbundling prices stimulate broadband uptake.	Distaso, Lupi, & Manenti, 2006
The policy enforced by the local NRAs is more important than the existence of an alternative infrastructure. The appropriate national policy and strategy would depend on the competitive nature of the market itself (weak or mature). Mature markets should focus on competition and market-monitoring issues, while weak markets should focus on the multiple options of bitstream access and the imposition of cost orientation, non-discrimination and service transparency.	Polykalas & Vlachos, 2006
Steps be taken fully by the EU is to mobilise incentives to invest in next generation networks where there is competition	Huigen & Cave, 2008
PPPs are an appropriate instrument to implement a broadband infrastructure in areas with unattractive economic conditions. They involve mutual collaboration between public and private partners, especially in case of market failure.	Lattemann, Stieglitz, Kupke, & Schneider, 2009
Implementation of public-private partnerships (PPP) can be launched by not only traditional telecommunications operators but also by non-traditional operators, for instance utility companies (mostly in fiber), and by non-profit organizations.	Falch & Henten, 2009
The EU needs to consider more specific guidelines for addressing separate geographic markets, and the criteria for NRAs to choose between sub-national markets or differentiated remedies.	Houpis, Lucena Betriu, & Santamaria, 2011
Municipal initiatives are highly dependent on national factors. The resulting interventions bear strong resemblances within a single country, while they can be substantially different in trans- national contexts. Thus, national regulatory frameworks may need adjustments to handle emerging access monopolies of regional and city broadband infrastructures.	Troulos & Maglaris, 2011
None of the three European markets, the Netherlands, the UK and Sweden, is advanced enough to rely entirely on market forces to boost NGA deployment and incentives of some form are required at the early stage of network deployment.	Ragoobar, Whalley, & Harle, 2011

The literature shows that, several regulatory instruments are implemented in telecommunications market in order to maintain competition and stimulate broadband penetration. However, a lesson can be drawn from the literature that there is no particular instrument that fits every market. Geographical differences may favour the selection of different instruments. In addition, apart from facilitating deployment by private operators through regulatory instruments, alternatives to deploy broadband infrastructures are PPP and municipal initiatives.

3.3.3. Comparative studies regarding different countries

Comparative study between countries which implement different strategies to deploy broadband networks were conducted. A summary of those literatures is provided in Table 6.

Table 6 Summary of literature on comparative study

Research findings	Author(s)
Comparative study between the US and Europe on the relationship between infrastructure investment and regulatory policy changes suggest that a lower access price promotes greater deployment of digital technology among US incumbent local exchange carriers. As for the EU, competition has worked by facilitating new entry through decreasing interconnection prices	Chang, Koski, & Majumdar, 2003
Using data from 30 OECD countries during 2000-2002, the results suggested that the broadband coverage is mainly explained by the economic level of the country. Nevertheless, the existence of strong competition among broadband technologies (i.e., between DSL and cable networks) seems to be the major driver for broadband deployment. However, low urbanization levels, and the resulting high cost of network deployment per user, appear to be the constraints for building network.	Cava-Ferreruela & Alabau-Munoz, 2006
From a comparison on the policy for DSL and cable modem in the European Union, Korea and the US, the results, in particular for the EU, show that with regard to public-good-related aspects, Member States have stressed different measures to support broadband on the supply as well as the demand side. However, most of these measures yield increasing demand for broadband or the deployment in rural areas, and can therefore be described as soft or medium interventions. From a competition-related perspective, the most striking aspect of Europe's regulatory framework is the concept of neutrality concerning different technological platforms, which leads to the view of a single broadband market. Local loop unbundling and access obligations play important roles throughout Europe and have contributed to high deployment rates in countries lacking alternative infrastructure, as well as in countries with competing platforms.	Picot & Wernick, 2007
Three underlying factors that can explain the differences seen in BB development between EU-25 countries: (1) enablers and means which include broadband penetration, PC access, telework usage, household income, broadband service price; (2) usage of information services which include electronic purchasing, Internet usage for information retrieval; Internet usage for gaming; and (3) the information and communication technology sector environment which includes communications technology expenditures, number of phones, Internet access over phone, population density, and education level.	Trkman et al., 2008
This study compares broadband rollout policies in Finland and Sweden. The study shows that the contrasting policy approaches of Sweden and Finland – (a publicly funded broadband network was defined as an important part of the Swedish strategies, whereas the Finnish one concentrated on promoting competition) have not led to any major differentiation in terms of broadband use.	Eskelinen, Frank & Hirvonen, 2008
Based on a sample of OECD countries, the analysis finds that inter-platform competition has been a main driver of broadband penetration. The two types of intra-platform - facility-based and service-based, competition - have a considerably smaller effect on the broadband penetration. Linking these findings back to access regulation suggests that the stepping stone or ladder of investment theories might not provide the justification to impose extensive mandatory access obligations on DSL incumbents.	Bouckaert et al., 2010

From an international comparison on next generation access (NGA) supply-side interventions, most countries are using many different policy instruments and combine them to an overall strategy. Therefore, combined instruments shall support demand and supply side in parallel not only in infrastructure rollout, but also in fostering the availability of applications, services, and content. If economic and social goals are the key drivers for policy interventions, the main focus is on the improvement of the regulatory framework and accompanying measures to incentivize investment. In these countries the belief in market forces as driving elements is growing. Thus, limited intervention in the market is foreseen.	Ruhle, Brusic, Kittl, & Ehrler, 2011

From comparative studies, a conclusion can be made is that the growth of broadband penetration depends on three major factors: regulatory policy whether based on competition mechanisms or government intervention, regulatory instruments such as inter-platform competition or access pricing regime, and socio-economic factors. There is no perfect recipe that can apply to every country, however, experiences of countries are worth learning.

3.3.4. Literature concerning a new role for the telecommunications sector

A number of articles mentioned the new challenges of telecommunications sector. A summary of those studies is given in Table 7.

Table 7 Summary of literature on a new role for telecommunications sector

Research findings	Author(s)
Concern for sustainability has been rising on the world scene as one of the most important issues for the future of mankind. Sustainability is now viewed less as an exclusively ethical or redistributive question and more as a question of enlightened self-interest. Industrialization and growth without attention to sustainability may not only be problematic for some ill-fated groups in society, but may seriously limit any region's aspiration to prosperity, as the dynamic repercussions of non-sustainability on its citizens may be significant and unexpected. While the information society will certainly restructure distance and time constraints, and hence the need for certain types of transport, the emerging new net-based market structure and increasingly information-based consumption may serve to increase environmental pollution as well.	Bohlin, 2001
Important as ICT is, achieving sustainability does not happen by itself, this cannot be done automatically or through some technical quick fix, but requires supporting changes in the system. That is, the systems of incentives, political support and stimulation. ICTs needed also to be translated into a systemic concept if the social sustainability of the information society is to be achieved. In particular, the information society raises a challenge to achieve bold changes in the political and administrative spheres. The opportunities arise from changes in society as much as from changes in the technology itself. But making gains from these will require multi-level efforts.	Ducatel, 2001

Broadband contributes to environmental sustainability on many different levels. It increases access to information, improves international accountability, provides a platform for lobby groups and concerned individuals to raise awareness and creates new markets for sustainable products. Broadband will be central to international activity to reduce carbon emissions, and manage the risk that changing environmental conditions will bring to the growth of the clean technology industry. The application of broadband to these purposes is the true value of the infrastructure. The key to ensuring a sustainable society will be dependent on ICT developments adhering to environmental sustainability principles and committing to a life cycle management approach.	Dodd, 2007
Without the active participation by both State and Federal Governments to support both the development and expansion of high speed broadband into the non-metropolitan areas, the potential for action to be taken by these communities to conserve and protect the environment is constrained. While it would be desirable for private enterprise to initiate the collection and aggregation of the information on environmental issues made available by technology for provision or sale to the agricultural industry, without some commitment by government decision-makers, this is unlikely to happen.	Saunders, 2007
Wide adoption and use of broadband applications can achieve a net reduction of 1 billion tons of greenhouse gas over 10 years, which, if converted into energy saved, would constitute 11% of annual U.S. oil imports. Also, reduced energy use and lower greenhouse gas emissions associated with information technology and broadband use are significant and deserve to be an important consideration in developing a comprehensive energy policy. Focusing on ways to use these technologies as a tool to change behavior and energy use may achieve even greater savings.	Fuhr & Pociask, 2007
Although there are various ways in which households can use broadband technologies to reduce consumption of resources in activities, Australian households have not yet embraced these practices in any substantial numbers. The majority of Australian adults do not access the Internet daily; thus it is perhaps not surprising that the number of users conducting various activities described above is low. Another serious concern is the limited availability of high quality broadband connections outside metropolitan and regional centres. This means that the areas that could reap the biggest benefit by substituting Internet usage for travel are least likely to gain the capacity to do so.	Middleton, 2009

The above articles suggest that moving towards an information society raises a challenge to telecommunications sector because the opportunities arise from changes in society as much as from changes in technology itself. Therefore, the role of telecommunications sector is not only a means to communicate but it can contribute to environmental sustainability. However, this new role cannot be achieved without support or active participation from governments.

3.4. Summary and implications for the thesis

Key characteristics of the evolution of the telecommunications sector can be summarized as following:

Firstly, the market structure of telecommunications structure has been transformed from a monopoly to a competition-based structure. However, telecommunications sector under competition structure creates more complexity then in the past due to the presence of market power and increasing demand. Many initiatives have been implemented within the three approaches as referred in Section 3.1.2 to deal with this complex situation.

Secondly, as for the EU before 1987, the telecommunications sector in the European countries at the national level was operated by state-owned monopolies. The telecommunications sector was integrated into the single market policy of the European Commission in 1987 whereby competition was introduced to the EU market. Changing from a monopolistic structure to a competition-based structure was done gradually through several regulatory instruments.

Thirdly, the first broadband policy of the EU, An Information Society for All, was introduced in 1999 in order to stimulate broadband growth. The main regulatory instrument, the Local Loop Unbundling was issued in 2000 as a means to foster competition in the telecommunications market. In addition, several policies and non-regulatory instruments such as state aid mechanisms were issued and implemented in the later years to increase broadband penetration and speed.

Fourthly, since fibre technology has a very low deployment among broadband technologies, fostering new investment has been set as a policy target in the latest policy, the Digital Agenda for Europe, in order to increase competitiveness. The policy also addresses how the ICT sector can contribute to sustainability in other sectors. The Digital Agenda for Europe comes with the NGA Recommendation as a tool to achieve the policy goal of fostering new investments.

The literature review in the previous section provides the basic ideas for understanding how broadband has been viewed by academic research and what the primary focus is of that research. There are several implications in relation to this paper.

(a) Most of the literature focuses on industry interest of telecommunications sector, which is about development within the telecommunications industry, itself. Much attention has been paid to policies and regulatory measures, particularly those that develop over time. An observation can be made that the main aim of these policies and regulatory measures is to increase the penetration rate or cope with market and technological developments in the telecommunications sector.

(b) Along with technological development, broadband connectivity is widely accepted as having strategic importance to all countries in moving them towards an information society. The results of broadband penetration can be evidenced in growth and productivity in many studies not listed here. At the same time, the outcomes of being an information society in the EU are not only improved quality of life for EU citizens, but also a greater ability for the EU to compete in the global market as a result of globalization. Even though some research points to important issues for which the EU needs to be prepared in order to move towards an information society, most of them do not touch on the issue of how much impact government policy has on the market and society in terms of influencing changes in the whole system.

(c) There is growing concern over environmental issues all over the world as a result of natural disasters. Some research raises the issue that telecommunications technologies, in particular broadband, can support a reduction in energy consumption in other sectors. Some research also points out the negative impact of ICT equipment in terms of energy consumption and that although ICTs are important in achieving sustainability, they cannot do it by themselves or by any technical solution without supporting changes in the system. However, very little research has been conducted that integrates the challenges of telecommunications into broadband policy. Also, few studies recognize the interrelatedness of telecommunications policy and sustainable development.

4. Challenges facing the telecommunications sectors

As mentioned in previous chapter, the new telecommunications structure is an integration of three main aspects: a national strategy, a regulatory framework and a firm strategy. This chapter addresses national strategy in relation to telecommunications sector. A national strategy is a country's vision for the future. It is a long-term development that requires collaboration and participation by every sector in order to strengthen the capability of a nation to compete on the global market. It is therefore crucial to explore the new challenges facing the telecommunications sector. This chapter, together with Papers 2 and 9, addresses some significant challenges facing the telecommunications: competitiveness and sustainability. More specifically, it provides empirical perspectives, and their relationship to the telecommunications sector.

4.1. Competitiveness

The world has been in a process of structural transformation for over two decades. This structural transformation can be associated with the coming of broadband technologies to the telecommunications industry. A new dimension that has been added to the telecommunications structure is the global market, because of the ability of broadband networks to connect people in every part of the world. An advanced broadband infrastructure becomes a major factor for a society in moving towards an information society. The national network becomes a global network. The national market becomes a global market (Castells, 2005). Every country has to compete in this new market, particularly developed countries, in order to maintain its leading and powerful position at international level. In the era of globalization, international markets have become a substitute for domestic markets, especially for small countries. There is vast empirical evidence showing that trade openness is positively associated with growth (World Economic Forum, 2009).

Technological development, particularly broadband, is not only technology for improving the quality of life of people. Each national government must realize its country's potential to compete in the global market in both the short run and the long run. According to Cowhey (2009), global market governance – whether by informal or formal agreements or by institutions – is important because choices about the design of market governance influence innovation and efficiency in the global ICT market, and help determine who the winners and losers will be. International institutions, for example the ITU, OECD and WTO, often make and administer rules for the marketplace, including technical cooperation on standards and competition rules. Initially, changes at the technological frontier induce stakeholders to reconsider their market interests.

There are many issues from a global perspective that can be improved by having an advanced broadband infrastructure. A nation's competitiveness is one of these. Several criteria are used to judge the level of a nation's competitiveness, including the penetration of an advanced telecommunications infrastructure, which is crucial. Broadband is becoming vital to business and offers such competitive advantages that it is being compared with utilities like water and electricity (UNCTAD, 2006). The availability of a telecommunications infrastructure benefits users and downstream industries. Users can easily access information and communicate with others. At the same time, having a good telecommunications infrastructure also enhances efficiency in other sectors, such as transport, education, health care and emergency services – all sectors regarded as major factors in improving national welfare.

Competitiveness is a measure of a country's comparative advantage or disadvantage in selling its products on international markets. It refers to the ability of companies, industries, regions or

supranational regions to generate relatively high income and employment levels on a sustainable basis while competing internationally (OECD, 1996). Many criteria can be brought into account when measuring level of competitiveness, and those criteria differ among institutions such as the Global Competitiveness Report of World Economic Forum, or the World Competitiveness Scoreboard of the IMD. However, even though these instruments contain different factors, availability of telecommunications infrastructures is always one of them.

In addition, the relationship between the information and communication technology environment (e.g., information society, innovation and R&D and network industries) and global national competitiveness is supported by academic research. Liberalization positively influences network industries, which, in turn, positively influence global national competitiveness (Sarker, Cavusgil, & Aulakh, 1999: Katos, 2009). Katos (2009) demonstrated that determinants of the economic environment positively affect global national competitiveness. Specifically, the relationship between liberalization, financial services, enterprise environment, social inclusion and sustainable development, on one hand, and global national competitiveness, on the other, is mediated through the information society, innovation and R&D, and network industries. Camagni and Capello (2005) pointed out that incomplete competitive markets and network quality gap are factors that reduce competitiveness.

As for the EU, the European Council recognized that implementing the information society is critical for improving the competitiveness of EU industry and, more generally, meeting the demands of society and the EU economy (European Council, 1995). However, the European Competitiveness Report 2011 (EC, 2011a) states that despite all past successes, the shortcomings within the internal market and its unexploited opportunities remain major challenges that hold back the EU's competitiveness Hence, five key priorities of the October 2010 Industrial Policy Communication are proposed, three of which are related to telecommunications sector;

- The need to deliver the right framework conditions for industry and ensure that EU policies all work together in the same direction. To achieve this, all important policy proposals impact industry (e.g. environmental standards or new Single Market and competition legislation) should undergo a detailed assessment of their overall impact on industrial and sectoral competitiveness before implementation.

- The Single Market plays a role in fostering industry's competitiveness, but needs to address its shortcomings. For example, the efficiency of the Single Market crucially depends on the quality and efficiency of the energy, transport and communications infrastructure. The related policies should therefore be considered integral parts of an integrated industrial policy approach. Also, the provision of business services is becoming ever more crucial for modern industry, and the Single Market needs to be modernised in this area.

