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Future networks and the internet

Indexing Broadband Performance

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1. INTRODUCTION

In a short space of time, high-speed internet (broadband) has become fundamental to modern economies. It has changed the way we access the internet and how we use it. It has made economic activity more efficient and has extended social interaction in previously unforeseeable ways.

In the past, fixed telephone lines were used exclusively for voice telecommunications. Cable TV networks and satellite only transmitted television signals. With the development of ADSL and other broadband technologies, these networks can transmit a wider range of services. Operators increasingly provide bundles of voice, data and video-related services. ‘Triple-play’ and ‘multi-play’ offers are the first step towards a long-term evolution that will allow users to seamlessly access content and services through a variety of fixed and wireless networks.

The diffusion of broadband has stimulated the migration to the participative web, or web 2.0, encouraging users to become content producers and the rise of more open innovation systems. It has offered new opportunities for professional and personal activities and encouraged creation as well as more intensive uses of the internet.

The European broadband market is developing rapidly and already outstrips that of the United States. The penetration rate reached 20% of the population in January 2008, a threefold increase since enlargement in 2004, with Denmark, Finland and the Netherlands being world leaders. In the course of 2007 speeds have significantly improved, with almost half of Europeans accessing speeds above 2 Mbit/s. Broadband in rural areas has been made available to 80% of population, up 7 percentage points over the previous year. However, there are some signs of fatigue: growth in penetration is slowing down and there are increasing gaps between Member States in terms of take-up, speed, price and coverage. There is a need to analyse the underlying conditions in the Member States to assess the EU readiness to progress in the development of broadband.

The Council Conclusions of 12.06.2008 invite the Commission to ‘develop, in consultation with the Member States, a Broadband Performance Index, to be published together with the values observed for each of its component indicators, that will seek to compare broadband developments in the Member States and their propensity to further take up of advanced services and the benefits that arise from their use’.

High-quality monitoring is crucial to the design of an appropriate policy framework. The Commission has announced¹ that it will benchmark the overall performance of the Member States on a range of factors, which could include speeds, rural coverage, affordability, innovation and other socio-economic dimensions. In consultation with the Member States, it has developed a Broadband Performance Index that seeks to compare broadband developments. This document details the results of this first exercise, which may be extended in future to other relevant indicators as data become available. Results show that France and the UK are now on a par with the Netherlands and other Nordic countries in having world-class potential while large countries like Poland, Italy, Germany and Spain need to do more to bring their broadband economy up to speed. It also highlights the very important role played by the socio-economic context in furthering developments in several other Member States.

¹ COM(2008) 199, ‘Preparing Europe’s digital future — i2010 Mid-Term Review’.

1.1. Broadband take-up — and beyond

Broadband penetration, i.e. the overall number of broadband lines divided by the national population, has been traditionally used as the main benchmark for setting broadband objectives². The 2007 Strategic Report on the renewed Lisbon strategy³ calls on Member States to set national targets for high-speed internet usage, aiming for a 30% penetration rate in the EU by 2010. The June Council Conclusions add that all Member States should achieve a penetration rate of at least 15%. In January 2008 the EU average was 20% (Figure 1). However, the gap between Member States with the highest and lowest penetration increased from 27.4 percentage points in January 2007 to 28 in January 2008.

