

## Best Practices Worldwide for Broadband Growth

Christos Bouras<sup>1,2</sup>, Eri Giannaka<sup>1,2</sup>, Thrasylvoulos Tsiatsos<sup>1,2</sup>

<sup>1</sup> Computer Engineering and Informatics Dept., University of Patras and

<sup>2</sup> Research Academic Computer Technology Institute

N. Kazantzaki Str., GR-26500, University Campus, Rion, Patras, Greece

{bouras, giannaka, tsiatsos}@cti.gr

### Abstract

This paper investigates and analyses the best practices followed by various countries worldwide for supporting the broadband growth. The methodology used to locate the best practices is based on three main steps: (a) the presentation of the main factors that have a major impact on broadband growth; (b) the definition of what is a “best practice” based on quantitative criteria; (c) the calculation of a best practice index and a good practice index, which indicates that a country followed these best or good practices to support its broadband growth respectively. This methodology indicated that Denmark, United States, Japan, Canada and Rep. of Korea followed best practices for their broadband growth, while United Kingdom and the Netherlands followed good practices.

### Introduction

Broadband is a key element of the developments that are taking place in the electronic communications markets. Consumers are benefiting from lower prices and higher speeds and a variety of broadband offers due to increasing competition in this market. For that reason one of the main objectives in many countries is to support broadband growth. For example, broadband is considered crucial to European competitiveness. In this context, the European Commission has been particularly active in promoting broadband developments. The EC adopted an initiative supporting the Lisbon 2010 goals, i2010, where broadband take-up is considered an important factor for the emerging digital economy and competitiveness.

The current situation concerning the broadband penetration is presented in Figure 1. According to these data the OECD average is at 11,7% and the EU15 average is at 11,8%. Iceland led the OECD in broadband penetration, with more than 25 subscribers per 100 inhabitants, while Greece (with broadband penetration at 1,4%) is far behind.

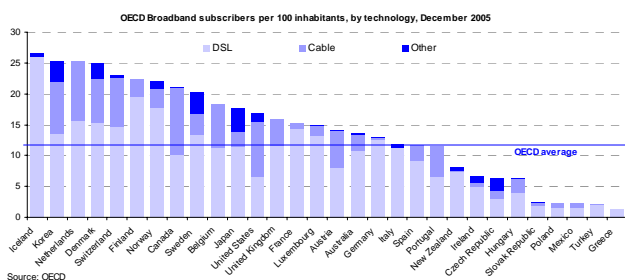


Figure 1: OECD Broadband subscribers per 100 inhabitants (Source: OECD [5])

The main focus of this paper is to summarize the lessons learned from countries worldwide that present high broadband penetration rate. The policies adopted by these countries for supporting the broadband growth could be proved very beneficial for countries with very low broadband penetration rate (such as Greece)

However, the high broadband penetration rate cannot alone stand as the criterion for considering a broadband strategy of a country as a best practice. There are more criteria and factors that have a major impact on the broadband penetration growth. Some of these factors are the following:

- The **regulatory framework**: The regulatory framework of telecommunications is one of the major factors that can seriously affect the broadband growth. In cases, where the regulatory framework is insufficient, the telecommunications sector may malfunction.
- The **structural changes that take place in the information and communications technology (ICT) markets** (e.g. increase of competition, privatization of public organizations, market liberalization, globalization, etc.).
- The changes of the **broadband services** and of their use (e.g., VoIP, mobile telephony, 3G, WLAN, WiFi, WiMAX, digital television).
- The **technological developments** (e.g., creation of innovative and interoperable solutions in an IP environment, adoption of IPv6 protocol, creation of optical networks, content digitalization, increment of the computational power of personal computers, etc.).
- **The users' need for fast content access**. Since the demand for broadband infrastructures is led by the need for content access, both the requirements for broadband services and infrastructures are strongly interrelated.
- The **cost**: one of the most important economic elements seems to be the income, compared to the cost of a broadband subscription.
- **E(electronic)-readiness**. **E-readiness** constitutes an essential measure of the e-business environment of a country and is defined by a collection of factors that indicate how amenable a market can be to Internet-based opportunities. Some of these factors are: a) the connectivity and technology infrastructure, b) the business environment, c) the consumer and business adoption, d) the legal, policy, social and cultural environment, etc.

