# HIGH TECH MADE BY NORTH KOREA: COMMUNICATION TECHNOLOGY IN THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA AND ITS IMPACT ON SOCIETY

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## Introduction

At Christmas 2003, the *Tagesspiegel*, a Berlin newspaper, reported that KCC Europe (www.kcc-europe.de), a company set up by a former bank manager, Jan Holtermann, would construct internet access for the Democratic People's Republic of Korea (DPRK). KCC stands for Korean Computer Centre. The director of the Korean company is the son of Kim Jong Il. Since Germany and other states do not allow the export of computer technology to North Korea, Holtermann installed the server in the embassy of the DPRK in Berlin, which is connected via satellite with Pyongyang. After three years of negotiations he had signed a contract with North Korean officials and had invested around one million euros in the network's infrastructure, although "he initially expects slim profit margins due to the limited number of users."[1]

In an interview, the entrepreneur pointed out that North Koreans, now computer specialists, would be able to offer their services cheaply to the world and because of the time difference would be able to work for German companies during the night.[2] He said: "The North Koreans are the Indians of tomorrow". All they had to learn was how to write computer programmes. He estimated that North Korea already has around 6,000 computer experts with an average age of 27. Holtermann explained that the web project would involve the use of filtering software similar to that employed in Chinese and Cuban networks. According to their internet site presentation, the KCC project includes:

- Planning of infrastructure and design to meet local requirements

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- Consultation and arrangements with German and international interest groups
- Building up of an internet connection from Germany to the DPRK via satellite
- Complete design of an ISP infrastructure
- Building up of an infrastructure in Germany and the DPRK
- Start of operations and control centre

However, use of the internet is restricted. Only a group of hand-picked people (the Communist elite) and state institutions, the leaders of the party, the military and the state office for tourism have access to PCs and mail. In spite of the internet café for foreigners in Pyongyang, which is connected via a line to China and used by a handful of tourists and diplomats, international organisations have to pay for an international call to Beijing to access the Worldwide Web (WWW). Holtermann told the German magazine *Der Stern* that in a charity performance for a kindergarten, the Nigerian embassy gained access free of charge to the web.

This paper focuses on the recent development of both the internet and the telecommunications system in the DPRK. By identifying and reviewing the reasons and trends involved in this process, it will analyse the political, economic and social consequences of the information revolution in one of the world's most isolated countries.

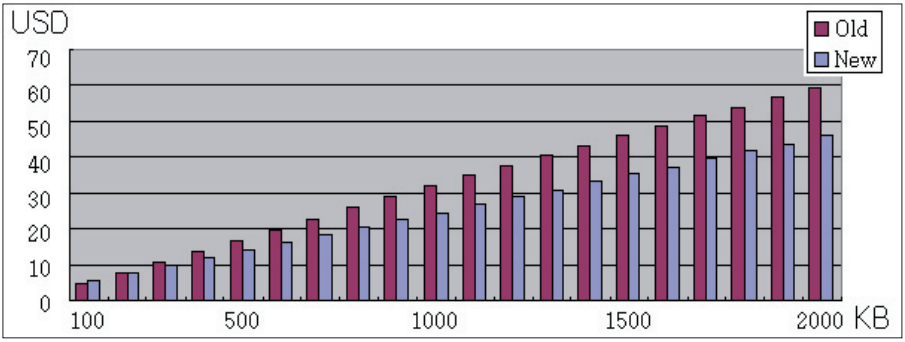
## Development of internet and email communication in the DPRK

Emailing is not really new; since October 2001 North Korea has been linked to an email server.[3] The Silibank company in the northern Chinese city of Shenyang offers an email server and provides an email relay service (once an hour) between the two servers in China and the North Korean capital by using a high-speed bandwidth (since 2003 it has replaced the conventional internet access lines in Shenyang with 10Mbps fibre-optic cables) and "guarantees the privacy of correspondence."[4] After registering with Silibank (which costs US $100, the estimated average income per month of a North Korean person) and stating their nationality, employer or business partner, customers can freely communicate with those who have email addresses at Silibank and a programme such as Outlook Express.

