

Financial Technology Infrastructure for Hong Kong

Report by the Informal Working Group on
Financial Technology Infrastructure

December 1997
Hong Kong

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Preface and Acknowledgments

“The journey of a thousand miles begins with the first step”

This report is the product of many persons. With the encouragement of Joseph Yam, Chief Executive, Hong Kong Monetary Authority (HKMA), the support of Mr Rafael Hui, Secretary for Financial Services and the approval of Mr Donald Tsang, Financial Secretary, the Group was formed in December 1995 with an idea of understanding the next steps in the development of the financial infrastructure in Hong Kong.

As the study progressed, it became clear that the Group must understand the rapid development of technology on financial markets, especially the rise of the Internet and the growing emergence of electronic commerce and electronic payments. These are such rapidly evolving fields that the Study Group called upon experts from Bloomberg, Hitachi Research Institute, Hong Kong Securities Industry Group, Mastercard, Reuters, Sun Microsystems and SWIFT to brief the Group on latest developments in their fields. The Chairman and Secretary to the Working Group attended the Annual ACH Conferences and SIBOS Conferences to update themselves on latest thinking on the subjects and gathered perhaps one of the more comprehensive bibliography on an exploding literature.

The Chairman is indebted to present and former members of the Informal Working Group who all contributed to the intellectual conception, formulation and production of this report. Drafting of this report was undertaken by a team headed by the Chairman and included Dr Peter Hsueh, Head, Information Technology Division and Christina Lee, Carmen Chu and Dorcas Kee of the HKMA. Chapter 6 was the work of Paul Whitmore of Consultancy Associates Ltd. The eye-catching captions and layout were designed by our student helper, Clarence Leung. The impact of technology on the work of the Group was phenomenal. Research work was helped by rapid access to libraries and websites globally, so that the latest information can be obtained at a fraction of time. The final editing, printing and formatting of the report could not have been achieved without the virtual technology of simultaneous drafting and editing under Lotus Notes environment, ably provided by the HKMA Office Automation Unit.

The team would like to express particular gratitude to Paul Whitmore, David White, Rebecca Lai, Henry Chan, K.H. Lau, Raymond Li and Esmond Lee for providing constructive comments on the draft report. The sterling work of the two secretaries of the Group, Mr T.K. Ngai and Ms Christina Lee are gratefully acknowledged.

The Group is consciously aware that rapid developments in the field of technology and competitive action taken in Asia can make this report rapidly obsolete. The report has incorporated as much new information and analysis as possible. It is at best a brave attempt to take a (slightly blurred) snapshot of a fast moving scene. Any errors, omissions and lack of acknowledgement to many sources are regretted.

Andrew Sheng
Chairman
Informal Working Group on Financial Technology Infrastructure
December 1997

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Chapter 1

Executive Summary

Introduction

In the 1995/6 Budget, the Financial Secretary announced his Vision of Hong Kong as a Service Economy. Towards that end, he announced the establishment of a Task Force on Services Promotion, which has published a “Framework for Action” and 14 individual “Action Agendas”.

The Financial Secretary has also recognized that in order to take advantage of the special opportunities which rapid Asian and Chinese economic growth will bring, Hong Kong needs a world-class infrastructure. Hong Kong already possesses one of the most modern telecommunications infrastructures in the world. Hong Kong has one of the highest densities of optic fibre cabling in any modern city. The deregulation of the local fixed network services will bring in another \$32 billion of new investments over the next 10 years. The improvements in telecommunications has helped Hong Kong emerge as a world-class international financial centre. At the end of 1996, Hong Kong installed one of the most modern real time gross settlement high-value payment systems in the world. At the same time, Internet usage is rapidly gaining acceptance, with more than 90 Internet Service Providers serving more than 500,000 Web users in Hong Kong, one of the highest densities in Asia.

The provision of services to the community cannot be separated from technology. The growth of technology in recent years has been dazzling in speed and complexity. Technology has transformed the services landscape. New technology has helped create new services and new markets, but also threatens the competitive standing of established players. As wages and rents rise in Hong Kong, the maintenance of productivity growth can only come through technology. Payment system costs have been estimated at between 2-3% of GDP in OECD countries. Electronic payments costs are estimated at only one-third to half of paper-based transactions costs. Regulatory costs in the US alone are estimated at roughly 7% of GDP. Considerable savings can be achieved through straight-through processing (STP), by reducing regulatory burden and barriers to electronic commerce.

*“The nature of money—
who issues it, how it’s
used—is being
transformed and altered
by technology”*

*Walter Wriston, former
Chairman, Citibank*

The importance of technology and telecommunications is so vital to the development of any economy that the US initiated in 1992 the creation of a National Information Infrastructure (NII). The Japanese Government responded in 1993 with a “New Social Infrastructure” initiative that aims to install fibre optic cables to all homes and offices by 2010, costing nearly 53 trillion yen (HK\$3.2 trillion). Singapore, as early as 1992, published its IT2000 Report on “A Vision of an Intelligent Island”. Successes in such NII initiatives could have implications on Hong Kong’s future competitiveness.

The Financial Secretary has established an Informal Working Group on Financial Technology Infrastructure with the following Terms of Reference:

- a) To take stock of the current financial technology infrastructure in Hong Kong, and determine its capabilities and potential for development.
- b) To study trends in the evolution of the financial system in Hong Kong and overseas, particularly in relation to the emergence of new financial products and assess the likely demands that may be placed on and the quality expected of the financial infrastructure of Hong Kong.
- c) Having regard to the findings in (a) and (b), to identify areas in which Hong Kong’s financial infrastructure should be improved and develop a strategy for doing so, covering but not limited to the functions of information delivery, transaction, clearing, settlement and custody.
- d) To develop a Vision of Hong Kong as a Financial Technology Supercity for the 21st century.
- e) To make appropriate recommendations to the Financial Secretary’s Task Force on the Promotion of Services.

The Group has met 11 times and has invited numerous experts in the field of finance and technology to make presentations to the Group.

Unlike other Asian economies, Hong Kong has not yet formulated its NII strategy, though the technology infrastructure is already in place.

Chapter 1 summarizes the key findings and recommendations of the Group. Chapter 2 surveys the global National Information Infrastructure (NII) initiatives, especially those in the Asia region and their implications on Hong Kong’s competitiveness in the financial services area. Asian economies have generally fairly advanced planning in NII initiatives. Most of these envisage a fibre optic network that would form the backbone of a multi-media environment to facilitate the development of multi-media services for the economy, supporting government services to the public and improving knowledge-based industries that would enhance economic competitiveness. Whilst there are common objectives in promoting R&D in

computing, telecommunications and multimedia technology, developing common standards and legal framework, encouraging education and training, the NII is seen as an essential platform to fulfill national objectives. Unlike the other economies where NII is in place, Hong Kong has the telecommunications infrastructure in place, without so far the NII framework. The conditions for Hong Kong to achieve competitiveness through the implementation of electronic commerce and payments are therefore propitious.

Chapter 3 examines the nature of financial markets and areas where technology has helped to develop such markets. It considers also the risks involved. Financial markets facilitate the transfer of property rights. They rely on the availability of market information to make decisions. Once a stable policy and regulatory framework is in place, the efficiency of financial markets depends on the skills of its participants, breadth of product range and the speed and accuracy of its transactions processing. Every transaction involves a delivery leg and a payment leg. Financial markets therefore have a topography, whereby all financial transactions intersect at the payments level. In other words, financial markets involve either Delivery versus Payment, Payment versus Payment or Transfer versus Payment. The gaps or delays between delivery versus payment involve risks that markets try to solve through faster transactions processing.

The efficiency of markets depend on their liquidity and security of transactions, which in turn depend on the technology of financial transactions processing. Markets are also more liquid if the products and the processes, as well as the legal framework are standardized. Because markets are networks, their efficiency depend on their interconnectivity, interoperability and harmonization.