This paper tries to quantify the above factors for locating the countries worldwide that followed best practices for supporting the broadband growth. The rest of the paper is structured as follows: The section that follows presents the methodology adopted for quantifying the above factors and for providing a definition of “best practice” based on quantitative criteria. The results of this methodology are the best practice index and the good practice index, which indicate that a country adopted the best or good practices for supporting its broadband growth. The third section (i.e. “Best practice analysis”) presents the calculation of the best practice and good practice index and discusses the results. The last section (i.e. “Conclusions”) summarizes the results of the paper as well as the main characteristics of a best practice for supporting the broadband growth of a country.

### Methodology: Definition of Best and Good Practice Index

Based on the factors presented in the introductory section, this section aims at quantifying the above factors and at defining two new indices: (a) the Best Practice Index (BPI), which indicates that a country followed some of the best practices worldwide for supporting its broadband growth, and (b) the Good Practice Index (GPI), which, accordingly, indicates that a country followed some of the good practices worldwide for supporting its broadband growth. In this section the criteria, their sources, and the indices are presented.

#### Criteria

The first step of the methodology is to select the main criteria that could be used for defining the above indices. These criteria are the following:

- The cost of 1 Kbps per United States Dollars (USD) calculated in PPP. We refer to this criterion as “A”.
- Annual average growth rates of Gross Domestic Product (GDP) per hour worked. This criterion is referred as “B”.
- The Economist Intelligence Unit’s e-readiness rankings. This criterion is referred “C”.
- The broadband penetration growth rate. We refer to this criterion as “D”.
- Broadband subscribers per 100 inhabitants. This criterion is defined as “E”.
- Internet subscribers per 100 inhabitants. This criterion is referred as “F”.
- The Internet penetration growth rate. This criterion is called “G”.
- The investment in information and communication technologies (ICT): This criterion is the percentage of non-residential gross fixed capital formation, total economy and is referred as “H”.
- The level of competition in telecommunications sector. This criterion is called “I”.

We can categorize the above criteria in three basic categories. The first category contains technological criteria such as D, E, F, and G. The second category contains

financial criteria such as A, H and I. Finally, the third category contains social criteria such as B and C.

#### Data sources

For quantifying the above criteria the sources used for each criterion are presented. (It should be noted that data for all the above criteria were available for the following countries: Australia, Austria, Belgium, France, Germany, Denmark, Greece, US, Japan, Ireland, Spain, Italy, Canada, Rep. of Korea, United Kingdom, New Zealand, Norway, The Netherlands, Portugal, Sweden, and Finland):

- Criterion “A”: The data for the cost concern Internet access by DSL in OECD member countries, including tax, in November 2004 (apart from The Netherlands, Belgium, United Kingdom, Austria, Germany, Portugal, Ireland and New Zealand, for which the available data apply for 2002) 0.

The cost of 1 Kbps/USD PPP were calculated as the quotient of:

#### Monthly cost (USD PPP) / Speed of connection downstream (kbit/s)

- Criterion “B”: The data concern the Annual Average Growth Rates during 2000-2004 and based on GDP per hour worked. These data have been drawn from [2].
- Criterion “C”: These data concern the 2005 e-readiness score and they were drawn from the report «The 2005 e-readiness rankings, a white paper from the Economist Intelligence Unit» [3].
- Criterion “D”: The data concern the broadband penetration growth rate during 2002-2005 and are based on [4].
- Criterion “E”: The data concern the broadband penetration at June 2005 and they based on [4].
- Criterion “F”: The data concern the Internet penetration at June 2005 and are based on [6].
- Criterion “G”: The data concern the Internet penetration growth rate during 2000-2005 and are based on [6].
- Criterion “H”: The data concern the ICT investment by asset in OECD countries, 2003 (2002 for Australia, France, Japan, New Zealand, Norway and Spain; 2001 for Italy) and present the percentage of non-residential gross fixed capital formation in the total economy. ICT equipment is defined here as computer and office equipment and communication equipment; Software includes both purchased and own account software. Software investment in Japan is likely to be underestimated, due to methodological differences.
- Criterion “I”: The data used for the level of competition in telecommunications sectors were drawn from ITU World Telecommunication Regulatory Database [247]. The level of competition in each country has been calculated as the average of the level of competition in each sector.

