1. Introduction

**Mitsuhiro Kagami, Masatsugu Tsuji
and Emanuele Giovannetti**

1. QUICK CHANGES IN 'IT'

Information technology (IT) has greatly changed our society and this change is indeed worth calling the 'third industrial revolution'. Basic trends can be observed in the IT revolution in terms of structural changes. That is (1) from telephony to the Internet; (2) from fixed to mobile telephone; and (3) from narrowband to broadband. In the near future, the next trend will be multimedia convergence, in other words (4) from TVs to personal computers (PCs) if TVs have the digital broadcasting function. Also, it has been pointed out that diffusion of the Internet depends on three factors: availability; accessibility; and affordability. Availability means the network's penetration into households. Accessibility focuses on providing access points such as public telephones and community Internet access sites. Affordability is measured in terms of price of connection.

Technological changes in IT have been quickly advancing beyond people's imagination. Demand for broadband access (digital subscriber line or DSL, asymmetric digital subscriber line or ADSL, and CATV) is intense and growing while lower technologies such as Integrated Services Digital Network (ISDN), have quickly become obsolete. The third generation mobile phone is now on sale and people can enjoy photos and moving pictures through these cellular phones. Wireless networks such as Bluetooth, home servers and wireless LAN make our lives more convenient as electronic home appliances can be connected to mobile phones. The convergence of broadcasting and the home computer is taking place and TVs will function as PCs when terrestrial digital broadcasting begins. Such possibilities, which only a decade ago seemed fantasy, are actually within our reach.

Under such circumstances, several fundamental factors should be grasped. First, IT-related infrastructure in both physical and software terms should be established. In the future optical fibre networks – especially fibre to the home or FTTH, which is the most convenient and speediest, but rather expensive – are expected to be deployed. Authentication and certification on the Internet is

another area of importance, not only for e-government but also for all kinds of e-businesses. Here, suitable systems such as digital signature and certificate authorities are necessary and safe encrypted data transfer by the public key method should be established. This is called public key infrastructure (PKI).

Second, connectivity issues should be addressed, especially affordability. The Internet route has become more complex reflecting worldwide competition and technical changes in routers and software. There are basically three layers: end-users; Internet service providers (ISPs); and major Internet backbone providers (IBPs). IBPs are usually global class telecommunications conglomerates. Message senders and final receivers on the Internet are identified but the intermediate routes upon which messages travel are not certain because messages are divided into several packets and sent to final receivers through different vacant routers and network interconnection points (or 'hops') so exact paths cannot be traced. Connectivity pricing (or wholesale prices) is thus difficult to determine. Therefore we have to clarify what rational prices are for Internet pricing. In addition, the possibility of collusive activities by oligopolistic backbone companies should be monitored and controlled.

Third, standards in IT have also become complex and fierce competition is going on in such fields as cellular phones, digital TVs, coding and decoding, and business models. Standards are closely related to intellectual property rights. However, open source software such as Linux and TRON¹ has gained popularity even for commercial use. Because technological changes are so quick, new standards swiftly replace existing standards. Therefore it is difficult to draw a clear line between market-induced standards and mandatory standards.

Fourth, the digital divide has been growing not only within advanced countries but also between developed and developing countries. Basically information networks use existing telephone lines such as DSL and ADSL and this basic infrastructure is lacking in developing countries. Thus, the gap between rich and poor countries is expanding, especially in the broadband era. For example, the diffusion of the Internet and broadband in Latin America is quite slow (Argentina is an exception in terms of possible broadband penetration due to its high CATV diffusion) as compared with East Asian countries. Chile, which has the highest Internet penetration (1155 per ten thousand inhabitants in 2000) in Latin America, is less diffused than Malaysia (1590), the sixth ranked in East Asia.

2. 'IT' RECESSION

The IT revolution has been overshadowed by the US economic downturn, especially after the dot.com bubble burst at the beginning of 2001. Rapid decreases in IT-related stock prices and venture capital brought about recession

in IT industries. This in turn resulted in further stock price declines. Indeed, people who speak ill of IT thought that the IT revolution was over.

