Broadband in South Korea

Introduction

The Republic of Korea, also known as South Korea, has since the year 2000 been the global leader in broadband use. Korean broadband connections have on average 4 megabits per second, and 50 megabits per second connections are widely available. Most European broadband connections would not be counted as broadband connections in Korea, as the official definition for high-speed Internet connection requires more than 1 Mbps connections. Korea has now more WiFi hot spots than the U.S. Three licenses for the new mobile Internet, WiBro, were granted in January 2005. Reflecting heavy competition and financial difficulties in the broadband service sector, one of the licensees, Hanaro Telecom, gave up its WiBro license in April 2005, just before it was to pay its first license fee.

Korea had about 12 million broadband subscribers in March 2005. It had about 10 percent of the global xDSL subscriptions, the second largest subscriber count after China. In December 2004, Korea had 31.58 million people who had used the Internet during the previous month, or 70 percent of the over-6 year population. Yet, on the World Economic Forum's Network Readiness Index, it ranked only 24th, just after United Arab Emirates and before Estonia.

The Republic of Korea is the leading country in broadband penetration. Its position as the first mover in several broadband developments makes it an interesting case, also for highlighting challenges that may become important for other countries. Important social, economic, technical, and policy factors are clearly visible in this country. This

chapter, therefore, provides a relatively detailed description of the history of the Korean developments and its context. The chapter uses recent statistical data and combines results from several earlier studies to analyse the reasons for the rapid broadband diffusion in Korea and to highlight potential lessons in the development of broadband policies in the EU.

Korea is geographically somewhat larger than Portugal or Hungary. It has a higher population density than all European countries except Malta, about the same as the Netherlands, twice as high as the U.K., and 25 times higher than Sweden. About 80 percent of its population lives in urban areas, about 70 percent in its seven largest cities, and almost 50 percent in large high-rise apartment complexes.

Figure 1. The Republic of Korea (source: CIA Factbook).

The legal system in South Korea combines elements of continental European civil law systems, Anglo-American law, and Chinese classical thought. It ranks 47th in the 2004 Corruption Perceptions Index produced by Transparency International, worse than Hungary, Italy, Lithuania, but before Greece and Czech Republic. Its overall rating was 4.5—higher than Poland (3.5) and Latvia and Slovakia (4.0), but considerably lower than the leading countries Sweden (9.2), Denmark (9.5) and Finland (9.7). The Korean economic system has historically been characterised by large and extremely diversified family conglomerates called chaebols. The "big five" chaebols are the Hyundai, Samsung, LG, Daewoo, and SK groups.

The basic demographic indicators of the Republic of Korea are shown in Table 1.

Table 1. Basic demographic indicators of the Republic of Korea.

Total area		98,480 sq km
Land area		98,190 sq km
Population		48,598,175 (July 2004 est.)
Population density		495 persons per sq km
	0-14 years	20.4% (male 5,223,344; female 4,681,594)
	15-64 years	71.4% (male 17,625,302; female 17,072,029)
	65 years and over	8.2% (male 1,597,085; female 2,398,821) (2004 est.)

Median age		33.7 years	
Population growth rate		0.62% (2004 est.)	
Life expectancy at birth		75.57 years	
Migration rate		0 migrant(s)/1,000 population (2004 est.)	
Ethnic groups		homogeneous (except for about 20,000 Chinese)	
Human capital	Literacy	97.9%	
	PISA 2003 rankings	Mathematics	3rd
		Reading	2nd
		Science	4th
		Problem solving	1st

Economic overview

Since the early 1960s, South Korea has achieved an incredible record of growth and integration into the high-tech modern world economy. In 2004, it was the 9th biggest OECD economy and the 11th largest economy in the world, when measured in nominal GDP. Four decades ago its GDP per capita was comparable with levels in the poorer countries of Africa and Asia, at less than 100 USD per capita. Today its GDP per capita is about 15 times North Korea's.[1] South Korea is now in the same low-middle income group as Spain, Israel, New Zealand, Cyprus, Greece, Portugal, Slovenia, Malta, Czech Republic and Hungary.[2] This success was achieved by a system of close government/business ties, including directed credit, import restrictions, active promotion of specific industries through five-year plans, and strong labour effort supported by cultural factors. Historically, the government has promoted the import of raw materials and technology at the expense of consumer goods and encouraged savings and investment over consumption.

In 2003, GDP per capita in Korea was about $18,000, or 52 percent of U.S. in purchasing parity adjusted terms. GDP per employed person was $39,349. In 2004, agriculture represented about 3 percent of the GDP, industrial production about 40 percent and services about 56 percent. In nominal terms, the GDP per capita for year 2004 was about 13,000 US$, and purchasing power adjusted GDP per capita about 19,200 US$. Adjusted for purchase power parity, the annual growth of GDP was 7.4 percent in the 1980-1990 period, and 5.9 percent over the 1980-2003 period.

Korean won exchange rate was in 3 January 2005 about 1,040 KRW per US$ and 1,400 KRW per euro. In mid-2005, the exchange rate is close to 1,010 won for a dollar. For historical data, this report uses exchange rates of 1,300 and 1,200 per US$, depending of the year.

[1] The estimates typically range from14-18 times the North Korean GDP. The GDP numbers are not necessarily very accurate; for North Korea because of lack of data and for South Korea because of the importance of ICT products which are not measured well in the current statistics.

[2] OECD 2005, Purchasing Power Parities and Real Expenditures: 2002 Results.

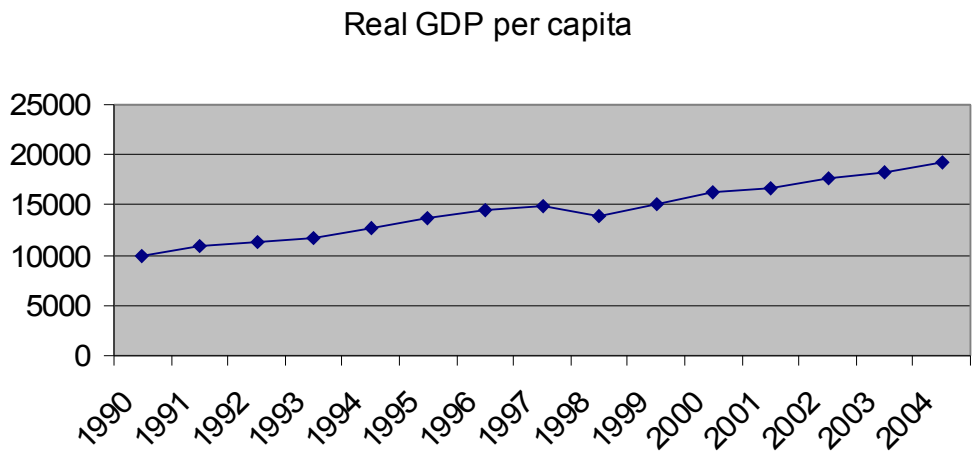

Figure 2. Real GDP per capita in Korea (PPP adjusted)

In general South Korea has been a clear economic success story. The Asian financial crisis of 1997-98, however, exposed some weaknesses in its development model. The problems included massive foreign borrowing and an undisciplined financial sector. Growth plunged to a negative 6.6% in 1998. Korea, however, recovered quickly, helped by rapid growth in ICT exports, including semiconductor memory chips, TFT-LCD displays, and mobile phones. In 1999 the overall economic growth was 10.8%. Growth fell back to 3.3% in 2001 because of the slowing global economy and falling ICT exports. Led by consumer spending and exports, growth in 2002 was an impressive 6.2%, despite slow global growth, followed by moderate 2.8% growth in 2003. The fast growth of 2002, however, was to some extent created by a rebound from the slump of 2001, as well as a rise in semiconductor memory prices. The growth in 2004 was under 4.6 percent, more than one percent less than expected during the first half of the year. The business and consumer confidence indicators were pessimistic in the beginning of 2005. In May 2005, the country recorded negative growth of IT outbound shipments for the first time since February 2002. IT exports, which have been the main source of economic growth during the last years, fell at 2.1 percent annual rate from May 2004. The main reasons for the decline were the depreciation of the US dollar and the very rapid decline in flat-panel display prices. The value of flat-panel display exports plunged 26.3 percent from the previous year. The current estimates show that the Korean ICT exports growth may remain close to zero in 2005.

Historically, economic development in South Korea has been driven by coordinated industrial policy and centralised five-year plans, which have systematically pushed the economy towards high-value added industries. Import substitution, increased knowledge-intensity, and cultural values that promote hard work and human capital development have been important factors in the development of the ICT sector in Korea. Foreign Investment Zones and incentives for research and development have also been important, making, for example, Nokia and Philips major investors in Korea.

In 2003 the National Assembly approved legislation reducing the six-day workweek to five days. The salary levels in the ICT industry were the third lowest in OECD countries, after Hungary and Czech Republic in 2002. Corrected for purchasing power, however, the Korean ICT workers earned similar salaries than workers in the U.S., Japan, and Ireland. For engineers, the income levels were relatively low when compared with global levels. In the large Korea cities the living costs are high, with Seoul being as expensive a city to live in as San Francisco. Only a relatively small fraction of total labour force, about 6 percent, worked in ICT industries in 2002. The discrepancy between the high percentage of ICT of total GDP and low percentage of labour force is explained by the fact that Korea focuses on high-value added and export-oriented ICT manufacturing, where labour inputs are low.

Korea ranks in the top four in science, mathematics, problem solving, and reading skills among 15-year old students, putting it second after Finland among the OECD countries.[3] The high ranking, however, hides important challenges in the Korean education system. According to IMD (2003) and WEF (2003) surveys, Korea's mathematics and science education level is one of the lowest among OECD countries. In particular, Korea's education and training level in IT is in the mid to low percentiles, placing Korea 21st among OECD members. The social interest in science and technology are below the OECD mean, and considerably lower than in Singapore, India, China, and Finland, for example. Korea, however, has the largest share of engineering degree holders among total university graduates in the world. About 41 percent of degree holders with BAs, MAs and PhDs majored in science and engineering, compared to 29.2 in Japan and 18 percent in the U.S.[4] In addition, about 400,000 Koreans studied abroad in 2004.

The Korean educational culture is based on Confucian values where education is perceived as a main source of social advancement, and parents are held socially responsible for guaranteeing that their children succeed well at school. This means, in practice, that Korean children often study very long hours, frequently complementing the basic schooling with various forms of private teaching. Comparing the educational achievements in the 15-year group between the two leading countries Korea and Finland shows, however, that Finnish students achieve the same or better results with considerably less hours of study. It is commonly argued that in the Korean educational system, competition within the peer-group becomes a factor that at least partially hinders the development of collaboration skills, autonomous competencies and innovativeness. As in all educational systems influenced by Confucian values, internalisation of pre-existing knowledge is often valued more than the creation of revolutionary and creative new ideas and knowledge. This is frequently perceived as a challenge, as Korea strives to move to a leading position in the knowledge- and innovation-based economy.

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[3] OECD: Learning for Tomorrow's World: First Results from PISA 2003. Available at http://www.pisa.oecd.org.

[4] Park Chung-a: Korea ranked 34th for quality of life: KITA report shows Seoul World's No. 1 IT Power. The Korea Times, 30 September 2005.

Korean ICT exports have been growing rapidly during the recent years. In 2003, Korean ICT exports were, however, hurt by geopolitical factors, including the Iraq war, North Korean nuclear crisis, SARS, levying of tariffs on Hynix by the U.S. and EU, and to some extent relocation of LCD production to China. In 2004, the ICT exports were a main source of growth in Korea and ICT exports were still expected to continue strong, at an average rate of 17.8 percent during the 2003-8 period.[5] Due to the rapid depreciation of the U.S. dollar, fast price declines, and the fact that Korean export prices strongly depend on the U.S. dollar, year 2005 export growth may, however, remain close to zero.

The U.S. has been the main customer of Korean ICT products, although China is rapidly becoming the largest importer. This can be seen in Table 2, which shows the five largest import destinations of Korean ICT products. In 2002, seven percent of Korean ICT exports went to mainland China and eight percent to Hong Kong. In 2003 China and Hong Kong imported together 26.8 percent whereas the U.S. imported 20.4 percent of Korean exports.