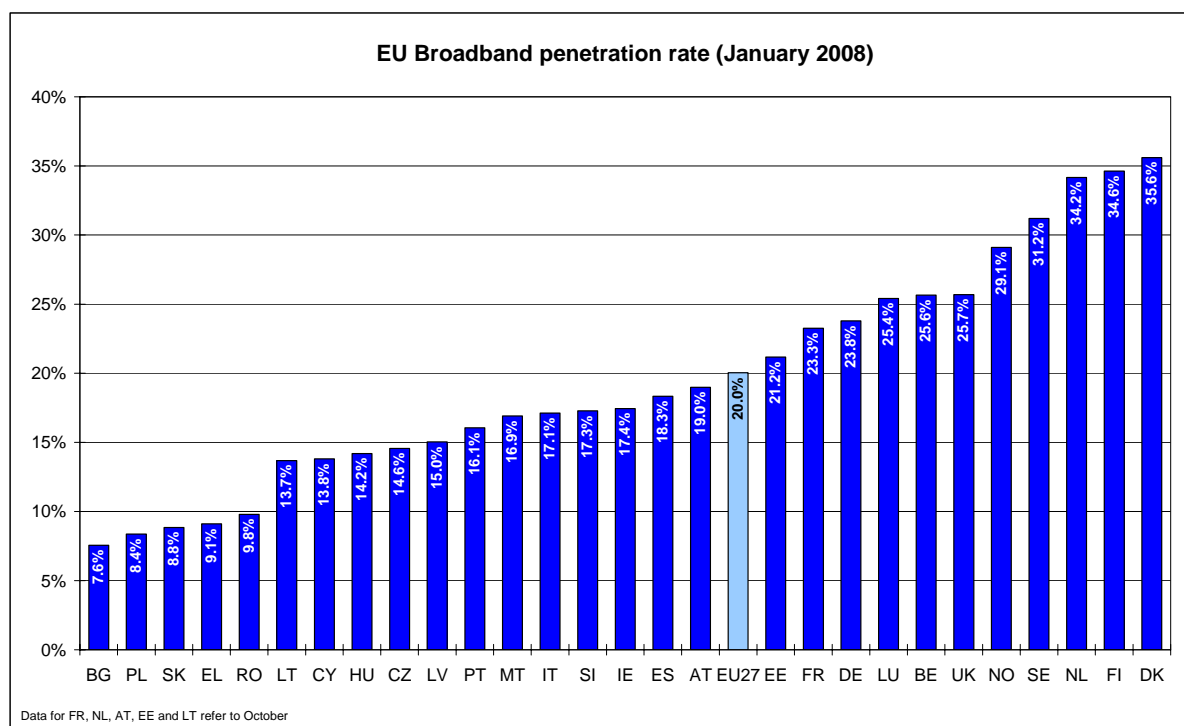


Figure 1 Source: Communications Committee. The EU average does not include Norway.

The penetration rate indicator is a useful tool for a number of reasons:

- It is very simple to construct, as it is calculated from primary indicators (fixed broadband lines and population).
- It is a straightforward measure, being relatively easy to collect, update, understand and communicate.
- It is widely collected and international comparisons are relatively easy.
- The methodology for data gathering is sufficiently tested and robust, at least for EU and other OECD countries.
- It facilitates target-setting.

² Data for the European Union are currently collected in the Communications Committee using a harmonised methodology.

³ COM(2007) 803.

By its very nature, however, this indicator has a number of limitations, arising mainly from the fact that all broadband lines are considered a homogeneous product:

- It does not give the split between business and residential customers. Countries with similar penetration rates may follow completely different patterns, demand being led either by business or by residential customers.
- Differences in the average size of households imply that the real gap between the most advanced and the least developed countries may be smaller than the official figures based on population indicate.
- It does not indicate differences in speeds. Users in countries with similar penetration rates may experience very different levels of quality and innovation.
- The current measure concerns the penetration rate of fixed lines and does not include wireless solutions. The Communication Committee is in the process of collecting these data, but the exercise is proving cumbersome.
- Penetration rates do not provide information about the availability of broadband over the country as a whole.
- Penetration rates do not provide information on the drivers of growth.

Different factors may impact on the take-up of broadband services and result in increasing gaps between Member States. Differences are visible not only in terms of penetration rates but also in coverage, speeds, prices and level of usage, as a result of competition and other socio-economic factors. The result is that the overall patterns of broadband development in the European Union are increasingly fragmented. Close monitoring of broadband markets, taking into account all relevant variables, is crucial to provide a fair, reliable picture of how the broadband market is evolving in each Member State and in the European Union.