There are several reasons why the IT recession came to the fore. First, excess capital and investment in this sector resulted in oversupply of IT-related equipment and inventories, while demand reached saturation point. PC and mobile phone use quickly spread to almost all necessary consumers and the market went flat. In a sense this sector, too, cannot be free from business cycles.

Second, stock prices relating to IT were excessively overvalued. After the IT enthusiasm was over, inflated prices had to shrink. The US economy itself had been on a buying spree reflecting the arrival of the 'new economy'. This monetary bubble led the IT sector to instant boom but equally its collapse brought the sector crashing down.

Third, the IT sector lacking a traditional foundation got itself into trouble since new business models sometimes lacked marketing and distribution infrastructure. For example, Amazon.com at first did not have its own distribution systems including distribution centres and warehouses. It had to establish its own infrastructure ('click or brick') and these investments were accompanied by chronic red tape.

Fourth, contents were not so attractive. Although kids can enjoy interactive games and the older generation take pleasure in digital high definition TVs, most ordinary working people cannot spare much time for IT-related entertainment and the poor of course cannot afford expensive IT equipment while at the same time most people remain skeptical of an insecure e-business environment.

Fifth, the terrorist atrocities in the US on 11 September and succeeding air strikes on Afghanistan threw a dark shadow over the world economy and froze consumer demand including for IT-related products.

However, the importance of the Internet as a communication and business tool has not diminished so the IT revolution continues. In particular, future utilization of broadband is a guide to the second IT boom.

3. BEYOND THE 'IT' RECESSION

Recent phenomena show signs that a new wave in IT business is coming. Current broadband accesses are: (a) CATV (cable modems), (b) DSL/ADSL, (c) FTTH, and (d) FWA (fixed wireless access). Speed for downloading is up to 20 Mbps for CATV, 8 Mbps for DSL, and around 100 Mbps for optical fibre access (FTTH). Due to the compression technologies of digital information, people can enjoy movies/videos and interactive games through broadband services. Since DSL/ADSL uses traditional telephone lines and prices for its

facilitation are not so expensive as other broadband accesses, DSL/ADSL users are increasing.

In Korea, the number of high speed Internet subscribers reached 7.04 million inhabitants in September 2001. The penetration ratio is almost 14 per cent, which is one of the world's highest ratios. Out of these, four million are ADSL subscribers and 2.4 million are CATV subscribers. In Japan, DSL/ADSL subscribers dramatically increased from 211 subscribers in March 2000 to 112 thousand in March 2001 and reached 1.20 million in November 2001, while CATV grew from 216 thousand in March 2000 to 1.15 million in September 2001. These figures show that broadband is widely accepted and that its deployment globally continues.

FTTH access is very expensive in terms of infrastructure investment. However, the realization of the information highway through FTTH is the most widely expected and the construction of its networks depends on government policy and private sector initiatives supported by users' demand. The diffusion of broadband can act as a kind of ignition switch against the present IT downturn. Furthermore, quality contents should be devised and increased to enhance broadband services.

4. FRAMEWORK OF THE BOOK

This volume consists of two parts: Part I, 'Country/area studies'; and Part II, 'Challenging issues'. Part I surveys country/area situations which cover Asia (India, Japan, South Korea and Thailand), Europe (EU and Eastern Europe, especially Estonia), the Americas (USA and Latin America, especially Argentina and Mexico), and South Africa. Part II deals with contemporary issues such as standardization, convergence between TVs and PCs, IT uses in newspapers, PKI, and upstream Internet pricing. Finally, policy implications, particularly for developing countries, will be drawn from these analyses.

Chapter 2 titled 'Beyond the IT revolution: the Japanese broadband strategy' by M. Tsuji focuses on the characteristics and issues of the Japanese broadband strategy, and analyses how the second IT revolution in Japan can be promoted through broadband services as an engine of growth. He explains the current situation of broadband infrastructures in Japan such as FTTH, DSL, ADSL, CATV, and FWA. Also, government policies such as the National Broadband Network Initiative of 2001 are introduced. He clarifies the fact that the recent increase in CATV and DSL subscribers has been triggered by a 'technology-push' and 'cost-push' but consumers are not necessarily satisfied with the existing contents. Without introducing 'killer contents', competition between broadband and existing e-commerce will end up with a zero-sum game, meaning that broadband will only replace e-commerce. Further development of

broadband requires a 'demand-pull'. He concludes that a wide variety of broadband uses and new applications such as 'telecare' and e-education can overcome the so-called IT recession and enrich our immediate future life.