The sectors are the following: Local services, Domestic long distance, International long distance, Wireless local loop, Data, DSL, Cable modem, VSAT, Leased

lines, Fixed Wireless Broadband, Mobile, Paging, Cable TV, Fixed sat, Mobile satellite, GMPCS, IMT 2000, Internet services, and International gateways. The level of competition in each sector is denoted as:

- 0 in case of monopoly
- 1 in case of duopoly
- 2 in case of partial competition
- 3 in case of full competition

According to the above we resulted to Table 1.

Country	I
Australia	3.000
Austria	3.000
Belgium	2.750
Canada	3.000
Denmark	2.833
Finland	2.882
France	3.000
Germany	3.000
Greece	2.722
Ireland	3.000
Italy	3.000
Japan	3.000
Rep. of Korea	2.923
The Netherlands	2.417
New Zealand	3.000
Norway	2.813
Portugal	3.000
Spain	3.000
Sweden	3.000
UK	2.824
USA	3.000

**Table 1: Level of competition in telecommunications**

#### Indices

Based on the above criteria, we used the following equation for defining both the Best Practice Index (BPI) as well as the Good Practice Index (GPI):

$$\text{Score} = 2*(A) + (B) + 2*(C) + 3*(E) + 2*(F) + 2*(H) + 2*(I) \quad (1)$$

Where (A), (B), (C), (E), (F), (H), and (I) are the normalized values (in a range of 1 to 10) for the values of criteria A, B, C, E, F, H, and I respectively.

As it appears from the above equation (1), we consider criterion E (that is the broadband penetration) to have high importance as it is considered as the most indicative factor for the calculation of the best practices for the broadband growth. Therefore, we multiply this factor by 3 (weight 3).

Furthermore, criteria A, C, F, H, and J are considered to have equal (among them) importance to the broadband penetration growth. However, we consider that these indicators have lower importance than indicator E and

higher than indicator B. Therefore, they are calculated with weight 2.

Indicator B is considered as a depended factor and therefore it is assigned with weight 1.

It should be mentioned that equation (1) does not take into account indicators D and G. If both these factors have been taken into account in equation (1), then we would subsidize the countries with minimal broadband penetration in 2003 and minimal Internet penetration in 2000, even though they have not presented a good rate of broadband and Internet penetration.

Both indicators D and G are taken into account in the Good Practice Index, as explained later in this section.

According to the above we define as Best Practice Index (BPI) the following:

$$\text{BPI} = \text{AV}(S_1, \dots, S_n) + \text{Number of criteria} \quad (2)$$

where:

- $S_i$  is the *Score* of a country
- $\text{AV}(S_1, \dots, S_n)$  is the average of  $S_1, \dots, S_n$
- $n$  is the number of countries
- the Number of criteria is 14

The equation (2) means that a country with *Score* bigger than BPI ( $\text{Score}_i \geq \text{BPI}$ ) could be regarded as best practice.

Furthermore, we define as Good Practice Index (GPI) the following:

$$\text{GPI} = \text{AV}(S_1, \dots, S_n) \quad (3)$$

where  $S_i$  is the *Score* of a country and  $\text{AV}(S_1, \dots, S_n)$  is the average of  $S_1, \dots, S_n$

A country $_i$  could be regarded as good practice when:

$$S_i \geq \text{GPI} \ \&\& \ D_i + G_i > \text{AV}(D_1, \dots, D_n) + \text{AV}(G_1, \dots, G_n) \quad (4)$$

where  $\text{AV}(D_1, \dots, D_n)$  is the average of  $D_1, \dots, D_n$  and  $\text{AV}(G_1, \dots, G_n)$  is the average of  $G_1, \dots, G_n$

The equation (4) indicates that we can consider as good practices the practices of countries with score higher than the average score and furthermore present a rapid growth of broadband and Internet penetration (criteria D and G respectively).

#### Best Practice Analysis

Based on the equations (2) and (4) we calculated the *Score* for each country. The average score is 87. Table 2 presents the following info for each country:

- The normalized values for each criterion [i.e. (A), (A), (B), (C), (E), (F), (H), and (I)]
- The *Score* (i.e. S)
- The Result, where BP means “Best Practice” and GP means “Good Practice”.

According to the data presented in Table 2 the practices of the following countries raised as **best practices**:

- Denmark
- United States
- Japan
- Canada

- Rep. of Korea

Furthermore, the practices of United Kingdom and the Netherlands came up as **good practices**.