A composite indicator can be a useful tool to summarise multi-dimensional issues that cannot be captured by a single indicator, to compare broadband adoption among countries, to provide support for policy makers and to offer insights on the readiness of countries to progress in the development of broadband. It is easier to interpret and facilitates benchmarking. Information on the individual components of a composite indicator is necessary to improve the understanding of trends and identify policy responses.

1.2. Maximising broadband impacts

While the rate of broadband take-up will remain a crucial measure of the development of broadband markets, the Broadband Performance Index (BPI) provides complementary information on barriers to and drivers of growth. In particular, the BPI ranks the EU-27 countries plus Norway in terms of the supply and demand factors that affect the take-up and use of broadband.

The index has three main objectives:

- To compare the relative performance of countries in the area of broadband, strengthening benchmarking.
- To identify the relative strengths and weaknesses of individual countries to facilitate and fine-tune policy making.
- To assess the relative propensity of the EU Member States to progress in the area of broadband.

1.3. Methodological note

Given the general objectives above, the framework for the index has the following components:

- *Broadband coverage*, reflecting developments in rural areas;
- *Competition by coverage*, reflecting countries' innovative capacity, propensity to invest and consumer choice (the level of competition as corrected by the relative size of the market);
- *Speeds*, reflecting quality developments;
- *Prices*, reflecting affordability;
- *Use of advanced services*, reflecting the propensity of individuals and businesses to take up innovative services and the perception of trust;
- *Socio-economic context*, reflecting factors that summarise preferences, skills and capital equipment that influence the propensity to use advanced communication technologies and services. While components may be partly correlated (as often happens for economic and social phenomena), each adds something particular to the index and to overall performance⁴.

Basic statistical indicators have been selected according to the following criteria:

⁴ The composite index can be thought of as a latent variable that cannot be observed directly but that can be calculated through a linear combination of basic indicators, gathered along some dimensions which may partly overlap, but which need to be included for the sake of exhaustiveness.

- Relevance with respect to the theoretical framework and the dimensions of the composite index;
- Availability, quality and coherence across the different EU Member States.

All the indicators have been collected according to methodologies agreed at EU level. The index will be updated as new data become available. If new sources of measurement that could be relevant to the index become available, the index will be revised accordingly.

The outcome of the BPI is represented by a value ranging from 0 to 1, where the maximum and minimum values of the scale are arbitrary decisions depending on the selected normalisation method. The value has no meaning in itself unless compared with the results obtained for other countries. It does not refer to any specific dimension that can be expressed with usual basic or derived metrics. The composite index tells whether a country performs worse or better than other countries.

Methodological issues

Normalisation is required prior to any data aggregation, as indicators in a data set tend to have different measurement units. We consider normalisation through **re-scaling** as the best option because it uses all available information and is easy to express and communicate. According to this methodology, indicators are normalised to an identical range of (0;1), according to the following formula:

$$I_{ci} = \frac{x_{ic} - \min_c x_i}{\max_c(x_i) - \min_c(x_i)} \text{ for a given country } c \text{ and indicator } i$$