The following graph shows the comparison between former and current ways of evaluating prices. Silibank has decreased costs. For example, a user in 2001 paid US $52.20 for an email of 1.6 MB, but in 2004 only 36 euro (US $43.20).

To send an email from Seoul to Pyongyang today would require more than three days. A representative of Hanarp Telecom of South Korea[5] reported that they would send files via mail to Beijing. There they would be downloaded, burnt on CDs and

**Graph 1: Comparison between old and new methods of evaluation**




Source: http://www.silibank.com/silibank/english/emailprice.asp, accessed on 20 March 2004

sent by airmail to Pyongyang. Up to the present, North Korea does not accept business by mail. Moreover, South Koreans must be careful that they do not violate the ROK National Security Law. Permission it required to contact North Koreans. In August 2001 the public prosecutor arrested six South Koreans who had exchanged electronic letters with members of the DPRK administration.[6]

According to the Chinese Xinhua News Agency, North Korea has had an intranet since 2001[7] with the name *Kwangmyong* ('light'), in which around 1000 users from the party, the military, government and universities can communicate and do research in more than 30 million documents. Because of the large amount of data, it is believed that North Korean agents have already had access to the internet and have copied and transferred documents into the intranet. In this context, the domestically developed translation programme, the Electronic Multilingual Dictionary with seven languages—English, French, German, Chinese, Japanese, Russian and Korean—plays an important role.[8] Before Holtermann announced to the world his activity with the North Koreans in creating internet access, experts already believed that technically North Korea had gained access. *Chosun Ilbo* of 13 September 2001 claimed that "[t]he diagram [in the North Korean magazine *Science World* under the title 'Intranet'] indicates that North Korea, having completed a study on a fire wall, to a certain extent is preparing itself for access to the internet."

Although the national domain '.kp' is reserved for the DPRK, information and goods (from the Pyongyang Informatics Centre: www.pic-international.com) are distributed from Japan, China or Singapore. The official press agency Korean Central News Agency (KCNA) has its provider in Tokyo. In July 2003, KCNA reported that the country's Academy of Sciences had opened a website partly to "introduce local scientific and technological achievements to other countries". The report also included an address for the site, http://www.stic.ac.kp, although it is inaccessible at present.

The agency hinted that the site might be available from overseas. It is the first time a website address under the North Korean '.kp' domain has been scheduled to run.[9]

Since June 2004, the KCC has offered its homepage (http://www.kcckp.net/external_e/) at *Naenara*, which provides a platform for the DPRK's politics, tourism, foreign trade, arts, history and customs, for Korean reunification and for the information industry. After registration it is possible to read the daily *Pyongyang Times* in English or French as well as the monthly *Korea Today* in English, French, Spanish, Russian or Chinese.

## Computer technologies in the DPRK

North Korea has had a specialised software industry since 1986 and employs more than 200 engineers educated to university level at Kim Il Sung University, Kim Chaek University of Technology,[10] the University of Science and the Computer Technology College. In May 2003, KCNA reported that North Korea had started an education offensive in information technology by offering new classes in colleges. Competitions take place in writing software programmes. For example, the Tokyo correspondent for IDG News Service reported that children were studying computer programming at Mangyongdae Schoolchildren's Palace in Pyongyang and were sitting in front of modern desktop computers running either Windows 98, 2000 or XP operating systems.[11] One North Korean report revealed that out of 52 graduates of Hamhung University of Chemical Engineering, 20 had chosen an IT topic, as confirmation of the general efforts in IT development.