Table 2. Top five export destinations of Korean ICT products (source: KISDI).

Rank	1998	1999	2000	2001	2002	2003
1	U.S. (29%)	U.S. (28%)	U.S. (29%)	U.S. (31%)	U.S. (27%)	U.S.(20.4%)
2	Japan (10%)	Malaysia (8%)	Japan (9%)	Japan (10%)	Japan (10%)	China(15.6%)
3	Malaysia (8%)	Hong Kong (8%)	Taiwan (8%)	Hong Kong (7%)	Hong Kong (8%)	Hong Kong(11.2%)
4	Singapore (8%)	Japan (7%)	Hong Kong (7%)	Singapore (7%)	China (7%)	Japan(8.5%)
5	Hong Kong (7%)	Taiwan (7%)	Singapore (7%)	Taiwan (7%)	Taiwan (7%)	Taiwan(5.7%)
Total	**62%**	**58%**	**60%**	**61%**	**59%**	**61%**

The communication market

The diffusion of broadband in Korea is closely related to Information Society policies that have actively promoted the ICT industry. Korean policymakers have used the domestic market to improve the global competitiveness of the industry, as part of their development policies, combining export-led industrial policy with policies for local capability development. Korean manufacturers are now the leading producers in DRAM and flash memories. Korean LCD displays account for about 45 percent of global market. According to recent market estimates, Korean plasma display panel (PDP) manufacturers produced about 50 percent of the world output in 2004. Korean firms also dominated the organic light-emitting diodes (OLED) display market, with Samsung SDI having a 40 percent global market share. Since 1996, Korea has been the leading manufacturer of cathode-ray tubes, now with about 57 percent global market share.[6]

[5] KISDI 2004: IT Industry Outlook of Korea 2004.

[6] Digital Chosun 2004: Korea oversteps Japan's lead in display panels market. 8 December 2004.

Korean firms are also leading producers in broadband subscriber equipment and have rapidly gained market share in mobile phones. Domestic production of IT equipment in 1999 amounted to about US$ 70 billion (86.8 trillion KRW) and in 2003 to about US$ 120 billion. The software market has increased annually 31.4 percent over the 1998 to 2003 period, from KRW 4.684 trillion to 18.319 trillion (15.4 billion US$). Software exports grew at an average annual rate of 41.9 percent, from US$ 52 million to US$ 304 million in the same period. In 2003 the exports, however, declined 0.1 percent from the previous year. Packaged software declined 27.4 percent from the pervious year to 57.5 million US$. Computer service markets grew at an average annual rate of 28.1 percent, and the digital contents production at 46.4 percent annual rate in the 1998-2003 period.[7]

The most rapid growth was in communications equipment, where the compound average annual growth rate was 32.3 percent over the 1996 to 2002 period. Korea is now in this area about twice as large an exporter than Japan and probably reaching the size of than Germany. In electronic components, Korea exported 20.4 billion US$ in 2002, compared to Germany's 14.7 billion, U.K.'s 12.0 US$ billion and Japan's 39.9 billion.[8] Korea had the second largest ICT goods export/import ratio in 2002; at the same level as Japan (1.7), after Finland (1.9), and higher than Ireland (1.5). Since 1996, Korea has also had the fastest growth in its ICT exports, as can be seen in Figure 3. As of 2003, mobile handsets accounted for 67.3% of all communications equipment exports, and the figure is expected to rise to 79% by 2008. The production of communications equipment is expected to rise at an average annual rate of 16.7 percent and exports by 23.5 percent through 2008.[9] These numbers, however, do not take into account the impact of the recent depreciation of the US dollar.

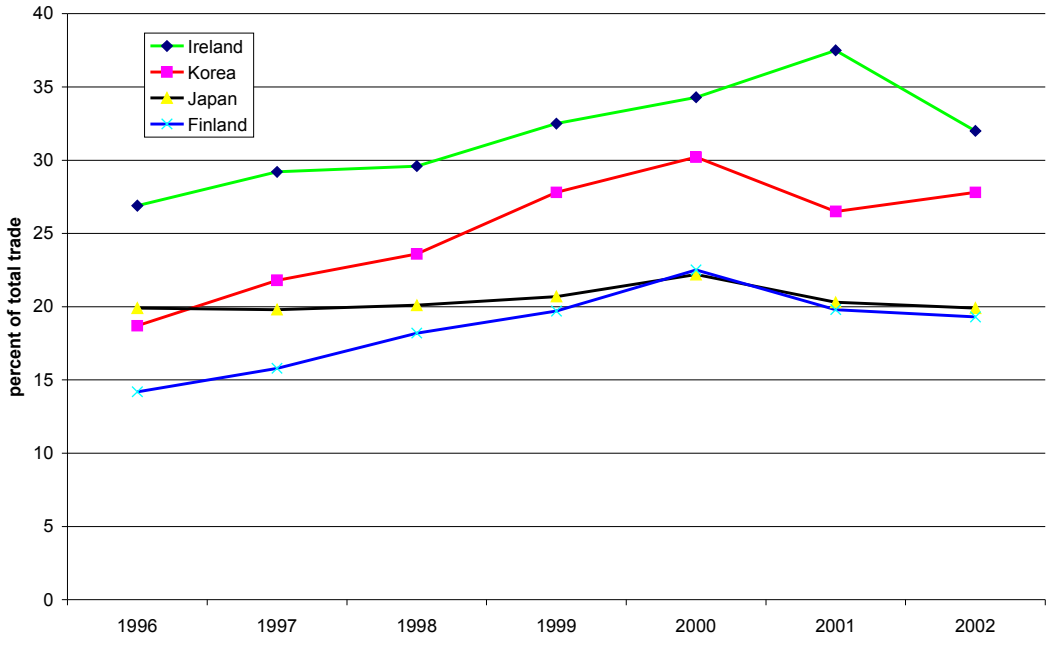

Figure 3. Trade of ICT goods as a share of total trade, 1996-2002 (data from OECD).

[7] NCA 2004, Broadband IT Korea Informatization White Paper.

[8] OECD 2004, Information Technology Outlook 2004.

[9] KISDI 2004: IT Industry Outlook of Korea 2004.

Since year 2000, Korea has been the country with the highest rate of broadband access in the world. According to OECD, Korea's broadband access rate at the end of year 2004 was 24.9 per 100 persons, ahead of the runner-up Netherlands's 19 per 100. In December 2004, 70.2 percent, or 31.58 million Koreans aged 6 and older had used Internet at least once in the previous month.[10] The number is somewhat smaller if the OECD definition of broadband penetration is used. Since December 2004, the Korean Internet statistics count as Internet users also mobile phone users who access Internet only through their phones (about 280,000 persons).

According to the Ministry of Information and Communication, in March 2005 there were about 12 million broadband Internet subscribers in total. In December 2004, 72.2 percent of Korean households had a wired Internet access at home. The most popular access mode was xDSL, with 86 percent of households using it, followed by cable modems (13.5 percent), dial-up (4.2 percent) and ISDN (1.5 percent).[11] Males are more frequent users, at 76 percent of over-6 year population. 65 percent of females use the Internet, or 46 percent of all Internet users. The female usage rate, however, has been growing faster than male usage rate. The highest usage rate was in the 6-19 year age group with 96.2 percent, but the fastest growth was in the age group of people in their 40's and 50's. Almost all students used the Internet (98.1 percent) and the next highest usage rates were in the professionals/managers demographic group (95.5 percent). The highest annual increase was seen in the sales and services workers group, where the usage increased 14.2 percent to 65.8 percent between December 2003 and December 2004.

[10] Survey on the Computer and Internet Usage. Ministry of Information and Communication, National Internet Development Agency of Korea, February 2005.

[11] Survey on the Computer and Internet Usage. Ministry of Information and Communication, National Internet Development Agency of Korea (NIDA), February 2005. The cable modem use rate reported in the survey is, however, considerably lower than the about 30 percent subscriber share of cable reported by the operators. See Table 4 below.

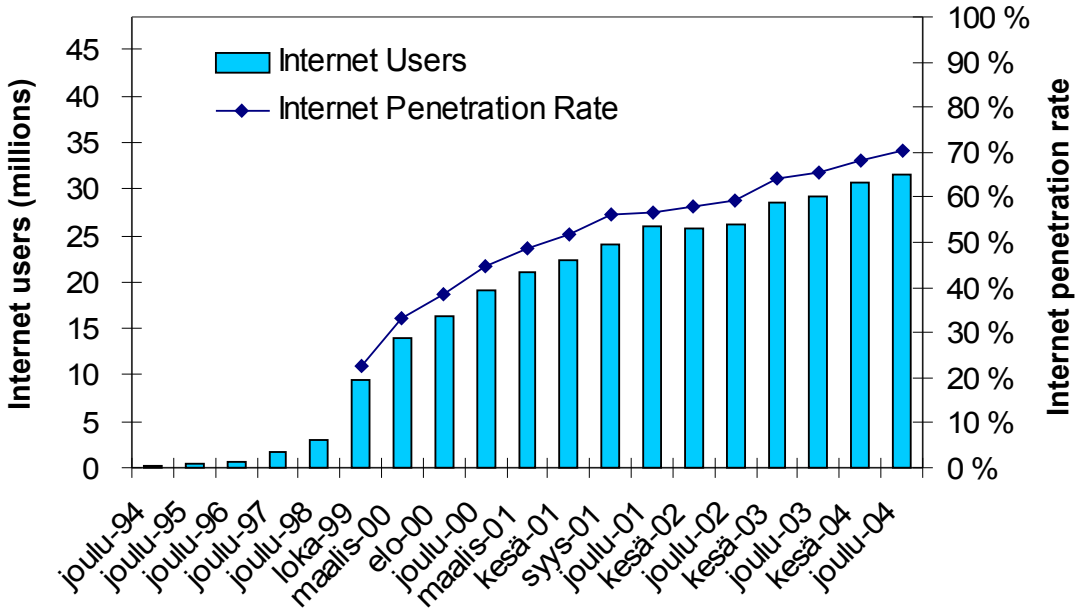

Figure 4. Internet users in Korea (source: KRNIC and NIDA).

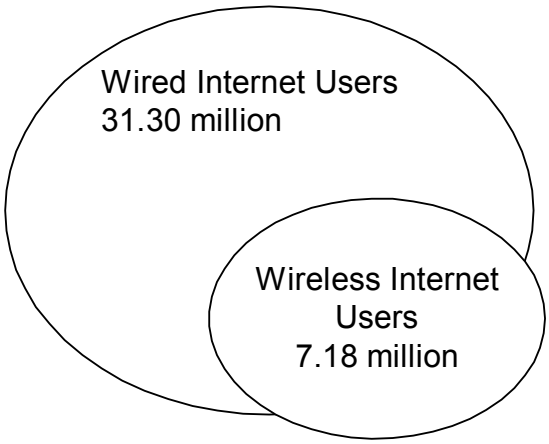

Figure 5. Internet users in Korea, December 2004.[12]

Pricing of broadband services

Broadband access prices have been low since their launch in 1998, typically around 25-30 US$ including modem rental. The low subscriber prices reflect mainly heavy competition. Broadband service providers competed by investing in their own facilities and generated large losses during the first years, hoping that larger market shares and customer bases would later allow them to become profitable. In this sense, the new broadband entrants introduced the "forward falling new economy" logic to Korea.

[12] Survey on the Computer and Internet Usage. Ministry of Information and Communication, National Internet Development Agency of Korea, February 2005.

The historically low subscriber prices of Korea also reflect some government pressure to promote rapid diffusion of broadband. Although prices have not been regulated, the Ministry of Communications and Information has indicated to the operators that it would be good if the prices would be low. When facilities-based competing service providers entered the Internet access market, their low flat-fee pricing rapidly attracted existing dial-up Internet customers. This has been an important factor in making Korea the global leader in broadband penetration.