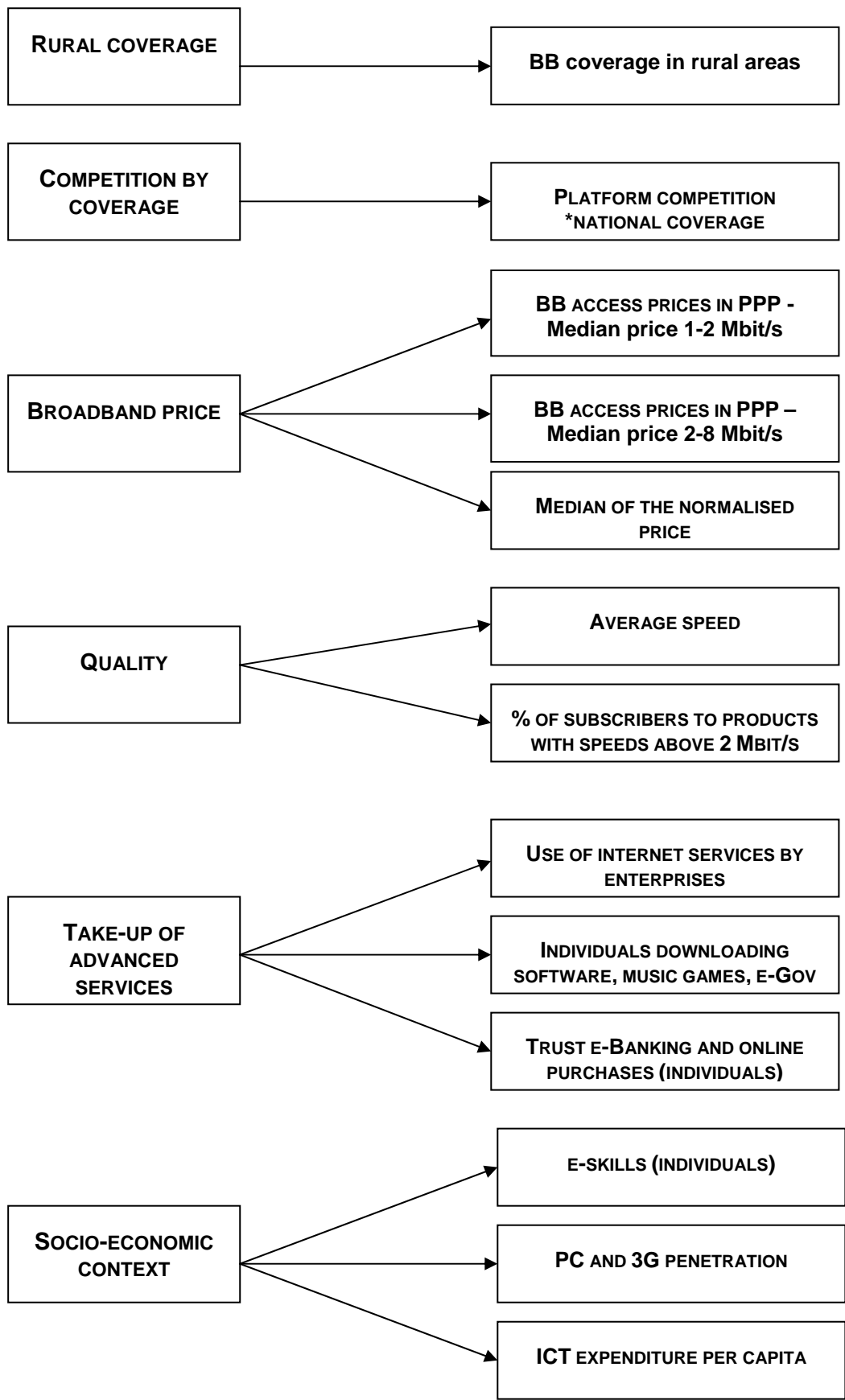
One main methodological issue concerns **missing data**, which are replaced by data available for a contextual variable highly correlated with the missing variable.

For example, in the case of broadband prices, the composite indicator includes the monthly price of broadband products in the 1–2 Mbit/s and 2–8 Mbit/s brackets (currently the most used speed brackets). However, products with these speeds are not always available. When not available, prices are replaced by the prices of bundles in the same speed bracket (i.e. broadband access associated with other services such as telephony or TV) or, when a speed bracket is simply not offered, by the price of a product with the next higher speed, which can then be considered the entry level price for consumers.

When contextual variables are not available, missing data have been replaced by the average normalised scores across the remaining variables. In practice this means assuming that the performance of one country for a single missing indicator is the same as for the remaining ones (for which data are available). This has been the case for the "competition by coverage" indicator for Bulgaria (because national coverage data were missing) and for ICT expenditure in Cyprus, Luxembourg and Malta.

Weighting is the last element that needs to be taken into account. Each of the dimensions should be given a weight in line with its political relevance. Weights are calculated as simple arithmetical averages of the opinions expressed by experts through a survey of Member States plus Norway⁵ (Table 1).

⁵ Experts were designated through the i2010 High Level Group, see http://ec.europa.eu/information_society/europe/i2010/high_level_group/index_en.htm.