One result is the Pyongyang Informatics Centre (PIC). It distributes products from Singapore mainly to China and Japan. Promotion material in the internet[12] lists the development of general Korean electronic publication systems, 3D CAD, embedded Linux software, web applications, network servicing and development, karaoke editing systems, Korean desktop publishing, word processing, fonts, optical character recognition, translation, and Input Method Editor (IME) development, interactive programmes, accounting software and virtual reality software. Its advertisements say that "PIC promises to be a company to lead the IT industry by providing software with user-centred best quality and highest profit." In addition, the DPRK is looking forward to establishing international joint ventures. The only computer manufacturing enterprise in North Korea is the Taedonggang Computer Joint Operated Company. Together with the Chinese Panda Electronics Group, they set up a common project in 2002 to support the development of advanced technology.[13]

Such enhancement to build up an independent and competitive computer industry has economic reasons for the regime. North Korea argues that:

> Thanks to his [Kim Jong Il's] loving care many heroes of the times were produced from

> among the scientists and technicians in the period of the 'arduous march' and forced march [during the hunger crisis 1995–9] and more dependable youth scientists are being trained to occupy a high eminence of ultra-modern science and technology. The 21st century is a century of great national prosperity in which the Korean people will build a nation strong in science and technology by using the existing potentials to the maximum under the leadership of Kim Jong Il.[14]

One is reminded of East German attempts, when, before unification, the Communist regime developed micro-processors. But North Korean politics is very serious on this point: in April 2002, North Korean software managers presented their products in an exhibition of foreign chambers of commerce in Beijing (Comdex).[15]

Since December 2001, North Korea has been a member of the global commercial network SWIFT. Over 7,300 financial institutes in 194 states are members of this system, which allows B2B transactions.

## Telecommunications

Since May 2001, North Korea has been a member of the International Telecommunications Satellite Organisation (INTELSAT). This association offers commercial services such as internet, media broadcasting and information telecommunication around the world.[16]

As with development of the internet, telecommunications, especially the mobile phone sector, presents a challenge for the leap into the information century. Although, with the support of the United Nations, cities are supposed to be connected by conventional telephone cables, the DPRK might be installing a wireless communication system. The North Korean *Rodong Sinmun* (Labour Daily) reported in September 2003 that the North Korean government had started the construction of 40 different transmission/relay stations in large cities. The United States (US), however, according to a *Financial Times* article, is against the installation of a mobile phone system in the DPRK.[17] The US company Qualcomm holds certain patents of the desired Code Division Multiple Access (CDMA)-2000 technology and would need special export permission for the American standard in wireless voice and data communication, which enables many more people to share airwaves at the same time than other alternative technologies.[18] The first generation supports an average of 144 kbps packet data in a mobile environment, the second release will support rates up to 2Mbits per second, and the third generation higher peak rates, high-speed data and even simultaneous voice.[19] The strategy of the South Korean consortium (Korea Telecom, SK Telecom, Samsung Electronics and LG Electronics) is to launch this new technology in North Korea as in the South, in view of future reunification. US diplomats have refused this request, because they fear that North Korean soldiers could operate in the future with high-tech mobile phones. However,

in the special economic zone of Rajin-Sonbong, a joint venture of Loxley (Thailand), Teltech (Finland) and the Taiwanese Charungthai had already started in August 2002 to construct a Global System for Mobile Communication (GSM) network with relay towers to the northern city of Chongjin.[20] Full access to this technology might eventually lead to a blockade by the US administration. The second generation of GSM delivers full roaming capabilities across the world.[21] Like the internet, only primary leading officials would have the right to use mobile phones, and a cell phone moreover is quite expensive, therefore subscribers have numbered only around 3,000.[22] Hwang Chol Pung, president of the Korean Communications Company said: "From now on, we are going to upgrade equipment and to expand our equipment supply capacity so as to meet the growing demand. Then, it will be possible to lower the rate. We are going to farther spread communications networks and a plan is afoot to extend the cellular phone service to all the provincial seats of government and main highway."[23]

Despite progress in mobile phones communication, North Korea has announced restriction of the use of cell phones after the tremendous train accident at Ryongchon station in North Pyongan province in April 2004: "There were unconfirmed suggestions that a recent train explosion … could have been a bomb that was detonated by cell phone and the clamp down is due to this link."[24] And finally, on 25 May 2004, North Korean banned mobile phones completely.