Chapter 4 looks at the impact of technology on financial markets. The convergence of telecommunications and computing capacity has revolutionised financial markets, improving the range of products, accelerating the speed of transactions, expanding the volume of business and widening the geographical and time span to a 24-hour global market. The rise of Internet and smart cards has brought electronic commerce to the retail level, reducing the intermediary function of traditional financial services, and giving rise to electronic money and cybercash. Thus, the whole nature of financial intermediation is beginning to change. Because electronic commerce and electronic payments depend critically on a sound information infrastructure and technology, building such a sound and efficient infrastructure would be critical to Hong Kong's long-term competitiveness.

Understanding the nature of financial markets helps us identify areas where technology can be used for reducing risk and promoting efficiency in these markets.

Chapter 5 surveys the rapid developments in electronic commerce and electronic money around the world, and attempts to draw conclusions from recent trends. With the emergence of Internet, electronic commerce (eCommerce), defined as business conducted through electronic networks, is rapidly gaining acceptance, as suppliers market products and services directly on the Web, bypassing middlemen. At the production level, companies and governments are improving internal productivity through the adoption of straight-through processing (STP), moving onto paperless electronic transactions and services. Electronic money (eMoney) comprises two broad groups: smart cards, which are substitutes for currency, and Internet-based systems, which are substitutes for cheques and are used for electronic payments. The main concerns of eMoney are the security and regulatory issues.

Major market initiatives have meant that eCommerce and eMoney are rapidly adopted in Hong Kong. Hong Kong has an excellent infrastructure for this trend to prevail, but there needs consideration in the areas of regulation, tax and computing.

Chapter 6 reports on the survey undertaken by the Working Group on the existing financial technology infrastructure in Hong Kong. The survey compared the technologies employed in existing systems, their future plans and comments on infrastructural issues.

Despite the lack of local technical skill, Hong Kong has the advantage of having an open technology infrastructure which can adopt new technology easily.

The conclusion is that, in general, most of the existing systems employ proprietary and dated technologies. They have limited interconnectivity, and their architecture does not make it easy to provide for interoperability. However, several respondents cited that they were planning infrastructural changes to facilitate the linking of systems.

The survey found that the vast majority of the current systems rely on imported innovations, skills and technology. There are three categories of financial service providers in Hong Kong, with heavy reliance on technology: sole providers, such as clearing houses and exchanges; overseas-based providers; and locally based providers. The sole providers do respond strategically to international trade practices and standards, such as the introduction of Real Time Gross Settlement. The overseas-based providers import technology developed in their head offices for implementation globally, e.g., credit card companies. Hong Kong benefits from such technology imports. Locally based institutions also tend to bring in products and services first developed overseas, for example smart cards.

The reliance on imported technology was not always the case. In the past, Hong Kong led the way in innovative products. It pre-dated UK with CHATS and ATMs were well established long before most other countries. EFTPOS has been around for 10 years, while electronic banking services have been established for a similar time. The survey suggests that there is a risk that, in the financial services sector, Hong Kong may have lost its momentum in innovation and its ability to take benefit from cutting edge technology.

Chapter 7 concludes that there are major trends in technology and regional initiatives that pose competitive issues for Hong Kong. Specific recommendations are listed in that chapter. For Hong Kong to maintain itself as a major international financial centre, it must have an efficient and robust financial infrastructure. With worldwide growth in electronic commerce and electronic payments developed and pushed by the private sector, Hong Kong must take advantage of its superb telecommunications infrastructure to adapt technology toward the provision of superior services. This means that the Government can have a role in facilitating the application of electronic commerce and electronic payments.

The Government is a major user of technology, the key provider of public services, the primary database of public information and the main regulator. As an international financial centre, Hong Kong must have open systems that comply with international standards and best practices. The laws must be changed to facilitate electronic commerce and payments. The Government can take the lead in facilitating eCommerce and ePayments by providing government services through a sound and efficient technological infrastructure, such as a robust financial network, called FinNet. The emphasis should be on open, user-friendly systems that enhance eCommerce & ePayments, facilitating if possible, Delivery versus Payment (DvP), Payment versus Payment (PvP) and Transfer versus Payment (TvP) and Straight-through Processing. In specific areas, such as licence applications, tax payments, trade and customs declarations, welfare payments, Mandatory Provident Fund record keeping, the Government can maximise technology to improve productivity, facilitating easy public access to service electronically. The development of sound technology infrastructure, including the interconnectivity, interoperability and uniform standards would ensure that Hong Kong stays in the cutting edge of global financial technology.

Strategic Vision: Hong Kong as a Virtual Economy and a Virtual International Financial Centre of excellence.

Chapter 2

Global National Information Infrastructure Initiatives

What is NII?

“Information infrastructure” conveys logical as well as physical infrastructure—not just telecommunications channels but a new kind of infrastructure that arises because computers enable information to be functional. In fact, digitised information creates its own infrastructure.”

Brian Kahin, Harvard University

We live in a knowledge-based economy. The OECD estimates that more than half of total GDP in OECD economies is now knowledge-based, covering telecommunications, computers, software, pharmaceuticals, education and media (OECD, 1996). The dramatic changes in information technology in these areas have highlighted in many countries the importance of formulating a vision of a **National Information Infrastructure (NII)**. Infrastructure is typically defined as the fixed investments that support society, such as telecommunications, power and transport.

Definition of NII:

- The national networks of interconnected, interoperable and telecommunication systems;
- Public and private investments in computers, PCs, televisions, fax machines and telephones;
- The databases, software, information services, such as digital libraries; and
- Skilled people who use and develop information and knowledge using the above systems.

Source: US NII Agenda for Action, 1993

The modern NII, sometimes popularly called the ‘information superhighway’, is an interconnection of computers and telecommunication networks, services and applications. The US Government General Accounting Office defines it as “a popular term for the emerging global broadband digital meta-network” (GAO 1995, p.72). Others define it as “the computerized networks, intelligent terminals, and accompanying applications and services people use to access, create, disseminate, and utilize digital information.” (Drake 1995a, p.5).

The NII can be viewed as three layers of functions:

- *Applications* are information technologies that can be used to establish tasks across a range of application areas.
- *Services* provide the building blocks for applications and provide the interfaces for displays, sensors, and other input/output devices.
- *Bitways*, or physical infrastructure, are the ‘data pipes’, the cable, fibre optics, and other means of transmission, plus controlling software to transmit data from one place to another.

Rapid advances in information technology applications are occurring in areas such as:

- Education and life-long learning
- Electronic commerce
- Finance
- Government services
- Health care
- Libraries
- Manufacturing

Such technological advances are changing the way we do business. Some economies see the NII as a strategic direction to achieve competitive advantage through the use of new information technology (IT). In 1992, Singapore was the first to articulate its IT 2000 Report: Vision of an Intelligent Island, with the objective to make Singapore “among the first countries in the world with an advanced nationwide information infrastructure. It will connect every home, office, school and factory.”

In 1993, US Vice President Al Gore initiated the American NII with a common objective: to ensure that the full potential benefit of advances in information and telecommunications technologies are realized for all its citizens. An Information Infrastructure Task Force (IITF) articulated the US Administration’s Agenda for Action, which identified nine specific principles and goals:

- i) Promoting private sector investment;
- ii) Extending the ‘Universal Service’ to ensure that information is available to all at affordable prices;
- iii) Promoting technological innovation and new applications;
- iv) Promoting seamless, interactive, user-driven operation;
- v) Ensuring information security and network reliability;

NII’s initiatives provide a network to enable the efficient management of information.

Governments have the key roles in delineating the policy and technology framework to develop on this.

- vi) Improving management of the radio frequency spectrum;
- vii) Protecting intellectual property rights;
- viii) Coordinating with other levels of government and with other nations;
- ix) Providing access to government information and improving government procurement.

The NII is a partnership between the government and private sector. The private sector builds, owns, and operates the NII. The US government would assist the private sector in developing an advanced NII.

In May 1995, the APEC economies proposed the creation of an **Asian-Pacific Information Infrastructure (APII)**, which would enable interconnectivity and interoperability amongst APEC members, promotion of technical cooperation, free circulation of information, and development of human resources and the policy/regulatory framework for the promotion of APII.

The GII is a network of networks interconnecting local, national, and regional networks. This helps create a global information marketplace through information sharing, interconnection, and communication.