- Industry must be accompanied in its transition to a low carbon resource efficient economy. Indeed, combating climate change and increasing resource efficiency should not be seen exclusively as a burden on companies, but also as an opportunity for sustainable growth and gaining competitive advantage.

4.2. Sustainability

4.2.1. Overview of sustainability

Climate change is perhaps the most critical issue of humankind at this time, being one of the most profound challenges ever to have confronted social, political, and economic systems. The consequences of many disasters for example, Hurricane Katrina in the US in 2005, the 2011 tsunami in Japan, or the great snow storm in Eastern Europe in 2012 affected whole societies, which may not be able to achieve short-term recovery. Instead, this problem calls for the realization by every part of society that nature is at risk and needs to be protected.

Rockström et al. (2009) indicates that humanity has already transgressed three planetary boundaries, among them climate change (see Figure 6).

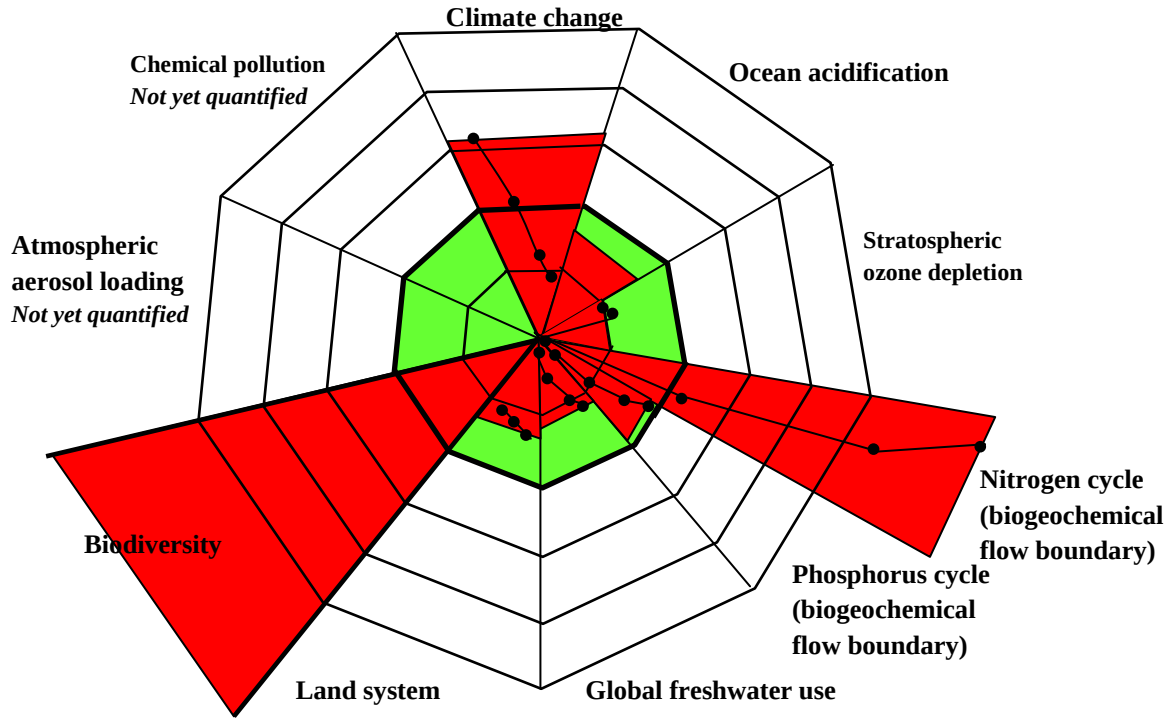


Figure 6 Nine planetary boundaries
(Rockström et al., 2009)

The very nature of climate change, with its multiple driving forces, makes it a complex problem The current observed warming trend is driven primarily by a suite of greenhouse gases, including methane, nitrous oxide, and tropospheric ozone, in addition to carbon dioxide (the most important of the gases) (Steffen, 2011).

According to Forster et al. (2007), human activities result in emissions of four principal greenhouse gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and the halocarbons (a group of gases containing fluorine, chlorine and bromine). Among those four gases, carbon dioxide has a very long residence time – on average, about 100 years. This means, however, that a significant fraction of the carbon dioxide emitted at any one time will still be present 500 years into the future (IPCC, 2007). The policy implication of this fact is that delays in reducing emissions lead to an accumulation of the gas in the atmosphere that will continue to influence climate for a very long time (Steffen, 2011).

The idea of sustainability dates back more than 40 years, to the new mandate adopted by the IUCN in 1969. The concept was coined explicitly to suggest that it was possible to achieve economic growth and industrialization without environmental damage (Adams, 2006). As the Brundtland Commission stated in 1987, “Humanity has the ability to make the development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs”.

The core of sustainability thinking has become the idea of three bottom lines: environmental, social and economic (see Figure 13) (Elkington, 1998). There is little consensus among experts in each discipline on how the ecological, economic and social systems are related to one another (Robinson & Tinker, 1999). Even most policy analysts do not perceive a real connection between environmental problems and either economic or social policy (Paehlk, 2004).

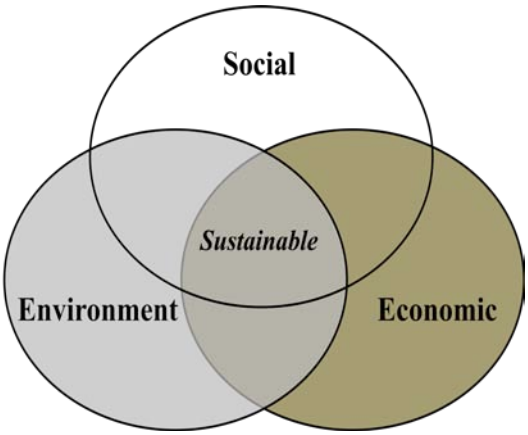


Figure 7 Three bottom lines of sustainability
(Elkington, 1998)

The tension between the social good and industrial benefit that is inherent in the sustainability problem has been long recognized in social science. Traditionally, political science has studied man's behaviour in the public arena; economics has studied man in the market place. Political science has often assumed that political man pursues the public interest. Economics has assumed that all men pursue their private interest, and has modelled this behaviour with a logic unique among the social sciences (Mueller, 2003). In addition, sustainability needs to be made the basis of a new understanding of human aspiration and achievement. This is not currently central to thinking about social and economic development choices, which separate political and economic risk into the mainstream of debate, and sidelines environmental quality and risk to the arena of scientific disagreement or some secondary concern about quality of life (Adam, 2006). Rather, it is an issue for the whole society that requires the cooperation of every sector.

Nevertheless, the three dimensions are not really attained in practice because governments, businesses and other actors do allow trade-offs and put the greatest emphasis on the economy above other dimensions of sustainability, in particular environment protection (Adams, 2006). Robinson and Tinker (1998), however, proposed two strategies to achieve sustainable development - dematerialization and resocialization strategy. Dematerialization strategy, by developing more environmentally friendly technologies, can succeed in reconciling economic and environment goals. Resocialization is a strategy to reconcile economic and social goals.

In the EU, the concept of sustainable development is also adopted by the European Commission. It comprises three elements - economic, social and environmental - which have to be considered in equal

measure at the political level. The strategy for sustainable development, adopted in 2001 and amended in 2005, is complemented, *inter alia*, by the principle of integrating environmental concerns with those European policies that impact the environment. In July 2009 the European Commission adopted the Review of the EU Sustainable Development Strategy (EC, 2009b), which underscores that in recent years the EU has mainstreamed sustainable development into a broad range of its policies. In particular, the EU has taken the lead in the fight against climate change and the promotion of a low-carbon economy.

In December 2009, the European Council affirmed that sustainable development remains a fundamental objective of the European Union under the Lisbon Treaty. As emphasised in the Presidency's report on the 2009 review of the Union's Sustainable Development Strategy, this strategy will continue to provide a long term vision and constitute the overarching policy framework for all Union policies and strategies. Significant additional efforts are needed to curb and adapt to climate change, to decrease high energy consumption in the transport sector and to reverse the current loss of biodiversity and natural resources. The shift to a safe and sustainable low-carbon and low-input economy will require a stronger focus in the future.

In 2011, the European Commission has published a monitoring report of the EU sustainable development strategy (EC, 2011b). Even though the telecommunications sector is not specifically targeted under the sustainable development theme, at present, some data presented in the report is referred below.

Firstly, availability of e-government is widespread in the EU and has been steadily increasing, from 58.3% in 2004 to 84.3% in 2010. The European Commission recently concluded that "Europe has continued to make progress in the delivery of online public services towards meeting the objectives of the Lisbon Agenda and the i2010 e-Government Action Plan. However, this increase masks substantial differences between services for businesses and services for citizens: the former have almost reached saturation with 83% availability while the latter, with 63% availability, shows a significant shortfall".

Secondly, the economic upturn of 2003 to 2007 has not led to above average increases in labour productivity growth due to several factors, among them the relatively small size of the EU's information and communication technology industry

Thirdly, because of the economic crisis, household expenditure dropped by 3.1% (or EUR 368 per inhabitant) between 2007 and 2009. Reduced expenditures on transport (-5.0 %), other goods and services (-4.3 %), entertainment (-3.9 %) and food and drink (-3.6 %) drove this decline. Even though expenditures on housing and utilities and on communication continued to increase, they grew at a lower rate than before the crisis. The biggest increases were in communications (4.4 % per year). This implies that the increasing use of communications technologies continue despite the economic crisis.

4.2.2. Sustainability and the telecommunications sector

Currently, the information society has become a central organising principle for future information society, and a long-term strategic concern. Not surprisingly, then, there has been a growing desire to find ways in which the information society will promote sustainability, and where sustainability will reinforce the uptake of the information society. It was initially held that the information society would contribute only to environmental sustainability, being driven by the immaterialization and dematerialization of the economy, enabled by information and communication technologies.

Immaterialization refers to the fact that the value added in the information society is intangible in nature, taking the form of information and knowledge. Information use and reuse is, to a large extent, a clean activity. Dematerialization refers to the fact that ICTs contribute towards an economy where output is raised at the same time as input of material resources is reduced (Bohlin, 2001; Ducatel, 2001; Tochtermann, 2001; Hilty, Peter, Erdmann, Goodman, Lehmann, & Wäger, 2006b).

On the one hand, broadband connection can help to reduce energy consumption, for instance, by reducing transport needs and logistic costs and improving cross-border trade and transportation in landlocked countries. Broadband can also improve electricity generation and distribution as well as environmental performance of urban systems and buildings (EC, 2010). On the other hand, broadband technologies can have negative effects, direct and indirect.

Direct effects include increased electricity use from ICT equipment, as well as waste, while indirect effects relate to increased consumption of goods and services fuelled by broadband. These indirect effects are typically devoted rebound effects (Hilty, Köhler, von Schéele, Zah, & Ruddy, 2006a), especially in situations in which adverse effects of increased ICT use come about as a secondary effect of initially desirable ICT use (i.e. reduced travel due to on-line shopping but more transport due to customized delivery). Increased use of sophisticated IT equipment and broadband has accelerated the flow of information and resulted in increased consumption of electrical power. As a result of broadband connectivity, energy consumption from devices, such as handsets, PCs and terminal equipment, can have environmental impacts such as the direct energy used by devices and the power consumption involved in connecting remote networks.

Regarding the effect on waste, telecommunications equipment typically contains a considerable amount of scarce materials and heavy metals. Both the extraction of these materials, typically through mining, and the treatment of the waste represent a large environmental challenge. A research study by Vereecken, van Heddeghem, Colle, Pickavet, and Demeester (2010a) points out that when considering green technologies, the entire life cycle has to be taken into account. A life cycle analysis considers material extraction, production, use, transport and end-of-life as the five phases in the life cycle of a product and all phases should be considered in order to gain a complete view of the environmental impact of a product.

As for the effect on energy consumption by ICT equipment, according to International Energy Agency, the energy consumption by ICT equipment has been increasing over the years (see Figure 8).

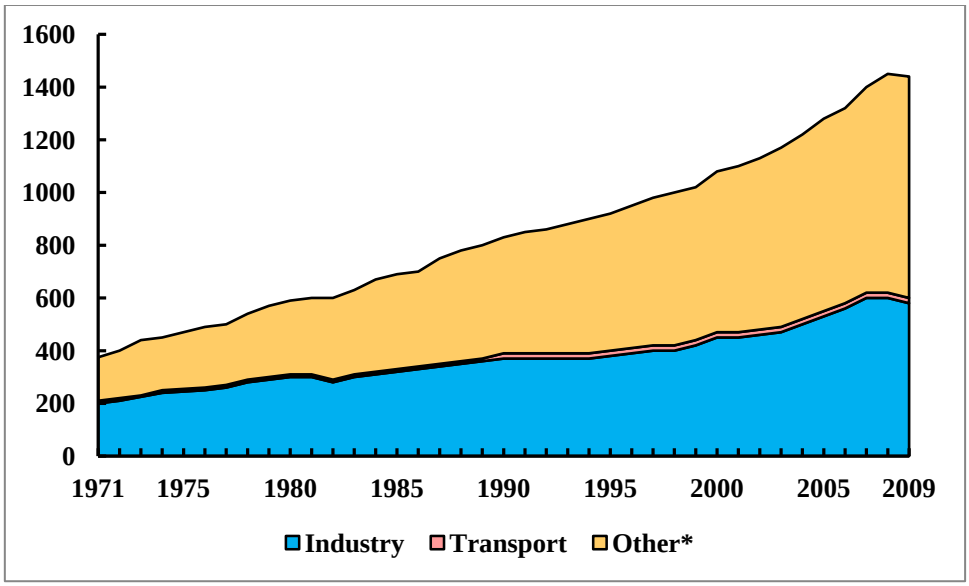


Figure 8 Total final consumption of electricity from 1971 to 2009 by sector (Mtoe)
(IEA, 2011)
(Note * includes agriculture, commercial and public services, residential, and non-specified other.)

Much research points out that different telecommunications technology and different network designs have different levels of energy consumptions (Lange, Kosiankowski, Weidmann, & Gladisch, 2011; Vereecken et al., 2010a, 2010b; Siraj, Fatehmulla, Alshebeili, & Bakar, 2011; Tzanakaki, 2011; Valcarenghi, Cerutti, & Castoldi, 2010; Bishop et al., 2010). The energy consumption of telecommunication networks is growing significantly over the approximately ten years studied. Home networks, in particular, consume the most energy. In the network segments under the responsibility of the network operator, the heaviest energy-consumption increases are estimated in core networks as well as data centres. The access networks—fixed and mobile radio— consume the largest shares of overall energy consumption by telecommunication networks owing to the many active network elements that are widely distributed throughout the field (see Figure 9).

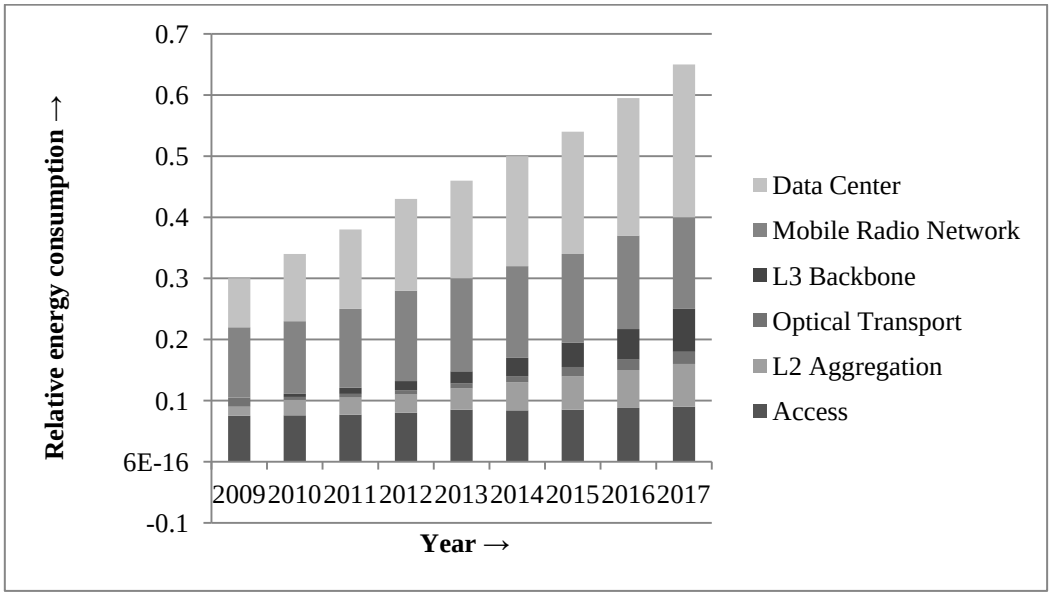


Figure 9 Development of energy consumption of operator's network
(Lange, 2011)

In the EU, it is estimated that wider use of applications such as on-line public services and applications, and advanced collaboration technologies could save at least 1 to 2% of total worldwide energy use by 2020. Moreover, the dematerialisation of ICT is recognized as a process for reducing the need for the physical equipment that underlies electronic services delivery. Thus, to generate savings on a large scale, a Europe-wide broadband infrastructure will be essential (EC, 2009a).