## Cyberwar

The DPRK is not only a focus of the international community through the nuclear debate, but its computer industry also alarms the intelligence services. On 29 May 2001, as reported by *Chosun Ilbo*, the National Intelligence Service of the Republic of Korea (ROK) (www.nis.go.kr) gave warning of the new databank of the North Korean government (www.dprkorea.com):

> "If this site is deliberately conveyed to South Korean internet users, it will be in violation of the South Korean law … However, simply viewing this site, or reading the contents do not constitute a violation of the law," added the official. "In the case one is to sign up as a member of the DPRKorea Infobank, one must first register with the Ministry of Unification." In addition, "[i]f one sends e-mail to the webmaster of the DPRKorea Infobank or uses any of the information found in the website publicly, the party must first receive permission from the Ministry of Unification."

But it is not only propaganda from the *juche* regime that might affect the ROK, but also the activities of computer hackers. According to the South Korean military, the DPRK was educating 100 cyber-soldiers or hackers annually, who could start a cyber attack against the ROK.[25] "Graduates of the elite hacking program at Mirim

College are skilled in everything from writing computer viruses to penetrating network defenses and programming weapon guidance systems."[26] However, the US intelligence service has not confirmed this assumption about North Korean cyber-terrorism. Alexandre Mansourov, professor at the Pentagon's Asia-Pacific Center for Security Studies, discussing the accusation of "some US defense experts" that South Korea is "hyping the cyber threat posed by its northern neighbor, which they claim is incapable of seriously disrupting the US military", has said that "[t]he KPA [Korean People's Army] is still predominantly an analog and vacuum-tube force … We tend to overestimate the level of information-technology expertise in the North Korean military, and South Korea is especially guilty of this."[27]

Nevertheless, the ROK Ministry of National Defence has increased its efforts to protect one of the most wired nations in the world from any form of information warfare. The South Korean internet was attacked several times, since broadband penetration (more than 70 per cent) is very susceptible to any forms of viruses and worms. Simulation processes of the US Department of Defence have recognised the potential threat of North Korean cyber-terrorism.

> In a 1997 Pentagon war game called Eligible Receiver, National Security Agency computer specialists posed as North Korean hackers and reportedly were able to disrupt command-and-control elements of the US Pacific Command. The following year, Pentagon adviser and Rand consultant John Arquilla concocted a fictional scenario, published in Wired magazine, of a global cyberwar engineered by—whom else—the North Koreans.[28]

But this magazine also reported a further story in 1998. South Korean hackers blocked access for millions of internet users of GeoCities of California, because this server was managing the homepage of the Australian Association for the Study of the *Juche* Idea. Eventually, experts in international law discussed the consequences of cyberwar attacks in the virtual world, in which both political and military determinants have lost their geographical meanings.

## Internet, globalisation and democratisation

According to the report 'Censor Dot Gov: the internet and press freedom', issued by Freedom House, only 69 out of 186 states have a free press, 51 have part censorship and 66 extreme censorship.[29] Countries like Azerbaijan, Myanmar, China, Iraq, Iran, Saudi Arabia, Libya, Tunisia and the DPRK are especially accused because of the attempt by governments to restrict full access to the internet and to censure its content by the use of firewalls or filter programmes. In most cases, governments argue, censorship should protect society against immorality.

**Table 1: Press freedom in 186 countries, 2000**

| | By country | By population |
|---|---|---|
| Free | 69 (37%) | 1.253 (21%) |
| Partly free | 51 (27%) | 2.357 (39%) |
| Not free | 66 (36%) | 2.364 (40%) |
| | 186 (100%) | 5,974 (100%) |

**Changes in average ratings of 186 countries, 1995–1999**

1995=48.33 (*partly free)
1996=45.78 (*partly free)
1997=46.04 (*partly free)
1998=46.29 (*partly free)
1999=49.04 (*partly free)
2000=47.01 (*partly free)

*partly free=31 to 60 on a scale of 100 (lower is freer)

Source: http://www.freedomhouse.org/pfs2000/tables.html, accessed on 20 March 2004