In February 1995, the G-7 and EU members organized a Ministerial Conference on the Information Society. They agreed to collaborate on the following eight principles in order to realize their common vision of the *Global Information Society*:

- promoting dynamic competition;
- encouraging private investment;
- defining an adaptable regulatory framework;
- providing open access to networks while ensuring universal provision of and access to services;
- promoting equality of opportunity to the citizen;
- promoting diversity of content; including cultural and linguistic diversity;
- pursue adequate education and training;
- encouraging dialogue on worldwide cooperation, including the participation of the developing countries.

These principles will apply to the Global Information Society Infrastructure by means of:

- promotion of interconnectivity and interoperability;
- developing global markets for networks, services and applications;
- ensuring privacy and data security;
- protecting intellectual property rights;
- cooperating in R&D and in the development of new applications;
- monitoring of the social and societal implications of the information society.

By June 1995, the Halifax G-7 Summit endorsed the concept of a **Global Information Infrastructure (GII)**. To quote: “Governments around the globe have come to recognize that the telecommunications, information services, and information technology sectors are not only dynamic growth sectors themselves, but are also engines of development and economic growth throughout the economy.”

“By interconnecting local, national, regional, and global networks, the GII can increase economic growth, create jobs, and improve infrastructures. Taken as a whole, this worldwide ‘network of networks’ will create a global information marketplace, encouraging broad-based social discourse within and among all countries. By interconnecting local, national, regional, and global networks, the GII can increase economic growth, create jobs, and improve infrastructures.”

The GII will generate economic and social benefits to all participants, including job creation, economic growth, infrastructure improvements and less expensive customer services.

NII, Investments and Economic Growth

The OECD has estimated that OECD annual expenditure on IT hardware was US\$132 billion (HK\$1.0 trillion) in 1996. Worldwide software sales in 1996 was estimated at US\$108 billion (HK\$0.8 trillion), growing to US\$180 billion (HK\$1.4 trillion) by 2000 (Financial Times, 1996). The OECD also reported that OECD public telecommunication services generated sales of US\$395 billion (HK\$3.1 trillion) in 1992 or roughly 2% of GDP, while investments averaged 3% of gross domestic fixed investments. According to researcher International Data Corp., the United States is the leader in the global PC market with 37.5% of total worldwide sales, and Western Europe is second at 28.5%. While the United States accounts for only 15% of the world’s population, it accounts for 42% of global IT spending. Asia accounts for 56% of the world’s population, but only 24% of IT spending.

According to research specialist Dataquest, the Asia/Pacific IT market between 1995 to 2000 will grow from US\$6.4 billion (HK\$49 billion) to more than US\$22.2 billion (HK\$172 billion). Asian growth is estimated to be in excess of 28%—well above world growth of 16%, and 14% growth in the United States. The worldwide market for professional services is expected to be about US\$260 billion (HK\$2.0 trillion) by 2000.

The US NII is estimated to increase sales by US\$300 billion (HK\$2.3 trillion) annually for various industries, and would increase productivity by 20 to 40% by 2007. An expenditure of US\$50 to \$100 billion (HK\$390 to \$770 billion) is expected to upgrade telecommunications facilities for the NII. In Japan, the national

fibre optic network will cost US\$1 trillion (HK\$770 trillion) to build by 2010. In France, the cost of the nation-wide fibre network would cost between US\$30 to \$40 billion (HK\$230 to \$310 billion) by 2015.

In sum, NII initiatives are likely to generate large sums of new investments to promote growth through the availability of new services in the information/knowledge field.

Singapore's IT2000 Vision

IT 2000 Vision is to Transform Singapore into an Intelligent Island, where the use of information technology is pervasive in every aspect of its society-at-work, home and play.

In March 1992, the Singapore Government announced its vision of an Intelligent Island, as outlined in the IT2000 Plan, the framework of a national information infrastructure (NII). The Plan aims to promote the diffusion and adoption of information technology (IT) in Singapore, so as to lead the country to gain national competitive advantage and to sustain productivity of the economy towards the next century.

The IT2000 report set forth the vision that, within 15 years, Singapore will

“... be among the first countries in the world with an advanced nation-wide information infrastructure. It will interconnect computers in virtually every home, office, school, and factory. The computer will [by then] evolve into an information appliance, combining the functions of the telephone, computer, TV, and more. It will provide a wide range of communication modes and access to services. Text, sound, pictures, videos, documents, designs and other forms of media can be transferred and shared through this broadband information infrastructure made up of fibre optics reaching to all homes and offices, and a pervasive wireless network working in tandem ...”

The IT2000 Plan was compiled by the National Computer Board (NCB) which was first set up in 1981 to promote computerisation and IT industry development in a coordinated manner. To date, the NCB is conducting a series of government endorsed IT2000 projects with both private and public sectors to turn the vision into reality.

The vision identified five strategies for Singapore to leverage the nation-wide information infrastructure (NCB, 1992):

- Developing a global hub;
- Boosting the economic engine;
- Enhancing the potentials of individuals;
- Linking communities locally and globally;
- Improving the quality of life.

The IT2000 plan has two major focuses: the need to develop an integrated and advanced NII, and the need to promote content digitalisation and the development of multimedia content industries. Under the mastermind of the NCB, the IT2000 Plan is currently divided into eight industry applications clusters. They are: Construction, Digital Library, Education, Healthcare, Manufacturing and Distribution, New Media and Internet, Public Services, and Tourism and Leisure. Each sector shares the responsibility in promoting IT culture and manpower development, nurturing emerging IT industries, and deploying IT2000 'flagship' projects (See Box 1).

The NCB has allocated more than S\$200 million (HK\$1.1 billion) for IT2000. Singapore has achieved one of the highest levels of informatisation in Asia, with 36 PCs per 100 employees, and 58% of companies using LANs. Up to 10% of Singaporeans regularly use the Internet, with 100,000 accounts opened so far. The aim is to wire up 800,000 homes in Singapore. By August 1995, more than 158,000 km of fibre optic lines had been laid, covering over 80% of high rise buildings in Singapore. In 1996, Singapore has linked up all key on-line networks maintained by Internet providers, businesses and government to build a seamless pool of information and services. The Internetwork Hub or I-Hub, was built on the Internet backbone operated by Singapore's three service providers. Also recently announced (28 April 1997) was a S\$2 billion (HK\$11 billion) plan for acquiring computers in education.

Singapore ONE

A recent development in the IT2000 masterplan is the concept of Singapore ONE, which is a national high-capacity network platform that will deliver multimedia services to the workplace, the home and the school at two distinct levels - an infrastructure level of networks and switches, and a level of applications and multimedia services.

The infrastructure level will consist of a core broadband network connecting several local access networks. The core or backbone of Singapore ONE will be built, owned, and operated by an industry consortium. The local access networks will use various technologies such as the hybrid fibre coaxial cable and the Asymmetric Digital Subscriber Line (ADSL), provided by Singapore Telecom's and Singapore Cable vision's extensive local access networks.

Singapore ONE—"One network for everyone", creating an open broadband network for the Intelligent Island.

Box 1 Singapore's IT2000 projects

- **Accelerating the use of IT in Primary schools (AITP).** A pilot project was launched in 1995 by the NCB and the Ministry of Education to trial test the use of multimedia courseware and Internet in primary schools.
- **Singatouch.** A nation-wide public information kiosk system that enables the public to conduct a variety of transaction and information retrieval tasks on easy-to access information kiosks. The system has been released in 1996 to provide services of reservation and purchase of tickets for concerts and cinema, perform banking transactions, provide on-line tourist guide, perform government transactions and so on.
- **Construction and real estate network (CORENET).** The objective of CORENET is to re-engineer the business processes in the construction industry, through IT, to achieve a quantum leap in turnaround time, productivity and quality. The proposed network would provide a wide range of system services such as: plan checking concurrent design, electronic submission, information services, automatic quantities takeoff system, electronic inspection, and integrated project management system.
- **Student's-Teacher's Workbench (STW).** The aim of STW is to enhance teaching and learning processes in secondary schools by giving teachers and students access to a rich depository of multimedia courseware and contents.
- **Digital Museums/Library.** The project called 'Library 2000' aims to transform the traditional public library system into a network of multimedia information services.
- **Electronic road pricing (ERP) System.** The proposed ERP aims to replace the existing manual road pricing system by attaching a pre-paid cash card on all vehicles entering selected roads, where usage fares will be deducted automatically by the system.
- **Development of Broadband Network Testbed.** This national highspeed testbed allows potential NII application developers and users, whether from private or public sector, to collaborate in running a common testbed network for testing of new products and services.
- **Promotion of Singapore as a regional telecommunications and broadcasting hub.** The government is encouraging global MNCs to use Singapore as a regional telecommunications and broadcasting hub through a combination of investment incentives, liberalization policies and promise of sustained superiority in infrastructures. By 1993, Reuters, Telerate etc. use Singapore as their regional hub. Much of the region's satellite corporations are also headquartered in Singapore.