Given the level of average income, the subscription prices, however, have been higher than the EU average. In economic terms, and given the fact that broadband penetration has been high, Koreans apparently have been willing to pay more for their broadband services than most Europeans. This can be seen in Figure 6.

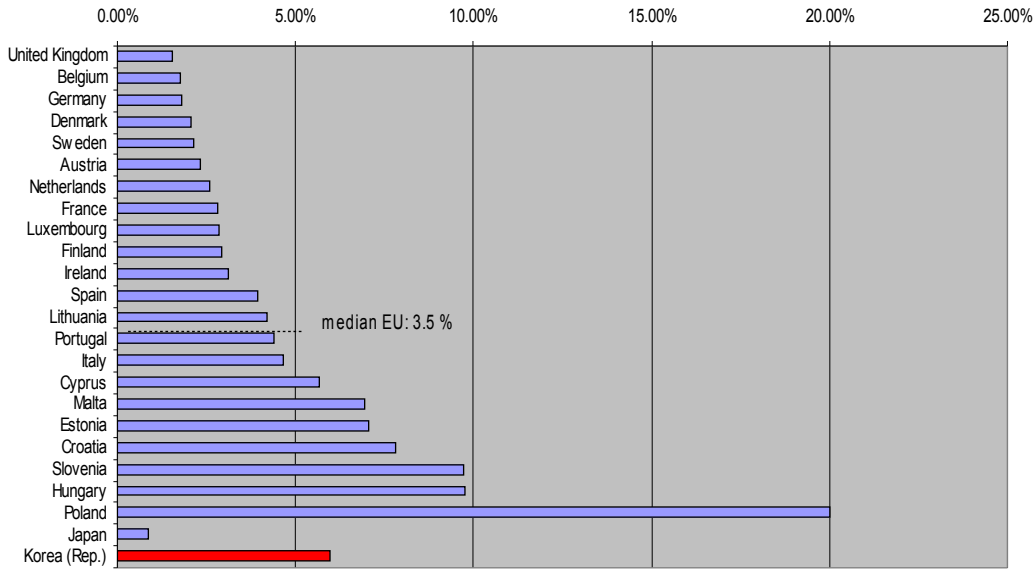

Figure 6. Broadband subscription cost as percentage of average monthly income, 2003 (data from OECD).

The picture, however, changes radically when the connection speed is taken into account. The average connection speed in Korea is now 4 megabits per second, and the subscription to 20-40 megabit per second service costs about 50 US$ per month. In comparison with the EU countries, Koreans have often ten times higher bit rate per euro. This can be seen in Figure 7.

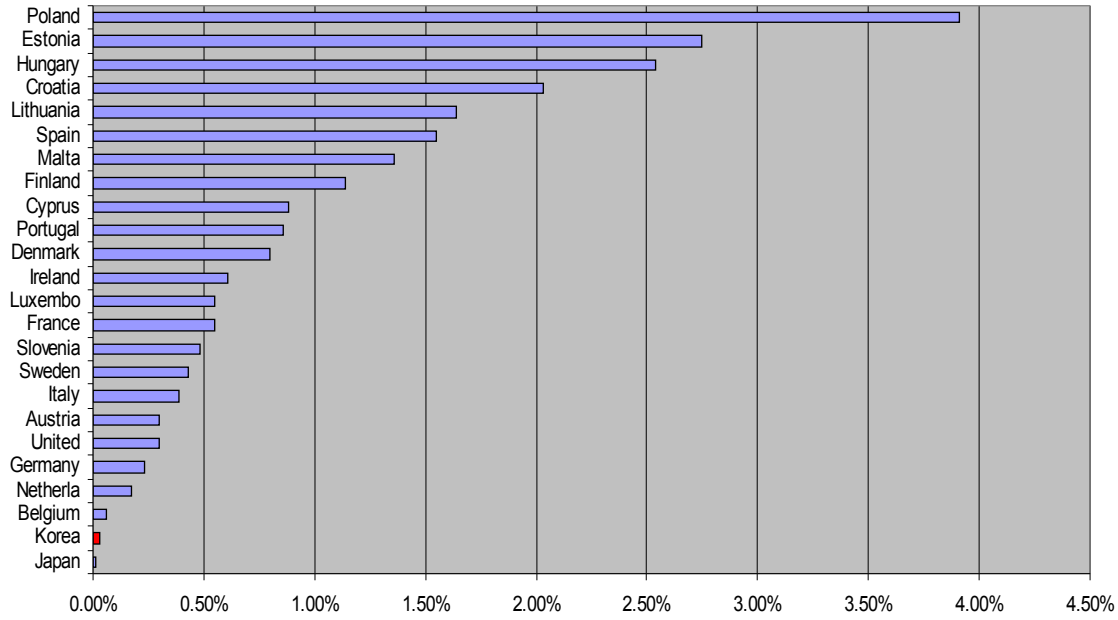

Figure 7. Broadband subscription cost per 100 bit per second, as percentage of monthly income, 2003 (data from OECD).

The drop of the US dollar has increased the prices when measured in dollar terms, to above 32 US$ monthly fees including equipment rental. In January 2005, KT xDSL/BWLL service was about 25 euros, including terminal rental and taxes, LAN access about 23 euros, and satellite about 26 euros per month. For customers that were willing to wait 15 days for the installation, the one-time installation fee of about 21 euro was waived. Satellite service subscribers had to pay for the installation of their equipment separately. Thrunet's broadband cable modem service was about 33 euros, and a low-speed 1-1.5 Mbps connection was available for 25 euros, including equipment rental and taxes. Thrunet also provided ADSL connections to customers it could not reach using its cable network, at about 25 euros per month. In addition, Thrunet had a reduced cost service for customers who were willing to receive advertisements.

The supply side: Major operators and the level of competition for each type of service.

The rapid development of telecommunications in the Republic of Korea is a relatively new phenomenon. Although the first automatic exchange was introduced in the Korea in 1935, up to 1960s telephones were mainly used for military and government purposes. The incumbent operator is Korea Telecom (KT), which was established in December 1981. KT was created to address the rapidly growing demand for private telephones in the 1970s, which had put hundreds of thousands of people on waiting lists for telephone connections. The Korean government pushed for a one-phone, one-family policy, directed investments in rural areas to minimize regional disparities, and funded ETRI (Electronics and Telecommunications Research Institute) to develop Korean telecommunications equipment. Korea Telecom was created as a fully government-owned corporation by separating the communication sector from the

Ministry of Communications (Now Ministry of Information and Communication). The statute of Korea Telecom was changed in 1989 to allow for its privatisation. The privatisation process has been a lengthy one, and closely linked with telecom deregulation and privatisation efforts in Korea. The Korean government has gradually reduced its ownership interest in KT since 1993. Upon the repeal of the Korea Telecom Act as of October 1, 1997, KT became a government invested institution regulated by the Korean Commercial Code and changed its name from Korea Telecom to Korea Telecom Corporation. The government completed the disposition of all of its equity interest in KT on May 24, 2002. On March 22, 2002, the company changed its name from Korea Telecom Corporation to KT Corporation.

In its initial stage, KT focused on supplying telephone facilities to the general public. In 1980, Korea still had the low household telephone penetration or 21 percent. The company expanded from about 4.5 million telephone lines in 1982 to about 20 million lines in 1993. By 1990, Korea had household telephone penetration of 90 percent. This created a strong domestic demand for telecom equipment. Telecommunications was given a priority in the fifth Five-Year Socio-Economic Development Program, which run from 1982 to 1986. With a coordinated policy between KT and ETRI, Korea developed the world's 10th domestic electronic switch TDX-1, in 1984.

Although telecommunication infrastructure improved rapidly during the 1980s, in the early 1990s Korea was still catching up the leading countries. It had 38 telephone lines per 100 inhabitants in 1993. In the same year Japan and the U.K. had 47, Germany 46, and France and the U.S. 53 telephone lines per 100 inhabitants. Mobile phone penetration was about one percent, less than a quarter of the U.S. mobile phone penetration of 4.4 per hundred inhabitants in that same year.[13]

Partly because of pressure from the U.S., Korea started to liberalise its telecom sector during the 1990s. It first opened international long distance service, with the entry of Dacom in December 1991. Dacom was originally set up as a government monopoly to construct and operate data communication networks in 1982. When the data communication market was opened for value added network services in the early 1990s, Dacom was allowed to enter the voice market and to start to compete with KT. In January 1996, the domestic long distance service became a duopoly when Dacom entered the market. The last monopoly market, local telecom services, opened for competition in April 1999 with the entry of Hanaro.

Korea joined the International Telecommunication Union in 1952 and signed the World Trade Organization agreement on basic telecommunication services that became effective in November 1997. The WTO agreement committed the country to liberalisation of its telecommunication sector. The dial-up Internet service market was opened through trade negotiations with the US already in 1989. In addition, the Uruguay Round in 1994 eased regulations for entry and pricing conditions from

[13] Jeong, K-H. & J.L.King (1997): Korea's National Information Infrastructure: Vision and Issues. In B. Kahin & E. Wilson (eds.) National Information Infrastructure Initiatives: Vision and Policy Design. The MIT Press, Cambridge, MA, 1997, p. 122.

registration to notification and abolished foreign ownership limitations on domestic value-added service providers.[14]

In 2001, local telephone services were provided by 33 facility-based carriers, value added telecommunications services by 4,890 carriers, and special telecommunications services by over 78 carriers. To a great extent, foreign investments were liberalized.

Although KT has given some of its market to its competitors, it is still the dominant service provider in fixed-line communication networks. The KT market share in year 2001 in the different market segments can be seen in Table 3.

Table 3. Telecom liberalisation in Korea (source: ITU[15]).

Service	Year competition was introduced	KT's market share, 2001
Local service	1999	96.9 %
Domestic long distance	1996	85.5 %
International long distance	1991	67.1 %

Under the Korean law, the Ministry of Information and Communication (MIC) and other government entities have extensive authority to regulate KT. The MIC has responsibility for approving rates for local service and interconnection services provided by KT. Beginning in January 1998, KT was allowed to set its own rates for domestic long-distance service, international long-distance service and other services without approval from the MIC.

The entry of Hanaro became a critical turning point in the development of broadband in Korea. Hanaro was created in June 1997, when MIC licensed a second local telephone operator. With government encouragement, Korea's chaebols, including LG Group and SK Group, jointly formed Hanaro and provided it with strong economic backing. Hanaro was originally supposed to increase competition in the local phone services. Its launch, however, occurred exactly at the time of the Asian currency crisis, when the Korean economy contracted rapidly. It also became clear that Hanaro would have a very difficult time in competing with KT, as there was no number portability and KT was able to charge large reconnection costs from customers who switched to Hanaro and who subsequently wanted to switch back to KT. Realising its difficult position, Hanaro decided to focus on the provision of Internet connection.

After studying alternatives, Hanaro focused on ADSL, for which it originally purchased equipment from Alcatel. The idea was to lay out fibre to access large

[14] Lee, Nae-Chan, Broadband Internet Service: Korea's Experience. KISDI, February 2002.

[15] Kelly, T., V. Gray & M. Minges (2003) Broadband Korea: Internet Case Study. ITU, 2003, p.5.

apartment blocks and then use ADSL within the building to provide broadband service for the end customers. The strategy also relied on the expected rapid decline of ASDL equipment costs.[16] Hanaro also collaborated with the cable network operator Powercomm[17] to provide cable modem broadband access to those households that it could not economically reach using its own network. Powercomm was eager to sell access to its hybrid fibre cable network, as it was legally barred from engaging in retail services, with its business operations limited to wholesales to fixed-line telecom providers and regional cable television operators. To increase the coverage of its services, Hanaro also used unbundled local copper network from KT.

Hanaro was able to roll out broadband services extremely rapidly partly because the Korean construction regulations require that large apartment buildings have a central telecommunications room. In Korea, the wiring within the buildings is owned and controlled by the building owners. In this sense, Korea has no "local-loop bottleneck," and regulators have not had to create complex rules for accessing the local loop. After getting access to the local decision-maker who controlled the building's telecommunications room, it was a relatively easy task for Hanaro to drop fibre to the room and provide services for all the households in the building. Hanaro first focused on large apartment complexes, with more than 300 households, and later targeted smaller complexes with 200 households.