The BBC, as reported in March 2004, described thus the situation of the media in the DPRK:

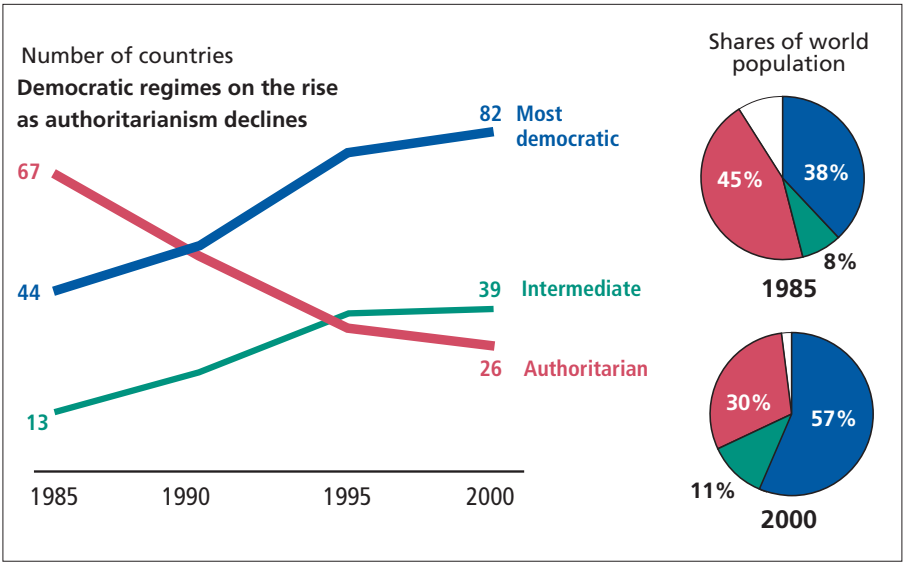
> Radio and TV sets in North Korea are pre-tuned to government stations that pump out a steady stream of propaganda. The state has been dubbed the world's worst violator of press freedom by the media rights body 'Reporters Without Frontiers'.
>
> Press outlets and broadcasters—all of them under direct state control—serve up a menu of flattering reports about Kim Jong-il and his daily agenda. North Korea's economic hardships or famines are not reported.
>
> However, after the historic Korean summit in Pyongyang, media outlets toned down their fierce denunciations of the Seoul government.
>
> Ordinary North Koreans caught listening to foreign broadcasts risk harsh punishments, such as forced labour. North Korea has a minimal presence on the internet. The web pages of North Korea's official news agency, KCNA, are hosted by the agency's bureau in Japan.[30]

In this context, we must ask what the impact of information technology might be on North Korean politics and economics, and probably on future Korean unification. In answering this question, it is necessary to look at other authoritarian regimes like Cuba or the People's Republic of China (PRC) and especially at the latter. This Communist country has some influence on the North Korean government and is considered even for the DPRK a model in which transformation processes in politics and the economy are possible for both integration into the international community

and the creation of a permanent new legitimacy by reforms that should have the effect of stabilising the regime (not of leading to a collapse as in the Soviet Union). The DPRK has started with economic reforms aimed at recovering its industrial production, which should stabilise the country.[31] Like the PRC, the DPRK has established special economic zones (SEZ) in Kaesong (industrial development) and Kumgangsan (tourism).[32] It has also attempted, so far unsuccessfully, to set up a special administrative region (SAR) in Sinuiju that would guarantee free economic capitalistic activities, rights to vote and work, freedom of the media (no censorship), freedom of association and religion, and industrial production with very low taxes. In accordance with the ROK's unification strategy—the 'sunshine policy', to prevent a regime collapse—Seoul supports the SEZ projects by investing and advertising for more foreign direct investment.