However, according the BioIntelligence Report (2008), total electricity consumption related to ICT end-user equipment and ICT infrastructures accounted for 8% of total EU-25 electricity use in 2005. This is equivalent to 1.9% of the total CO_2 emission of the EU-25. The projection of the Business-As-Usual scenario shows that in 2020, the ICT sector could consume 10.5% of the total electricity consumption and represent about 4.2% of EU-25 CO_2 emissions.

In response to the dual role of information and communications technologies in the climate-change debate – as an enabling tool for energy-efficiency in other sectors and in its own sector, the recent broadband policy in the EU, the Digital Agenda for Europe (EC, 2010b), reflects on the sustainability issue as follows:

- ICT offers potential for a structural shift to less resource-intensive products and services, for energy savings in buildings and electricity networks, as well as for more efficient and less energy consuming intelligent transport systems;

- The ICT sector should lead the way by reporting its own environmental performance by adopting a common measurement framework as a basis for setting targets to reduce energy use and greenhouse gas emissions of all processes involved in the production, distribution, use and disposal of ICT products and the delivery of ICT services.

It is interesting to note that an opinion poll across the 27 EU countries in 2008 included in the Digital Agenda for Europe reveals that for most citizens a healthy environment is as important to their quality of life as the state of the economy. A 64% majority favours prioritizing environmental protection must be given priority over the competitiveness of the economy. However, 42% of the citizens still feel poorly informed – especially about the health impact of pollution. At the same time, 63% agree that policies aimed at protecting the environment provide a motivation to innovate.

4.3. Implications for the thesis

From the above issues, the following implications can be drawn relating to the thesis:

Firstly, the telecommunications sector gains strategic importance for national strategy as the new expectations of competitiveness and sustainability arise and challenge the existing regulatory structure. These new expectations have a broad impact on society and expand telecommunications beyond its sectoral boundaries.

Secondly, both availability of advanced telecommunications infrastructures and their quality are considered as a factor in increasing the competitiveness of a country.

Thirdly, current levels of energy consumption from ICT equipment seem to be low compared to the other industries. However, the level of CO_2 emissions is quite high, at about the same level as aviation. Considering that broadband connectivity is increasing, as is telecommunications network utilization, CO_2 emissions as well as energy consumption will increase as a result.

Fourthly, moving towards the information society, broadband will be an underlying infrastructure in every sector of business and society. Therefore, a well-designed and concrete broadband policy will not only affect growth within ICT sector, but also have an indirect impact on country competitiveness, which is a long-term policy.

5. Theoretical considerations

Government policy has a great impact on society and economic structures. Public policies depend on several factors that determine what are, and what are not, acceptable domains of public policy. These factors include the nation's norms, values, culture, history, traditions, constitution, and technological sophistication (Gupta, 2011). Telecommunications policy is no exception. It is interwoven with not only social and economic aspects, but also political and technological considerations. Based on this notion, three concepts - the policy cycle, the four levels of social analysis, and theories of information society - are examined.

5.1. The policy cycle

The study of public policy requires an understanding of the rationale for resource allocation, specifically of public goods. The best course of action for the government is to interfere as little as possible in the natural course of the market (Gupta, 2011). However, the market process is not without its own shortcomings. Therefore, government intervenes in the market process for four desired goals: efficiency, equity, liberty, and security (see Figure 10).

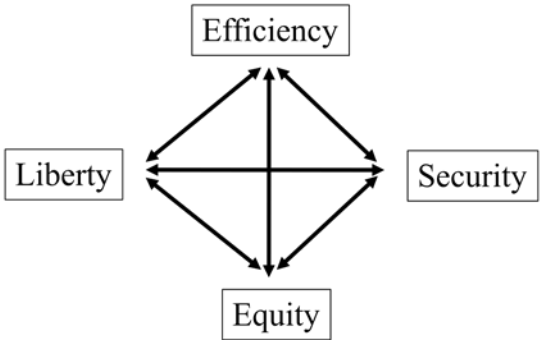


Figure 10 Four desired policy goals
(Gupta, 2011)

According to Gupta (2011), efficiency is defined as the ratio between output and input, or in other words, whether or not something is worth paying money for. The question of efficiency can be measured in two different ways: as an absolute measure or as a relative measure (or opportunity cost).

The concept of equity can be found in legislation in many areas. However, the meaning of equity remains vague though significant progress has been made in gender and racial equity.

Trade-off between efficiency and equity goals is inevitable. An example can be seen in the public consultations on broadband universal service in the EU in 2005 and 2010. The issues raised in the consultations were obviously seen as the debates between efficiency and equity goals (the details can be found in Papers 1 and 4).

Security remains an important goal for governments. Even in the most libertarian interpretation of Adam Smith's invisible hand and the primacy of market forces, the role of government in providing a secure environment is universally recognized. Security, however, is a broad notion, encompassing physical security, as well as protection from natural disasters or ecological collapse.

Liberty and freedom are used interchangeably. John Stuart Mill, the English philosopher, argued that a man should be allowed to do whatever he wants to do – unless it harms others in the process. This argument also can find expression in the fact that the first principle of public policy is to do no harm.

Trade-offs between security and liberty can be clearly seen if security is defined in the traditional sense of managing internal and external threats. When a nation felt insecure (e.g. from terrorist attacks), the general public accepted as necessary steps, government measures limiting individual liberties.

Hence, public policy analysis involves intricate balancing on multiple levels. Governments must balance notions of liberty and security, and efficiency and equity, in order to maintain a functioning society. However, when a new situation arises, it may call for re-consideration of existing policy, and this triggers the policy cycle.

Gupta (2011) proposes a diagram of the policy cycle. The policy cycle or policy formation is the process through which policy is formed. It explains the cycle of public policy on how an issue can lead to a deliberate government policy (see Figure 11).

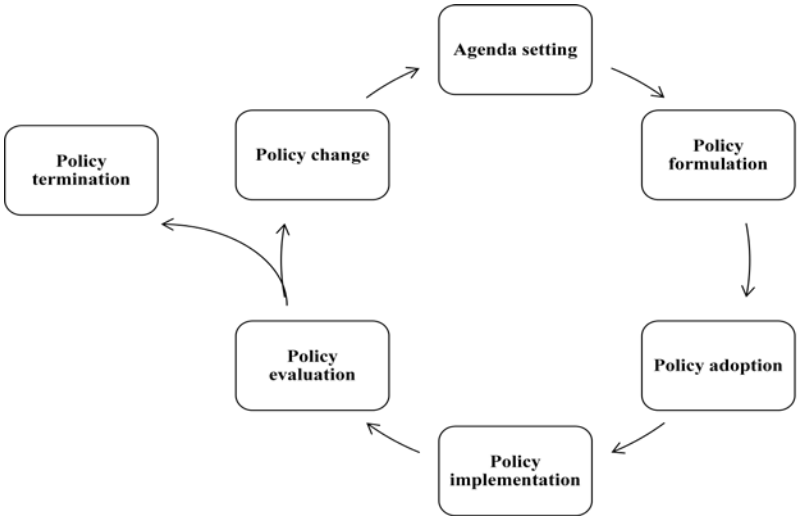


Figure 11 The policy cycle diagram
(Gupta, 2011)

The policy cycle starts when the government pays serious attention to an issue or agenda setting. According to Gupta (2011), policy scientists identify two kinds of agendas: institutional or governmental agenda and systemic or non-institutional agenda. Systemic agendas percolate in society, waiting to be elevated to the active agenda. A systemic agenda consists of all issues that are commonly perceived by members of the political community as meriting public attention and involving matters within the legitimate jurisdiction of existing governmental authorities. In contrast, an institutional agenda consists of those problems on which legislators or public officials feel obliged to take appropriate measures.

Once an agenda attains institutional status, specific policies must be formulated. Before a policy is formulated, the effectiveness of the proposed policy must be checked. To make a determination, a behavioural model is developed, by making certain assumptions about human nature. The model is used to make a forecast in order to identify alternatives. Then, legislators outline the course of action that the policy will follow. To determine the plan, lawmakers specify objectives, identify policy alternatives, and adopt the one alternative that gives the best results.

Policy adoption comes at the end of the formulation process. Once policy analyses are complete, they are sent to the official decision-making bodies, which enact legislation or issue executive orders. After

a policy has been adopted, it must be implemented. Adopted policies, particularly legislative acts, almost never specify exactly what is to be done.

If there is one area over which policy analysts exercise primary responsibility in the policy cycle, it is in the evaluation phase. Analysts inquire about the possible impact of an adopted policy and whether or not the policy meets the greater needs of society or achieves its goals. After the policy evaluation process, the policy cycle concludes in policy change or policy termination. There are several factors that cause a policy to be shaped or reshaped, such as new technology altering the feasibility of the policy, and changes in political and economic circumstances, which impose new conditions on an existing policy

5.2. Four levels of social analysis

Apart from policy goals and the policy cycle, the issue of how policy and regulation affect society as a whole is also important. To provide better understanding, the four levels of social analysis framework, developed by Williamson (1998, 2000) are brought into this thesis as another theoretical foundation. Williamson provides a useful framework for distinguishing different levels of institutional analysis that is based on different approaches in the field of social science, although his framework was subsequently modified by Groenwegen (2005). This section discusses both the Williamson's original framework and the new modified framework, in detail.

5.2.1. The original four levels of social analysis

A useful starting point for the analysis of institutions in a broad sense is the so-called the four levels of social analysis of Williamson (1998). Based on his framework, institutions have been separated into four levels (see Figure 12), with corresponding differential durability. These four levels have a hierarchical relationship in the way that the higher level imposes constraints on the level immediately below, with the longer term governance impacting the shorter term, albeit with possible feedback from the lower levels. The brief characteristics of these four levels and the analogy to the telecommunications sector are described below.

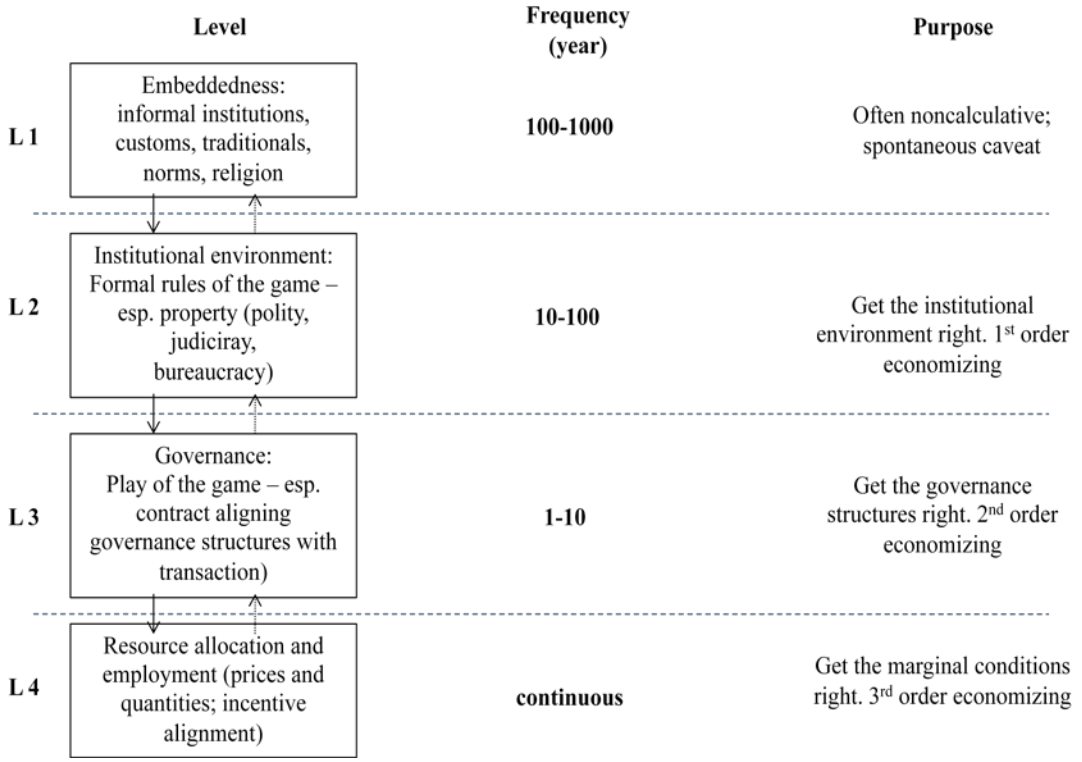


Figure 12 Four level of social analysis
(Williamson, 1998, 2000)

a) Level 1 or social embeddedness

The institutions at this level are composed of norms, customs, traditions, etc. These values and norms are deeply rooted in society and have a very pervasive influence on social and economic processes. Institutions at this level change very slowly (in the order of centuries or millennia). Mostly these institutions are informal, and socially and culturally inherited through many generations. The resulting institutions have a lasting grip on the way a society conducts itself. Therefore, insular societies often take measures to protect themselves against alien values. The purpose of these embedded social institutions is difficult to explain by rational reasoning, and deliberate choice of a calculative kind is minimally implicated. They are mostly non-calculative and develop spontaneously. Understanding these institutions is the domain of anthropology, history and sociology. To this interpretation of Williamson it can be added that the level of analysis is, in a broad sense, the functioning of social systems. In economics, the formation and influence of informal institutions (and the interaction with formal institutions) is often referred to as Old Institutional Economics (Kunneke, 2008).

b) Level 2 or institutional environment

The second level is referred to as the institutional environment. The structures observed here are partly the products of evolutionary processes. Going beyond the informal constraints of the first level, formal rules are introduced at this level. This opens up the opportunity for first-order economizing: get the formal rules of the game right. Constrained by the shadow of the past, the design instruments at this level include the executive, legislative, judicial and bureaucratic functions of government as well as the distribution of powers across different levels of government that shape the social and economic activities according to specific objectives. This level is the product of politics that provide the rules of

the game within which economic activity is organized. Major changes in the rules of the game occur in the order of decades or centuries. The level of analysis is often the state or government. Williamson argues that there are only very rare windows of opportunity for reforming these formal institutions. A gradual change is difficult to orchestrate because of the many different actors and interests involved, the complex nature of these formal institutions and the accompanying decision-making processes. The development of the European Union might serve as an example in this respect. Williamson points to some rare occasions for radical changes: for instance, civil war, occupations (like the Second World War), breakdowns (Soviet Union and Eastern Europe), or a military coup (Chile).

c) Level 3 or institutions of governance

Going beyond the rules of the game, the play of the game is needed and that is where the institutions of governance are located. Although the rule of law remains important, a perfectly functioning legal system for defining contract laws and enforcing contracts is not achievable. The accepted problem for dealing with this constraint is vertical integration, which was the solution posed by Coase in 1937. As Williamson has argued in many publications, any issue that arises as or can be reformulated as a contracting problem can be examined in transaction cost economizing terms. The governance of contractual relations then becomes the focus of analysis. Williamson suggests that the possible reorganization of transactions among governance structures should be re-examined periodically, in the order of a year to a decade, often at contract or equipment renewal intervals. Transaction costs economics and the positive agency theory provides typical examples for an institutional analysis on this level.

d) Level 4 or production function of a firm

Level four moves from discrete structural to marginal analysis. This is the level with which neo-classical economics and, more recently, agency theory have been concerned. The neo-classical decision variables are price and output. Third-order economizing prevails, which entails getting the marginal conditions right. An optimality apparatus, often marginal analysis, is employed, and, for these purposes, the firm is typically described as a production function. Resource allocation and employment of scarce resources is the focal interest of this level. The main purpose is to satisfy the marginal conditions for resource allocation in order to accomplish narrowly defined objectives like profit maximization or the achievement of certain financial or output targets. These problems of resource allocation are often very short term and have to be continuously resolved. A typical level of analysis would be a production plant within a firm. In traditional, mainstream neoclassical economics, actors are assumed to adjust prices and/or output in such a way as to gain maximum profits. More recently, normative agency theory applies to this level of analysis by elaborating efficient incentive structures related to different risk profiles and/or multi-task factors or multi-principal concerns (Kunneke, 2008).