E. Giovannetti in 'Internet upstream connectivity and competition policy: Western Europe and South Africa' in Chapter 3 analyses wholesale prices of Internet connectivity. Internet connection has three tiers: final users, ISPs (Internet Service Providers), and IBPs (Internet Backbone Providers). Price structure is divided into two: retail prices which users pay for ISPs and telephone companies (prices for the 'last mile'), and wholesale prices which ISPs pay for IBPs (sometimes called 'upstream' connectivity prices). He points out that while a rich and varied economic debate has developed on the issues of liberalization of the telecom market in terms of cost structure and pricing, little has been done on the less known side of the Internet: the upstream connectivity offered by IBPs. The main problem is the elusive nature of the commodity traded, wholesale transmission of information packets along routes which are often recalculated at each step of the transmission process. Even a single e-mail message is decomposed into many sub-messages (packets) which may, or may not, reach the final destination traveling across different routes and networks and while some of the networks crossed are for a fee others are free. Thus, he emphasizes that we need measures to monitor and clarify the paths that data packets take through the Internet, recording all the 'hops' (routers) along the way. He discusses antitrust issues for multinational telecom companies or IBPs through mergers and acquisitions. He also illustrates the relevance of cyber-geography or Internet connectivity maps of Europe as well as South Africa.

In Chapter 4, 'IT policies and issues: US and the Americas' A. Whinston shows that US Internet users are expanding and connection speed is upgrading. For example, the US Internet penetration rate is 58.1 per cent, second to only Sweden (61.8 per cent) according to Nielsen Net Ratings and broadband users reached 12 million at the end of 2000. Such expansion is backed by the Telecommunications Act of 1996 which promoted and liberalized the following major fields: (1) relaxation of FCC (Federal Communications Commission) regulatory intervention; (2) a more favourable environment for mergers/acquisitions across the telecommunications sector; (3) expanding competition to achieve lowered price and better service; (4) promotion of new technologies and businesses; (5) promotion of the convergence and integration among telephony, cable and computer industries; and (6) minimizing state regulatory powers. He argues that despite such strengths, however, the 'digital divide' still plagues many groups of the US population, mainly those with low income and low education levels. Especially, inner city neighborhoods have the lowest Internet penetration rates. He points out that low Internet penetration rates for Latin American countries are mainly due to the following three factors: first, inadequate infra-

structures such as electricity, telephone connections, and postal services for e-business; second, the low level of income along with the associated problem of uneven income distribution; and third, a significant number of Internet users connect to the Internet from various locations (away-from-home Internet access such as work places, libraries, schools and Internet cafés).

In 'Software in India: development implications of globalization and the international division of labour' in Chapter 5, P. Kattuman and A. Bhat-tacharjee demonstrate the possibility of 'leapfrogging' developments through knowledge intensive industries such as software in India. They carry out a firm-level survey of the software industry and explore differences and similarities between foreign firms and domestic firms (with and without foreign subsidiaries) in terms of their inputs and strategies (as regards markets, specialization and application areas), and their resultant output variables. The international location tendency, the learning process and evidence of a move up the value chain by Indian software firms show that domestic firms have a route available to them to overcome the difficulties of growth and join the high value club by leveraging their relationships with foreign high value end firms. They argue that one advantage of software as a sector is its absence of backward linkages, making it possible to maintain the software industry as 'an island of competitiveness' notwithstanding the rest of the economy. It means that once the sector has developed, it could contribute substantially to domestic development in the more general sense. Therefore, they conclude that the software sector offers a pathway to development for middle group countries such as India in which the preconditions exist in the form of substantial investment in education.