The higher *Score* (i.e. S) is achieved by Rep. of Korea, while the lower *Score* is achieved by Greece.

Country	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	S	Result
N. Korea	4	10	9	0	10	9	2	5	10	114	BP
USA	2	6	10	1	6	9	4	10	10	106	BP
Japan	10	5	8	1	6	8	2	4	10	103	BP
Canada	3	4	9	0	8	9	3	6	10	102	BP
Denmark	1	4	10	1	9	9	3	6	9	101	BP
Sweden	0	6	10	1	6	10	2	8	10	100	
Finland	0	6	10	2	7	8	2	8	10	99	
Netherlands	1	2	9	2	9	9	6	5	8	93	GP
Belgium	3	4	9	1	7	6	5	6	9	91	
UK	1	6	10	4	5	8	5	7	9	91	GP
Norway	1	6	9	2	7	9	1	4	9	91	
Austria	1	4	9	1	5	9	4	4	10	85	
Australia	0	5	9	4	4	7	4	7	10	83	
Germany	1	4	9	1	4	8	4	5	10	82	
France	1	6	9	3	5	6	7	4	10	81	
Ireland	1	10	9	10	2	7	6	2	10	74	
Portugal	0	2	8	2	4	8	5	4	10	74	
Italy	1	1	8	4	4	6	4	5	10	73	
Spain	0	3	8	2	4	5	8	4	10	69	
N. Zealand	0	3	4	2	3	10	10	4	10	68	
Greece	0	10	7	5	0	4	10	3	9	56	

Table 2: Best practices results

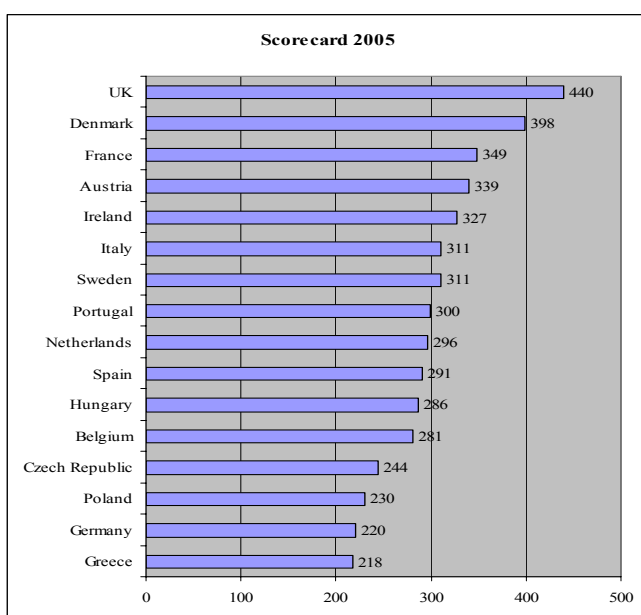


Figure 2: ECTA Regulatory Scorecard 2005 (Source: ECTA [9])

A considerable result is that Norway, Sweden and Finland are not presented as best practices neither as good practices, although their score is higher than the average score (91, 100 and 99 respectively). However, this can be explained by the value of indicators D and G for these countries, which indicate that they presented small broadband and Internet presentation growth rates. In other words, we can say that there is a maturation concerning broadband growth in these countries. Therefore, these countries are not considered as best practices.

Comparing the results of Table 2 with ECTA Regulatory Scorecard 2005 (Figure 2), there is a relation between the effectiveness of the telecommunication regulation frameworks and the Score in Table 2. For example the practices of Denmark and UK, which constitute best and good practices respectively, present a high score in the Regulatory Scorecard 2005 as well. Moreover, Germany and Greece that both appear with low Scores in Table 2 (85 and 56 respectively), they also present low scores (220 and 218 respectively) in the Regulatory Scorecard 2005.

*Analysis*

Investigating the broadband strategies in the above countries (Denmark, United States, Japan, Canada, Korea United Kingdom and the Netherlands) and analyzing them basic results can be extracted for the policies and practices that could be followed by a country for increasing its broadband growth.