Several steps have been taken to encourage development of applications and services for the broadband network, with emphasis in four areas—government, home, education, and business.

Singapore ONE will broaden public services access to the people and make it more user-friendly to carry out government transactions, such as:

- multi-function kiosks for government transactions
- one-stop government centres with video conferencing facilities

While potential home applications include:

- high speed Internet
- entertainment on demand
- electronic shopping
- home banking
- electronic information services

Singapore ONE will enable the community to have easy access to multimedia training materials and open up new avenues for learning through:

- distance learning
- tele-students, with multi-party learning and tasking by students at different locations

Potential business applications using high speed multimedia network include:

- video conferencing
- multimedia information services for corporations
- telecommuting
- electronic commerce

Roll out plan

By 1998, Singapore ONE will be up and running as an operational pilot network. In the initial years, the government will be the anchor tenant, using the bandwidth to make government services available to the public. It is expected Singapore ONE will eventually be self-sustaining as a critical mass of applications and services developed on the network. There will be two overlapping phases.

Applications and services are essential to the success of Singapore ONE.

Phase 1 (1996-2001) will start with the selective deployment of a pilot core broadband network, comprising several broadband ATM switches via local access networks. The pilot will initially cover 300 homes, with an extension to over 5,000 homes later. By 1997, the following services will be piloted:

- Home access to schools' curriculum
- Home access to the digital library
- Home access to high speed Internet
- Commercial services for homes
- Virtual government services in various public sites

Phase 2 will roll out during 1999 to 2004, involving an expansion of the network, with growing applications and connections.

Singapore ONE is spearheaded by three government agencies—the National Computer Board (NCB), National Science and Technology Board (NSTB) and Telecommunication Authority of Singapore (TAS).

- TAS will drive infrastructure development and facilitate the realisation of a cost-effective and affordable broadband network platform.
- The NCB will spearhead application development with active participation from the IT industry and user-sponsors in various government ministries.
- The NSTB will fund companies and research institutes such as the Institute of Systems Science and the Information Technology Institute. The R&D work will produce the technology for advanced multimedia applications and create new products and services for delivery on Singapore ONE.

The development of Singapore ONE calls for the right mix of ideas, and the expertise to transform them into applications and services.

Because Singapore ONE will utilize path-breaking technology, much of it will be imported, but others will have to be developed domestically.

Singapore ONE requires a partnership between the Singapore Government and the private sector to develop. Currently, 14 multinationals have taken stakes in Singapore ONE, with total investments exceeding \$100 million (HK\$550 million) over the next two years.

The Pioneer Club of Content, Service and Technology providers in Singapore One is open to all companies who can commit to launch a commercial service or application by 30 June 1998. These new members will receive a host of incentives,

including preferential tariffs for broadband connectivity, support under the Innovation Development Scheme, additional tax incentives like the Pioneer Service Status, Investment Allowance and Double Deduction, and joint publicity and promotion programmes.

Malaysia

On 6 May 1996, Prime Minister Dr. Mahathir Mohamad launched the Seventh Plan 1996-2000, which seeks to propel Malaysia into the 21st century. The Plan stresses strategies for generating sustained rapid economic growth and ensuring that the benefits of economic growth are equitably shared among all Malaysians.

Under the Plan, intensified efforts are expected to expand and upgrade telecommunications infrastructure and skills—the prerequisites for the development of IT. In late 1996, Dr. Mahathir Mohamad announced plans for creation of the **Multimedia Super Corridor (MSC)**. The 15km by 40km Corridor will be constructed, stretching from the **Kuala Lumpur City Centre (KLCC)** in the north through to Putrajaya, the federal government's new administration centre, to the new **Kuala Lumpur International Airport (KLIA)** in Sepang in the south. The cost of MSC will be about US\$2 billion (HK\$15 billion), served by a 2.5 to 10 gigabyte, fully digital fibre optic network that will directly link MSC with Asia, US and Europe.

A multi-media development corporation would be set up to oversee the world's first MSC. The corporation will have governmental powers but will run like a private corporation to ensure the best environment for harnessing multimedia services. Incentives would be incorporated into legislation to safeguard investors in the capital-intensive industry. The National Information Technology Council, chaired by the Prime Minister himself, will monitor closely the growth of the corridor and ensure its role as the global facilitator of the information age.

Investors in Malaysia's budding multimedia industry will benefit from first-in-line advantages, access to a growing market for multi-media products and services internally as well as globally, and resources to tap the regional niche markets for language-based IT products for the large Chinese, Indian and Malay markets.

The MSC kicks off with eight flagship applications which enable the implementation of an electronic, or paperless government; telemedicine; remote

The Multimedia Super Corridor project has three pronged strategies:

- *building and developing the physical infrastructure;*
 - *the creation and development of systems of IT-based applications that are demand driven;*
 - *the human development effort involving all education and training systems from primary to tertiary and continuing education systems.*
-

manufacturing coordination and engineering support hub; borderless marketing; multimedia financial haven; and the world's first multimedia smart card.

For example, the electronic governance and public administration applications being developed for Putrajaya will act as models for adoption by other government agencies, as well as for export to other developing countries.

The new KLIA will act as the vehicle for the development of IT applications for airport management services. While the KLCC is designed to create a viable commercial enclave in Kuala Lumpur, it will be a self-contained, city-within-a-city. Infrastructure will emphasize on accessibility and efficient transportation, with KLCC being served by the light rail transit, roadways and other proposed inter-city transportation systems. It will have the latest in telecommunications and be linked directly to the country's first telecommunication satellite, MEASAT 1.

The Malaysian government will offer tax exemption of 5-10 years for foreign investors in the MSC, with minimal employment restrictions for expatriates and skilled manpower. Intellectual property rights will be enforced, and with lower operating costs in Malaysia, easy accessibility to international airport and the capital, MSC is expected to do well.

Korea

The Korea's blueprint for an information society intends to create an electronic society which benefits citizens and commerce.

The Korean government recognizes the strategic importance of establishing an information superhighway network both to serve as a core element of the country's infrastructure in the new information society, and to serve as the basis for strengthening national competitiveness. This recognition is reflected by a series of public policy statements by the Korean Ministry of Information and Communications (MIC). The creation of Korea's information superhighway will represent the implementation of a 21 year blueprint for an information system intended to permit the whole nation to work and play electronically.

The main objectives of the Korean NII are:

- to promote informatisation in the country and bring information superhighway business to full-scale;
- to build information industry strategically;
- to fix a viable competition system in the information industry;
- to support industries concerned with broadcasting;

- to improve quality of postal services;
- to heighten information technology;
- to strengthen international cooperation; and
- to establish good usage and promote convenience of users.

Korea's officially-sponsored **Information Superhighway Project** will cost over HK\$400 billion. Of the 45.2 trillion Won budget (about HK\$430 billion) assigned to the New Korea Net project, the government will invest about 1.8 trillion Won (roughly HK\$17 billion), with the remaining 43.4 trillion Won (HK\$417 billion) coming from the private sector. The Project is chaired by the Prime Minister and an inter-ministerial Korea Information Infrastructure Task Force (KIITF) was established in August 1995 to supervise the project. The Project will interconnect public administration offices, universities, research institutions, and companies through fibre optic cables, and transmit and exchange multi-media information at speeds in the Gbps range. In the first stage of the project, which runs through 1997, 80 major cities across the nation will be linked by fibre optic cables, carrying information at the speed of 155-622 Mbps.