In Chapter 6 Y. Ueki explores broadband diffusion and the e-commerce situation in Korea 'Jumping up to the Internet-based society: lessons from Korea'. He describes the fact that the number of Internet users reached 24.4 million in December 2001. The number of high speed Internet subscribers was 7.8 million in December 2001, and among them 4.5 million were subscribing to ADSL and 2.7 million to cable modem. Moreover, it is said that there were more than 25 000 'PC-bangs' (Internet cafés) in 2001 in Korea where the youth enjoy interactive games and Web surfing. He analyses the reasons why this rapid expansion takes place, identifying the following factors: (1) strong government support toward IT-based society (deregulation of the telecommunications sector, infrastructure building, guiding with national plans and projects, and human resource development in terms of Internet literacy); (2) collective housing, especially, in urban areas, coupled with an eagerness for education; (3) people's homogeneous mentality and a sense of alienation in the case of differences. He also indicates negative side effects of the IT society such as high tech crimes and distortions in daily life and culture.

C. Mephokee explains the Thai case in 'Information technology: some implications for Thailand' in Chapter 7. He states that Thailand plays the role of the IT consumer as well as producer. The Internet penetration rate was around 6 per cent in Thailand in 2001. This low penetration rate comes from three factors: first, high prices due to monopoly of the state enterprise (Communication Authority of Thailand); second, the lack of qualified IT personnel; and third, the language barrier (English). On the other hand, Thailand plays a role in the production and export of IT-related products (HDDs, PCBs, ICs, keyboards, printers, and monitors). Computers and computer parts and ICs have become the two most important exporting items in Thailand, accounting for about 18 per cent of total exports. In order to reduce the 'digital divide' and create a literate IT society, he recommends the government liberalize the telecommunications market to allow more competition from new entrants, domestic and foreign. He points out that market liberalization has been included in the Telecommunications Master Plan 1997–2006; however, it has not shown any progress yet. He also recommends promoting human resource development throughout the country. This includes formal education from elementary schools to colleges and informal education for workers and people of all ages, under the slogan 'IT for all'.

Chapter 8, 'Information policy and information technology in Central and Eastern Europe with emphasis on Estonia', written by T. McDaniel, discusses various IT policies and programmes relating to Central and Eastern Europe (CEE). In most cases, data are provided on the following ten countries: Albania, Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Poland, Romania, and Slovenia. In these regions, IT-related changes are also quite rapid. Monopoly concessions in the telecommunications sector that have helped to keep the price of local phone service from falling are ending. The monopoly agreements granted to the dominant telecommunications operators in the Czech Republic, Estonia and Slovenia ended on 31 December 2000. In the remaining seven countries the agreements were scheduled to end in 2002 and 2003. Combined with the existing policies of liberalization in wireless technologies and in Internet service provision, liberalization of local voice telephony could help to provide more depth to the IT sector (for example by making existing connections faster). Achieving greater network range requires forward-looking policies involving both the public and private sectors. Many CEE countries have national policies for expanding and enhancing IT use; these policies often begin with the liberalization of national telecommunication companies and plans for bringing government itself into the information age. Policies for educational and rural communities have also been adopted, and the use of 'telecentres' has helped to make these national policies feasible. The author emphasizes Estonia because it has adopted an aggressive national programme for IT expansion, has the highest per capita Internet use in the region, and has an innovative financial

sector with most banking transactions already occurring online. The use of 'telecentres' has helped to provide greater access to school networks and rural communities (programmes called 'Village Road' and 'Tiger Leap' in Estonia). In this context, Hungary has its own programme called Telecottages. She concludes that the needs of countries that have already embarked on extensive liberalization and IT development programmes (most of the countries in this chapter) are very different from countries that are not only developing their infrastructure but are also rebuilding their infrastructure after periods of sustained civil and international conflict. Albania, Bulgaria and the countries of South East Europe may find it more beneficial to altogether leapfrog conventional PSTN (Public Switched Telephone Networks) and find outside investment for increasing wireless and satellite technologies.