Since the launch of the internet, scientists have been asking whether it would support the democratic process around the world. And indeed, since the end of the East-West conflict we can point out that globalisation and accelerated processes in communication technology have promoted civil society and freedom of speech. Besides, the Human Development Report[33] of the United Nations has emphasised the victorious course of democratisation processes (even if it does not consider the role of the legal state):

**Graph 2: Democratic regimes in the world**




Source: http://hdr.undp.org/reports/global/2002/en/pdf/charts-graphs.pdf, accessed on 18 March 2004

In a study of the question 'Is the internet an instrument of global democratisation?', Kevin Hill and John Hughes come to the conclusion that:

> We find that newsgroups devoted to countries with lower levels of democratization have a much higher content of anti-government messages than the newsgroups about nations that are more democratic … The utopians that think the Internet will bring about a democratic revolution have reasons to be slightly optimistic. If the mere fact that political discourse against repressive governments is taking place is a good in itself, then the utopians have reason to celebrate. Perhaps the Internet *will* bring about a wider democratic revolution in the world. At least people *are* talking about politics and virtually protesting against lesser democratic governments on the Usenet.[34]

The internet might accordingly be considered as an instrument of global democratisation. In the PRC, it is comprehensively controlled. Firewalls block critical foreign newspapers or pornographic material. Software like Wangluo Shentang, a web detective developed by the Shanghai Rainsoft Company, scans the internet for subversive words. Moreover, for the past four years, a special police for "security control of the internet" observes internet chats, and each provider has the duty to keep its online protocol for at least one year so that subsequent investigation might be possible. As an eventual consequence, almost 40 cyber-dissidents are in prison.[35]

In China, there is a very popular website: www.sina.com.cn. The example of a special court case demonstrates how the internet has forced the consciousness of civil society and its participation in publicity via the internet:

> In the province of Harbin, a peasant couple was transporting leeks to the local market by tractor. A bundle of the vegetables touched the outside mirror of a BMW. The female driver and her sister jumped out of their car, beat up the couple, went back into their car and crushed the woman with their vehicle against a tree. She died immediately. Two months later a provincial court gave the driver a probation sentence, they agreed to pay the family around 8000 euros out of court and hoped to forget the case. However, this crime became well known through the internet. While newspapers did not report this case because of an order by the town's administration, witnesses used the internet to claim that this was not an accident as the police had stated, but was an intentional attack. The discovery of the story spread through the country and even newspapers like the *Beijing News* began reporting this story.[36]

Eighty million users in the PRC and more than 50,000 daily, especially young people, consider the internet as the first and most reliable source. The internet is thus a new, but informal, form of public plebiscite that is challenging the state's monopoly on information and may increase in the long term the likelihood for democratic regime change, because it provides numerous possibilities for the growth of civil society and for dissidents to organise and communicate. In this context, the growth of cell phone usage is important too. More than 300 million Chinese transmit around 7,000 short

messages per second, more than the rest of the world together. During the SARS virus crisis in 2003, Chinese mobile phone owners used their cell phones to inform their families, neighbours, colleagues, etc. Information about the disease spread like the virus itself. The mobile phone has become a new media form, especially because of the silence of the official media. Of course, the wide distribution of any new communication technology might support freedom of speech and democracy, as television did in East Germany, when citizens watched the daily news from Western Germany, reporting the first demonstrations which eventually led to the end of the socialist system.

However, the Chinese Communist Party is willing to restrict these possible trends. It has therefore forced providers to control the transmission of messages. Companies who do not agree with the new policies have had to pay harsh fines or lose their permits. Now, each message is filtered, and even numbers like 04 and 06 have been eliminated from the system. These numbers were able to give hints about the massacre on Tiananmen Square on 4 June 1989.[37]

Finally, the internet is, like other media, a perfect tool for political propaganda. While engineers are developing new software, they can be kept informed through new emails about the new achievements of the regime and the dear leader Kim Jong Il. As KCNA reported on 25 November 2003, "[t]he modernization and informationalization of the national economy are an important work to provide a material guarantee for the building of an ideologically strong nation. If the national economy is modernized and put on an IT basis, material means for ideological education will be replaced by modern and IT based equipment to bring about greater successes in the ideological education."