5.2.2. The modified framework

Building upon Williamson's framework, Groenewegen (2005) proposed another model where technological factor was considered as a driving force, so-called a dynamic layer model of technological, socio-economic systems (see Figure 13).

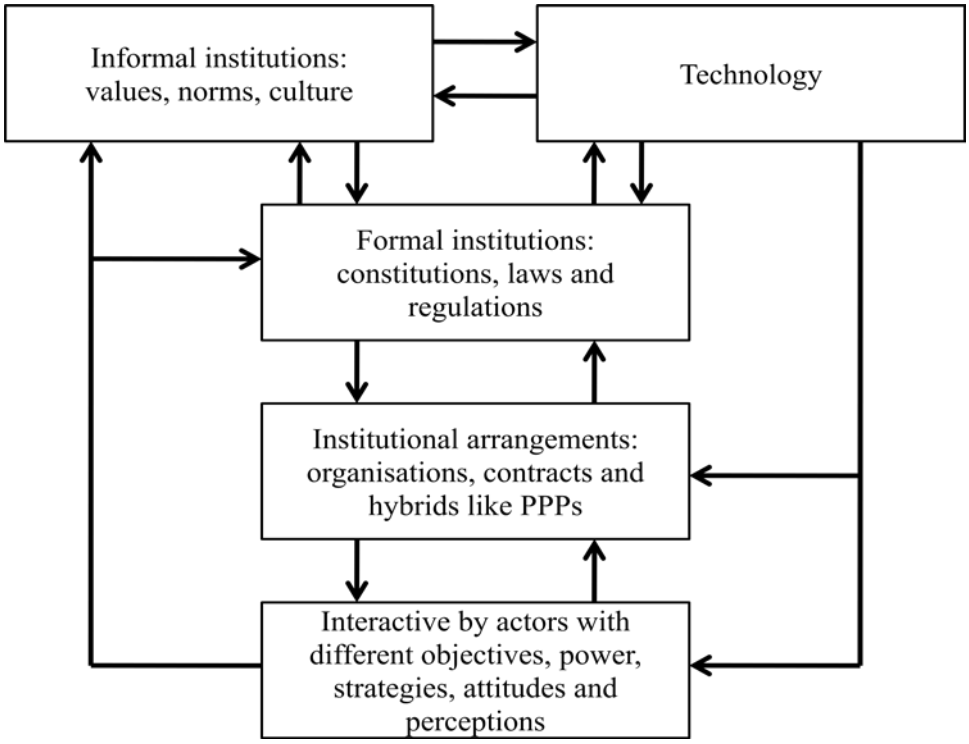


Figure 13 The dynamic layer model of technological, socio-economic systems (Groenwegen, 2005)

Williamson's framework is criticised since it represents the equilibrium-oriented approach due to its hierarchical relationship. Under the equilibrium-oriented approach, static competition implies that new entrants come into the market with that same product as incumbent firms: the competition is about prices and every firm should produce at a scale that minimizes productions costs. The same holds for the minimalization of transactions costs: all firms should align the transactions with the same efficient governance structures, otherwise their costs are higher. Groenewegen (2005) clarifies his model as process-oriented approach which has a dynamic characteristic. The causality in his model is both downward and upward creating over time the values, norms, habit, formal institutions, institutional arrangements and mental maps of the actors. The driving force, like technology and learning, cause changes in the institutional structures and in the longer run also in the habits and mental map of the actors. In a dynamic process-oriented perspective a completely different kind of competition is considered vital to survive. Firms should constantly look for new geographical markets, for new combinations of product factors, new products and services in order to distinguish themselves from their competitors. One of the most important instruments is that of effective competition.

The degree of coherence between the technical and the institutional coordination is also emphasized by Finger, Groenewegen, and Kunneke (2005) and Finger and Varone (2006). They argue that both technical and institutional aspects are strongly interrelated with each other and need to be jointly approached because they affect the performance of infrastructures.

5.3. Theories relating to the information society

Technological revolution has transformed social and economic structures towards an information society. There are many theories being developed under the concept of the information society, albeit under different names, such as the post-industrial society and the network society. This section provides an overview of those two concepts.

5.3.1. The post-industrial society

Amongst those who subscribe to the notion that a new society is emerging, the best known characterisation of the information society is Daniel Bell's theory of post-industrialism. The terms are very frequently used interchangeably: the information age is presented as expressive of post-industrial society and post-industrialism is widely regarded as an information society (Webster, 1995). Though the term of the post-industrial society was coined by Daniel Bell as the late 1950s, it was presented in his book, *The Coming of Post-Industrial Society: A Venture of Social Forecasting*, in 1973 (Bell, 1999). It is about the changing of social structure due to technological evolution. The post-industrial society, as a concept and as a reality, arises within the frame of socio-economic history, the contexts of the pre-industrial, industrial, and post-industrial worlds. The idea of a post-industrial society is not a point-in-time prediction of the future but rather a speculative construct, based on emergent features.

The central focus of the concept has been in the role of technology and the ways that technology has become a strategic resource and a lever of social change in society as a result of greater amount of information being in use. According to Bell (1999), the technological revolution has had a profound effect on the changes of society for a hundred years. Since the start of the industrial revolution in the 18th century three major technological revolutions have had an impact on the development of society. The first technological revolution was the use of steam for pumps, controlled chambers for locomotion and machines, which paved the way for the industrial revolution. The second technological revolution, only a hundred years ago, can be identified with two innovations: electricity and chemistry. The third technological revolution, which is the foundation of the post-industrial society or network society, is built on four innovations: the change of all mechanical and electrical systems to electronics, miniaturization, digitalization and software. The most crucial fact about the latest technological revolution is that these changes pervade all aspects of society and reorganize all previous relationships.

Technology has an impact on changes in social and economic structure. Changes from old relationships can be seen ranging from the daily interactions of people to the relationships between nation states. Communication through various technologies is beginning to replace transportation as the major mode of connection between people and the mode of the business transactions. The ability to work from any place through an Internet connection renders fixed workplaces less meaningful. The conceptions of time and space transcend the boundaries of geography and take place in real time. An Internet connection brings in the ordinary citizen as a user and consumer, emphasizing interaction and participation. It provides enormous access to the cultural resources of humankind in a way never known before. It multiplies the number of affinity groups across national boundaries. Bell (1999) describes the concept of a post-industrial society by comparing its attributes with those of industrial society and pre-industrial society. Some significant characteristics are presented in Table 8.

Table 8 The post-industrial society: A comparative scheme
(Bell, 1999)

Schemes	Pre-industrial	Industrial	Post-industrial
Mode of production	Extractive	Fabrication	Processing, information
Transforming resource	Natural power: wind, water, animal, human muscle	Created energy: oil, gas, nuclear power	Information and knowledge: programming and algorithms, computer and data-transmission
Strategic resource	Raw materials	Financial capital	Human capital
Technology	Craft	Machine technology	Intellectual technology
Skilled base	Artisan, manual worker, farmer	Engineer, semi-skilled worker	Scientists; technical and professional occupations
Mode of work	Physical labour	Division of labour	Networking
Methodology	Commonsense, trial and error, experience	Empiricism experimentation	Models, simulations, decision theory, systems analysis
Axial principle	Traditionalism: land/resource limitation	Economic growth: productivity	Codification of theoretical knowledge

The concept of the post-industrial society also points out another two interesting models: the economizing mode and the sociologizing mode. According to Bell (1999), the growing problem for modern society is the increasing divergence of private costs and social costs. Along with this awareness there arises the question whether the concept of costs is at all adequate today. Social costs are not just the social responsibility of any particular corporation, but also include the social goals of the society. Therefore, the economizing mode and sociologizing modes

- The economizing mode is based more on an economical rationale that emphasizes the best allocation of scarce resources among competing ends. The conditions for economizing are a market mechanism, which serves as the arbiter of allocation, and a fluid price system, which is responsive to the shifting patterns of supply and demand. It is based on the proposition that individual satisfaction is the unit in which costs and benefits are to be measured.

- The sociologizing mode is the effort to judge a society's needs in a more conscious fashion, and to do so based on some explicit conception of the public interest. Since social goods, such as national defence, public parks, environmental protection, and the like, are not divisible, they are subject to communal or political, rather than individual demand.

5.3.2. The network society

The concept of the network society, proposed by Castells in 1996 (Castells, 2010) is similar to the concept of the post-industrial society, although there are differences in some details,. The perspective of the network society (Castell, 2010) is caused by three processes: the information revolution; the economic crisis of capitalism and statism; and the blossoming of new social movements.

The key feature of the network society is the networked connection between local and global (Castells, 2010). Digital networking technologies power social and organizational networks in ways that allow expansion and reconfiguration, overcoming the traditional limitations of organization. The new economy is organized around global networks of capital, management, and information, whose access to technological know-how is the root of productivity and competitiveness. The consequences of this new evolution are an increase in the importance of awareness of new opportunities and possibilities for advancement through new information. However, while spanning the world, the network is in fact limited to those countries and areas that have a supporting infrastructure, essentially a modern telecommunications system. The information technology revolution, because of its pervasiveness

throughout the whole realm of human activity, will be an entry point in analyzing the complexity of the new economy, society, and culture in the making.

The exploration of emergent social structures across domains of human activity and experience of Castells leads to an over-arching conclusions: as an historical activity trend, dominant functions and processes in the information age are increasingly organized around networks. Networks constitute the new social morphology of societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power, and culture. While the networking form of social organization has existed in other times and spaces, the new information technology paradigm provides the material basis for its pervasive expansion throughout the entire of social structure. Presence or absence on the network and the dynamics of each network vis-à-vis others are critical sources of dominance and change in what is known as the network society.

5.4. Considerations based on the theories

5.4.1. Considerations based on the policy cycle

Public policies are important because they shape private sector activities and national strategy. Normally, government policy should respond to the needs and expectations of society, and several mechanisms are needed in order to achieve a policy goal.

A public policy traditionally serves one policy goal in one policy area even though there are competing goals. Tension and trade-offs between the efficiency and equity goals are typical policy discussions in telecommunications policies. In recent year, the importance of the security goal is increasing and getting more attention from public in order to have a better quality of life, particularly in the area of environmental protection.

As policies from one period may not be suitable in another period, they should be changed to respond to new situations or circumstances. The process of change should not focus only on narrow considerations, but should take all related factors into account.

5.4.2. Considerations based on the original four levels of social analysis

Williamson’s framework explains the governance structure of a system. It suggests that in order to understand economic behaviour, it is important to know the institutional mechanisms surrounding the issues. Consequently, the relationship between each level in the framework has a more top-down approach. Changing behaviour at the lower level will require a change in the mechanisms at the upper level, and that requires a long time.

This framework has been referred to in many research areas such as the telecommunications, electricity and energy sectors. The importance of telecommunications institutions on each level of matter for economic performance and firm behaviour is addressed in academic research (e.g. van Leiden and Monasso (2005), Kodwani (2006)).

The hierarchical relationship in the framework makes a social structure rigid, which implies that the changing of economic activity or outcomes takes a long time. Long-run changes in behaviour are influenced and constrained by the hierarchical levels of governance.

In telecommunications sector, though policies at the formal institutions level are the same, the outcomes in each country may differ because each country has different environments, such as market

structure, geography, socio-economics, and social structure. It may therefore not be possible to replicate the success of a country or region (Bauer, 2010b).

5.4.3. Considerations based on the modified framework

The modified framework by Groenwegen takes a more dynamic view of a market and does not have strictly hierarchical relationships, which implies that the changes on a lower level can influence the changes on a higher one. Consequently, the process of change takes a shorter time.

Changes of economic activities or social structure can be influenced by driving forces, like technology and learning, and, in turn, result in the changes in the institutional structures, in the long run.

The framework allows for having more than one agenda or one goal in the same policy and takes effective competition as important. In this sense, Melody (1999) demonstrated that competition must be seen, not as a substitute for regulation, but as a valuable tool of regulation that in many circumstances can be the most effective vehicle for achieving both efficiency and social policy

5.4.4. Considerations based on theories of the information society

Having advanced telecommunications infrastructures is of strategic importance for the information society because they are necessary for the emergence of a new form of social structure, as roads and transportation were in the past. They become strategically important as they are the backbone of the information society and should be made available to all people. Much research from the literature shows that broadband can have economic and social impact on a country. In terms of the economic impact, incremental broadband penetration can result in the growth of GDP (Katz & Suter, 2009; Bohlin & Kholilul Rohman, 2009; MICUS, 2008; Climate Group, 2008). Broadband can also contribute to employment growth (Lehr, Osorio, Gillet, & Sirbu, 2005; Crandall, Lehr, & Litan, 2007; ITIF, 2009; Gillett, Lehr, Osorio, & Sirbu, 2006). Several studies show that a lack of broadband access can increase the knowledge gap between social classes (Kim, 2008; Norris, 2001). The study by Forman, Goldfarb and Greenstein (2009) also suggests the existence of a considerable divide between the benefits of advanced Internet use across urban and rural areas.

The divide between people is the outcome of a society in which the necessary cognitive resources are distributed unequally between the generations. Societies which have established better formal learning and literacy in the past will present a lesser degree of differences between generations (Cardoso, 2005). The network society is a society based on an informational development model in which some cognitive skills are more valued than others, namely: the highest education level, formal literacy and forms of technological literacy. Correction of this massive exclusionary process requires a concerted international public policy that goes to the root of the new model of development (technology, infrastructure, education, diffusion and management of knowledge) rather than just providing for the needs arising from social exclusion in the form of charity (Castells, 2005).

Several issues need to be addressed by governments when a society is moving towards the information society since this movement is unavoidable and the process to achieve it is irreversible. It will change the ways people live and conduct business transactions and remove the physical boundaries between countries.

A challenge facing the information society is the rise of the sociologizing mode. In modern industrial life or in an industrial society, the economizing mode of life was introduced. Here costs and benefits to

firms or individuals apply, with a fluid price system, and market mechanisms as the arbiter of allocation. In contrast, the sociologizing mode is the effort to judge society's needs in a more conscious fashion and to do so based on some explicit conception of public interest. The major sociological problems in areas like environmental pollution or education will test the public sector's ability to foresee the effects of social and technological change and construct alternative courses in accordance with different valuations of ends at different costs.

In addition to an advanced telecommunications infrastructure, a conception of public interest is also important for an information society. Some issues may not be sustainable under the perception of economic goods but should instead be regarded as public goods that require public policy. Telecommunications sustainability is one of these. While encouraging the telecommunications sector to realize and take more responsibility for environmental issues may not be the first priority for business firms, due to the increased costs, all the above issues suggest that the existing telecommunications policy, in particular broadband, may need to be reconsidered.

6. A comprehensive framework for broadband policy

The analysis of the empirical evidence in Chapters 3 and 4, and theoretical considerations in Chapter 5, with regard to the telecommunications policy, is discussed in this chapter. The main objective is to propose a policy framework to deal with the new challenges of telecommunications sector.

6.1. Review of the implications from previous chapters

The development of the telecommunications sector indicates that the market structure of telecommunications structure has been transformed from a monopoly to a competition structure. However, the telecommunications sector under a competition structure creates more complexity than in the past due to the presence of market power and increasing demand. As increasing broadband penetration in a competition environment cannot be done with only one instrument, several initiatives are implemented to deal with such complexity through three approaches. These are the government approach, market approach, and regulatory approach. In the pre-1987 EU, for example, the telecommunications sector in the European countries was operated by state-owned monopolists. The telecommunications sector was integrated into the single market policy of the European Commission. Since liberalization and harmonization process began in 1987, competition was introduced to the EU market. Nevertheless, increasing broadband penetration has been encouraged by several initiatives such as funding mechanisms (e.g., broadband state aid), asymmetric regulations to reduce barrier to entry (e.g., open access, local loop unbundling).

A great many studies point out that the existing telecommunications regulatory policy focuses on interest of telecommunications sector, as an industry, which focuses on industrial considerations such as developing the telecommunications industry, increasing the penetration rate, or coping with market and technological developments in the telecommunications sector.