2. RANKING AND RESULTS

The outcome of the BPI is represented by a value ranging from 0 to 1, higher values implying that a country performs better than others in terms of the various components. Results for EU27 Member States plus Norway are shown in Figure 2. The aim is to identify strengths and weaknesses that may stimulate or hamper further growth of broadband.

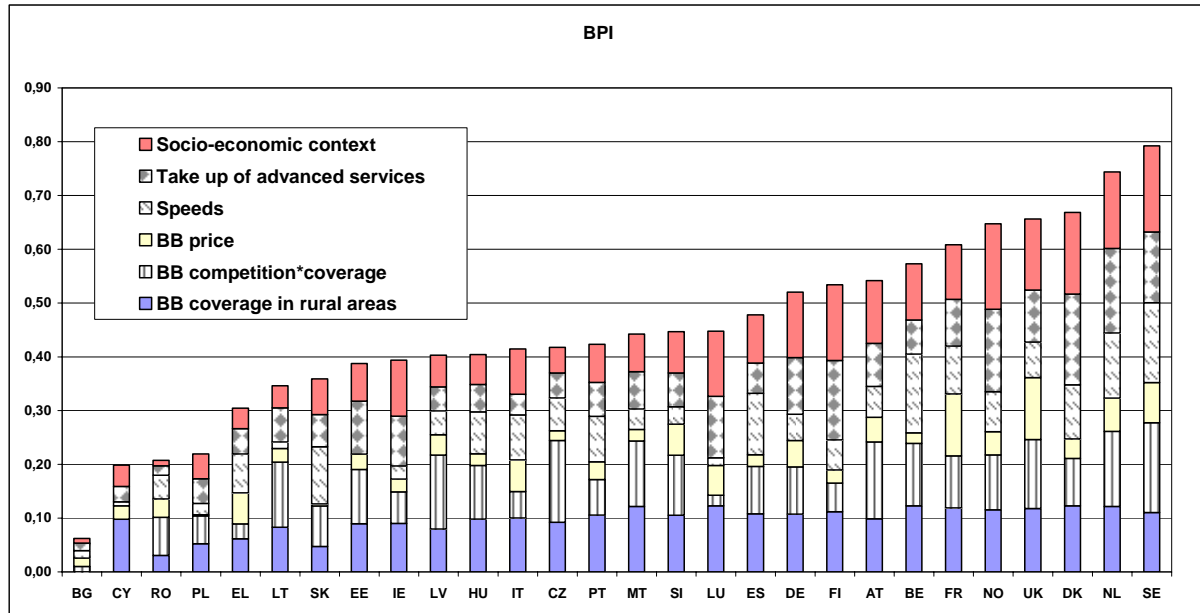


Figure 2

The highest ranked is Sweden, followed by the Netherlands. Both countries have a favourable socio-economic context, with a high propensity to use advanced services and a competitive environment that has ensured affordable prices and high speeds.

Denmark, UK, Norway, and France form a second cluster. France's performance is very good in terms of supply-side indicators such as speeds and prices, but is limited by the take-up of advanced services (in particular by individuals) and the socio-economic context (in particular in terms of PC and 3G penetration). The other countries in the group are characterised by a positive socio-economic environment. Denmark has strong broadband take-up, driven by a favourable socio-economic context (in particular in terms of preferences and skills), a positive propensity to use advanced services, but limited competition which translates into high prices. Average speeds have improved significantly in the course of 2007, driven by strong demand. The UK performs well in most indicators but lags behind in speeds and take-up of advanced services, in particular by businesses, although trust in the online environment is generally positive.

A third group of countries includes Belgium, Austria, Finland, Germany and Spain. In Finland broadband take-up is high and largely favoured by a positive socio-economic context that ensures a strong propensity to use ICT services. Broadband in Finland is widely available despite its scarcely populated regions. Relative to other countries, however, its performance is limited by the degree of platform competition, high prices and low speeds. The socio-economic environment in Belgium and Spain is less favourable as the penetration of PCs and 3G (in Belgium in particular) is relatively limited. Moreover, their performance is constrained by high retail prices and a relatively low take-up of advanced services (by Spanish enterprises

in particular), despite positive results for broadband coverage and speeds. Relatively low speeds are the main barrier to further developments in Germany and Austria. Competition in Germany and rural coverage in Austria are relatively weak.