The incumbent KT was a late bloomer in the high-speed Internet market, which was opened by the cable network operator Thrunet in July 1998. KT had a slow start partly because it believed that future broadband services would be based on ISDN according to earlier national Information Society visions. KT was, for example, heavily invested in the government Broadband Integrated Services Digital Network (BISDN) project that was originally planned to run from 1992 to 2015. It had also launched pilot tests with ADSL in 1997 and decided that, due to the high equipment costs, ADSL could not be a viable broadband technology. According to KT's calculations, it needed at least half a million subscribers who would pay 50 to 60 US$ per month to break even.[18] When KT realised that Hanaro and Thrunet were about to carve a slice of the emerging broadband market, it, however, reacted rapidly. It was ranked first in the domestic industry already in June 2000, a year after launching its commercial services. Its high-speed Internet service subscribers exceeded 4 million in March 2002 and 5 million in December 2002, making KT the largest broadband access provider in the world.

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[16] The purchasing price of ADSL modems fell from about 600 US$ in 1999 to less than 100 US$ in 2002. For cost breakdown, see footnote 28.

[17] In 2002, Powercomm, established in January 2000, had 75,170 km of fibre-optic cable lines across the nation and other intercity networks. Its clients included LG Telecom, Thrunet, Hanaro, SK Telecom and Dacom. It was owned mainly by Korea Electric Power Corporation. After privatisation and Hanro's unsuccessful attempt buy it, Powercomm became part of the LG Group in February 2003. Powercomm now has 95,000 km of optical backbone cable and a 57,000 km hybrid fibre-cable (HFC) network.

[18] DTI Overseas mission to South Korea. Brunel University, 2002, p.16.

The Korean broadband and telecommunications market has been characterised by fierce competition since the end of the 1990s. This has also meant that service providers have had difficulties in making profit. For example, in 2001, only KT and one of the mobile operators made profit. During its history, Hanaro, the second largest broadband provider, has never made net profit. To some extent this was because it invested very heavily in new facilities until year 2000, in an attempt to gain market share. After that it has rapidly decreased its annual capital expenditures, which in 2003 were less than one-fifth of the expenditure in year 2000. After heavy cost-cutting, Hanaro was able to post nominal operating profit in 2002 and 2003, although its profit after capital depreciation and interests remained strongly negative. Thrunet, the third largest service provider, has never been able to make operating profit. Due to its difficult economic situation, Thrunet sought court protection in March 2003 and tried to auction its shares. The bids were not accepted due to their low price. A new auction was launched in December 2004. In this auction Hanaro outbid Dacom, paying perhaps up to 450,000 KRW or 430 US$ per Thrunet customer, a price that analysts have claimed to be difficult to justify simply by revenue generation.

The economic difficulties of broadband access providers have also led to other changes in ownership. Hanaro is now controlled by a consortium led by the U.S American International Group and Newbridge Capital, which invested about 1.1 billion US$ to the company in November 2003. Analysts see a possible merger of Hanaro and the leading mobile operator SK Telecom looming on the horizon. Dacom, in turn, is now part of the LG Group, which also controls Powercomm. The telecom units of LG, the second largest chaebol in Korea, are currently struggling along, with Dacom's sales stagnant for the last five years, and Korea's smallest mobile operator LG Telecom having a debt-equity ratio of 300 percent at the end of 2004 and most probably making considerable losses when the mobile number portability will be fully established in 2005. Analysts therefore expect mergers and acquisitions.

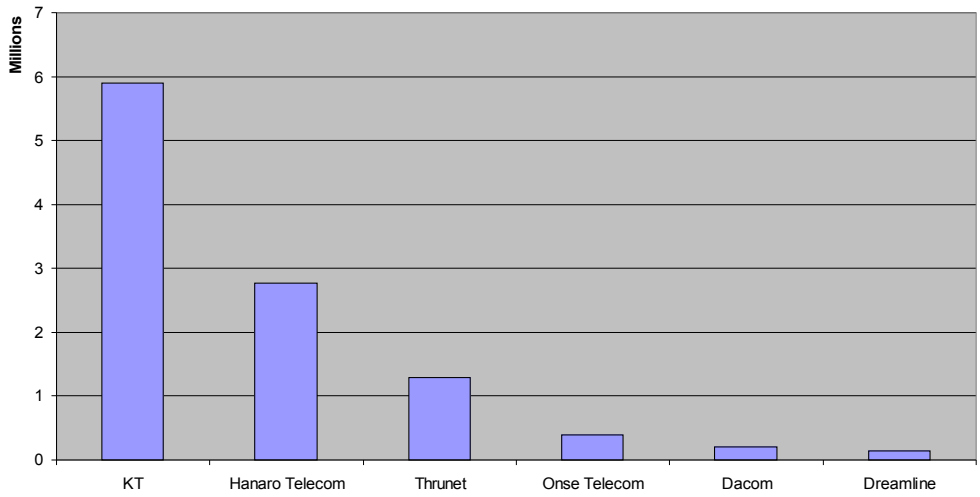

Figure 8. Broadband service providers by subscribers, July 2004 (source: MIC).

The subscriber numbers for the different broadband providers and the access technologies used at the end of 2003 are shown in Table 4. The Korean broadband

analysts have suggested that the Thrunet subscriber numbers may have been about 30 percent inflated before the auction in December 2004, and that the subscriber numbers could be close to 1 million in the end of 2004. Thrunet, on the other hand, has claimed that it has not included non-paying subscribers in its subscriber numbers. KT was estimated to have about 6 million subscribers and Hanaro about 2.8 million subscribers in December 2004.

Table 4. Broadband subscribers by service provider and access technology in Korea, Dec. 2003 (source MIC).

	xDSL	Cable	LAN	Satellite	Total	Market Share
KT	5,230,342	-	353,880	4,836	5,589,058	50.0%
Hanaro Telecom	1,093,261	1,290,150	342,152	-	2,725,563	24.4%
Thrunet	-	1,287,502	5,862	-	1,293,364	11.6%
Onse Telecom	-	419,293	3,769	-	423,062	3.8%
Dreamline	56,178	89,546	3,874	-	149,598	1.3%
Dacom	-	135,884	65,820	-	201,704	1.8%
Value-added operators	3,362	605,791	9,950	-	619,103	5.5%
Resellers	52,812	-	124,235	-	177,047	1.6%
Total	6,435,955	3,828,166	909,542	4,836	11,178,499	100%
Market Share	57.6%	34.2%	8.1%	0.1%	100%	-

Detailed analysis of the broadband market

In December 2004, Korea had 31.58 million people who had used the Internet during the previous month, or 70 percent of the over-6 year population. Since the commencement of the commercial service in 1994, the number approached 1 million in 1997, 10 million in 1999, over 20 million in 2001.

In June 2004, computer users averaged 14.6 hours per week for using computer and more than half of the users spent more than 10 hours using computer.[19] The most popular use was to access the Internet (82 percent), followed by games (41.5 percent) and information and data management (30 percent). The most common motives for using the Internet were “curiosity/fun” (31.5 percent), followed by “work” (15.7 percent), “homework” (14.4 percent), and “searching for information” (13.2 percent). The reasons for using the Internet in December 2004 are shown in Figure 9.

[19] Survey on the Computer and Internet Usage. Ministry of Information and Communication, National Internet Development Agency of Korea, September 2004.

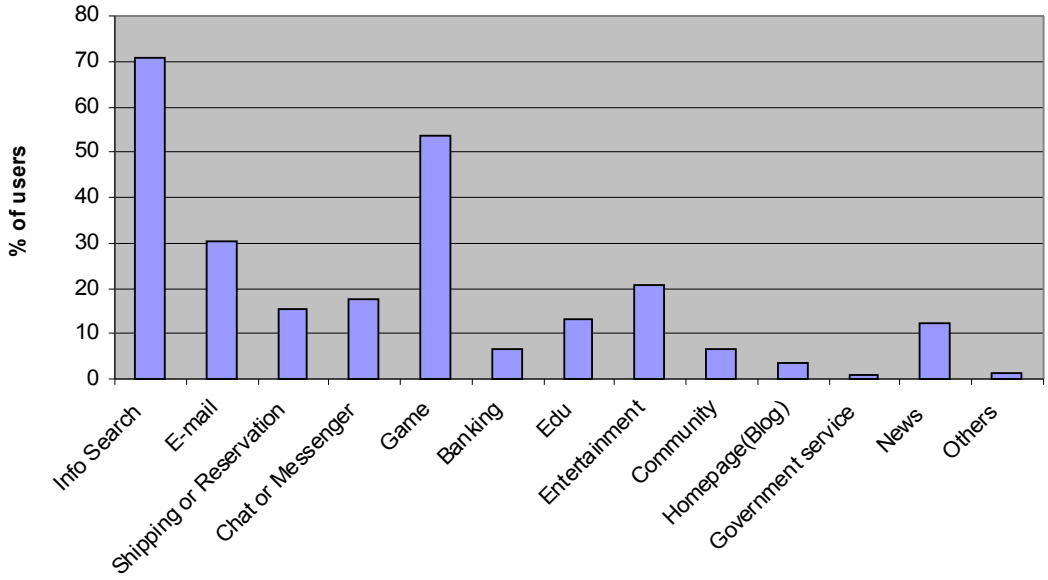

Figure 9. Reasons for using the Internet, December 2004 (source: NIDA).

Electronic commerce and purchasing are widely spread. B2B commerce grew 32.8 percent from 2002 to 2003, reaching 207 trillion won, or about 170 billion US$. There were 260 B2B e-market sites in 2003. The consumer Internet purchasing grew 17 percent from 2002 to 2003, reaching 7 trillion won, or about 5.8 billion US$.[20] Over 45 percent of Internet users aged 12 years and older had experience of Internet shopping in June 2004, and 19 percent have paid for Internet content.[21]

Korean Internet users are already quite experienced, with average Internet experience of almost four and half years. They access the Internet most often from home (90 percent), followed by office (30 percent), public PC rooms (22 percent) and school (16 percent). The gender and age distribution of Internet users is shown in Table 5.

Table 5. Gender gap and Internet users in different age groups, June 2004 (source NDIA).

Age group	total	male	female	Gap(%)
Total	68.2	74.4	62.0	12.4
6-19	95.5	95.6	95.4	0.2
20's	95.0	96.2	93.7	2.5
30's	86.4	89.8	82.9	6.9
40's	58.3	67.6	48.6	19.0
50's	27.6	39.0	16.2	22.8
60 and older	7.3	12.2	3.8	8.4

[20] NCA, 2004 Broadband IT Korea: Informatization White Paper, p. 32.

[21] NIDA survey, referenced in footnote 16.

What technologies are used – the role of existing infrastructures

According to the NIDA June survey, the most common access technology in Korea is xDSL, with 84 percent of Korean households using it to access the Internet, followed by cable modems at 11.6 percent. The penetration of the different Internet access modes in Korean households in December 2004 is shown in Figure 10 below.