Under the concept of the information society which was adopted in the 1990s within global policy discourse, broadband connectivity is widely accepted as having strategic importance due to its contribution to economic growth and productivity. Advanced telecommunications infrastructures are crucial to an information society as they are necessary for the emergence of a new form of social structure. In addition, they become strategically important as they are the backbone of the information society and should be made available to all people. In this context, competitiveness and sustainability have previously been portrayed as antagonistic, but there is a growing recognition that, in fact, these two issues are mutually reinforcing (see Figure 14).

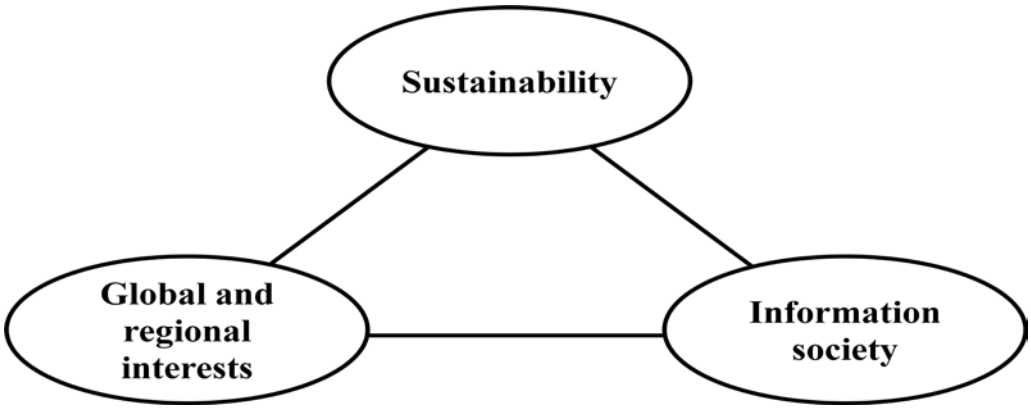


Figure 14 The context of information society
(Bohlin, 2001)

However, the outcomes of being an information society also challenge telecommunications infrastructures in two ways. Firstly, they are not only improved quality of life but also a greater ability of a country to compete in the global market as a result of globalization. Secondly, the growing concern over environmental issues all over the world raises the issue that telecommunications technologies, in particular broadband, are a major tool to support a reduction in energy consumption in other sectors. However, the negative impact of ICT equipment in terms of energy consumption will be increased as a result of dematerialization in an information society and its rebound effect.

From theoretical viewpoint, the challenge of an information society is the rise of the sociologizing mode. In modern industrial life or in industrial society, the economizing mode of life is introduced whereby costs and benefits of firms or individuals are applied and market mechanism is the arbiter of allocation and a fluid price system. In contrast, the sociologizing mode is the effort to judge society's needs in a more conscious fashion and to do so based on some explicit conception of public interest. The major sociological problem ahead of, for example, environmental pollution or education will test the public sector's ability to foresee the effects of social and technological change and construct alternative courses in accordance with different valuations of ends at different costs.

All the above mentions suggest that emerging environments of an information society are complex, and that challenge public policy because to be an information society is unavoidable and the process to achieve is irreversible.

6.2. Two sides of the coin

Public policies play a major role to the outcomes of a market. Thus, the current performance of the telecommunications market is a result of actions from different institutions governing that market on three main levels: informal institutions, formal institutions and governance institutions. The telecommunications section can be analyzed using Williamson's four-level framework (see Table 9).

Table 9 The adaptation of the Williamson's framework to telecommunications sector

Williamson's level	Telecommunications sector
Level 1: Embeddedness	Competition
Level 2: Institutional environment	Regulatory framework (asymmetric regulations for SMP)
Level 3: Governance	Firms profitability, functional separation, local loop unbundling
Level 4: Resource allocation	Competitive market price, high penetration, low innovation and investment

At Level 1, the value of public utility was embedded in the telecommunications sector for a long period of time, in particular until 1980s in Europe. The change of value from public utility to market goods came as a result of technological revolution and cartel problems, and, at present, enabling competition is embedded as a norm in telecommunications sector.

Accordingly, the institutional environment (Level 2) is oriented towards competitive market structures. As a result, many regulations have been implemented in broadband market to enable competition (as discussed in Chapter 3), and these can be characterized as asymmetric regulations in the case of the EU. The governance (Level 3) of private firms is oriented towards economic

profitability. Particularly, firm strategies in response to the imposed regulations such as functional separation and unbundling the local loop can be seen among incumbents. Consequently, in Level 4, competitive market prices are the resource allocation mechanism of firms. Firm innovations or investment in reaction to their governance structure can also be found on this level.

However, though the path of development at the first level and the second level were replicated in most countries around the world, the outcomes of the telecommunications market differ from country to country. The different outcomes could result from many factors, not only institutional structures, but also from surrounding circumstances, such as GDP per capita and population (Garcia-Murillo, 2005). Garcia-Murillo (2005) also found that unbundling an incumbent's infrastructure yields a substantial improvement in broadband deployment only for middle-income countries, but not for their high-income counterparts. This means that governments in less developed countries can promote the deployment of broadband networks by both fostering competition and requiring unbundling of local loops. Therefore, it may not be possible to replicate the success of a country or a region (Bauer, 2010).

If sector development is one side of the "telecommunications coin", national development is the other side. National development is growing its importance in the context of developing the information society for several reasons, as explained in Chapter 5. Firstly, telecommunications infrastructures are a factor that indicates the level of a country's competitiveness. Having an advanced infrastructure and a regulatory environment are variables for measurement. Secondly, telecommunications infrastructures are a major tool for achieving a low-carbon economy as a result of the dematerialization effect of the information society. Also telecommunications infrastructures should not cause harmful effects as a result of increasing connectivity or use of telecommunication equipment.

This empirical evidence suggests that during the past decade, the strategic importance of ICT sector has increased. From theoretical considerations, theories of information society in Chapter 5 provide that the consequences of technological revolutions are changes in social and economic structures. The importance of telecommunications networks is increasing. Information is becoming a mode of production and knowledge is becoming an important resource for human capital. Society will rely more and more on telecommunications infrastructures as a means to access and deliver information and knowledge.

The traditional regulatory sector focuses on narrow industry interests in order to foster or maintain competition in telecommunications market. However, when the new challenges from societal concerns are imposed on telecommunications sector, the boundary of telecommunications is expanded to be wider than it was before (see Figure 15).

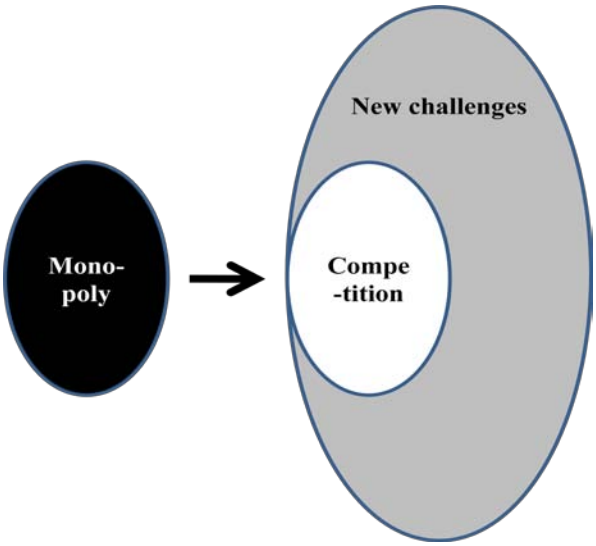


Figure 15 The expansion of telecommunications sector

Public policies evolve partly in response to changes in perceived demands and opportunities, changes that may result from the evolution of technologies and market structures or from other identifiable shifts in policy objective condition (Nelson & Winter, 1982). Moving towards the information society, policy makers are facing challenges of industry interest and societal concerns in telecommunications networks.

The emerging environments and the increasing complexity of the sector alter the conditions of governance in traditional telecommunications sector (Bauer, 2004). This complexity sometimes cannot be analyzed through the rigid and hierarchical relationship under the Williamson's framework. Instead, the framework by Groenwegen (Groenwegen, 2005) takes a more dynamic view of a system whereby technology factor is taken into account and does not have strictly hierarchical relationship. These features imply that the changes of economic activities or social structure can be influenced by the driving forces, like technology and learning, and therefore result in long-term changes in the institutional structures.

The complexity of the telecommunications sector with its new challenges can also be discussed from policy goals and the policy cycle concept. The expansion of the telecommunications boundary in the emerging environment also shifts the policy goals (see Figure 16). Traditionally, the most fundamental of existing broadband policy instruments strive to achieve efficiency of the telecommunications market. Policy instruments to achieve the equity goal can be found in this sector, such as universal service regulations.

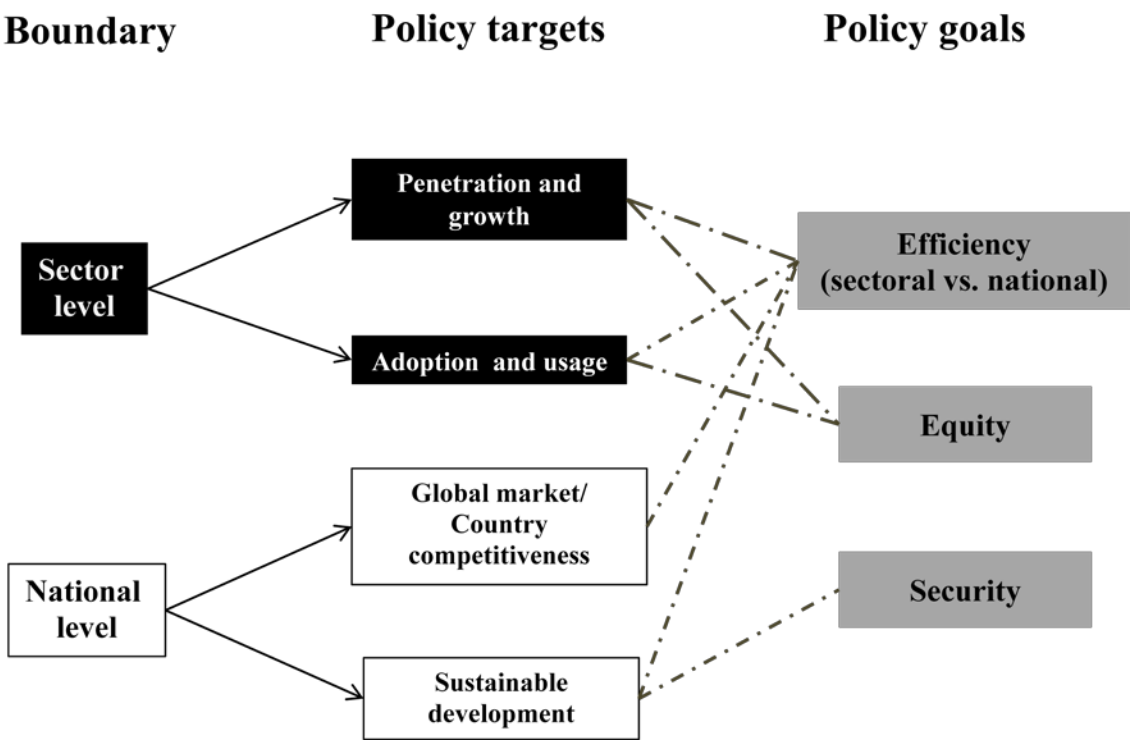


Figure 16 Mapping policy goals to policy targets in telecommunications sector

In the new environments, the policy goals are shifted from sectoral goals to national goals. Therefore, efficiency goals of the telecommunications market at the sector level differ from efficiency of a country, which involves many factors.

The issue becomes more complex when a new goal arises, such as security. When sustainability has come to the attention of the public, whether or not the economics of market efficiency are applicable to this issue, it is worth investigating. Though, research in the electricity sector by Moss and Kwoka (2010) suggested that competitive issues can be expected to persist through the transition to a low-carbon, energy-efficient future, there is no research in telecommunications field that has investigated this issue. However, the existing telecommunications instruments which focus more on market power may not be appropriate for dealing with sustainability, which relates to public goods and negative externalities. Therefore, under existing regulatory tools, telecommunications firms may not be motivated to use low carbon emission equipments for the sake of earth system security or to protect the environment for future generations.

One article pointed out that the difficulty to reform and restructure governance stems from people and institutions having strong status quo biases (Samuelson & Zeckhauser, 1988). Also the problems are even worse than they seem for sustainability since a vast variety of behaviours by individuals, nations, and other entities affect climate, and those are governed by an equally vast array of different regimes with different mandates, and in many cases, even different parties (Jamieson, 2011).

Therefore, in this emerging environment, the telecommunications sector is like two sides of the same coin. On one side, it relates to the developments of the sector or industry. On the other side, it involves the national development and societal concerns. To deal with those two aspects, this thesis therefore proposes that it is more applicable to have a new framework for broadband policy.

6.3. Two perspectives of broadband policy

In relation to the above analysis, three key points can be identified. Firstly, the post-industrial society and the network society concept suggested that social structure is undergoing change as a result of broadband technologies. These changes are more fundamental than typically expected Secondly, the current telecommunications regulatory and policies address more narrow industry interests, and market efficiency is usually regarded as priority policy goal. This policy goal is set in order to achieve the policy target of increasing penetration and growth in the sector by means of competition mechanisms. Policy for equity goals can also be seen in telecommunications regulations such as universal service, which is an instrument to close the digital divide. Thirdly, new challenges of telecommunications networks, in particular competitiveness and sustainability, take broad societal concerns into account and are required as a basis for future development.

Therefore, broadband policy should be able to encompass these multiple societal levels, both from a long term and short term perspective. In order to deal with both narrow industry interests and broad societal concerns, an integrated broadband policy is proposed consisting of two dimensions: a sector agenda and a strategic agenda (see Figure 17). The sector agenda addresses industry interests and the strategic agenda addresses broad societal concerns.

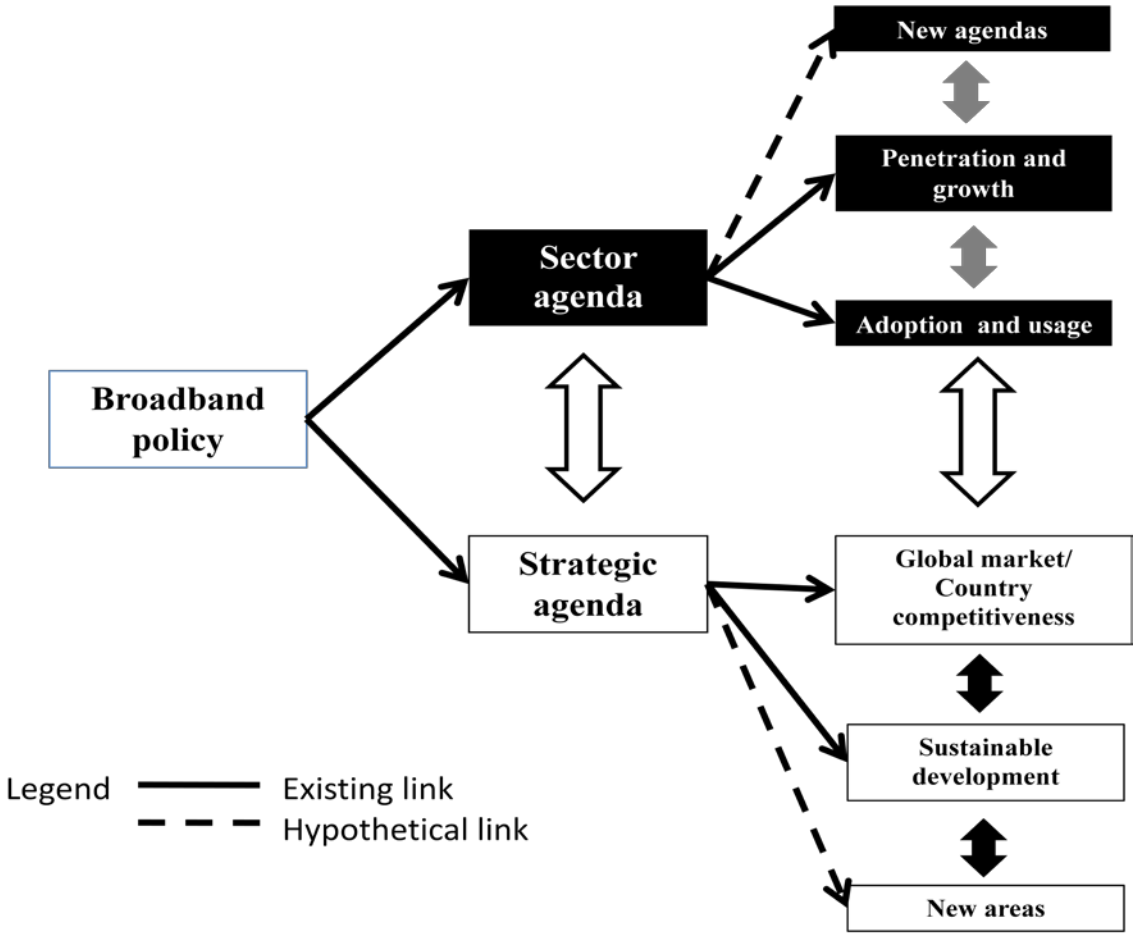


Figure 17 The two perspectives of broadband policy

The sector agenda consists of strategies or measures implemented by a country with the primary objective of increasing its broadband penetration. This objective of the sector agenda is based on the

existing structure of telecommunications, which can be pursued under the current regulatory regimes. Another objective of the sector agenda is to increase adoption usage. There are many other purposes that could be regarded as the sector agendas, for example, interoperability or quality of service, but this thesis does not elaborate on these in detail because they require another set of discussions.