The second stage of the project aims at the provision of a nation-wide remote medical service, a remote learning service, an electronic library service, and a geographic information system (GIS) service. An ATM network, with a capacity of 2.5 Gbps, will be established by the end of 1997. By the year 2015, the electronic superhighway will have been completed, with a capacity of 10 Gbps.

Components of the Project include:

- Establishment of a New Korea Net Project. About 100 large-scale buildings in Seoul and Pusan will be connected with fibre optic cables by the end of 1996. Under a Korea Telecom (KT) plan, fibre optic cables will replace the conventional phone wires in all buildings with more than 300 circuits by 1999. Ordinary households will be linked by fibre optic cables by 2015. Average telephone transmission speed will increase by a factor of 700 to 45 Mbps. New media services such as wireless PC communications, VOD (video on demand), home shopping, E-library, E-newspaper, videotext, video-conferencing, and telecommuting will be widespread by around 2015;
- As a demonstration model, a model fibre optic city will be built in the Daedok Science Town, in Taejon and in Yoido (in Seoul). The government has also constructed an ultra high-speed communications line linking the nation's 12 major cities in 1996.

Fibre-optic cables, penetrating high-speed, high-quality, multimedia communications, will continually replace conventional coaxial and copper telephone lines.

“The superhighway is aimed at sharply improving the quality of life for ordinary people and fostering the nation’s telecommunications industry.”

Korean President Lee

- 26 public service applications include:
 - Pictures of missing children and runaways distributed to the public by the police;
 - Environmental pollution monitoring system on rivers;
 - Emergency medical service through computerized distribution and management of blood supply;
 - Integration of the residence I.D. certificate, driver’s license and medical insurance card into one smart card;
 - Promotion of teleworking to reduce commuting costs; and
 - Launch of the Koreasat, or Mugunghwa Satellite, to facilitate DBS (direct broadcasting satellite) service.

Korea plans to invest heavily in the development of software for the information superhighway network’s application services and technologies. It has selected a high-speed multimedia modem and 24 other types of telecom equipment. The 25 strategic items include a high-powered CDMA cellular bidirectional amplifier, a wireless closed circuit (CC) TV, a portable GPS (global positioning system), a touch screen, a wireless in-house communications system, a high-speed actuator, a satellite broadcasting receiver tuner, a high-speed optical pick-up system, a voltage controlled oscillator (VCO), an on-line lottery terminal, a high-frequency chip IC filter and a MPEG-2 encoding system.

In addition, the government has also established a special prize called the New Software Commodity Grand Prize, which is awarded monthly, to encourage small- and medium-size software companies.

Taiwan

As a major producer of PCs, Taiwan has an advanced programme in NII. As early as 1980, the Taiwan authorities realized that IT was an enabling technology and decided to incorporate IT development as part of the overall economic growth policy. Under the Science and Technology Programme initiated by the Council for Economic Planning and Development, a Science and Advisory Group was formed, together with an Institute for Information Industry (III) to promote effective use of IT and to strengthen the competitiveness of Taiwan’s information industry.

A draft “Information Industry 10-Year Development Plan” was completed in 1981 and enacted by the Executive Council (Yuan) in early 1982 with the key objectives:

- To migrate labour-intensive industries to knowledge- and technology-intensive industries.
- To strengthen competitive advantage through effective exploitation of IT by the public and private sectors.

In August 1994, the Executive Council established a NII Steering Committee to formulate and coordinate plans for the promotion and implementation of the NII in Taiwan. The NII vision includes the following:

- Taiwan will have one of the most advanced national information infrastructure that connects all computers and information devices in homes, businesses, schools and factories.
- The NII will allow Taiwan to play an active role internationally through the Asia-Pacific regional operations centre where a vibrant information economy can emerge.
- The NII will be an important component of Taiwan’s investment and opportunities in the information economy. The integration of computers and telecommunications into manufacturing processes makes the economy more productive and competitive. New technologies like real-time internetworking, multimedia data digitisation and transmission, and mass storage will also drive the development of new products for the global market.
- The deployment of full-service telecommunications networks will also provide a platform for hosting information providers, thus stimulating the development of new interactive end-user services in government affairs, healthcare, education, entertainment and commerce.
- Open communication on the NII will result in wide access to vast information resources which will benefit information providers and end-users.

The Taiwanese authority is playing a pivotal role by placing high priority to coordinate the public and private sectors to develop an advanced infrastructure to suit the societal needs.

Important components of the NII initiatives include:

- **IT Education and Training.** To reinforce formal computer science education in universities and colleges, the III has expanded IT education to all schools. The focus is to promote NII literacy through networking and Internet training.

- **Exploitation of IT in Application Usage.** Government, public and private sector organizations have expanded their use of computers and on-line applications. Examples include the Residence Information System, Tradevan for customs clearance, the National Health Information Network, and the use of transaction systems on low cost mini computers in public facilities. These systems will serve as the core applications in the NII.
- **IT Promotion and Computer Literacy Programmes.** Since 1981, the III has organized an “Information Month” programme each December, designed to bring IT concepts and applications to the public through conferences, seminars and IT exhibitions. There are also programmes to promote EDI (Electronic Data Interchange) and EIS (Electronic Information Services), along with consulting services to SMEs (small- and medium-sized enterprises).
- **Interoperable Networking Technology Development.** Under the ITIS (Industrial Technology Information System) programme, the III has developed the technology to allow different networking infrastructure to interoperate. All Taiwan information industries have been “wired” for years.
- **Frontier Technology Research and Development (R&D).** The III conducts R&D in advanced technologies and products either independently or with leading IT organizations worldwide. Some projects include: the Distributed Database Project aimed at developing an environment that integrates distributed and heterogeneous systems; the EDI Translator programme that supports authentication, authorization and related security services for electronic commerce; and the image processing technologies developed under the GIS (Geographic Information System) programme.

The scope of Taiwan's information infrastructure is a key factor for enhancing national competitiveness and the quality of life to “leapfrog” towards modernisation and to survive.

The NII Steering Committee has formulated a ten-point proposal covering, inter alia, the following issues:

- Private sector participation
- Open competition and liberalization of the telecommunications industry
- Encouraging core technology R&D
- Construction of high-speed broadband telecommunications networks
- Integration of telecommunications networks
- Pilot experimental applications/services implementation
- Humanity and cultural development

In the Taiwanese NII, plans include:

- **Construction of the Broadband Telecommunications Networks.** The telecommunications backbone network for the NII (HiNet) will expand from frame relay to fibre optic transmission through ATM switching within six years.
- **Integration of Telecommunications Networks.** Narrowband, broadband, wireless communications, CATV, satellite and microwave networks were integrated by 1996, to support digital, voice, video and multimedia services.
- **Implementation of Pilot Application Services interconnecting to NII Backbone for Universal Access.** This calls for wide involvement from end-users, developers, service and content providers, and telecom companies. Experimental applications of Human Welfare Services (e.g. Distance Medicine, Distance Learning, Electronic Library, Email to Schools, Electronic Banking and Teleshopping) and Government-on-Line Services (e.g. Health Information System and Resident Information System) will be connected to the overall NII backbone network.
- **Core Technology R&D.** Under the sponsorship of the Ministry of Economic Affairs, programmes will cover both networking and applications technology.
- **Legislation, Regulation and Standards Development.** The plan looks into areas like: liberalization of telecommunications, integration of telecommunications with CATV and wireless communications, Incentive Acts to promote private sector participation, and laws to protect information flow.

Under the legislative programme, the regulatory framework, universal access, standardization, and intellectual property rights issues will be examined together with experts from industry, academics, law experts and professionals.

The success of the Taiwanese NII will depend mostly on the power of the human mind, one of the most creative forces in nature.

Japan's Vision: An Intellectually Creative Society

Japan's vision of the NII is still evolving, with different perspectives from various players. The Ministry of Post and Telecommunications (MPT) introduced in 1994 a vision of "Reforms Toward the Intellectually Creative Society of the 21st century". The Japanese telephone company, Nippon Telephone and Telegraph (NTT) had its

own vision: “NTT’s Basic Concept and Current Activities for the Coming Multimedia Age”. Moreover, the Management Coordination Agency of the Prime Minister’s office has published its own plans for government computerisation (MCA, 1994). Think tanks such as the Nomura Research Institute also developed their own views (Murakami, 1993).