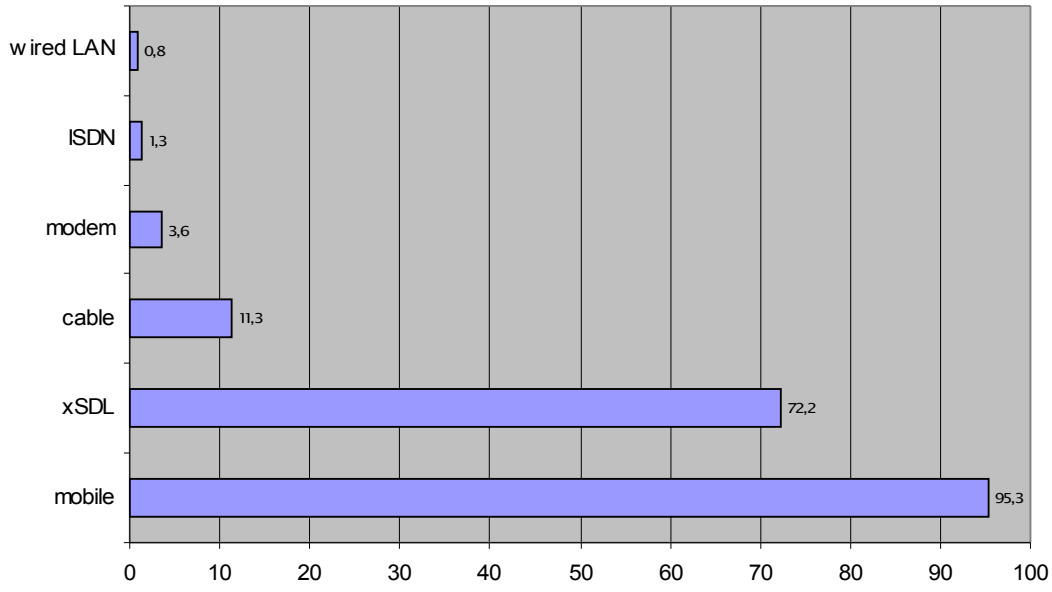

Figure 10. Internet access modes in Korea, December 2004. (source: NIDA)

Service provider statistics give higher rates for cable, close to 33 percent of all broadband subscribers at the end of 2003.[22] The detailed subscriber numbers by technology at the end of 2003 can be seen in Table 6.[23]

Table 6. Internet subscribers, Dec. 2003 (source: KRNIC).

Leased Line	CATV	xDSL	ISDN	Dial-Up	PCL	BWLL/ WLL	Satellite Internet	Metro-Ethernet	Wireless-LAN
85,958	4,023,488	6,877,118	77,095	259,058	-	2,462	5,915	2,320	145,233

The cable operator Thrunet provided the first broadband service in Korea in July 1998. Initially, the number of residential cable model subscribers exceeded ADSL subscribers, with the latter taking over in 2000. The main reason for this was Hanaro's pre-emptive strategy, where it used ADSL to provide services to large apartment complexes. Hanaro also has provided cable access, and at present it has about 1.5 million cable modem broadband subscribers and about 1 million ADSL subscribers.[24] In the early phases of broadband rollout in Korea, KT also used LAN Ethernet to address the shortage of ADSL equipment and to respond to Hanaro's

[22] The reason for this discrepancy is at present unknown.

[23] The KRNIC numbers for December 2003 are systematically higher than the numbers reported by MIC. The reason for this discrepancy is at present unknown.

competition. The rapid growth of both ADSL and cable modem subscribers can be seen in Figure 11. The figure also shows that the growth rates are now slowing down.

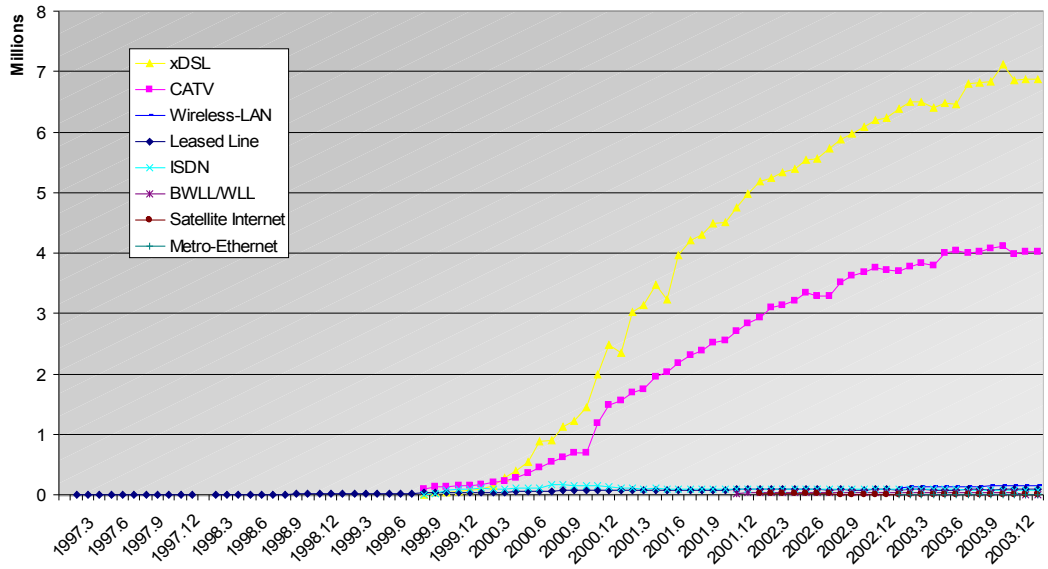

Figure 11. Internet subscribers in Korea, 1996-2003 (source: KRNIC).

Although the subscriber growth is slowing down, the speed of connections continues to grow. Hanaro launched the first commercial VDSL service in 2002, with 20 Mbps downstream and 6 Mbps upstream. In February 2003, KT launched a trial VDSL service at 50 Mbps.

The competition to deploy Korean mobile Internet, called WiBro, began in November 2004, as Hanaro Telecom, KT and the largest mobile operator SK Telecom applied for the three business licenses. The licenses were granted in January 2005, and the commercial service is expected launch in April of 2006. The fees for the seven-year licenses were expected to be set somewhere between 117 billion won to 128.5 billion won depending on the specific schemes presented to the government. In March 2005, KT and SK Telecom each paid US$ 116.5 million license fees. A few days before Hanaro should have paid its first license payment, it announced that it would forego its license. As a reason it gave its focus on fixed-line broadband, and the fact that it should have invested about 500-700 billion won, or about 500-700 million US$, on WiBro in the next five years.

WiBro (Wireless Broadband), formerly known as 2.3GHz portable Internet, is part of the IEEE 802.16 family of wireless Internet specifications. In tests, WiBro has provided up to 3 Mbps connection to devices travelling at up to 60 kilometres per hour. Theoretical downstream speed is 18 Mbps and upstream 6 Mbps. WiBro is related to but different from the WiMax system that has been developed to send a

[24] In December 2004, Hanaro reported 961,513 residential ADSL subscribers and 1,438,649 residential cable modem subscribers. At the same time, it had 18,363 corporate ADSL subscribers and 1,143 corporate cable modem subscribers. In addition, Hanaro had 272,900 VDSL, 20,187 broadband WLL, and 36,179 Wireless LAN subscribers. Cable modem subscribers were, therefore, 52 percent of the total.

higher-bandwidth signal of several tens of megabits per second to fixed receivers over a distance of several tens of kilometres. The Korean portable Internet was originally to be based on a national standard. WiBro, however, is now based on technologies that are planned to be compatible with international standards. In November 2004, after negotiations with LG Electronics, Intel announced that it will secure compatibility with WiMAX and WiBro to avoid global market fragmentation. According to the Korea Information Strategy Development Institute (KISDI), the WiBro service is forecast to attract as many as 9.3 million subscribers by 2011. Analysts estimate that WiBro services via cell phones are unlikely to be possible in 2006 but at least SK Telecom has announced that it will have dual-band CDMA 2000 1x and WiBro handsets available at the time of the commercial launch. Though voice service is technically possible using WiBro, the carriers have stated that they will provide only data services.

As was noted above, the plans for developing broadband are closely connected with industrial policy in Korea. The rollout of services and infrastructures are linked with products and technologies where Korea sees potential for rapid growth and opportunity for global competitiveness. A central piece in the current Korean Information Society Strategy is the broadband convergent network (BcN), which will be used for video, data, and voice, and which will seamlessly combine wired and wireless access.[25] The expected schedule and subscriber numbers for BcN are shown in Table 7. Early applications will include high-quality voice-over-IP and video-telephony. The network is also expected to support interactive digital media broadcasting (DMB) for portable devices and, in its final stage, full broadband multimedia with guaranteed service quality.

Table 7. Plan for BcN schedule and subcriber numbers.

		Early phase 2004-'05	**Building phase '06-'07**	**Completion phase '08-2010**
Example services		Convergence videophone; High-quality VoIP	Portable Internet; Interactive DMB	HD multimedia with QoS
Wired subscribers	50~100Mbps	1.2	3.5	6
	100Mbps	0.3	1	4
	Subtotal	*1.5*	*4.5*	*10*
Wireless subscribers	50Mbps	0.5	3.5	9.5
	100Mbps	-	-	0.5
	Subtotal	*0.5*	*3.5*	*10*
Total (millions)		**2**	**8**	**20**

DMB has recently had high visibility in the Korean Information Society policy. TU Media, the affiliate of the leading mobile operator SK Telecom, launched free DMB pilot services in January 2005. The commercial launch was in May. DMB enables people to receive video, high-quality audio and data through handheld devices like handsets or in-car terminals. Video channels will feature news (YTN), music (M-Net of CJ Media), drama (SBS and MBC), sports, and games while audio channels include various kinds of music programs, English and Chinese conversation, and audio books. TU Media is planning to increase the number of channels from 20 to about 40, also adding data broadcasts from next year. The satellite-based DMB now

[25] MIC 2004, IT 8-3-9 Strategy: The Road to $20,000 GDP per capita.

also includes a disaster warning system, which will be used to broadcast information both to subscribers and non-subscribers. The subscription price is 20,000 won (15 € or 20 US$) and the monthly subscription fee 13,000 won (9.6 € or 13 US$). TU Media has waived the subscription fee and the monthly fee during the first month of the launch. There are now about 10 different DMB receiver models available for the consumers, including phones from Samsung and LG Electronics. In December 2004, World Digital Audio Broadcasting (DAB) Forum decided to propose Korea's terrestrial DMB technology as a European standard to the European Telecommunication Standard Institute (ETSI). The ministry said that the adoption of the Korean terrestrial DMB technology as a European standard would enable Korea to secure core technologies of next-generation digital broadcasting, which will help Korea to take up favourable position in pre-empting the market.

Operator strategies including pricing schemes

Broadband subscriber prices in Korea have been among the lowest in the world since the introduction of the services. Early on, the subscription fees dropped to about 25 US$. In 2002, monthly subscription fee, including modem rental, was about 25 US$ for residential ADSL and 32 US$ for business ADSL. Cable modem subscriptions had similar prices. As was noted above, the subscriber prices are now somewhat higher in dollar terms, and about 25 to 30 euros, including equipment rental and taxes. At these prices, Korean subscribers get on average 4 Mbps connections.

An important reason for the low subscriber prices has been very strong facilities-based competition, created by heavy investments in competing networks, but also exceptionally easy access to the customers and their local network. Korea has a rather unique competitive environment in the local loop, as wiring to the customer premises is often owned by the customers themselves, instead of telecom operators. In this sense, the local loop in Korean networks has been unbundled and open for competition by default. Whereas in many other countries dominant operators have been slow to provide local loop access to their competitors and have charged fees that have in many cases made competing services economically unviable, this bottleneck has not reduced the speed of broadband diffusion in Korea.

In fact, this lack of local-loop bottleneck has benefited the diffusion of broadband for two reasons. In many European countries, opening up the local-loop for competition has required intervention from policy-makers and the regulators. This has typically led to lengthy negotiation rounds. After the terms for unbundling have been defined, competition has subsequently been introduced in the market. In practice, the implementation of local loop competition has often been slow, as incumbents have not had any major interest in facilitating the entry of new competitors. This has created a multi-year delay in launching effective competition in many countries. In contrast, the Korean operators had to face very strong competition and the possibility of profit erosion early in the process. As the local-loop bottleneck has been of limited importance, also the policy-makers have been able to focus on other issues.

KTs competitors have also effectively used the possibilities to combine existing facilities. In particular, regional cable TV networks have been available for Hanaro and Thrunet as an alternative access channel to customer households. Cable TV operators, which have had exclusive licenses in their regions, have not themselves provided data communication services. This has left the market to Thrunet, Hanaro and other broadband providers. Cable TV operators simply share revenues with broadband providers, without competing with them. In effect, also the cable network, therefore, has been unbundled in Korea.