Meanwhile, the strategic agenda comprises a set of objectives that is regarded as the new challenges facing the telecommunications sector but go beyond the boundaries of the telecommunications industry. Nowadays, these objectives consist of matters such as country competitiveness and sustainable development (see Figure 16). Other issues can also be included on the strategic agenda of a country, such as national security, but, again, this thesis does not elaborate on these in detail. It is important also to note that objectives of each agenda can be changed over time depending on national and global development. Once the new issue has come to the attention of a country, the detailed analysis has to be changed for empirical and theoretical discussion.

The two agendas, sector and strategic, have the same level of importance, in that none has primacy over the other. Taking only one agenda into account would not be advisable for at least two reasons. Firstly, each agenda is independently crucial. To ignore the sector agenda is to accept that telecommunications market would find itself at a deficit due to less competition. To ignore the strategic agenda is to risk that a country would lag behind other countries. Secondly, the two agendas are interconnected. The extent of interaction among the two agendas suggests that addressing the issue of one agenda in isolation may affect the other. For example, addressing only the sector agenda may lead to the inability of the telecommunications sector to deal with energy consumption problem incurred from telecommunications networks. Addressing only strategic agenda may slow the growth of telecommunications market.

6.4. Broadband policy: An initiative for the sector agenda

Having an advanced broadband infrastructure, both wireline and wireless, is a fundamental factor of moving towards a network society. This is a justification for most broadband policies implemented around the world today with the primary objective of serving the sector agenda in which several strategies have been implemented with the intention of increasing broadband penetration and growth in a country (see Figure 18).

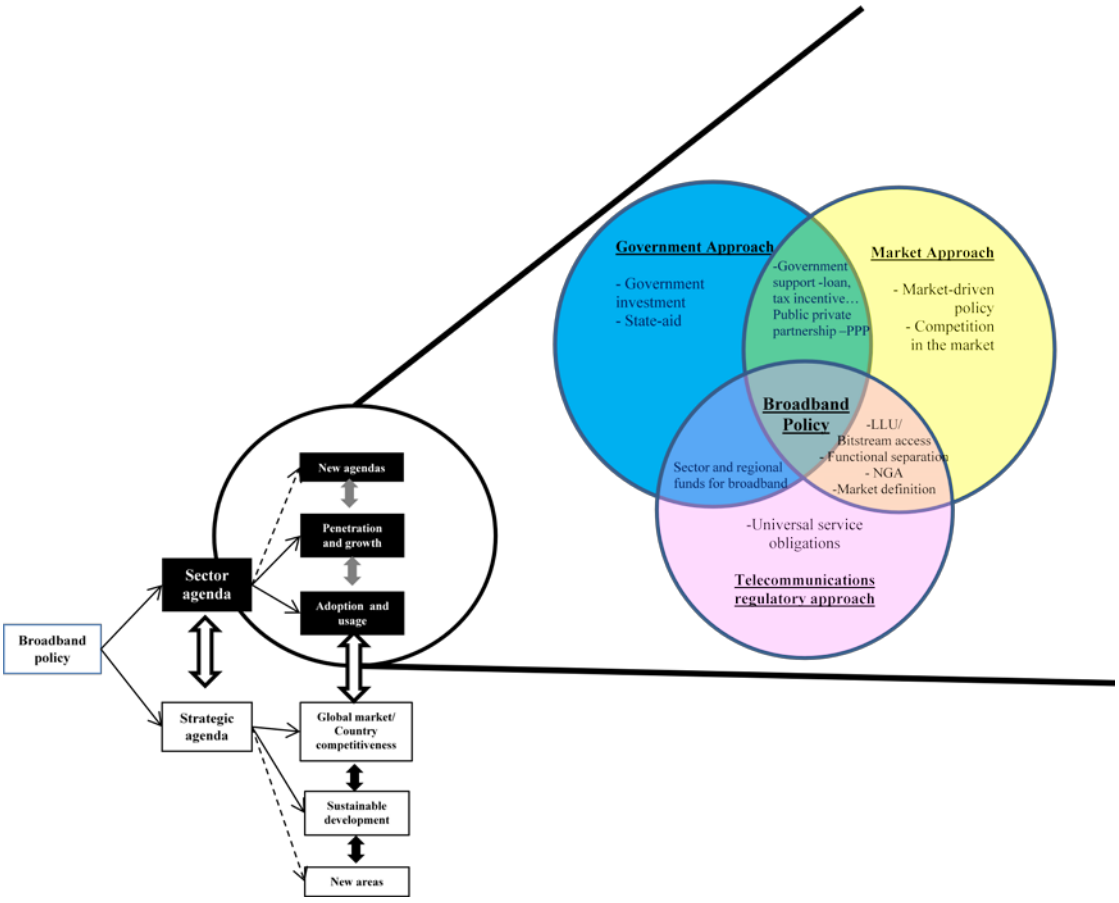


Figure 18 The new broadband policy and initiatives under sector agenda

The strategies to secure the sector agenda of a country can fully or partially fall into the three-dimensional framework composed of the government approach, the market approach and the telecommunications regulatory approach, as discussed in Section 3. However, according to Bauer (2010b), at the level of policy models and particularly instruments, the experience elsewhere may similarly sharpen the understanding of what is possible, and what does and does not work. Given the diversity of institutional arrangements and the dependence of policy choices and outcomes of complementary arrangements, effective learning will typically have to go beyond simple forms of imitation. There is therefore no single pattern in terms of a sector agenda for a country for implementation that results in a significant increase in broadband deployment, as increasing broadband growth depends on the social and economic circumstances of each country. The same strategy may not give the same result even among developed countries.

Nevertheless, from the perspective of the sector agenda viewpoint, market outcome is a result of policy goals and institutional frameworks. Though every government takes market efficiency as a policy goal for the sector agenda, different definition of efficiency, dynamic or static, leads to different policy designs. There is no “one size fits all solution” because it depends on many factors and circumstances of a country.

From a technology viewpoint, many technologies today, mobile and fixed line, have been developed for broadband connections. Though users increasingly tend to have broadband connections through mobile technology such as LTE, fixed line infrastructure is still important to business in every sector. As with fixed line infrastructure, fibre optic technology is regarded as having a higher capacity than any other technology. Many governments therefore encourage investment in fibre networks.

According to Atkinson, Noam and Schultz (2010), given the high investment requirements, and considering the practices of other governments around the world, fibre broadband network deployment can be encouraged by many approaches. Interestingly, most of them have been taken mainly from the government approach, except for the United States, which has a more market-based approach. These include, for example, government ownership of new infrastructure such as in South Korea and Australia, tax incentives, subsidies, public-private partnerships and permits for infrastructure sharing among competitors.

The case for public upgrade support programmes is mixed. It is strongest for high-cost rural areas, to prevent them from falling behind. It can also be extended to encourage the demand side by supporting content and applications, though such supportive policies can also be a double-edged sword because they may be tied to regulatory conditions. Whatever one may think of these policies, the mere fact of their entry into the public debate shows a transition from the competition-based model of just a few years ago. With major investment requirements looming and the long-term need for countries to remain competitive, a frequent acceptance of the government's active role in 'industrial policy' has now returned. Thus, ICT policy may move in different directions in Europe to those in other countries (Atkinson et al., 2010).

6.5. Broadband policy: The rise of the strategic agenda for a country

As mentioned earlier, the strategic agenda is set for a specific national agenda and includes more broad societal concerns, particularly when broadband is considered an infrastructure for future development, which means that broadband can contribute to increasing a country's potential future social and economic status. A strategic broadband policy can increase a country's competitiveness in the long run with broadband infrastructure being a fundamental factor for country and business growth in every sector (see Figure 19). As climate change attracts attention from people all over the world, broadband can contribute its capabilities to energy saving in other sectors. To achieve this goal in terms of energy savings, however, a concrete policy needs to be in place as the broadband itself can have an impact in terms of energy consumption, at the same time.

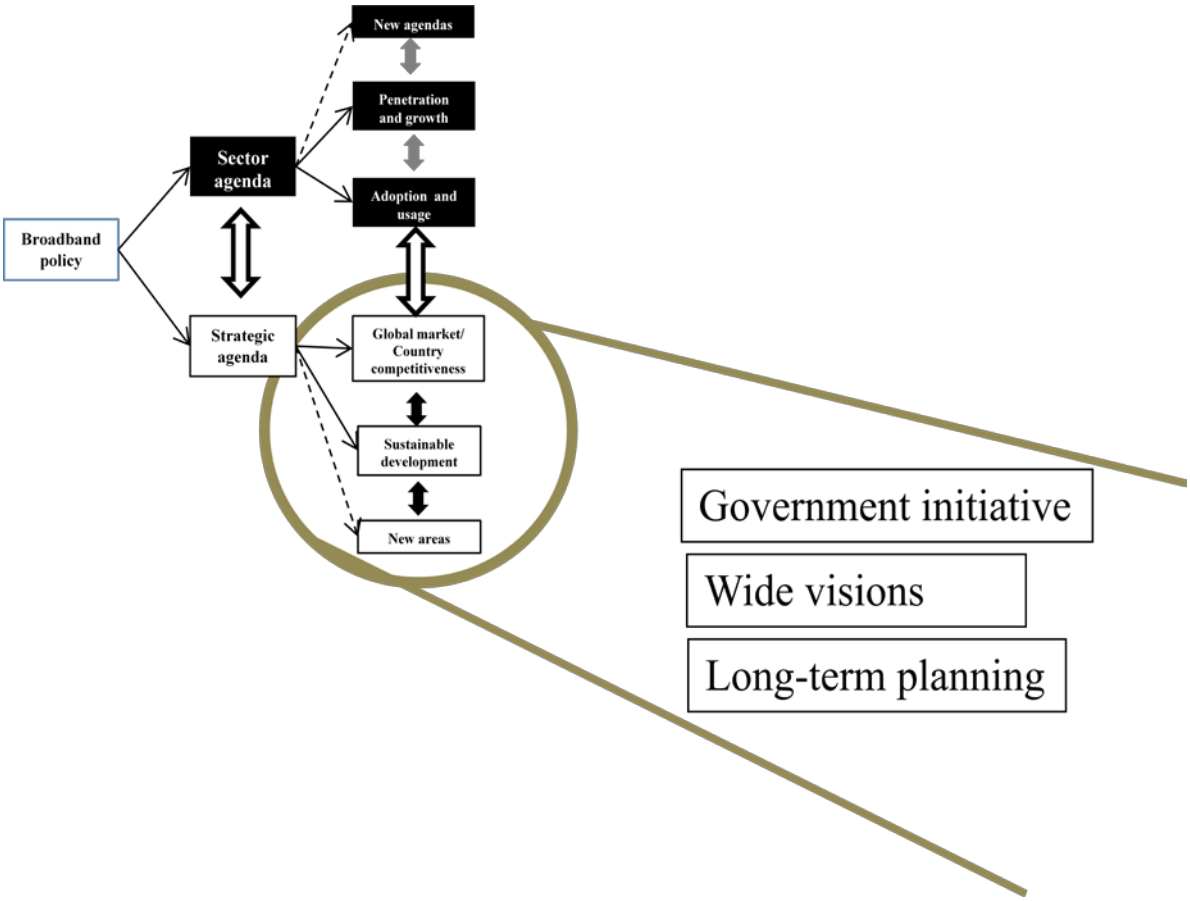


Figure 19 The relationship between strategic agenda and specific national agendas

A new context of broadband policy requires new institutional frameworks to pursue the political and policy agenda effectively. Changes in institutional frameworks can involve new priorities for the issues because of resource limitations and new boundaries between different government agencies (Poel, Linda, & van der Giessen, 2010). The typical broadband policy, which focuses more on broadband growth, may therefore need to be reconsidered in order to lay down a foundation for future development.

Although much research has addressed the importance of energy consumption by the communications infrastructure (e.g., Hilty et al., 2006a, 2006b; Ogasawa, 2006), there is no experience from governments around the world that introduced or implemented energy consumption measures in the telecommunications sector.

Nevertheless, the strategic agenda needs long-term planning and the vision of a government and, most importantly, it may need strong government support. Collaboration between public and private organizations is possible in terms of implementing these kinds of policies, but government involvement is important at the initial stage.

7. Analysis on the EU

The analysis in this chapter focuses on the development of broadband policy in the EU from 1987 to 2011, and how the sector agenda and strategic agenda have been addressed. Moreover, implications of the thesis to the research questions are analysed, and conclusions and thoughts regarding future research are provided.

Starting with the proposed policy framework in Chapter 6, with its sector and strategic agendas, it is clear that the EU broadband policies during 25 years of development have focused more on the sector agenda. Though a strategic agenda has been addressed in policy documents, subsequent processes do not appear to have responded to the issues. The analysis in this part is divided in to two main parts: the sector agenda and the strategic agenda perspective.

7.1. The sector agenda in the EU

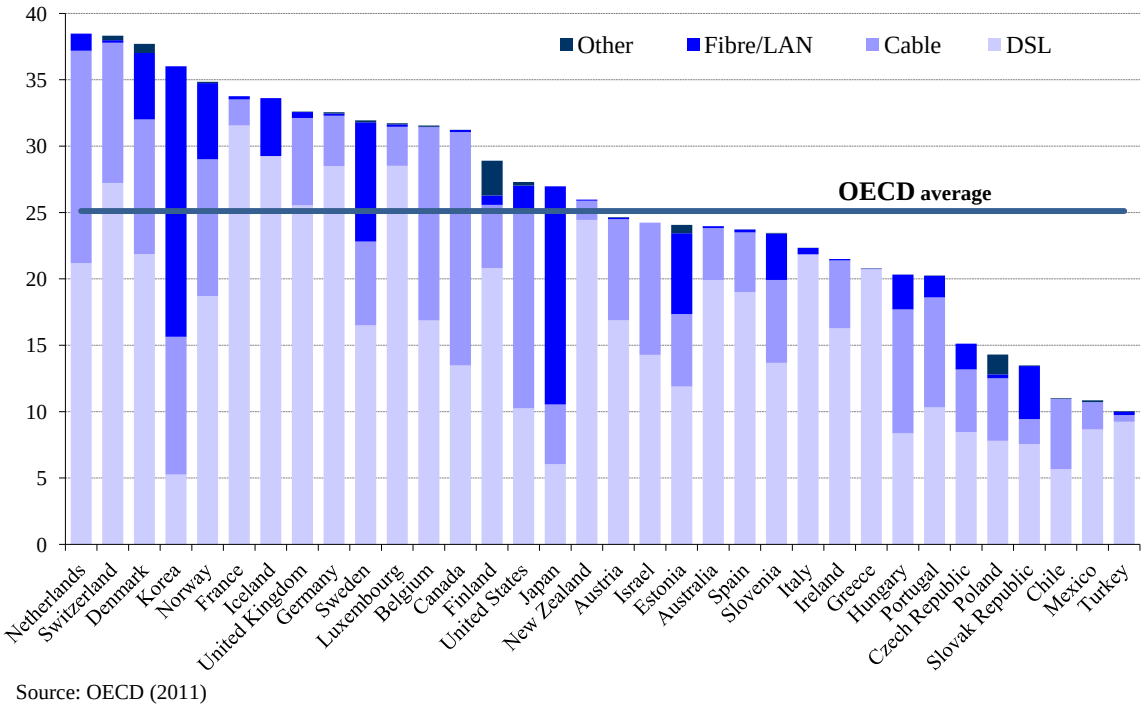
Even though the first movement of the EU policy, as stipulated in the 1987 Green Paper, recognized that the concept of having a high capacity broadband network came with two agendas: to increase the welfare of the people through a good infrastructure (the sector agenda) and to increase the competitiveness of the region (the strategic agenda), subsequent implementation focused only on increased penetration of the telecommunications infrastructure for 25 years.