A. Whinston and S.Y. Choi in 'Internet and telecommunications outlook in Latin America' in Chapter 9 focus on the current status of telecommunications markets, Internet access and e-business in Latin America, and investigate pricing, telecommunications policies and technological factors that affect current and future growth rates in Internet penetration. Most countries in Latin America during the 1990s opened up their telecommunications markets, privatized government-owned monopolies, and liberalized regulatory policies relying more on market forces than decrees. Such reforms coincided with the introduction of the Internet and the World Wide Web, offering them an opportunity to participate in the new information age as a full-fledged member. Still, Latin America as a region lags far behind North America, Europe and Asia-Pacific in terms of Internet penetration. Latin America in general needs better telecommunications infrastructure such as traditional telephone networks, advanced telecommunications networks, Internet backbone, interconnection points and access points. They argue that in most of these measures, Latin America is ill equipped to sustain future growth. Another limitation in the region is the lack of interconnection between major network access points within the region. Most international traffic is routed to and from US network access points adding considerable costs to the users. Policies to expand access to telephone service and the Internet can be evaluated by three broad measures: availability, accessibility and affordability. In these three factors the region is left behind. It is, however, worth mentioning that Argentina is best poised for broadband expansion due to its high cable penetration rate (more than 50 per cent). Finally, the low level of income is a critical factor that overshadows any future development in Latin America. Simple privatization, which is often made ineffective by monopolized private companies, may not bring about substantial gains that enable the majority of their population to participate in the digital revolution. Latin American countries, thus, must focus on providing Internet access through schools, work places and other public access sites such as telecentres.

S. Choi analyses the cases of Mexico and Argentina in 'Policies for Internet access: cases of Mexico and Argentina' in Chapter 10. Both Argentina and Mexico have a 10 per cent or lower rate of Internet penetration while some Asian countries such as Hong Kong, Korea, Taiwan, and Singapore surpass the 50 per cent rate. According to Choi, this disparity is due to the inadequacy in basic telecommunications infrastructure, high costs for telephone/Internet access, limited network service options, and uneven income distribution. Nevertheless, several policy initiatives were put in place during the last ten years, mainly the privatization of state-owned telephone monopolies and the introduction of a competitive, open telecommunications policy framework. As a result, substantial progress has been reported in terms of telephone and network availability. Mexico represents in many ways a typical case of Latin American political, economic and regulatory environment where a large privatized company, Telmex, dominates the telecommunications industry. Argentina, offering a more pro-competitive market, has instituted several innovative strategies, such as a special area code for Internet dial-up access (dial 0610) with discount pricing and community technological centres. However, fears remain that past rapid growth in telecommunications services and the Internet may have affected mostly the unfulfilled demand by upper and middle income households, given the economic problems and income distribution in Latin America. There is a significant skepticism about a sustained penetration beyond these segments in the future.

M. Kagami in 'Tipping, standardization and convergence: catch-up and failure in Japan's standards strategy' in Chapter 11, Part II highlights the importance of standardization. Technical standards have principally three categories: *de facto* standards; forum standards; and *de jure* standards. *De facto* standards are the result of competition. Markets decide the popularity of products. A slight change in the function or character of a product's features may produce a change in consumer response to the said product and result in falling sales and a loss of market dominance. This is called 'tipping'. A famous example is the VHS vs. Betamax rivalry for the home videotape market. Tipping is, in consequence, related to *de facto* standards. Group efforts of manufacturers bring about forum standards which can avoid losses and risks which come from severe competition through a *de facto* standards war. *De jure* standards come from public or international organizations to regulate and harmonize technical specifications from the point of view of public and/or international concerns. According to the author, Japan has not taken any initiative in the discussion of international *de jure* standards and, as a result, failed to set up some key standards such as the ISO 9000 series and ISO 14 000 series although Japan was recognized as a world leader in the above-mentioned topics relating to quality control and environmental management. He further explains the recent technological advancement on convergence of digital TVs and PCs where

standards of digitization are integrated in both technologies. Kagami claims that since Japan's technical levels and management skills are satisfactory as compared with those of other advanced countries, Japan should contribute more to international standards formations.