*The elements of Japan’s
NII vision focus on
creating an information/
communications-based
economy.*

The NII vision in Japan has two strategic goals:

- the creation of new economic activities such as production of intellectual property, including software, information content, entertainment and information services, to complement Japanese technical competitive advantage in hardware technology;
- the creation of an advanced national information infrastructure to make existing industries more productive and competitive through the application of network technologies.

As in other regional NIIs, Japan’s NII vision includes the following components:

- producing new multimedia products and services;
- installing a nationwide broadband, fibre optic telecommunications infrastructure;
- creating hardware products that can be manufactured domestically; developing software capabilities; and
- improving productivity of the economy through application of information and communications technologies.

The anticipated convergence of audio, video and computing technologies into multimedia hardware/software for the mass market has been a major goal of Japanese electronics companies for many years. These firms seek vertical integration into the creation of a multimedia revolution in consumer based video, telecommunications hardware and software.

It is thought that creation of a nationwide universal fibre optic network will create 123 trillion yen (HK\$8 trillion) in economic activity and more than 2 million new jobs.

In Japan, cable TV has not caught on due to tight regulation, being available to only 22% of all TV households and subscribed to by a mere 5% (Yamazaki, 1994). In 1994, NTT announced plans to wire every Japanese household with fibre optics by 2015. This was subsequently revised to 2010.

As one of the leading producers of computer hardware, consumer electronics, and communications equipment, Japanese manufacturers see the NII as a stimulant to domestic and global demand. Once a national fibre optic highway is established, demand for products such as computers, interactive HDTV, video servers, personal digital assistants (PDAs) will be driven by the availability of multimedia content.

Japan's software industry has traditionally been strong in video games, karaoke and animation, but in applications and software architecture, the U.S. industry is growing in dominance. One spin-off of the NII is to stimulate production of multimedia software.

The NII is also seen as a tool for increasing productivity in government and industry. Given fairly strong government involvement in the community and industry, improved inter-networking of different ministries would enhance productivity and decision making, including making government information more accessible as an information asset for all members of the Japanese society.

The Telecommunications Council (1994) report in May 1994 emphasized that information communications can both facilitate the nation's decentralization and help develop Japan's creativity. The latter goal would be obtained through the informatisation of education, medical care and government services, achieved through development of application databases and applications.

The implementation cost is estimated to range from 33 to 53 trillion yen (HK\$2 to \$3.2 trillion), plus 42 trillion yen (HK\$2.9 trillion) for underground wiring. The fibre optic network would be rolled out in three five-year phases culminating in 2010. The first phase would cover prefectural capitals, the second including all cities with a population of at least 100,000, and the final phase extending to cover the whole of the nation.

The first phase would also connect schools, hospital libraries and other public institutions, with the development of public applications. The report recommends interest-free loans and tax incentives to fund private development of the fibre optic network. Local governments should also encourage the undergrounding of the cables, as well as facilitate right-of-way for both underground and aboveground lines. To implement the necessary services, regulatory reforms should encourage the expected convergence of broadcasting and telecommunications, while considering a fibre optic version of universal service.

Japan's NII offers new opportunities in multimedia and interactive markets. Information sharing between governments and the public is encouraged.

Finally, the report anticipates the development of systems and standards as the basis for the Japanese NII, arguing for new standards from Japanese trade associations as well as cooperation on international networks with the International Telecommunications Union (ITU).

An interesting question raised by the NII debate in Japan is the debate over the provision of public multimedia telecommunications infrastructure. The “high-tech” supply-side economists claim that the new digital fibre optic and telecommunications infrastructure must be put in place, so that the consumers will find new applications and use for them. On the other hand, the demand-side economists claim that without consumer demand, there is no point in spending public funds on new technology (Egan, 1991).

The NII fits the classical definition of a public good, where infrastructure is expected to benefit the rest of society. Since government funding is limited, its role may be limited to seed projects, and usage of regulatory powers to direct private initiative through incentives (tax credits) or coercion (mandated universal service). In the case of Japan, the state-owned NTT would play a major role in shaping the NII.

The current Japanese vision of NII is based on the notion of a single unified network, using broadband ISDN technology as the main pipeline between the producer and the consumer. The rapid development of Internet is challenging this vision.

Japan's Internet market is catching up slowly despite high costs of telecommunications.

The Internet was initially slow to catch on in Japan, partly because of the high cost of telecommunications, MPT's licensing of Internet service providers, and government efforts to enforce Open Systems Interconnection (OSI) standards while the world was embracing the TCP/IP standard. Since Internet is already in operation without waiting for the new national network, businesses are beginning to use the Internet. It is estimated that there are currently 2 million Internet users in Japan, and large companies are beginning to use the Web for networking.

China

China is progressing rapidly in its efforts to build a national information infrastructure. As of early 1995, the country's telecommunications environment included 86,000 kilometers of fibre optic cables (representing 75% of total trunk lines), and had a switching capacity of 82.4 million lines. Meanwhile the Golden Bridge Project, which is designed to provide a national public information backbone network connecting 12,000 state-run enterprises across more than 400 cities, has already linked 20 cities via 24 satellite earth stations.

Multiplexing broadband channels have also been established between Beijing and Shanghai, and Beijing and Guangzhou for teleconferencing and image transmission services. By July 1995, 10.4 million credit/debit cards and several thousand smart cards had been issued under the Golden Card Project—a 10-year electronic payments projects which is expected to absorb US\$4.7 billion (HK\$36 billion) in total investment. Currently, there are 12,000 ATMs in China, with 20 million credit/debit cards and another 100 million cash dispenser cards. The China National Automated Payments Systems (CNAPS), a real-time gross settlement high value payment system is under construction and should be completed by 1999.

The potential for China's telecommunication industry is huge. In 1995, China's national post and telecoms service revenue volume amounted to US\$11.6 billion (HK\$90 billion)—more than six times the total in 1990. Long distance telephone figures were 10.3 times greater, the number of local telephone subscribers was 5.6 times greater, levels of mobile telephone use 200 times higher and volume of radio paging subscribers were 41 times greater than 1990 figures.

By the end of 1995, national fibre optic cables had surpassed 100,000 kilometers and digital microwave lines had topped 70,000km, with toll switching capacity exceeding 2.4 million lines and local central-office switching capability totaling more than 58 million lines.

The Chinese government's goal for the next five years is to continue the infrastructure expansion but at a slower rate. The number of packet-switching network ports in China are targeted to rise from 110,344 in 1995 to 155,000 in 2000. The number of mobile telephone subscribers is set to increase from 3.6 million to 15 million, and radio paging subscribers from just under 18 million to 40.5 million.

The bulk of China's telecommunications investment over the next five years will still be spent on developing local telephone communications. Two-third of the US\$48 billion (HK\$370 billion) total will go towards building main lines and exchange capacities, as well as adding telephone sets.

According to Vice Premier Zhou Jiahua, China is considering introduction of a new and more powerful governing body to oversee information technology initiatives and coordinate inter-ministry projects. The new group will be empowered to draft and formulate guidelines and policies on the IT industry, formulate development strategies, coordinate inter-ministry and inter-regional work on construction of key information projects vital to state interest, and promote China's IT advancement and external cooperation.

China is placing high priority in building a national economic information infrastructure through projects like the Golden Bridge Network and establishment of a Central government body which coordinates and promotes information technology in the country.

Rapid developments are happening in the Chinese IT market. The software market amounts to about US\$100 million (HK\$770 million) annually, but is currently confined to local products in China. However, because of the growth in telecommunications, the semiconductor market in China is expected to grow dramatically. Texas Instruments research suggests that China is expected to be the fastest growing semiconductor market in the world, growing at an estimated annual rate of 40% from US\$4 billion (HK\$31 billion) in 1995 to US\$500 billion (HK\$3.9 trillion) by 2010.