As a kind of baggage from the pre-1987 monopoly era, the market power led to control over the existing network of the incumbents. Competition was fostered through regulations in order to rein in dominant players who possess significant market power. Therefore, efficiency in the EU market is more static (Fransman, 2007). Regulatory instruments have been developed to address market power issues in particular. Strategies for networks development are characterized by more proactive government involvement in broadband infrastructure deployment to complement market functioning in geographic areas where there is a lack of broadband infrastructures (Cava-Ferreruela & Alabau-Munoz, 2006).

Examples of this are particularly, the introduction of financial strategies using the Structural Funds to facilitate deployment in remote and rural areas in countries such as Italy, France or Spain (EC, 2004) and the construction of publicly owned networks. Thus the European Commission considers promoting strong competition between services and networks as the best way to develop broadband services (EC, 2002b). Since the market is characterized by static efficiency, there is less incentive to invest or upgrade the networks (Fransman, 2007). Therefore, the European Commission employs public funding strategies to the EU and recommends that in the absence of market incentives to invest, public funding of open access infrastructure, (defined according to technological neutrality and managed by an independent entity) as the solution that is most conducive to effective competition (EC, 2004).

In terms of policy, the development towards an information society, as termed by the European Commission, started in the late 1990s. The shift towards an information society policy by the European Commission was inspired by a confluence of factors, including the widening of the productivity and competitiveness gap with the United States (Michalis, 2007). Many policy initiatives have been issued to lead the change towards an information society in the EU. The development can be observed in ‘An information society for all’ in 1999, eEurope 2002, eEurope 2005, i2010 and, recently, the Digital Agenda for Europe.

Nevertheless, all of these share the main goal of offering wide availability of broadband access by fostering an open and competitive internal market for the information society. The result is successful in terms of broadband penetration. Figure 20 shows that European countries are among of the world leaders in terms of broadband penetration subscriptions per 100 inhabitants.



Source: OECD (2011)

Figure 20 Fixed broadband subscriptions per 100 inhabitants, by technology
(As of June 2011, OECD (2011))

Figure 21 also illustrates that Europe leads in broadband connectivity, with fixed- and mobile-broadband penetration reaching 26% and 54%, respectively (ITU, 2011a). Another advantage of the EU regulatory model is also on price competition. Figure 22 illustrates that, compared to many countries, price in the EU is quite low (ITU, 2011b). However, the success of the EU model focuses more on static efficiency (Fransman, 2007) not dynamic efficiency.

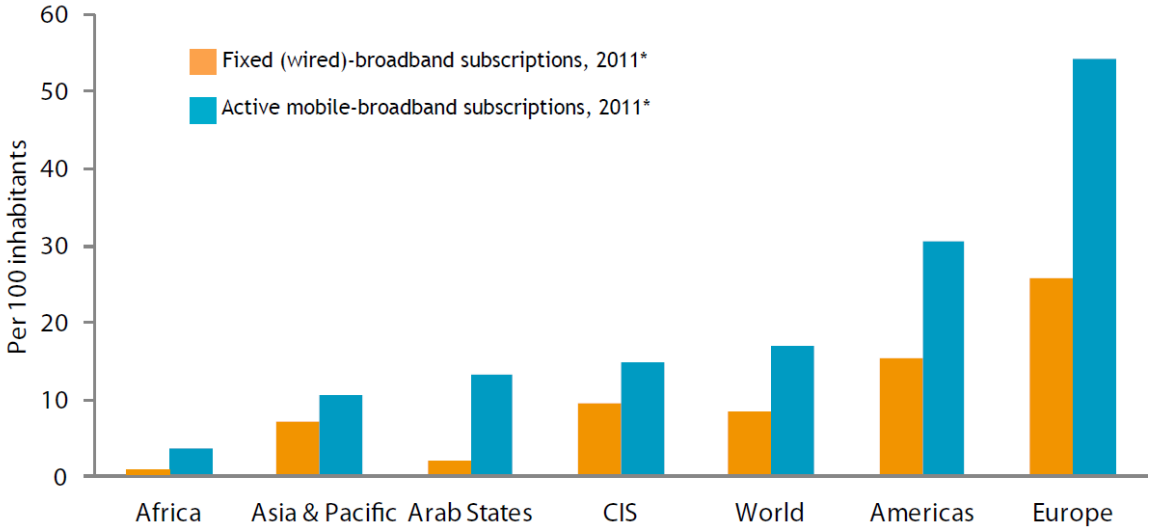


Figure 21 World broadband subscriptions
(ITU, 2011a)

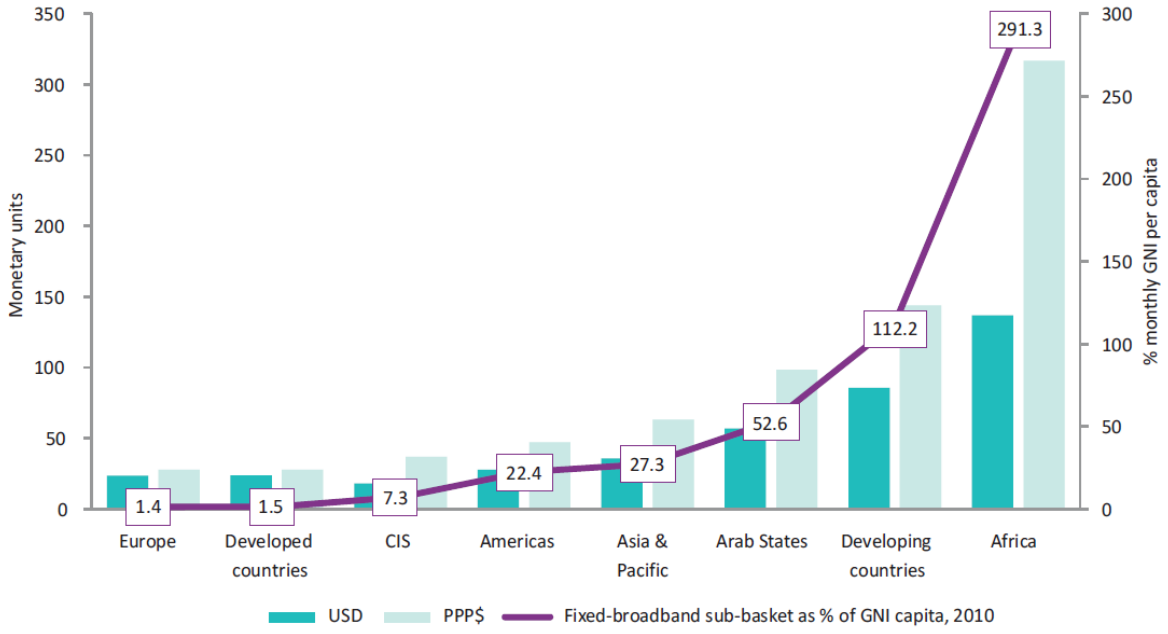


Figure 22 Fixed-broadband sub-basket by region and by level of development
(ITU, 2011b)

According to the Europe's Digital Competitiveness Report 2010 (EC, 2010d), two-thirds of fixed broadband lines in the EU offered speeds of between 2 and 10 Mbps (Figure 23). The most significant development is the shift in the two other categories of lines: low-speed broadband lines with download rates between 144 Kbps and 2 Mbps represented only 16 % of all fixed broadband lines in January 2010, down from 25 % in 2009, while the fastest category of lines (10 Mbps and above) increased its share, from 14 % in 2009 to 23 % of all fixed broadband lines in January 2010. Therefore, while on average the increase in broadband speeds is not yet significant, there is a clear trend towards faster access lines.

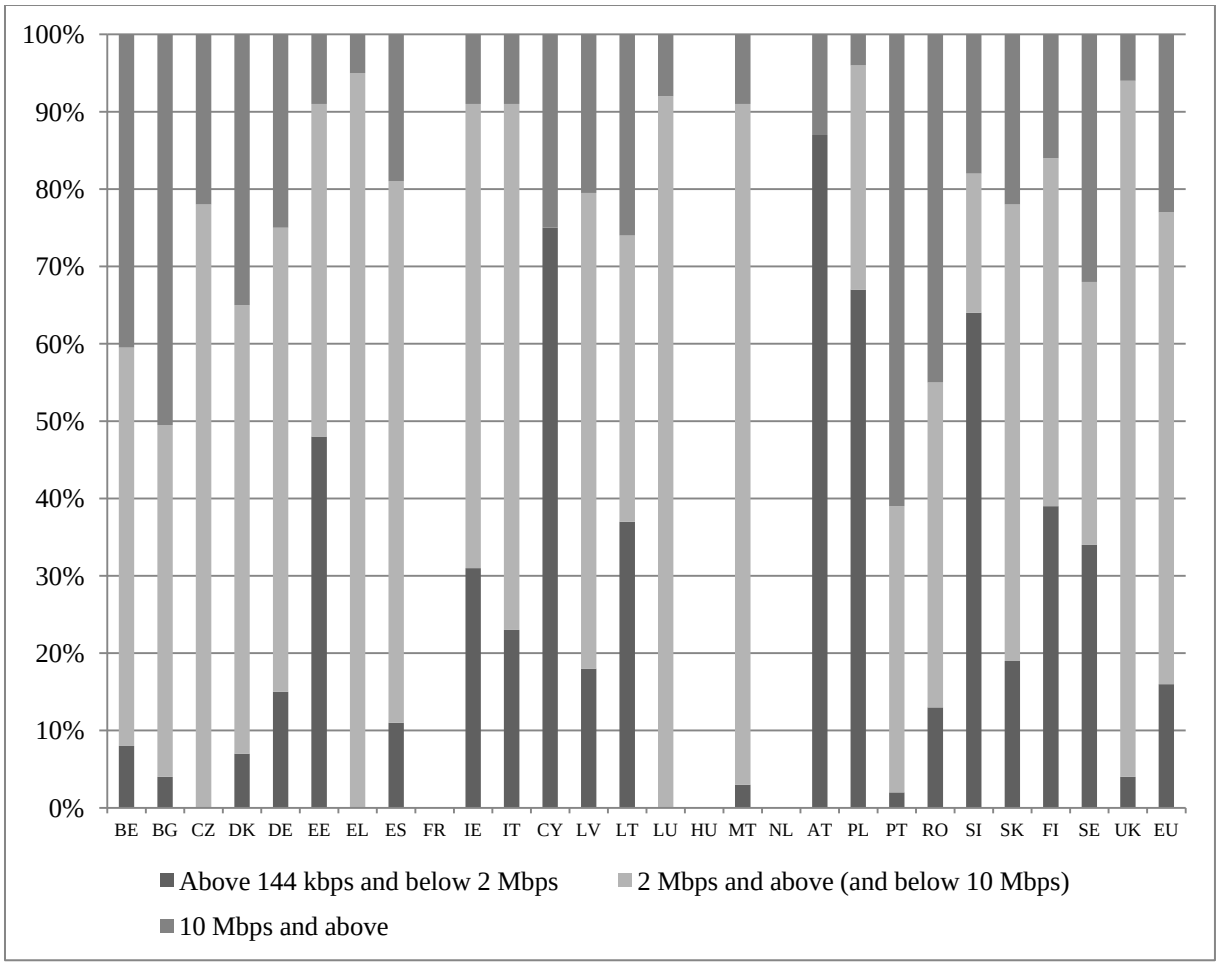


Figure 23 Fixed broadband lines by speed in the EU in January 2010
(EC, 2010d)

With regard to broadband retail prices, the median price for offers with download speeds between 2 and 4 Mbps in the EU-27 countries slightly decreased in 2009. Figure 22 indicates that, for broadband lines with speeds between 4 and 8 Mbps, prices decreased significantly in the newer Member States while remaining more stable in the rest of the EU (EC, 2010d).

The greater capacity of the fibre optic network attracts attention from the public. While the main technology deployed throughout Europe is based on DSL technology, the European Commission has launched A Digital Agenda for Europe, requiring a new investment in fibre technology through competition mechanism. Rolling out fibre technology in Europe is a big issue as there are mixed picture for most European countries. As a result, if the EU migrates to fibre technology, it has to undergo costly investment. The main strategy, the NGA Recommendation, was introduced by the European Commission in 2010 to encourage this new investment by applying the LLU regime.

Whether or not the EU regulatory model will be successful in terms of encouraging a major investment in fibre networks, no one can tell. But much research shows that there will always be a trade-off between competition and investment (details are discussed in Paper 5).

7.2. The strategic agenda in the EU

7.2.1. Competitiveness

At the very first stage of preparation to liberalize and harmonize the EU telecommunications market, increasing the competitiveness of the EU was one of the main reasons for these changes. Information industries were seen as a major source of economic growth and social development as they were essential to the competitiveness of the industries in world markets (EC, 1979). Lagging behind the US in terms of innovation, and behind Japan in terms of electronic equipment markets, prompted calls to harmonize the EU telecommunications market, or face a widening gap between the EU and the United States and Japan (EC, 1979, 1984).

The recognition that the telecommunications sector was a strategic sector of the Community also gave rise to several programs to support precompetitive research capacities such as ESPRIT program to support for information technologies and RACE program to broadband telecommunications infrastructure (Ducatel et al., 2000, Bauer, 2003). However, no any particular tool to support this strategic agenda was developed. The goal of increasing the competitiveness of the Community through telecommunications industry was left to the sector to handle. Now 24 years have passed since 1987, and the EU is again lagging behind Japan and the United States, but this time behind in terms of fibre broadband deployment.

Reinforcing the competitiveness of the economy as a whole through telecommunications networks has been the policy agenda of the EU for a long time (EC, 1984). A main reason for the European Commission to liberalize and harmonize the telecommunications market was in order to compete with the United States and Japan. The EU quite succeeded in terms of increasing penetration of telecommunications networks through its regulatory framework. However, increasing competitiveness is not just about only having infrastructure in place, but also ensuring that the infrastructure is utilized in every part of the economy, and that goes beyond telecommunications sector boundary.

Considering the previous EU policies, namely An Information Society for All, eEurope and i2010, a great deal of emphasis was placed on wide availability of broadband access though some other objectives were addressed such as stimulating the development of service, applications and contents. When the European Union approved a strategy known as the Lisbon Agenda in 2000 to catch up with the United States in terms of economic competitiveness while strengthening the European social model, much of the emphasis was placed on technological upgrading and enhancement of research capabilities. The European technological infrastructure improved considerably, but the effects on productivity, learning, creativity and entrepreneurialism were very limited. This is because acting on the developmental potential specific to the network society requires a combination of initiatives in technology, business, education, culture, spatial restructuring, infrastructure development, organizational change and institutional reform. It is the synergy between these processes that acts as a lever of change on the mechanisms of the network society (Castells, 2005).

According to the EU Digital Competitiveness Report (EC, 2010d), despite the good penetration rates, most EU broadband lines are based on xDSL technologies, and average speeds are usually lower than in other developed countries with high broadband penetration rates. Lines based on fibre-to-the-home (FTTH) solutions and fibre + LAN only represent between 2 and 5 % of all broadband lines, while this share is much higher in countries such as Japan (51.4 %) or Korea (46 %). In the United States, FTTH lines represent 6 % of all broadband lines. Although FTTH deployment accelerated in 2009 (Figure 24) differences are still very apparent. Price levels also reflect these differences. In October 2009, broadband standalone access at 100 Mbps was available at around 30 euros per month in Japan and 20

euros in Korea. These prices are between 20 and 50 % lower than prices for similar products in those EU countries where these are available.