## The wireless future: What would a North Korean information society look like?

In order to present a scenario for the next 10 or 15 years, we must realise the contemporary situation of North Korea. Who are the actors: the Korean Worker's Party or the military? What are their objectives: system consolidation or integration into the international community? Which tools are they using: market reforms, or international blackmail with threatening scenarios and the use of the spectre or of rumours as a form of underestimating the potency of North Korea, of what is behind the curtain? Nevertheless, scenarios[38] are not predictions. They help us only to visualise different possibilities by taking into account inherently unpredictable events. In particular, scientific breakthrough could create sudden new possibilities, even though it usually takes many years for profound discoveries to achieve a widespread social effect. Hammond, in his book *Which World? Scenarios for the*

*21st Century* (1998), distinguishes three different worlds in the future: market world, fortress world and transformed world.

The 'market world' reflects a continuation of current patterns. Actually, it assumes that regions are integrating into the world economy and are boosting human wealth. Privatisation and deregulation would push this tendency. The 'fortress world' focuses on the potential of unattended social problems, increasing environmental challenges and a growing gap between rich and poor that might lead eventually to rising conflicts. On the other hand, the 'transformed world' is a very optimistic vision of the future. It assumes that human ingenuity and compassion can extend opportunity to all of humanity. Transferring these models to the DPRK, we could identify the following scenario of the market world as the realistic one in a brief form, because the latest developments in North Korea have shown that in the next few years we cannot expect either a dramatic regime collapse or a war (against the US/South Korea) in spite of the nuclear crisis. Nor would the transformed world be very likely because of the apparently real stability of the political regime.[39] In order to gain an overview of a possible perspective, this writer presents a very brief sketch in a prognostic report style such as Hammond employs to write his scenarios:

> The Goethe Institute, a German cultural institution operating worldwide, has opened its library in the Chollima House of Culture in Pyongyang under the joint operation of the DPRK-Germany Friendship Association and the Goethe Institute. Visitors may read German newspapers or political magazines, although North Korean newspapers are always censored. On the intranet, every North Korean may research German literature, even critical assessments. University students are likely to be reading the intranet very carefully and studying thousands of copied books about computer science. The technology research linked to universities and the Pyongyang Informatics Centre develops highly valuable software. The dear leader Kim Jong Il supports the education and formation of a thousand young engineers financially and ideologically. He knows clearly that the cheap but modern software, distributed from Singapore and Hong Kong is competitive not only on Asian markets but also in the world. With the co-operation of KCC in Germany, North Korea software developers create joint ventures with European companies. One huge achievement is the modernised Linux programme: a bestseller like Windows. Although the technology boom supports the regime of Kim Jong Il, North Korean citizens don't profit from it. The Communists pay only benefits like beautiful, fast cars and nice houses to the new state's elite in order to prevent any migration to China, which offers better salaries. Meanwhile each North Korean is under surveillance. Instead of roaring loudspeakers in the streets, giving orders to the people, now the virtual dear leader, present on a high-tech screen in each room, gives new instructions to the people throughout the 24 hours. At the same time a web-cam observes each corner of any building or street in the city. Any incorrect behaviour is reported to the police, but people like the virtual talk with their leader. However, US software companies urge their administration and the CIA to stop this threatening market competition. By hiring South Korean software experts, they are able very quickly to start a cyberwar against

North Korea. A virus crashes the security codes, blocks police access and broadcasts nationwide speeches of the virtual dear leader with manipulated, but convincing, messages to the people that have him saying: "now the United States are our friend, we are opening the borders, welcoming our Korean brothers and sisters in the South and starting with democracy."