Luxembourg, Slovenia, Malta, Portugal, the Czech Republic and Italy make up the fourth cluster. Luxembourg and Italy have a favourable socio-economic context. Citizens and businesses in Luxembourg have a positive propensity to use advanced services, while performance in competition and speeds is weak. Use of advanced services in Italy is more limited, in particular because of low usage of eGovernment and other purchasing activities by individuals, as well as relative performance in platform competition and prices. The Czech Republic, Portugal, Slovenia and Malta feature a weaker socio-economic context, in particular for ICT expenditure and skills, with limited use of advanced services (due in particular to trust-related indicators) as well as relatively high prices and, in Malta and Slovenia, limited speeds.

A fifth cluster groups Latvia, Hungary, Ireland and Estonia. The socio-economic context is more favourable in Ireland than in the other countries, but relatively high prices and low speeds limit its performance, possibly as a result of weak competition. Relatively high prices, low speeds and limited rural coverage hold back performance for the whole group.

The remaining seven countries are more scattered. Their performance is limited in most dimensions by the socio-economic context and by high prices in some countries (Slovakia, Lithuania, Poland, Cyprus). Romania features a good degree of platform competition but coverage is limited; Cyprus on the contrary has good broadband coverage; Lithuania a satisfactory degree of competition and Slovakia relatively high speeds.

The BPI has been successful in illustrating elements that are not immediately apparent from a mere analysis of penetration rates. This was indeed the purpose of the BPI. Even in some of the leading countries, the results highlight weaknesses (in particular prices and speeds), apparently due to a weak competitive environment. Elsewhere, competition has translated into low prices and high speeds, but users have a low propensity to take up advanced services. In several Member States, the socio-economic context, resulting in low skills and a correspondingly low interest in advanced services, appears to be an important barrier to further development. By showing what is driving broadband take-up and in particular what is holding it back, the index will help Member States and the Commission to design and implement more targeted actions to improve take up.

3. INDICATORS OF SUCCESS

The list of components, indicators, their sources, weights (in italics) and rationale are listed in Table 1. Table 2 summarises the main results per country under each component.

Table 1

Component	Indicator	Source	Ref. date	Description	Rationale
Broadband coverage in rural areas <i>(0.68)</i>	Broadband coverage in rural areas	IDATE	31/12/07	% of population in rural areas connected to a local exchange equipped with a DSLAM. * Data for CZ, EE, RO and BG are based on estimates	This is a measure of the geographical digital divide. Because of sparse population and distance, rural areas suffer from underinvestment in broadband and coverage is limited. The indicator here measures the propensity of a country to provide broadband for all.
Competition <i>(0.92)</i>	Platform competition * national coverage	COCOM and IDATE	1/01/08 31/12/07	Platform competition = new entrants' lines (using LLU, own PSTN and non-DSL lines) over the total number of broadband lines * % of national population connected to a local exchange equipped with a DSLAM * Data for BG are not available * Data on competition for NO are from Idate	This is a measure of the level of competition as corrected by the size of the market. Stronger platform competition is assumed to lead to more innovation, investment and choice. Platform competition translates into high penetration rates when broadband coverage is generalised. Hence the geometrical average.