In contrast to many other countries, the dominant operator KT therefore has been unable to drag its feet. Instead, it has actively marketed its broadband services. First, it had to respond to competitors on the market, as it could not slow them down using its control over local loop access. Second, for historical reasons, KT was not the dominant player in leased line data communication market, where Dacom had monopoly until the end of the 1980s. In other countries, many incumbent telecom operators have found it difficult to cannibalise their leased line market, where subscription prices have been high. Third, the rapid diffusion of mobile phones in Korea meant that fixed line subscriber growth ground to halt in 1998, and in 1999 mobile phone penetration exceeded fixed line penetration. The growth in fixed line market was therefore mainly seen in data communications services, where the average revenue per user was up to seven times higher than in basic voice services. Given this competitive setting, the rapid rollout of ADSL broadband services was clearly an attractive choice for KT, as it could effectively leverage its existing copper-based network to provide services to this rapidly growing market. Heavy competition has therefore led to low broadband subscriber prices.

An important reason for the low subscriber prices has also been policy. Early on, the Ministry of Information and Communication indicated that it prefers prices that are among the lowest in the world. Although there is no formal price control for broadband subscriber prices, the strong role of MIC and its capability to direct investment funding and negotiate the conditions for competition means that service providers take also the information society development policies into account.

In the Korean broadband development, the economic downturn of 1997-98 played an important role. The economic crisis occurred at a time when the global Internet boom was about to arrive its peak. A large number of recently unemployed people looked for new ways to earn their income. The emerging availability of low-cost leased-line access to the Internet produced a large number of entrepreneurs who started to provide Internet access in “PC rooms.” The first PC rooms or “PC Bangs” emerged in 1998, and their number skyrocketed to 22,549 in 2001.[26]

To set up a PC bang, a new entrepreneur had to buy or lease PCs and some chairs and tables, and connect the room to the Internet using a broadband link. The high-speed

[26] NCA 2004: White Paper Internet Korea, p. 31.

connection enabled e-mail, chatting, music downloading, participation in on-line communities, and most-important, multiplayer online games.

PC Bangs became very popular for four reasons. First, they were attractive business propositions to people who were looking for income and work. They required relatively low investments, and as soon as the network was operating, they produced a steady revenue stream. This rapidly increased the supply of broadband access in Korea. Second, PC Bangs used hourly rates in the range of 1 US$ and less, which made them attractive and possible for young people, who actively experimented with new services and shared knowledge about them. Third, the rapidly growing PC bang user group provided the critical mass of Korean-speaking broadband users. This made business models based on content creation attractive. Finally, the fast national broadband backbone enabled the users in different PC rooms to be connected at high-speeds. This produced the killer-application in the content business: making multiplayer on-line games possible within Korea. The boom in PC Bangs was also reflected in the growth of Internet service providers. Between 1998 and 2002 the number of ISPs grew almost five-fold. Since the second-half of 2002, the ISP sector, however, as started to consolidate, as can be seen in Figure 12.

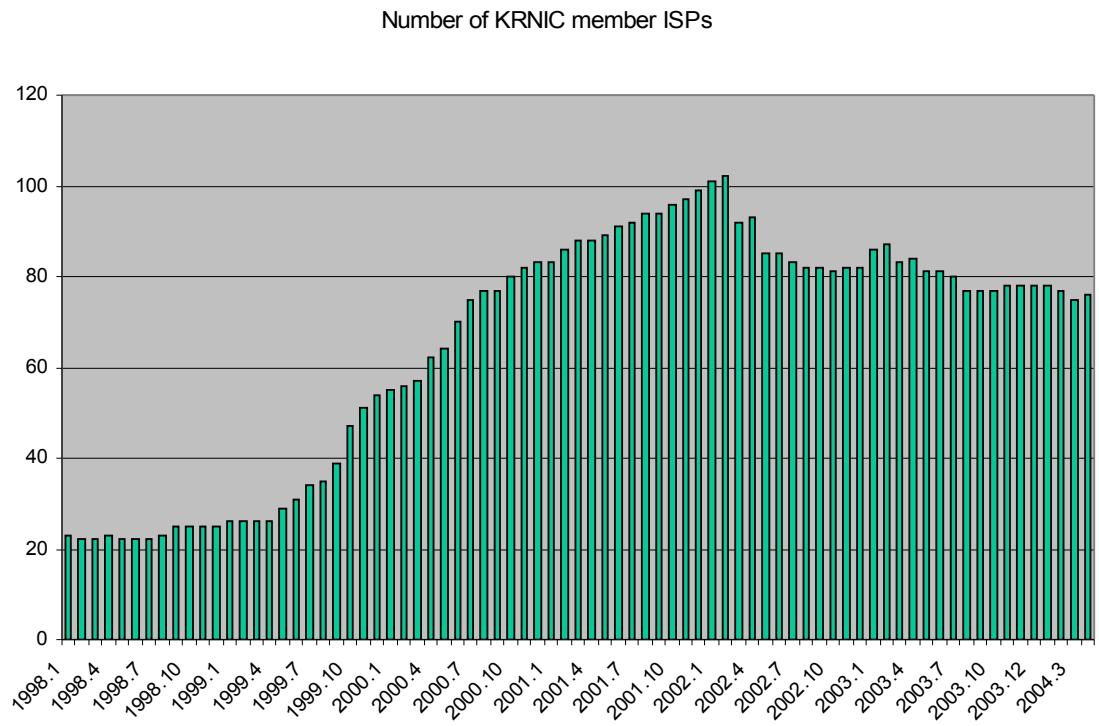

Figure 12. Internet service providers in Korea (source: KRNIC).

KT published its "KT Future Strategies 2010" in August 2004. CEO Yong-Kyung Lee stated that "in consideration of our close connection with the government's policy, KT's new industrial growth engines will be aligned with the country's IT 8-3-9 policy, and this is an expression of our willingness to play a leading role in implementing this beneficial policy." KT aims to invest 3 trillion won (about 1 billion

US$) annually until 2010 to develop five new growth engines. The new growth engines are next-generation mobile communications, including WiBro and 4G, home networking, media, IT services, and digital contents.

The role of alternative networks

Industry consolidation has been going on in the broadband Internet market already for some time in Korea. It may be expected that the convergence of fixed and wireless networks and multimedia content will lead to further rearrangements in the related industries. In particular, voice-over-IP (VoIP) will potentially erode revenues from traditionally profitable voice services, perhaps forcing KT and others to move towards content provision. The challenge here, however, is that unless the content is produced free, for example by the users themselves, it will be difficult for the network operators to retain profits. Indeed, traditional voice services were highly profitable exactly because phone users generated the content themselves and also because the historical and natural monopolies provided network operators considerable pricing power. As competing infrastructures become available, operators, content distributors and service providers need new business models.

KT, in particular, seems invest aggressively, up to 1 trillion won or about 1 billion US$, in WiBro over the next five years. It also seeks to combine its wireless local area network (WiFi) in areas where WiBro services might be blocked. KT has about 15,000 WiFi access points in Korea, which enable people to connect to the Internet at a maximum speed of 11Mbps. It has also started to upgrade its WiFi services, offering now a speed of up to 54 Mbps with an average throughput of 25 Mbps.

SK Telecom, in turn, tries to mix WiBro with digital multimedia broadcasting (DMB). Whereas KT will complement WiBro with fixed WiFi, SK Telecom could perhaps try and use its WCDMA 3G network to complement WiBro. SK Telecom and Hanaro also made a collaboration agreement just before submitting their WiBro license applications in December 2004. Under the agreement, Hanaro and SK Telecom will share their base stations and access networks for WiBro nationwide, excluding Seoul and six provincial cities. As noted above, Hanaro, however, gave up its WiBro licence in April, showing that the strategies are continuously being adapted. Also the WCDMA subscriber numbers have remained very low, which seems to slow down investments in the 3G WCDMA infrastructure.

Hanaro, in turn, agreed to share 451 base stations with KRT net, a company that exclusively holds and operates base stations in military facilities and remote rural areas. After its merger with Thrunet, Hanaro will have about 4 million households as customers. In principle, it could try to roll out innovative new broadband architectures and services. In theory it could, for example, combine VDSL or cable modems with wireless home networks, WiBro, and WiMax to provide ubiquitous voice and multimedia data access to its customers. Hanaro could then become a local phone

service company, as originally planned—this time, however, by providing voice-over-IP.

Government sponsored Internet centres also provide broadband access in Korea. Between 2000 and 2003, the local government constructed 5,477 access centres and post office 2,786 access centres. In addition, there are about 24,000 Internet-Cafés, or "PC Bangs," in Korea.

Key applications of broadband services

The distribution of content market is shown in Figure 13.

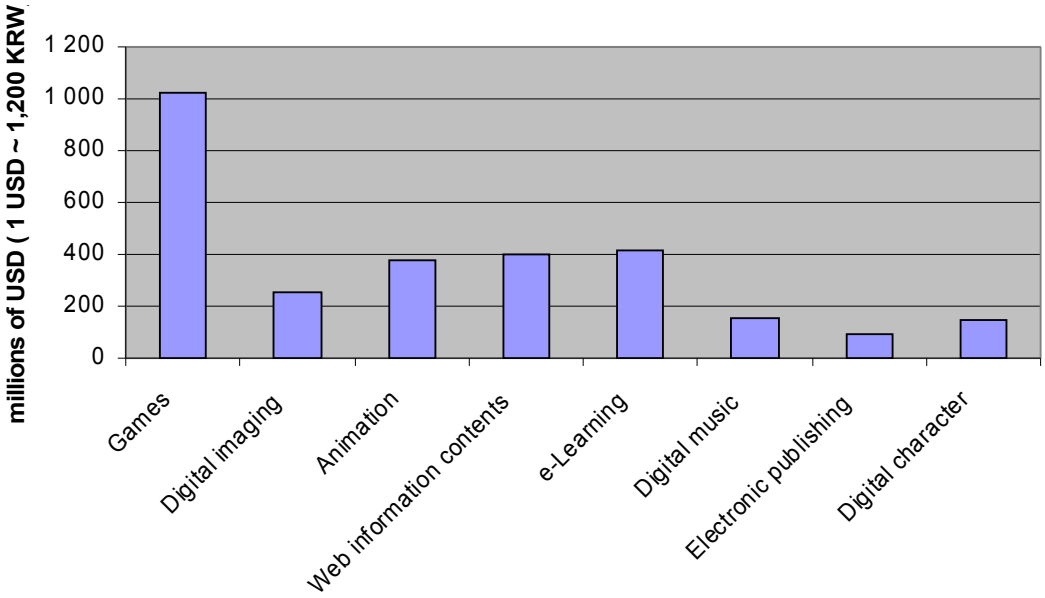

Figure 13. Digital contents market in Korea, 2003 (source: Korea Institute of Multimedia Contents and Software).

Korea has been the leading country in the development and use of multiplayer on-line games. The gaming phenomenon has, indeed, become a key driver in broadband diffusion. The leading game players are national heroes, and both fixed line and mobile operators spend huge sums to recruit top players. KTF, the KT mobile affiliate and the second largest mobile operator, has been reported to pay 7 trillion won for two leading players.

It has often been stated that the Korean interest in games would have a cultural basis. An alternative explanation could be that the rapid expansion of on-line games was simply generated by the availability of broadband infrastructure. The Korean PC Bangs were connected at high speed to the Korean broadband backbone, allowing interconnections with low latency and short delays between the users of PC Bangs, as well as interactive graphics in games. This infrastructure was necessary for the

development of massively distributed multiplayer role-games. If a similar technical architecture would have been available in other countries, it is possible that the popular "Korean interest in games" explanation for the rapid diffusion of broadband in Korea would lose some of its credibility. One factor in the success of multiplayer computer games in Korea has also been the fact that Korea has restricted Japanese imports. Instead of specialized game consoles, Koreans have therefore focused on PC-based games. The popularity of multiplayer games indicates that the Koreans have been early movers in the on-line game market. The idea that Koreans would be particularly interested in gaming does not however seem to have any robust scientific evidence. An alternative explanation is that the interest in multiplayer games could be quite culture independent, and the popularity of multiplayer games in Korea could simply result from the wide availability of broadband access and the lack of availability of game consoles.