## Conclusion: North Korea—the next Asian tiger?

From the author's point of view, the market world scenario would be very likely in the long term, because economic reforms generally lead to behavioural changes in politics. There cannot be any doubts; the greater the economic dependence on computer development, the greater the risk there appears to be of susceptibility of the regime to attack by foreign computer hackers or a virus. However, the British businessman Roger Barrett sees North Korea not as part of Bush's axis of evil, but as the next Asian tiger.[40] In pointing out the recent capitalist reforms, the planned industrial park at Kaesong, the country's educated working force, its abundant mineral resources and its expanding economic contacts with China and the ROK, he comes to this conclusion: "The North Koreans are so willing, and it's much easier to negotiate with the willing, rather than those who are already swamped with investment."[41]

According to Samsung Electronics, development of the internet in North Korea could have a future. Since 2000 the South Korean company has co-operated with the Korean Computer Centre, where engineers are developing software for search engines, media players or Linux programmes, even though productivity might be only 50 per cent of that of Russia or India. KCC's total investment in the development of computer software since 2000 under Samsung sponsorship has amounted to US$ 2.8 million. Animation technology is especially far advanced, although direct communication between North and South poses the biggest problem.[42]

In conclusion: North Korean computer and communication technology has a future, if it is cheap and competitive. The regime may use it for its own purposes in order to enhance propaganda. But the more the DPRK is linked to and integrated with the world, the more outside influence will challenge the stability of the regime.

## Notes

1. http://australianit.news.com.au/articles/0,7204,8277270%5e15318%5e%5enbv%5e15306,00.html, accessed on 20 March 2004.
2. No author noted: KCC Europe GmbH baut Internet-Zugang für Nordkorea, in: http://www.flexist.com/n-16773.html?flexist=b37c69eb965a01036a7786da2ab3ebf9, accessed on 18 March 2004.
3. *Guardian* (UK), 1 November 2001, 'First email link for North Korea'.

4. No author noted: 'North Korea launches "secure" email, in: http://news.zdnet.co.uk/0,39020330,39118217,00.htm, accessed on 10 March 2004.
5. http://futurezone.orf.at/futurezone.orf?read=detail&id=205952, accessed on 10 March 2004.
6. *Guardian*, 1 November 2001, 'First email link for North Korea'.
7. 'China report highlights in N. Korea's homegrown web', cited in Leonid Petrov, 'North Korea in cyberspace', 15 March 2002. See http://north-korea.narod.ru/dprk_internet.htm, accessed on 10 March 2004.
8. *Pyongyang Times*, 10 February 2001, in www.pic-international.com, accessed on 10 March 2004.
9. http://www.computerweekly.com/Article123734.htm, accessed on 13 March 2004.
10. This university has a co-operation agreement with Syracuse University in the US, whereby an exchange programme for researchers to study civilian information technology in the US has been running since 2001. The SU/KCUT project is the first partnership of its kind in which researchers from North Korean and US institutions have participated in ongoing collaboration and made extended visits to each other's campuses; a team from the US went to Pyongyang in June 2002, and KCUT delegations visited Syracuse in March 2002 and December 2002. The bilateral research collaboration, in the general area of integrated information technology, supports the development of civilian-sector IT infrastructure in the DPRK. See http://sunews.syr.edu/fullstory.asp?id=5060311, accessed on 20 March 2004. See also 'Bilateral research collaboration between Kim Chaek University of Technology (DPRK) and Syracuse University (USA) in the area of integrated information technology', at http://20030630-ASPAC-Kim-Chaek-Syracuse-rv.pdf, accessed: 20 March 2004.
11. http://archive.infoworld.com/articles/hn/xml/02/05/17/020517hndrpkorea.xml, accessed on 10 March 2004.
12. http://www.pic-international.com/main/main.htm, accessed on 10 March 2004.
13. http://www.phil-fak.uni-duesseldorf.de/ostasien/china/service/bbc/020616.txt, accessed on 10 March 2004.
14. KCNA, 28 October 2001.
15. *Der Spiegel*, 23 April 2002.
16. *Chosun Ilbo*, 30 May 2001.
17. See http://futurezone.orf.at/futurezone.orf?read=detail&id=126621&tmp=40673, accessed on 10 March 2004.
18. See http://www.cdg.org/technology/index.asp, accessed on 10 March 2004.
19. http://www.protocols.com/pbook/cdma2000.htm, accessed: 10 March 2004.
20. http://english.chosun.com/w21data/html/news/200301/200301150025.html, accessed on 10 March 2004.
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