Prices <i>(0.88)</i>	BB price 1 Mbit/s-2 Mbit/s	Van Dijk	1/04/2008	BB Price. Median offer in the [1 – 2] Mbit/s basket	A comparison of prices for BB access in PPP in the 1 Mbit/s-2 Mbit/s basket (around 31% of users in the EU subscribe to such products).
	BB price 2 Mbit/s-8 Mbit/s	Van Dijk	1/04/2008	BB Price. Median offer in the (2 – 8] Mbit/s basket	A comparison of prices for BB access in PPP in the 2 – 8 Mbit/s basket (34% of users in the EU subscribe to these products).
	Price/speed	EC based on Van Dijk	1/04/2008	Median of the price divided by the download speed	Calculated on the basis of all offers available in each market (including bundles), this indicator calculates the median of the monthly price in PPP divided by the advertised download speed and takes into account the availability of higher speed offers.
Speeds⁶ <i>(0.99)</i>	Take-up by speeds	EC based on IDATE	31/12/07	Weighted average of national broadband speeds, with weights equal to the take-up of each speed bracket * Data for CZ and EE, are based on estimates	Speeds provide a proxy for the quality of broadband.
	% of subscribers to speeds above 2 Mbit/s	IDATE	31/12/07	% of subscribers to speeds of 2 Mbit/s or more * Data for CZ and EE, are based on estimates	High-speed broadband lines are required to deliver advanced services such as IPTV. Countries with a higher proportion of subscribers currently using high speeds are assumed to have a higher propensity to migrate to faster speeds.

⁶ Experts from Member States agree on the need to improve the measurement of speeds, which is currently performed on the basis of advertised speeds rather than effective speeds.

Take-up of advanced services <i>(1.08)</i>	eInvoicing	ESTAT (ICT survey on ENT)	01/2007	% of enterprises sending e-invoices	A measure of the propensity of enterprises to use advanced services
	eGovernment take-up by businesses	ESTAT (ICT survey on ENT)	2007	% of enterprises filling in official forms online	A measure of the propensity of enterprises to use advanced services
	Downloads (games, music, films)	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals downloading music/video/games (last 3 months)	A measure of the propensity of individuals to use advanced services
	Downloads (software)	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals downloading software (last 3 months)	A measure of the propensity of individuals to use advanced services
	eGovernment by individuals	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals who have used the internet, in the last 3 months, for filling in official forms	A measure of the propensity of individuals to use eGovernment services
	Online purchases	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals purchasing online (last 3 months)	A measure of the propensity of individuals to make online transactions and therefore of trust
	eBanking	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals using e-banking (last 3 months)	A measure of the propensity of individuals to make online transactions and therefore of trust

Socio-economic context <i>(0.95)</i>	e-skills	ESTAT (ICT survey on HH)	1 st quarter 2007	% of individuals with at least basic skills in using the internet (having performed at least 1 internet-related activity)	A measure of the digital skills necessary for the take-up of services
	Household PC penetration	ESTAT (ICT survey on HH)	1 st quarter 2007	% of households with access to, via one of its members, a computer at home	A measure of the level of equipment enabling the use of broadband applications
	Penetration of 3G handsets	EC based on IDATE	31/12/07	Number of 3G subscribers / national population	A measure of the level of equipment enabling the use of broadband applications
	ICT expenditure per capita	EITO	2007	ICT expenditure per capita * Data for CY, LU and MT are not available.	A measure of preference for ICT