Australia

Australia's initiative can be represented by the Victoria 21 strategy for the State of Victoria. The Victoria 21 strategy aims to position Victoria to take advantage of benefits which are expected to be available to early adopters of information technology as the world moves into the Global Information Age. A key component of this strategy was the Electronic Service Delivery (ESD) project which is designed with the following objectives:

- provide impetus and facilitate the transformation of government services through re-engineered service delivery;
- assist Victorian citizens and business to adapt to, and align with, the new information age; and
- promote the development of the multimedia industry so Victoria could become a regional centre for media content development.

A co-ordinated whole-of-government approach was also seen as necessary to provide a "single face of government" to the public. Currently, a number of agencies were in the process of delivering their particular services with incompatible technology architectures, that may end up being less user-friendly to the public. It was unlikely that any single agency could, in their own right, mount a business case to establish a comprehensive ESD infrastructure to service all Victoria citizens. ESD was seen as part of an integrated approach to transforming government.

In 1995, Victoria set a goal for the ESD to deliver all government services on-line by 2001. The goals set for the ESD programme are:

- 1) all information currently printed for the public,
- 2) lodgement of all forms and registrations,
- 3) applications for payment by Government,
- 4) all payments to Government,
- 5) all payment by Government, and
- 6) all Government purchasing.

The initial launch of the ESD services was made on 9 December 1997. It included the provision of 26 transactions, via 22 kiosks and on Internet. The 26 transactions include the notifications to Government and utilities on change of address and other personal information, booking service, acquiring products, obtaining information, making payment, providing feedback, and monitoring status of applications.

Under the ESD programme, the Victoria government has taken several important steps to put the operational frame work in place. They include:

- *Information Security*—The ESD has chosen to use the Public Key Cryptography technology for protecting the information effecting transactions. This technology enables the electronic authentication of users, affixing of digital signatures, securing high level of confidentiality, and effecting non-repudiation of transactions. All these properties are essential to effect electronic payments and to make possible electronic commerce and the protection of privacy.

- *Certificate of Authority*—Central to Public Key Cryptography is the availability of a Certificate of Authority (CA). The CA is a trusted third party that certifies the identities of the holders of electronic keys that are used to carry out business transactions. Victoria, in support of the ESD services, has selected the Post Office to provide this CA services. This is an important step taken by the Victoria government to facilitate electronic commerce and to promote the use of electronic means of conducting business.

- *eCommerce Bill*—One of the impediment in the development of eCommerce is the lack of legal framework in support of transactions conducted through electronic means. For example, recognition of electronic signature is essential for payment instructions and for all other legal documents in electronic form. Victoria has drafted an eCommerce Bill along with an Information Privacy Bill, pending adoption by the Parliament. Adopting these bills is intended to help legitimatise the conducting of business in electronic form and will in turn accelerate electronic commerce.

- *Permeation*—The programme to transform the economy and deliver government services with state-wide networked information technology has permeated throughout Victoria society. In addition to the government-led ESD programme, the initiative has reached deep down to the neighbourhood adult education centres, in which adults and even learning impaired citizens were preparing homepages on Internet. Such deep penetration is impressive in developing information technology literate workers for Victoria.

The Hong Kong SAR Government established the Information Infrastructure Advisory Committee to develop information infrastructure in Hong Kong. Recently, it also initiated the set-up of an Information Infrastructure Coordination Office to coordinate existing activities and develop policy target for the establishment of Hong Kong's NII.

NII Initiatives in Hong Kong

Until recently, Hong Kong did not have an NII initiative, although various private sector groups, such as the Hong Kong Information Technology Federation (HKITF) and the Hong Kong General Chamber of Commerce (HKGCC), strongly supported such a move.

On 6 December 1996, a LegCo Panel on Information Policy was formed to discuss the issue of 'Development of information superhighway and Internet in Hong Kong'. Representatives from the private and public sector, government offices, and educational establishments were invited to express their views on the subject. Eleven organizations participated in the meeting. They are the Hong Kong Coalition of Service Industries, Hong Kong Internet Service Providers Association, Hong Kong Information Technology Federation, Hong Kong Computer Society, Hong Kong Development and Strategic Research Centre, Asia Television Limited, Office of the Privacy Commissioner for Personal Data, Vocational Training Council, Chinese University of Hong Kong, Hong Kong University of Science and Technology and Hong Kong Polytechnic University.

Members proposed that the Hong Kong SAR Government should be actively involved in the administrative structure of an information superhighway. Suggestions were made that the Hong Kong SAR Government should establish a policy branch or a statutory body on information infrastructure for the development of a regional information infrastructure in Hong Kong; impose new legislation to regulate Internet; and provide more resources and facilities to schools to strengthen education on computer studies and information infrastructure.

The Government established a Telecommunications Review on 1 March 1997 to enquire into the state of the industry and to provide advice on the way forward. The review will concentrate on three objectives:

- examining, on the completion of 18 months since the opening up of local telephone service to competition, the current state of development of Hong Kong's telecommunications industry;
- formulating policy options to respond to the foreseeable development of telecommunications technologies and the convergence of telecommunications, broadcasting and information technologies; and

- developing strategic options to maintain Hong Kong's leading position in telecommunications and competitiveness in the Information Age.

On 21 March 1997, a new advisory committee, the Information Infrastructure Advisory Committee (IIAC), was established under the Office of the Telecommunications Authority (OFTA) to co-ordinate the orderly development of the Information Infrastructure in Hong Kong. OFTA was established on 1 July 1993, to serve as the executive arm of the Telecommunications Authority (TA), who is appointed by the Government as the statutory body to oversee the regulation of the telecommunications sector in Hong Kong.

IT regulations, promotions and standardisation are all in the IIAC agenda.

The terms of reference of the Information Infrastructure Advisory Committee are as follows:

- To advise on the development and regulation of the information infrastructure in Hong Kong.
- To advise on the promotion of the effective use of the information infrastructure for various possible applications in Hong Kong.
- To advise on technical standards and related issues in the development of the information infrastructure in Hong Kong.
- To advise on the formulation of Hong Kong's position at, and contribution to, international and regional fora on issues relating to the global and regional information infrastructure.

The membership of the IIAC includes representatives of the local fixed network carriers, the telecommunications and information technology industries, and relevant professional bodies. Academics, industrialists, and experts in the relevant fields are also appointed to serve on an ad personam basis. The Committee is chaired by the Director-General of Telecommunications.

Indeed, the Hong Kong SAR Government has taken the lead by promoting the use of information technology within the Government itself. In 1996-97, HK\$330 million was spent on major departmental information strategy projects, another HK\$330 million on other applications/projects and \$240 million on increasing the provision of microcomputers and computer workstations up to a ratio of 300 workstations per 1,000 civil servants.

The Secretary for the Treasury is responsible for overseeing the use of IT within the Government. He is supported by the Computer Strategy Group which is tasked

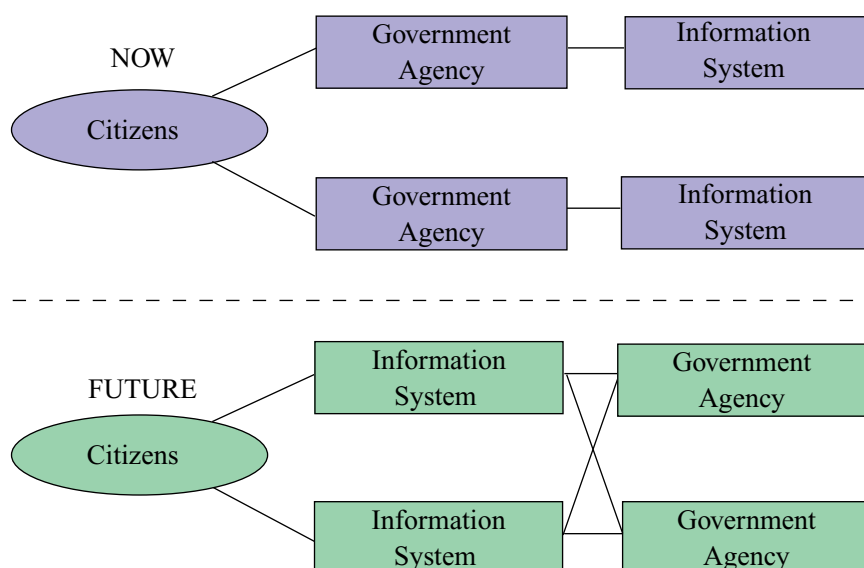
The Hong Kong SAR Government itself is a strong believer and achiever in IT. By 1999, all government departments will be linked up under the Government Communication Network.

to formulate service-wide IT policies and strategies, prioritise computer projects for funding purposes, and monitor Government's overall IT expenditure. The Director of Information Technology Services is Government's IT adviser and service provider, ensuring that departments' IT needs are met in an efficient and cost-effective manner. He is also the technical authority for the establishment of Government's IT infrastructure and architecture, and is responsible for setting IT standards for compliance within Government.