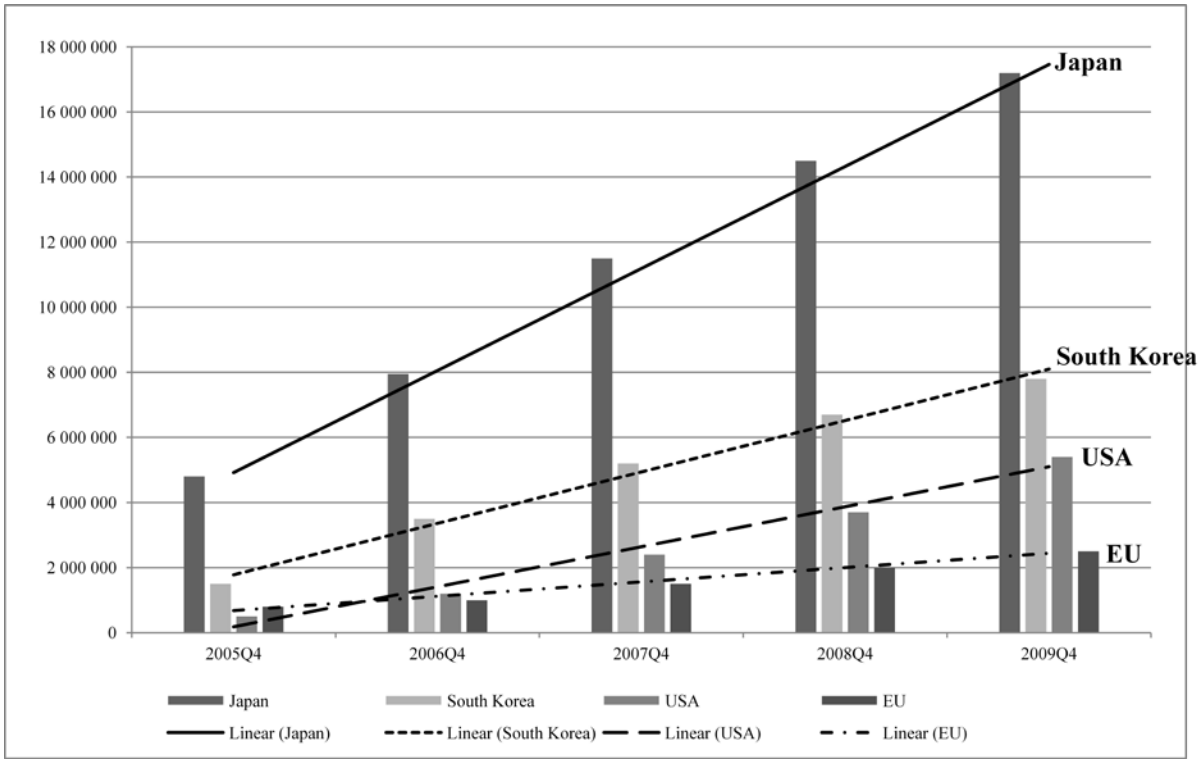


Figure 24 FTTx deployment in the EU, US, Japan and South Korea
(EC, 2010d)

Even though the EU telecommunications sector has improved in terms of price, speed and availability, it still cannot be compared to those major economies such as the United States and Japan. In the recent policy agenda, the Digital Agenda for Europe, upgrading and modernizing the networks is essential for the EU, where they are mostly based on DSL technology. The new policy aims to increase the competitiveness of the EU through fast and ultra-fast Internet access, in particular a fibre-based infrastructure, the availability of which is still very low in terms of percentage. Break down through the planned actions set by the EU to achieve Pillar IV, having Very Fast Internet whereby at least 50% of European households will subscribe to Internet connections above 100 Mbps by 2020. Several mechanisms are being initiated to encourage the new investment such as having clear and effective regulatory measures through the NGA Recommendation in 2010 or funding of high-speed broadband through EU instruments, such as the use of the Structural and Rural Development Funds.

However, most of the actions proposed under this new strategy seem not to differ from the previous tools implementing in the EU market since the Information Society initiatives was introduced. Relying on market mechanism may not be an effective approach because private firms have been reluctant to move beyond their established ADSL business. Most operators do not see a convincing business case for a large scale network upgrade to FTTH. Relying on funding mechanisms do not result in a good outcomes because expenditure figures for the Structural Funds show relatively slow absorption of funds targeted on broadband project (EC, 2010e).

Now, with major investment requirements looming and a long-term need for countries to remain competitive, frequent acceptance of the government's active role in industrial policy has returned. In this sense, even though fibre network upgrades are often essential to national economic

competitiveness, they are pursued less aggressively in the EU (Atkinson et al., 2010). Therefore increasing competitiveness of the region through the existing mechanisms is challenging the European Commission's capability in the long run.

7.2.2. Sustainability

As a result of living in an information society, 58% of EU consumers are PC users and this will rise to 75% by 2015. 50% of Europeans use the Internet daily (IMR World, 2010). Dematerialization is being introduced in every sector to both public and private activities (BioIntelligence, 2008). Information and communications technologies are a major tool to improve electricity consumption in other sectors such as transport. Electricity consumption and CO_2 emissions from telecommunications equipment and networks are increasing. A growing concern about environment protection is another policy challenge for the EU. The 2008 Eurobarometer opinion poll across the 27 EU countries revealed that for most citizens a healthy environment is as important to their quality of life as the state of the economy. A 64% majority considers that environmental protection must be given priority over the competitiveness of the economy (EC, 2010b).

The above phenomenon suggests that sustainability in telecommunications sector will soon be a critical issue facing the EU telecommunications market. In addition to increasing competitiveness, the contribution of broadband technology to environmental issues is also addressed in the recent policy agenda, a Digital Agenda for Europe. Though the environmental issues was recognized for the first time in the broadband policy document, unfortunately, it contains nothing about the kinds of actions that will be taken by the EU in terms of reducing electricity consumption and CO_2 emissions in the long run. Under the Pillar ICT for Social Challenge if the Digital Agenda for Europe, there is a recognition that the growing ecological footprint of the ICT sector threatens to hinder the deployment of ICT with consequences for the industry and the contribution of ICT to the recovery and growth of the economy (EC, 2012).

Nevertheless, the proposed action under the Digital Agenda is then to adopt common measurement methodologies for the sector's own energy performance and greenhouse gas emission and propose legal measurement if appropriate (EC, 2010b).

The latest policy agenda expresses the hope that fast and ultra-fast broadband networks can be an enabling tool for energy saving in other sectors. However, there is no implicit or explicit policy on energy consumption in ICT sector itself though there is the fact that energy consumption of ICT equipment will increase over time. The EU may be the leader in terms of introducing the new scheme of cap-and-trade in energy sector, but that scheme does not cover the telecommunications sector at this moment. If there is no long term planning on this issue, the telecommunications market may encounter trouble if it is forced to turn around to achieve sustainability in the near future.

8. Conclusions, policy implications and future research

The declared aims of the thesis were to propose a conceptual framework of broadband policy and to analyse the EU broadband polices and initiatives. The proposed framework brought a different perspective on the existing broadband policy by addressing both the existing policy objectives and the new expected objectives for telecommunications infrastructure, in particular broadband. In addition, the thesis has applied the EU broadband policy developed since 1987 as a case study for the proposed framework.

The findings in this thesis suggest the importance of addressing both the sector agenda and the strategic agenda under broadband policy. In addition, there is a need to have a new policy design for the EU if long-term development is expected. The answers to the three research questions have been reached. This chapter outlines the answers to the research questions, proposes policy implications and provide directions for future research.

8.1. Problems of the current policy framework

The development of telecommunications sector, the literature review in Chapter 3, the challenges of telecommunication sectors in Chapter 4 and the theoretical considerations in Chapter 5 suggest that the existing structure of broadband policy may not be applicable to the ongoing situation of telecommunications sector. The first research question was, therefore, formulated:

RQ 1: How is the existing broadband policy applicable to an information society?

From empirical findings, broadband connectivity is widely accepted as having strategic importance to all countries because of its ability to accelerate the contribution to economic growth in all sectors, enhance social and cultural development, and facilitate innovation. Though the contribution of broadband to social and economic development is very important, it may not be able to yield all those expected benefits that broadband could bring about to society under the existing perspective of broadband policy. The development of telecommunications sector for more than 100 years has suggested that broadband policy these days focuses primarily on a sector agenda, (e.g., increasing broadband penetration within the telecommunications sector). To pursue the sector agenda, a three-dimensional approach has been implemented consisting of a government approach, market approach and telecommunications regulatory approach.

The review of the literatures demonstrates that the current regulatory and policy model in the telecommunications sector addresses only market issue. Particularly, much attention has been paid on the effectiveness of various instruments being implemented in the sector. The problem of the existing model is that it deals only with narrow industry concerns which focus on the market power of telecommunications providers or on competition between providers. The ongoing development of technology and the changes of the social structure due to technological factors make telecommunications networks more important than they were previously. New issues arise and generate more broad societal concerns into account, and are not limited to penetration and sector growth. Those issues suggest that the traditional framework which is predominated by economic perspective may not be applicable. Hence, a new broadband policy framework is needed.

8.2. The new perspective of broadband policy

When a new broadband policy is needed, the proposed framework is discussed in Chapter 6. The framework takes both industry and broad societal concerns into account. It is formulated from a policy goal perspective in order to answer the second research question.

RQ 2: How can a broadband policy be formulated to consider the new challenges of the telecommunications sector in an information society?

Some academic papers in Chapters 3, 4 and 5 recognize the existence of new challenges facing broadband networks, such as competitiveness and sustainability. But no literature addresses the issue precisely from a policy viewpoint. Therefore, a new framework to assess broadband policy based on the relevant issues can be formulated. The proposed framework views broadband policy from two perspectives: the sector agenda and the strategic agenda. The necessity of the division between the sector agenda and the strategic agenda results from the facts that they are based on different concepts and objectives which are not able to be achieved through the same path. While the sector agenda evolves from the development of the traditional telecommunications structure, which focuses on the growth of telecommunications availability for the users, the strategic agenda emerges from the new challenges and expectations outside the telecommunications sector. The integration of these two perspectives needs a new policy design and new policy instruments.

8.3. Challenges facing the EU broadband policy

The EU broadband policy has essentially focused only on sector agenda concern of how to increase broadband penetration in the region. The importance of telecommunications infrastructure is increasing as a result of moving towards an information society. Though the new challenges, competitiveness and sustainability in particular, have been recognized at the European Commission, whether or not this new perspective has been suitably incorporated into broadband policy is questionable. This led to the third research question:

RQ 3: To what extent have the EU broadband policies addressed the new challenges of the telecommunications sector in an information society?

Since the 1980s, telecommunications reform discussion and practice in the EU have focused on regulatory matters, although some other tools have also been implemented, such as funding mechanisms. During the past decade, the strategic importance of information and communications technology (ICT) for the international competitiveness of national firms and for national welfare more broadly has moved to the centre of attention. However, traditional regulatory problems and strategic issues of technology policy related to broadband are often addressed by different institutions. Moreover, the frameworks and rationales used by different agencies in shaping policy are not always fully compatible. For example, much of regulatory practice is rooted in notions of market failure related to market power, whereas industrial policy is premised on a broader set of principles that take positive externalities and spill-over effects into account more explicitly. A systematic analysis of sectoral (regulatory) and strategic aspects of broadband policy and the way they are implemented by the European Union (EU), a region that has sought to integrate strategic aspects into broadband policy, is therefore crucial for future development of a country.

The empirical evidence presented in this thesis suggests that competitiveness is a reason for integrating the telecommunications sector into an umbrella of the European Commission. Still, regulatory instruments developed two decades ago are not leading the European countries to achieve

the goal. The EU lags behind the United States and Japan as before. Now that environmental issue has become concerns of the public, the telecommunications sector is being expected to provide a better quality of life as regards to electricity consumption and CO_2 emissions problems. The recent broadband policy of the European Commission, the Digital Agenda for Europe 2010, clearly sets the goals to achieve strategic agenda, both competitiveness and sustainability. Unfortunately, no new policy instrument has been proposed.

Even though the latest policy agenda has required the achievement of the strategic agenda, these objectives may not be easily achievable under the existing structures unless changed strategies and working concepts are implemented. Dealing with the strategic agenda may require mechanisms different from those of the sector agenda, due to the complexity of the situation.

Regarding sustainability, several mechanisms to reduce energy use and greenhouse gas emissions associated with ICT products and services are addressed in the recent policy. However, this statement is still vague. It does not provide either a sufficiently concrete path to achieving this reduction, or clear guidance for telecommunications providers to know what they will face or how they should act in the future. If the European Commission transforms the existing regulatory framework of the sector agenda which is based on competition mechanisms to the sustainability issue by assuming that competition mechanism would be able to deliver the objective of this strategic agenda, this assumption will challenge the European Commission sooner or later, since the instruments of the sector agenda have not been designed for this new challenge.

8.4. Policy implications

The proposed framework is based to address the importance of telecommunications infrastructures for building an information society, and to show the significance of policy in building telecommunications infrastructures. The usefulness of the proposed framework is the starting point of an analysis of existing broadband policy to demonstrate that this policy will not applicable to achieve all expectations regarding the information society. Since traditional regulatory problems and strategic issues of technology policy related to broadband are often addressed by different institutions, the frameworks and rationales used by different agencies in shaping policy are not always fully compatible.

To make a broadband policy that is applicable to an information society, an integrated broadband policy of both sector and strategic agendas is needed. An integrated broadband policy that tries to perceive different goals of different areas needs collaboration from various agencies and a government policy that is visionary and comprehensive. Typically, public policy is determined sectorally within each area by separate ministries or agencies pursuing relatively narrow goals, such as increasing the efficiency of the telecommunications market through competition mechanisms, or developing human well-being for people everywhere (e.g., security) based on sustainable development, or increasing efficiency to compete in global market of a country. To perceive different goals imposed on the telecommunications sector, an agenda, collaboration, close cooperation are needed.

More practically, in the case of the EU, the European Commission recognizes the importance of telecommunications infrastructures in an information society, however, the way that recognition has transformed into broadband policy strategies still lags far behind. Under the existing structure of the European Commission, the Commission is divided into several departments and services. The departments are known as Directorates-General (DGs). An issue can, therefore, fall into several related DGs, for example:

a) To pursue the Digital Agenda for Europe, the Directorate-General for Information Society and Media, the Directorate-General for Regional Policy and the Directorate-General for Agriculture for Rural Development are involved.

b) To increase competitiveness involves the Directorate-General for Trade, the Directorate-General for Research and Innovation and the Directorate-General for Enterprise and Industry

c) To perceive sustainable development involves the Directorate-General for Climate Action, the Directorate-General for Environment, the Directorate-General for Eurostat, and the Directorate-General for Energy

Therefore, to achieve both competitiveness and telecommunications penetration, the related DGs in a) and b) should work together to set strategies in a holistic fashion. Fragmented policy goals and agencies lead to the situation where neither type of goal can be achieved easily. While the level of competitiveness of the EU and the development of telecommunications infrastructures are stable, the different levels of development amongst Member States create an obstacle to increasing the competitiveness of the EU. From several global competitiveness reports issued by the IMD and World Economic Forum, for example, the rank of the individual Member States varies greatly even among the EU-15, as does the level of development of the telecommunications infrastructure. Hence, to increase the competitiveness of the EU, different policy strategies which apply more focus to geographical differences may be required. However, this needs details and deep analysis.

Similarly, regarding sustainable development, collaboration between a) and c) are required. Several strategies and agendas can be discussed in order to integrate these two goals, for example, whether or not subsidy mechanisms are required due to different economic rationales. In addition, the long term planning for CO_2 emission of new and existing infrastructures and equipment is required. For instance, a sustainability criterion could be included as one requirement for obtaining funding for fibre deployment.

8.5. Future research

This thesis has proposed a new perspective in viewing broadband policy in order to respond to both the existing objectives within the telecommunications sector and the new challenges facing the telecommunications infrastructure. Since telecommunications infrastructures are, and will be, a crucial factor for future society, it is important for the long term development of a country to consider those two agendas under a broadband policy. To have a broadband policy with a new perspective in place leads to the systematic thinking regarding the structures and better solutions.

The proposed framework represents the first step toward suggesting that a broadband policy should be viewed from two separate agendas in order to be applicable to the emerging environments of an information society. The analysis in the case of the EU suggests that the existing broadband policies focus mostly on sector agendas. From this point, a couple of directions for future research can be pointed out.

Firstly, regarding the proposed framework, the thesis has not yet explored or proposed policy implementations of the two integrated agendas in a more practical way. Several case studies need to be conducted as each country has different relevant policies, regulations, and factors.

Secondly, a detailed study on the relationship between telecommunications policy and each strategic agenda needs to be done, with both theoretical and practical considerations. It is interesting to investigate the ideology behind each area, and to find out to possible ways to integrate each of them.

Thirdly, the new broadband policy requires a new conceptual thinking in order to re-design the whole structure of telecommunications. The new working structures are also important and need to be explored.

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