Table 2

	BB rural coverage	Competition by coverage	Monthly Median offer. Basket [1 – 2] Mbit/s (€/PPP)	Monthly Median offer. Basket (2 – 8] Mbit/s (€/PPP)	Median price/speed (€/kb/s)	Take-up speeds (download kb/s)	% of subscribers to products with speeds above 2 Mbit/s	e-Invoicing (% of enterprises)	e-Government (% of enterprises)	Online games and music (% of individuals)	Software downloading (% of individuals)	e-Government (% of individuals)	Purchasing online (% of individuals)	e-Banking (% of individuals)	e-skills (% of individuals)	Household PC penetration	Penetration of 3G handsets (% of population)	ICT per capita expenditure (€)
BE	100%	42%	46.44	50.34	55.99	7,672	91%	8%	37%	23%	15%	8%	15%	35%	68%	67%	3.85%	1784
BG	0%	NA	36.38	47.34	25.60	2,069	7%	4%	29%	16%	5%	3%	2%	2%	34%	23%	2.87%	268
CZ	75%	53%	39.63	62.31	55.68	3,439	43%	14%	34%	20%	10%	4%	8%	12%	53%	43%	1.77%	675
DK	100%	34%	29.14	34.25	81.93	7,093	48%	25%	61%	33%	35%	33%	43%	57%	82%	83%	13.53%	2464
DE	88%	34%	37.59	37.97	157.49	3,262	32%	11%	43%	21%	30%	17%	41%	35%	74%	79%	12.59%	1620
EE	73%	38%	19.62	56.47	57.18	967	4%	11%	58%	29%	23%	20%	6%	53%	65%	57%	4.80%	610
IE	73%	26%	29.39	40.58	43.97	2,014	19%	15%	69%	13%	10%	19%	26%	24%	58%	65%	20.33%	1649
EL	50%	18%	25.86	25.74	138.20	5,900	30%	4%	77%	15%	9%	5%	5%	4%	37%	40%	8.24%	783
ES	88%	34%	36.34	46.19	53.92	5,000	83%	5%	38%	25%	21%	8%	13%	16%	56%	60%	22.96%	1136
FR	97%	37%	26.25/	26.25	389.59	5,242	55%	7%	59%	22%	14%	18%	26%	32%	64%	62%	13.58%	1607
IT	82%	23%	46.40	23.74	161.15	5,619	45%	10%	35%	14%	12%	5%	7%	12%	42%	53%	36.03%	1218
CY	80%	10%	30.32	30.32	23.45	1,285	9%	5%	14%	20%	11%	10%	8%	12%	40%	53%	0.99%	NA
LV	65%	48%	22.80	33.39	71.75	2,791	32%	7%	26%	27%	10%	6%	6%	28%	59%	49%	9.23%	476
LT	68%	44%	21.14	33.25	11.70	1,207	14%	5%	60%	27%	16%	11%	4%	21%	51%	46%	3.10%	367
LU	100%	15%	30.81	45.52	188.77	1,620	12%	7%	35%	33%	37%	21%	37%	46%	79%	80%	16.87%	NA
HU	80%	38%	35.41	54.02	59.78	5,086	45%	2%	44%	27%	17%	14%	7%	12%	54%	54%	3.28%	608
MT	99%	44%	36.58	60.77	67.49	2,439	29%	13%	49%	19%	13%	9%	16%	22%	47%	63%	6.71%	NA
NL	99%	49%	18.66	28.04	142.77	7,744	63%	6%	73%	45%	29%	33%	43%	65%	84%	83%	11.03%	2056
AT	81%	50%	27.25	49.54	147.33	3,069	43%	8%	54%	17%	17%	13%	26%	30%	69%	71%	14.81%	1779
PL	43%	24%	62.88	85.71	15.12	2,761	8%	3%	56%	17%	12%	4%	11%	13%	50%	54%	2.70%	410
PT	86%	28%	53.59	65.34	135.46	4,720	55%	9%	66%	21%	9%	13%	6%	12%	43%	48%	30.14%	915
RO	25%	30%	20.30	83.59	100.90	2,667	33%	12%	20%	12%	4%	2%	2%	2%	29%	34%	4.55%	213
SI	86%	41%	33.78	28.68	165.35	3,027	17%	4%	61%	25%	19%	6%	9%	19%	59%	66%	9.03%	828
SK	39%	31%	80.89	69.32	21.26	7,703	48%	9%	56%	23%	11%	8%	10%	15%	64%	55%	8.52%	450
FI	91%	25%	36.38	42.82	58.21	4,016	32%	16%	78%	34%	30%	17%	32%	66%	79%	74%	24.62%	1925
SE	90%	57%	23.44	27.16	213.19	11,305	57%	12%	55%	35%	23%	24%	39%	57%	78%	83%	27.81%	2473
UK	96%	46%	8.45	16.47	197.06	3,644	47%	8%	40%	26%	17%	18%	44%	32%	71%	75%	20.68%	2059
NO	94%	38%	25.47	35.85	106.86	6,093	62%	10%	61%	35%	34%	26%	48%	71%	85%	82%	25.54%	2260