The governments of the above countries articulated a vision of what ICT could do for both public and private sectors' beneficiaries. Furthermore, the policies and strategies adopted by these countries for supporting the broadband growth aimed at:

- **The improvement of users' dexterities in ICT:** United Kingdom, Republic of Korea and Japan adopted this action for supporting the broadband growth. For example in Republic of Korea the government has provided computer literacy training and education aimed at elementary and middle schools, housewives, the military, and the disabled. A major Korean initiative in this area has been the three-year "10 Million People IT Education project", which was launched in mid-2000. A similar action in Japan is "IT Human Resource Development Plan".
- **The Internet penetration growth:** Most of the countries aim at the growth of Internet use, mainly in rural areas. For example, the Community Access Program (CAP) in Canada aims at establishing free Internet access points in schools, hospitals and other public centers.
- **Tax exemptions/Loans:** Many countries include in their policies and strategies, tax exemptions for enterprises or citizens who want to use ICT. Examples are Korea, Denmark and United States. In US, the largest Federal program supporting broadband development in rural and remote areas is the Federal Rural Broadband Access Loan and loan Guarantees

Program where 1.4 billion US \$ in loans and loan guarantees have been made available on Federal level to provide broadband services in rural areas. Denmark has introduced a special taxation scheme, which enables employers to offer PCs as well as broadband connections to their employees as a tax free benefit. Considering the high levels of income taxes in Denmark, this implies that tax reductions in reality pay more than 50% of the costs. This scheme has become very popular and many companies provide this opportunity to all of their employees as part of their salary.

- **Development of broadband infrastructures and coverage of rural areas:** Almost all countries aim at the development of broadband infrastructures either for increasing the broadband supply in general or for creating new infrastructures in rural and underserved areas. For example in Canada one of the most important initiatives is the Broadband for Rural and Northern Development Pilot (BRAND) Program which aim at connecting unserved areas and unconnected communities.
- **Development broadband services:** Many countries aim at the development of broadband services for supporting e-health, e-government, and electronic public services in general. Furthermore, some countries aim at the increment of use of e-services in the public sector. For example in UK together with industry the Government plan to sponsor a “Digital Challenge” prize for a local authority and its partners – both public and private – to establish by 2008 universal access, advance public service delivery and provide a test-bed for best practice in e-government.
- **Improvement of the security of broadband connection/services:** Some of the above countries (i.e. UK and Japan) aim at improving the security on broadband connection/services. The UK’s digital strategy aims at making the “UK the safest place to use the Internet”.
- **Revision of the regulatory framework:** Almost all countries include regulation measures in their broadband strategies. The main reason is to support the competition. The best practice in this area has been adopted by UK, which presents the highest score in ECTA Regulatory Scorecard 2005 (Figure 2). The regulatory strategy in UK is set out by Ofcom, which has a duty to ensure that a wide range of electronic communications services –including high speed data services– is available throughout the UK. Ofcom has indicated that by the end of 2007/8, its “aim is to have encouraged the development of an environment in which there is much more competition and innovation in broadband networks and services”.
- **Broadband content development and digitization:** Almost all countries include broadband content development and digitization regulation measures in their broadband strategies. For example in UK, the Government aims at allowing people to use or reach any content, with any device, anywhere, anytime.

According to the UK Government, content, whether as a business tool, for entertainment, a community portal, e-learning or generated by consumers themselves, is key to driving up the effective use of ICT. Through the DTI’s Technology Programme, the UK Government is already providing funding to encourage innovation and research in developing broadband content.

- **Supporting of synergies between private-public sector:** Almost all countries support the synergies of private - public sector for increasing the broadband growth and to create or exploit broadband infrastructures. For example, the Dutch Government takes the view that municipal and provincial authorities and housing corporations can play an important and useful role in the development of broadband, in partnership with market parties. Also in Japan, the Government emphasized that the private sector had to be the driving force, with the government limited to establishing the right framework for the private sector and to the non-private sectors (e-government, R&D and overcoming the digital divide). In spite of this, the central Japanese government, actually, supports roll-out of broadband facilities by offering attractive financing schemes, tax incentives and guarantee of liabilities.
- **Financing of research projects:** Many countries (such as UK and the Netherlands) provide funding to encourage innovation and research in developing broadband. As already referred UK Government is providing funding developing broadband content. Also in Netherland “Kenniswijk” and “Broadband in Four Social Sectors” are the most funded projects (€ 9 000 000 and € 2 400 000 respectively).
- **Bridging the Digital Divide:** Some counties (such as UK, Korea, and Canada) aim at providing access to underserved areas and people with disabilities in order to close the digital divide. For example in UK one of the main actions in UK’s digital strategy is to “improve accessibility to technology for the digitally excluded and ease of use for the disabled.” One of the measures is the building of UK online Centres. Furthermore in Korea the Korean Digital Divide Act was established in 2001 and revised in 2002 [11]. It generated the five-year master plan for closing the digital divide, annual action plans, the “Digital Divide Closing Committee,” and launched the Korean Agency for Digital Opportunity and Promotion (KADO). The 2004 annual action plan consisted of constructing high-speed information network in rural areas, supporting assistive technologies for disabled people, the construction of 80 Internet access centres, recycling of PCs and Digital TVs to disabled and non-profit organisations, and providing IT education. KADO also developed content for disabled and the elderly, and engaged in international projects that aimed at closing the digital divide. Korean policies also included 30 to 50 % discounts in telecommunication service charges to low-income and disabled users.