The online game market is expected to be growing in Korea during the next years, with fastest growth in mobile games. The game revenues in PC Bangs are expected to saturate, as households now have their own broadband connections. The growth of the Korean game market is shown in Table 8. Korean online game producers have been extremely successful domestically, and they are now exporting software and game concepts to China, Taiwan and Southeast Asia. In 2003, Korean online games accounted for about 7 percent of the global online gaming market.

Table 8. Korean game market forecast (source: Korean Entertainment System Industry Association, Dec. 2003).

Market		2000	2001	2002	2003	2004	2005	2006	2007	annual growth rate
Online-game		1,628	2,985	4,656	7,042	9,330	11,168	12,406	13,145	28.0%
Mobile-game		17	497	727	1,352	2,474	4,125	6,422	9,491	63.5%
PC-game		1,323	1,810	902	1,275	1,276	1,277	1,278	1,278	-5.6%
Arcade-game		5,844	3,528	4,142	3,984	3,894	3,830	3,782	3,745	1.0%
Console	HW	18	29	1,012	1,015	1,512	1,649	1,947	2,238	106.3%
	SW	72	117	898	943	1,009	1,435	1,700	1,973	60.1%
	Total	90	146	1,910	1,958	2,521	3,084	3,647	4,211	75.1%
Subtotal		8,902	8,966	12,337	15,611	19,495	23,484	27,535	31,870	23.5%
Online Internet café		13,343	19,832	19,441	22,763	23,873	24,446	24,731	24,870	3.8%
Computer-game room		8,634	5,969	6,570	5,928	5,703	5,543	5,422	5,329	-1.9%
Total		30,879	34,767	38,348	44,301	49,072	53,473	57,688	62,069	10.1%

The sales of digital music industry in Korea was about 154 million US$ in 2003, with mobile ringtones representing about 70 percent of this market. Most of the music downloads occurred through file-sharing systems that did not charge for the content.

The online movie market was about 80 billion won, or about 70 million US$ in 2003. There were over 300 online movie websites. The sales ratio for adult movies and

domestic feature movies was about 6:4 in 2002 and 3:7 in 2003. This change was at least partly caused by government regulations concerning adult-oriented websites.

The availability of broadband connections has also made Internet broadcasts possible. In this area, entertainment content is the market leader, with 28 percent in 2003, followed by educational content, at 14 percent. The distribution of Internet broadcasts by content type is shown in Table 9.

Table 9. Internet broadcasts in Korea, Dec. 2003 (source: NCA / IT Public Webcasting).

	No. of Internet Broadcasts	%
Education/Study	66	14.3
Vocational education	29	6.3
School	44	9.5
Sports	14	3.0
Animation	6	1.3
Entertainment	14	3.0
Movies	21	4.5
Music	60	13.0
Games	4	0.9
Other amusements	11	2.4
Public institutions	12	2.6
Companies/Organizations	10	2.2
Society/Culture/Welfare	30	6.5
Regional information/Living information	50	10.8
Current issues/Economy/Management	22	4.8
Arts	5	1.1
Religion	18	3.9
Teens	11	2.4
Hobby/Leisure	26	5.6
News	4	0.9
Health/Medicine	5	1.1
Total	462	100

Identification and analysis of key drivers and inhibitors

Korea's leading position in the global broadband diffusion has produced several studies that have tried to explain the factors that underlie the development of Internet and broadband in Korea.

The U.K. DTI study[27] proposed that six success factors underlie the rapid expansion of broadband in Korea: 1) geography and demographics, 2) government leadership, 3) facilities-based competition, 4) the PC bang phenomenon, 5) pricing, and 6) the

[27] DTI Overseas mission to South Korea. Brunel University, 2002.

emergence of clear user benefits. The ITU Korean Broadband study[28], in turn, points out that Korea has a very high literacy rate and very high school enrolment rates. ITU also highlights the role of the domestic Korean IT equipment industry, which successfully reduced the cost of ADSL equipment.

A number of academic studies have also focused on the factors that underlie broadband diffusion in Korea. Lee, O'Keefe and Yun[29] proposed that the matching of demand and supply was the most important factor, produced by fierce infrastructure competition, online gaming, and social and cultural factors such as housing patterns, social pressure to keep up with the neighbours, and tight social networks. They also noted that the economic crisis of 1997 and the deregulation of telecom industry played an important role both by in increasing the government efforts to move Korea to the knowledge-based economy and by providing entrepreneurial opportunities for unemployed people. Lee and Chan-Olmsted[30], in turn tried to compare the U.S. and Korean broadband diffusion patterns using a modified Porterian diamond model of national competitive advantage. They found out that, in particular, active government policies have probably created more predictable roadmaps for the evolution of broadband and related technologies in Korea than in the U.S., where uncertainties concerning the future have perhaps slowed down broadband-related investments. Park and Yoong[31], in turn, argued that market and technological factors were the key drivers. They also noted that consistent and strong government policies that promoted competition, developed the information infrastructure and created demand were important; as well as socio-cultural factors such as PC Bangs, housing patterns, and cultural homogeneity.

Although some broadband diffusion factors in Korea are now taken more or less for granted—such as the importance of housing structure—one needs to be careful in interpreting and extrapolating them. As almost 80 percent of Koreans live in densely populated urban areas, cost effective deployment of broadband infrastructure has been exceptionally easy in Korea. According to the DTI report, construction costs accounted for only 14 percent of cost per ADSL subscriber in Korea in 2002.[32] About 95 percent of the population live within 4 kilometres of KT's local exchanges, which made it possible for KT to use its existing copper wiring to provide ADSL. Almost half of the population lives in large apartment complexes with up to 600 dwellings per building. Building regulations set up in the 1970s have required that these apartment complexes have a single communications room in the basement, from which all the apartments can be accessed using the in-house wiring.

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[28] ITU 2003: Broadband Korea: Internet Case Study, ITU, March 2003.

[29] Lee, H., O'Keefe, R.M. & K. Yun (2003): The growth of broadband and electronic commerce in South Korea: contributing factors. The Information Society, 19. pp. 81-93.

[30] Lee, C. & S.M. Chan-Olmsted (2004): Competitive advantage of broadband Internet: a comparative study between South Korea and the United States. Telecommunications Policy, 28(9/10), pp. 649-677.

[31] Park, S. & S-H Yoon (2005): Separating early-adopters from the majority: the case of broadband Internet access in Korea. Technological Forecasting and Social Change, In press.

[32] KT reported costs of about USD 360 per ADSL subscriber in 2000 and USD 273 in 2002. Construction work represented 14 percent, backbone transmission 24 percent, gigabit switch router 20 percent, and equipment 42 percent.

This, however, does not mean that high urban density or large apartment complexes would be drivers for broadband diffusion. More accurately, they are contextual factors that have influenced decision-making in specific historical moments of time. In fact, the associated driver has been related to a specific configuration of competitive power in Korea in 1999. The ownership structure of in-building wiring and unbundled cable networks in effect removed the local loop bottleneck. Unregulated Internet access service markets and ADSL made it possible for new entrants to use this opportunity to rapidly roll out Internet access services. Although, economically speaking, ADSL was "impossible" in the conventional business sense, the widely communicated "new economy" model where large economic losses were justified by future profit opportunities, made it possible to by-pass traditional profit models. At the same time, the rapid expansion of Internet content and the fixed pricing of broadband services made the new services attractive for a large customer base. The dominant operator realised that its traditional profit models were eroding, and it responded aggressively, trying to pre-empt the new entrants.

This logic cannot be repeated in other countries. New technologies and technical architectures have become possible, and the cost structures have changed radically during the last seven years. For example, the traditional local loop bottleneck has only limited importance today, both because alternative channels have become available and because local loop unbundling is now to a large extent implemented in many countries. After the Internet boom and crash, many investors are also more conservative, and require profit and effective management of economic risks.

Economic actors have been the main drivers of the broadband diffusion in Korea. The government, however, has also been very active in promoting information society in Korea. The Korean initiatives to build a nation-wide broadband backbone started already in the 1980s with the National Basic Information System (NBIS) project. Although the NBIS project and its follower Next Generation NBIS (NGNBIS) had only limited success, they provided the foundation for the Korean Information Infrastructure (KII) projects that were launched in 1995. The KII project consisted of a high-speed government funded network, the New Korea Network – Government (NKN-G), and the commercial New Korea Network – Public (NKN-P). The NKN-G provided high-speed connections for government agencies and universities, whereas the NKN-P was supposed to become the basic infrastructure for broadband multimedia information services for private firms and homes.

Competition has also been very heavy in Korea. The common claim that facilities-based competition is important for broadband diffusion is not, however, exactly appropriate in Korea. The new entrants Hanaro and Thrunet were able to use Powercomm's hybrid fibre-cable network to get access to customers. As the in-building wiring is owned by the building owners in Korea, the dominant player KT could easily be by-passed by connecting the building telecom room into the competing networks. The copper-based network was unbundled only in 2002. The relatively slow unbundling has not been a major factor in Korea, as the cable TV

networks have also been effectively unbundled and as the building owners have controlled the in-building wiring.

As the PC Bangs grew in popularity, they provided a very efficient marketing channel for the new broadband services. Because a large majority of broadband users were accessible to PC Bangs, there was little need to invest in general consumer marketing and advertising. For the customers, PC Bangs gave the opportunity to try out and learn broadband services without committing to monthly subscriber fees and expensive equipment purchases. PC Bangs also provided a critical mass of potential customers that were necessary for the success of content providers. For example, about 80 percent of the revenues of the leading online game provider NCsoft came from PC Bangs when it launched its first products. The large broadband user group that PC Bangs created further became a key factor in generating demand for home broadband services.

Broadband subscriber fees have been low since the introduction of the service. This was encouraged by the Korean government policy that viewed broadband as a key to social and economic development. Korean policymakers therefore wanted to avoid a situation where only high-income families would have access to the service.

The government and service providers have also highlighted the potential educational benefits of broadband access. In particular, the Korean government has been active in supplying high-quality educational content through the web. The educational potential of the broadband Internet has created both legitimacy and pressure on the parents to get broadband access to their children. These pressures have probably increased when children became familiar with the possibilities of broadband through PC Bangs. Children who had learned to play network games and use other content in PC Bangs could easily push their parents to get broadband access by borrowing the popular policy rhetoric of broadband as the key to educational success. To some extent, educational services on broadband have also replaced traditional after-school classes, allowing children to participate additional schooling and do their homework at home. In this sense, the various interests of the government, service providers, equipment manufacturers, parents, and their children have been well-aligned in Korea.

On the other hand, specific “killer content” has also been important in spreading awareness about the benefits of broadband. In particular, a 1999 video on Miss Korea 1998 having sex with her manager was distributed on the Internet. As video content clearly shows the difference between Internet dial-up and broadband access, broadband advantages became widely known early on in Korea.

It has also been argued that the culturally homogeneous Korean society has increased diffusion of broadband services. Socio-cultural homogeneity probably has been important in the sense that when new applications and technologies become interesting and relevant for early users, they often are interesting also for the rest of

the society.[33] Korean society, however, is also a Confucian society, where hierarchy is important. This combination has meant that the citizens, although being part of a homogeneous culture, also compete against each other in an attempt to climb the social ladder. This competitiveness has been effectively used by the Korean government, who early on started to certify buildings according to their broadband connection speed. New apartment complexes are often marketed by broadband access speed and their broadband certification is often visibly marked on the building walls.

Some of the main factors that previous studies have highlighted in their explanations of the rapid advance of broadband in Korea are shown in Figure 14.

[33] This has been argued to create similar fast diffusion patterns in Korea and Finland, for example. For a more detailed analysis of the links between social structure and technology diffusion, see: Tuomi, I. Networks of Innovation, Oxford, Oxford University Press, 2002.