In Chapter 12, K. Shiraishi analyses the Japanese press in the age of the IT revolution in 'Is the Japanese press a dinosaur in the 21st century?: the IT revolution and newspapers in Japan', focusing on one of the leading national dailies, *The Yomiuri*, which the *Guinness Book of World Records* lists as the world's biggest commercial newspaper with 10.2 million printed copies every morning. In November 2000, *The Yomiuri* launched a new department called the News Distribution Centre to efficiently disseminate breaking news to the Internet, satellite broadcasting and cell phones. Japanese reporters and editors have begun to change their newspaper-deadlines-first policy and become more cooperative toward news distribution services for electronic and electric wave media. An opinion widely shared by Japanese newspaper publishers and editors is that the Internet would deliver a direct blow to advertising and editing, the lifeline of newspapers, and that if proper measures were not taken, newspapers would be driven out of the market within a few years. According to Shiraishi, however, there is another opinion: 'There are many people who believe that newspapers are dinosaurs. We believe exactly the opposite. We believe that newspapers can in fact evolve into a new form of media that blends the old familiar aspects of newspapers with the new technologies that are emerging. So that you have the ability to read, browse and scan, and at the same time being able to interact with the newspapers, to interact with advertisers through your newspapers in ways that are not possible through media today.' He concludes that like it or not, the Japanese press is moving in this direction.

The transaction basis has been shifting from face-to-face commerce to commerce via the Internet. How to ensure mutual trust between those involved in such transactions has become an important issue. One measure to cope with this is system solution enterprises aiming to offer a trusted communication technology platform. Some of the systems established so far are a Digital Signature (DS) as a means of verifying the true identity of another party, and a Certificate Authority (CA) to verify registration of the communication partner. These are both based on technologies of encrypted data transfer by the public key method. These are called Public Key Infrastructure (PKI). A. Maeda in 'PKI solutions for trusted e-commerce: survey of the de facto standard competition in PKI industries' in Chapter 13 analyses competition and strategies of major PKI vendors. There are four major companies offering authentication and certificate technologies: RSA Security Inc. (US), VeriSign Inc. (US), Entrust Inc. (Canada), and Baltimore Technologies plc. (Ireland). These four companies are fiercely competing with each other to establish de facto standards. Maeda explains their strategies for making inroads into Asian markets, except

China which tries to avoid Western standards as much as possible. He worries that these four will take over global electronic certification markets and argues that much wider perspectives are necessary for the public sector with respect to a trust system. The trust framework of each society is determined in accordance with the status of each society respectively. It is not a simple matter of business tools, but of complicated political as well as security issues that face society as a whole.

Chapter 14, titled 'The interconnection and pricing of the Internet' by T. Ida and M. Ueda, provides a model framework to analyse the industrial structure of the Internet. They emphasize pricing of the Internet analysing three main elements of network costs: (1) the cost of connecting to the network; (2) the cost of providing additional network capacity; and (3) the social cost of congestion. They especially focus on the vertical features and interconnection among end-users, ISPs and IBPs and build a 'components model' in order to consider the one-way model and the two-way model respectively. The one-way model of connection is the network structure where one company needs access to another but the reverse does not hold. One example is that some ISPs provide access services to end-users in a retail market and at the same time serve as IBPs that provide transit services to ISPs in a wholesale market, while other ISPs that do not serve as IBPs have to buy transit services from IBPs to provide final services to customers. The two-way model of connection demonstrates that customers calling each other belong to two different local networks and each carrier must buy termination access from the other network. One example is that IBPs have to interconnect at a point of interconnection so that end-users on each network can exchange information. They set up mathematical models and compare the social welfare between the one-way and two-way systems. This is only a first step trial and actual applications for policy-making in the network economy remain.

Lastly, the 'Conclusion' (Chapter 15) by the three editors follows, emphasizing three negative aspects and two positive aspects in the rapidly changing IT revolution, especially from the developing countries' point of view. The former include: (1) digital divide and universal service; (2) monopoly and hegemony; and (3) demand consideration, while the latter contain: (4) leapfrogging industrialization; and (5) broadband expansion.

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NOTE

1. TRON stands for The Real-time Operating system Nucleus, which was invented by Professor Ken Sakamura, University of Tokyo as open source OS languages (see, for example, Mitsuhiro Kagami (2003) 'IT Revolution and its Meaning to Society', in E. Giovannetti, M. Kagami and M. Tsuji (eds), *The Internet Revolution: A Global Perspective*, Cambridge University Press).