## Conclusions

This paper presented a methodology for locating the countries that followed best practices for increasing their broadband growth. According to this methodology the paper showed that Denmark, United States, Japan, Canada and Rep. of Korea followed best practices for their broadband growth. Furthermore, it appears that United Kingdom and the Netherlands followed best practices for their broadband growth. Investigating the broadband strategies in the above countries and analyzing them, the main result is that the governments of the above countries articulated a vision of what ICT could do for both public and private sectors' beneficiaries. Furthermore, the policies and strategies adopted by these countries targeted at (1) the improvement of users' dexterities in ICT; (2) supporting the Internet penetration growth; (3) supporting the ICT use by tax exemptions and loans; (4) the development of broadband infrastructures and coverage of rural areas; (5) the development broadband services; (6) **the revision of the regulatory framework**; (7) the support of synergies between private-public sector; (8) the funding of research projects; (9) the bridging of the Digital Divide; (10) the improvement of the security of broadband connection/services; (11) the uptake of regulation measure and (12) the development of broadband content.

These results are in line with [8]. In particular, the cooperation of the private and public sector is of critical importance for the ICT development, where both types of sectors undertake roles that maximize the benefits. Nations achieving comparatively greater success in ICT development demonstrate the value in having a specific mission, achievable goals and policies designed to achieve success.

## References

- [1] OECD, Communications Outlook 2005.
- [2] OECD productivity database, available at <http://www.oecd.org/dataoecd/30/14/29861140.xls> (last visited 10/6/2006)
- [3] The 2005 e-readiness rankings, A white paper from the Economist Intelligence Unit, available at [http://graphics.eiu.com/files/ad\\_pdfs/2005Ereadiness\\_Ranking\\_WP.pdf](http://graphics.eiu.com/files/ad_pdfs/2005Ereadiness_Ranking_WP.pdf) (last visited 10/6/2006)
- [4] OECD Broadband Statistics, June 2005, [http://www.oecd.org/document/16/0,2340,en\\_2649\\_33703\\_35526608\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/16/0,2340,en_2649_33703_35526608_1_1_1_1,00.html) (last visited 10/6/2006)
- [5] OECD Broadband Statistics, December 2005, [http://www.oecd.org/document/39/0,2340,en\\_2649\\_33703\\_36459431\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/39/0,2340,en_2649_33703_36459431_1_1_1_1,00.html) (last visited 10/6/2006)
- [6] Internet World Stats, <http://www.internetworldstats.com> (last visited 10/6/2006)
- [7] OECD Science, Technology and Industry: Scoreboard 2005 (D. ICT: an enabler for the knowledge society, D.1. Investment in ICT equipment and software) ISBN 92-64-01056-4, © OECD 2005, <http://puck.sourceoecd.org/vl=3259653/cl=22/nw=1/rp/sv/scoreboard/data/d01.xls> (last visited 10/6/2006)
- [8] Rob Frieden, «Lessons from broadband development in Canada, Japan, Korea and the United States», doi:10.1016/j.telpol.2005.06.002, 2005 Elsevier Ltd
- [9] Regulatory Scorecard 2005, Edited by Jones Day and SPC Network for ECTA. Available at <http://www.ectaportal.com/en/upload/File/Regulatory%20Scorecards/Scorecard280406/Scorecard%202005.zip> (last visited 10/6/2006)
- [10] Regulatory Scorecard 2005 (U.S. Annex) Edited by Jones Day and SPC Network
- [11] BREAD: Broadband for all- Deliverable D22-D32, Available at: <http://www.ist-bread.org/>