	Lee, O'Keefe & Yun, 2003	Park & Yoon, 2005	Lee, N-C., 2002	ITU, 2003	DTI, 2002	Kim, T-G., 2005
Socio-cultural environment						
demography		homogeneous ethnicity; shared language				
purchasing power	low subscription prices; flat fee subscription; low-cost access through PC Bangs					
geography	high-density dwellings; closeness to local exchanges		unique urban geography	80% in urban areas; 48 % in large apartments	80% in urban areas, 49% in large apartment buildings	urban structure, high-rise apartment buildings close to switching stations
human capital	dial-up users; PC Bangs; online gaming			high level of education	PC Bangs as a location of skill development	
absorptive capacity	existing dial-up users				PC Bangs as commercial market for content developers	
values	"keeping up with neighbors"; competitive enthusiasm for children's education; preference for using the Internet for social communication	shared values				
latent demand		unsatisfied dial-up online customers; entertainment for early-adopters, e-commerce for majority	demand for entertainment and network games; existing dial-up users		education, games, access to information, financial transactions, time-shifted TV content, on-line communities	1998 Miss Korea sex video
timing	1997 financial crisis; Internet boom					
Public sector policy						
awareness building	"Ten million People Internet Education Project"; Cyber Building Certificate system; BB service provider benchmarking and monitoring		"Ten million People Internet Education Project"; Information Education Centers at post offices and schools; mobile education centers; Cyber Building Certificate system		provision of free IT training, wide-scale promotion of the benefits	
demand aggregation		free BB access at schools	KII-Government BB backbone; Internet service to non-profit organizations		provision of BB for schools	
lead user					construction of high-capacity backbone	
financial and investment policies	subsidies for training institutes	investments in the national broadband core network; support for the provision of cheap Internet PCs	KII-Private; KII-Government; KII-Test bed; R&D funding; prime rate loans for access network investments	financial support for target areas; rotation of license fees back to the ICT sector	soft loans, subsidies to low-income households	soft government loans in exchange for low flat-rate pricing
regulation	deregulation; hands-off policy for value added ISPs		market competition through deregulation on entry and pricing; BB Internet service regulatec as value-added service (free of regulation)		deregulation, encouragment of facilities-based competition; lowneed for regulation due to the absence of local loop bottleneck; government push for low subscriber prices	import restrictions for Japanese console games
research policy				high-level cooperation between gov. and the private sector	R&D funding	
content policy		provision of educational content				
Private sector actions						
industry competition	vigorous competition within and across BB technologies, driven by new entrants	competition among pre-bb proprietary online service providers	Hanaro's preemptive strategy for targeting densely populated apartment complexes; KT's extension of existing copper local loops to capture new customers; deregulated BB Internet service enabling cost competition and fast entry		facilities-based competition	
technology supply		emergence of local equipment suppliers	VoIP (Dialpad)	advanced and low-cost ICT products from local producers due to export orientation		
service supply		emergence of dial-up ISPs; change from closed network environment to open environment; wide-availability of BB through PC Bangs	free VoIP (Dialpad)			

Figure 14. Broadband diffusion factors in various studies.

Policy and regulation

Korean policymakers have been very active in promoting information technologies, based on the vision that the future of Korea depends on its capability to transform itself into a knowledge-based society and economy. In the Korean visions, Information Society is an "education welfare state," where every citizen is given the possibility to develop his or her full potential. Information and communication technologies are also viewed as the path towards higher economic growth, better incomes, and global competitiveness. A purely economic view of development, however, does not well describe the Korean policies. The Korean visions, in particular, have perceived information and communication technologies as a key to social transformation. This strong developmental emphasis contrasts the Korean visions, for example, with the U.S. visions, where ICTs are more often described as technologies that improve economic efficiency and individual choice. The strong societal dimension also brings the Korean Information Society strategies relatively close to the European and in particular the Nordic models. A major difference, however, is the existence of strong links and detailed roadmaps for industrial development and information society policies, as well as the strong coordinating role of public policymakers. Such close links would be difficult in the present European Union.

Key government policy makers include the Ministry of Information and Communciation (MIC) and the National Computerization Agency (NCA). The Framework Act on Informatization Promotion of 1995 created the Informatization Promotion Committee in 1996, which is led by the Prime Minister and which has other ministers as its members. The Presidential Committee on Government and Innovation Decentralization (PCGID), in turn, acts as an advisory body to the office of the president, with a specific aim at public sector reform and e-Government. The institutional framework of the Korean informationalization policy is shown in Figure 15.

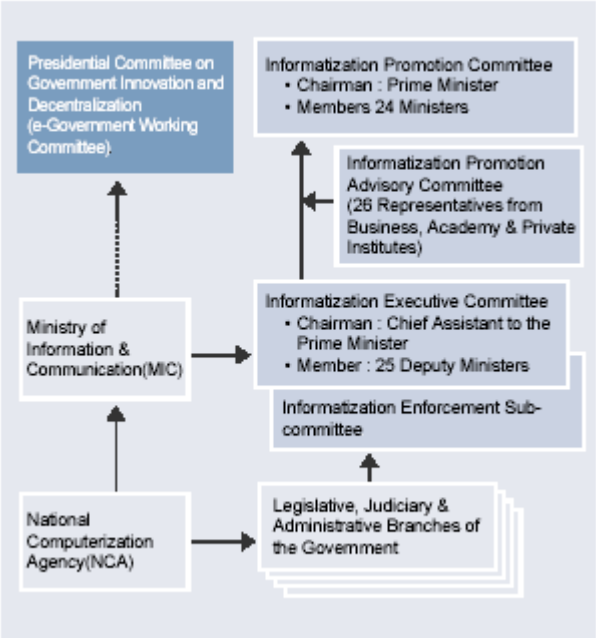

Figure 15. Korean framework for national informatization (source: NCA).

The MIC has developed the Korean Information Society both by gradually deregulating it and by putting pressure on the large chaebols to open up for competition. Deregulation and increasing competition has not occurred at random, though. Koreans have been quite successful in opening their industries after the domestic industry has been strong enough for global competition. In particular, in the 1990s Korea actively developed domestic standards and intellectual property that gave it simultaneously relatively protected domestic markets and time to develop competitive advantage. Recently, Korea has focused on international technology standards.

The Korean Information Society policies have also centered on skill development, industrial development, and the reduction of digital divides. To overcome the current and future shortage in IT skills, the government has invested 33.5 billion won in support of education in the information and communication area, establishment of a technical high school specializing in software development, and basic research in related subjects. Furthermore, the government has provided support for the development of a University Information and Communication Research Center, and Information and Communication University Overseas Scholarship Program for ASIC design and JAVA training. The government has also sponsored information and communication re-training courses for the unemployed with high academic backgrounds from traditional industries. This will assist such qualified unemployed to find jobs in the IT sector or to start new IT businesses. In addition, government support has been provided to IT professional education organizations, cyber universities involved in the field of information and communications, the invitation and training of foreign IT specialists and experts. To further develop human resources

in the IT field, the government has provided computer literacy training and education aimed at elementary and middle schools, housewives, the military, and the disabled.[34]

A major initiative in this area has been the three-year 10 Million People IT Education project, which was launched in mid-2000. Some 3.6 million people received basic Internet and computer training in this program in 2000, including over one million residents in local communities, about 300,000 housewives, and 23 thousand prison inmates. In total, almost 14 million people received training during the three years. The program was continued with the 2nd National IT learning program. A new four-year IT Education Program for 5 Million Underprivileged started in the beginning of 2005.

The government will invest approximately 430 billion won in expanding the involvement of regular educational organizations in information and communication education, as well as cooperation with overseas schools and universities. The government also plans to sponsor the retraining of industrial workers, bridge the digital gap among the populace, and develop a highly skilled workforce for the IT field. The government will expand its investments in discovering gifted IT talents in their early stages and nurturing them to contribute to the world economy.

Korean Digital Divide Act was established in 2001 and revised in 2002. 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 spending for the master plans is about 1.9 billion US$, with about 300 million US$ in 2004. The 2004 annual action plan consisted of constructing high-speed information network in rural areas, supporting assistive technologies for disabled people, 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 percent discounts in telecommunication service charges to low-income and disabled users.

The failed attempt by Hanaro to enter local telephony services had shown that competition in the local loop was difficult without number portability. As a result, the government announced detailed plan to implement number portability in fixed telecommunication services in January 2001 and for the mobile market in January 2002.

The Telecom Business Act of Korea mandated a new obligation in December 2000 to the facilities-based service providers (KT, Hanaro and Thrunet) to provide their unbundled elements to competitors. Furthermore, the government finalized the details of the obligation and a pricing scheme in December 2001, so that unbundling obligation also works in practice. The Telecom Business Act was enacted in

[34] http://www.kado.or.kr

December 2000, and the government finalized the regulation setting out detailed requirements for unbundling, including pricing, in December 2001.[35]

As the Information Society is perceived to be a systemic transformation in the Korean society and economy, broadband policies are also very tightly connected with industrial and R&D policies. In 2000, the government designated 174 core strategic technologies for technology development projects in order to gain a technological competitive edge in the world market including the next-generation Internet, optical communications, digital broadcasting, wireless communications, and computer software, among others. In addition, the government has improved the appraisal system for the selection of research subjects, and has helped to establish effective research management methods for the efficient utilization of R&D funding and maximizing the benefits of R&D. At the same time, the government is concentrating on the development of innovative technology that forms the basis of securing sustained national competitiveness in the future.

An important factor in the Korean broadband development has been the Informatization Promotion Fund. This fund has rotated license auction fees and telecom taxes back to telecom infrastructure development. In contrast to most other countries, where, for example, 3G license fees were not earmarked, Korea has been able to provide low interest loans for communications infrastructure development in less-advantaged regions, as well as funding for Information Society –related R&D. The actual amount of the fund for 2004 was 1.2 billion US$, with 740 US$ earmarked for R&D.[36]

The role of FDI in Korea has been relatively minor, although about 13,600 companies made investments in Korea in 2003. After the financial crisis in 1997, the government initiated tax reduction measures for high-tech businesses, businesses in foreign investment zones and service businesses (exemption from or reduced national taxes for 10 years, local taxes for 15 years) to cope with the economic recession. In 2003, LG Philips LCD and Nokia TMC were the largest foreign companies in Korea, the former with about 5 billion US$ and the latter with about 2.6 billion US$ revenues. Indirectly, the rapid growth of the ICT sector has, however, legitimized domestic investments in the ICT infrastructure and skills.

Rent reduction policies are applied in industrial complexes for foreign companies, 25 national industrial complexes, and Foreign Investment Zones, with 100 percent exemption for high-tech businesses and 75 percent reduction for general manufacturing industries. In the Foreign Investment Zones, companies that are more than 30 percent owned by foreign investors and have more than 10 regular full-time workers who have a master's degree or higher with more than 3 years of R&D

[35] Local loop unbundling has been in effect since 2002, based on LRIC (long-run incremental cost) charging. A fully unbundled leased line is charged 9,200 won per month and a shared-line ASDL service 6,100 won a month. See, Ure, J. 2003: Competition in the local loop: unbundling or unbungling? Info, 5(5), pp. 38-46.

[36] MIC, Investment Opportunities in Broadband IT Korea, p. 16.

experience, can get free land leases, exemption for traffic increase taxes and exemptions or reductions of national and regional taxes. Research and Development programs and related investments can get low-interest loans, government matching funds and cash grants.

Hostile takeovers by foreign companies have been allowed since May 1998. Currently, there are no ceilings on foreign ownership of special and value-added telecommunication service providers. The ceiling on single-person ownership on facilities-based service providers has been abolished except as to Korea Telecom. Foreign aggregate ownership of facilities-based service provider is allowed up to 49%. Acquisition by a non-telecom company has also been allowed. There is no foreign ownership ceiling on IT equipment and software businesses.

Conclusion

This section will discuss the emerging challenges of the Korean broadband development, including ENUM and VoIP, digital rights management systems, spam & scam, and payment systems for fixed-wireless gateways. The section will also draw some policy suggestions and learnings from the Korean case. The section will be written after expert review and comments.

The present draft uses the structure proposed in the BREAD project for country cases. The section titles may be revised in the final version.