The government information technology infrastructure comprises a government systems architecture (GSA) which specifies hardware and software standards, common IT facilities, compatible data communications networks, a structured set of IT standards and methodologies, quality management and a skilled professional workforce. The GSA will adopt international standards where they exist and use de facto standards if otherwise. Data communications, for example, will follow standards such as those recommended by the International Organisation for Standardization and the International Telecommunications Union.

An internal government network has been established which provides common IT services. A core part of this network is the Government Communication Network (GCN) which acts as central hub to provide electronic mailing service for government IT users through network connection. The first phase of the automation programme for the GCN has already been completed, linking up office networks in all 22 policy branches and offices of the Government Secretariat. The first batch of the second phase, which will link up policy branches with office networks in their key departments, is almost complete. The plan is to extend the service to the rest of the government by mid-1999.

In January 1997, the Government set up a high-level interdepartmental task force to develop, implement and monitor a coordinated strategy for Government's use of Internet and its related technologies (see Box 2).

Figure: Reinventing Government

Source: Washington State Department of Information Services

Internet technology is a driver to improve services and communication within the government.

International examples of technology-driven delivery of Government services:

- Welfare benefit delivery. Tulare County, California has a touchscreen welfare application system that is expected to save US\$108 million in administrative costs.
- Public record checking. British Columbia Online allows lawyers, realtors, insurance companies and banks to access public databases, court records such as land titles, car licenses, land tax registries etc. through PC and modem. This is operated by a joint venture telephone company and British Columbia Systems Corporation.
- Public information kiosks. The Washington Information Network (WIN) has a network of over 50 public information kiosks where the public can have access and enquiry function on licensing, welfare benefits, small business assistance etc.

Box 2 Task force on exploiting Internet technologies within Government

Aims

To exploit the potential of the Internet and related technologies to:

- improve intra-departmental and inter-departmental communications and service delivery for the Government
- make information and services more accessible for both civil servants and the community
- improve efficiency of internal processes and reduce paperwork in the Government
- provide momentum for broader development within the territory

Objectives

- (i) Building the foundations
 - build foundations (in phases) on top of current investments
 - raise awareness of the potential
 - promote the development of relevant knowledge and skills within Government
- (ii) Creating the environment
 - secure the development of the required technological, standards, legal and procedural environment
 - identify and manage constraints
- (iii) Developing and implementing applications
 - adopt standards for identified applications
 - improve current applications to acceptable standards
 - identify, prioritize and support early applications for the Internet technologies

Approaches

- Focus on the Government's use of the Internet and related technologies, leave aside other IT applications.
- Adopt a positive and realistic approach, balancing the potential and real constraints.
- Combine a broad strategy with a pragmatic and opportunist approach to make progress.
- Combine government-wide initiatives and studies with projects focused on particular processes or departments.
- Work alongside departments, securing departmental ownership of the work needed.
- Identify issues which need to be tackled and ensure clear ownership.
- Ensure that Government has the information on costs and benefits to justify any significant investments.
- Secure the development of the necessary policies, guidelines and standards.
- Identify priority areas, including potential quick wins to demonstrate the value of the technology.
- Quantify the resource requirements.
- Plan and manage the Programme in a phased and structured way concentrating initially on internal, intranet developments and the dissemination of information on the Internet.

Existing Infrastructure in Hong Kong

Typically, a NII involves three components, namely, developing a Vision of an Information Society, developing a Policy framework and mapping a Strategy for implementation. Mostly NIIs also include the development of fibre optic network as the key NII backbone.

Although Hong Kong has not yet a NII in place, there already exists a sophisticated fibre optic network, probably one of the most advanced in the world. Hong Kong is already well positioned to advance into the multimedia age. To date, 200,000 km of fibre optics have been laid connecting all telephone exchanges and reaching out to 1,500 buildings. [Box 3]

Box 3 Hong Kong's Telecommunications Infrastructure

Hong Kong has one of the most sophisticated telecommunications infrastructure in the world, having installed by June 1993 a fully digitalised network, the first in the world. Hong Kong Telecom has 5 submarine cables (3 analogue and 2 digital), 17 satellite connections and 80,000 km of fibre optic cables with broadband capabilities. In 1996, Hong Kong had the highest telephone penetration in Asia, with 3.4 million fixed telephone lines, 1.1 million cellular mobile subscribers and another 1.1 million paging subscribers. It is the regional hub for 500 multinational companies, and is a leader in mobile telephony, having international roaming and capacity for use even in the subway (MTR) as well as tunnels.

The capacity of the telecommunications infrastructure to support the financial infrastructure is rapidly increasing. There already exists 16 SONNET rings connecting 33 telephone exchanges, FTTB connecting more than 80 commercial buildings, dual fibre/exchange links to 250 buildings, and an installed Advanced Fibre Telecoms System (AFTS) to 80 buildings by early 1996. In 1997, ATM technology would be installed, while ISDN capacity is already available.

Source: William Lo, Hong Kong Telecom, 1995

Hong Kong possesses sophisticated optic-fibre cables with broadband capabilities, which support multi-media applications.

Hong Kong Telecom IMS has also in 1995 tested the Video-On-Demand (VOD) technology successfully and is planning to introduce broadband multi-media services in mid 1997 [Box 4]. It is expected that the public would have fibre optic cables reaching out to their homes by the turn of the century.

Box 4 Hongkong Telecom IMS provides interactive multimedia services

Hongkong Telecom IMS is developing a variety of interactive multimedia services ranging from Internet online service to Interactive TV applications for the people of Asia.

Netvigator, Hong Kong Telecom IMS's Internet online service, provides a variety of local and international contents including e-mail, cyber supermarket shopping, business and entertainment news, lifestyle magazines and games. As to business clients, Hongkong Telecom provide services such as planning and design of Internet/Intranet solutions; web sites design, production, hosting and management; interactive application development; security solutions; system integration; online advertising and promotion; and technical consultancy. Through Netvigator, businesses will have access to the Internet, which provides the "community"/"mall" to distribute or channel their services. Also, enterprises are exposed to the latest multimedia technologies to carry out their businesses more effectively and innovatively.

The world's first Interactive TV (iTV) service will be introduced in mid 1997. According to Hongkong Telecom IMS, Hong Kong is likely to be the first place in the world to have a variety of commercial broadband interactive multimedia services. iTV uses common TV set as a medium and it will provide various innovative services such as Video On Demand, Music On Demand, Home Banking, Home Shopping, etc.

- **Video On Demand (VOD)** provides customers the flexibility to watch any movie at any time, using their own TV sets.
- **Music On Demand (MOD)** provides customers with music videos, music shows and karaokes.
- **Home Shopping** gives all-at-home shopping convenience and that purchases will be delivered to the assigned address.
- **Home Banking** is scheduled to be launched in early 1998. A wide range of services including balance enquiry, fund transfer, payment and other financial transactions can be done at home. The digital decoder of iTV has also reserved a slot for the Smart Card, enabling deposit and withdrawal to be made at home.
- Other services being developed include Internet Broadcasting Service (to be launched in June 97), personalized newspaper (late 97), cyber-bookshop (June 97) and fast speed Internet access via iTV platform (early 98).

*Hong Kong Telecom IMS
is ready to be the world's
first interactive TV
service provider.*

The three fixed telecommunications network service operators (Hutchison Communications Limited, New T&T Hong Kong Limited and New World Telephone Limited) licensed in 1995 have all committed to constructing advanced fibre optic networks with state-of-the-art intelligent network technologies. In the next few years these operators will complete the installation of optical backbone networks along the Mass Transit Railway, providing coverage to the districts along this route which represent the major part of all urban and commercial areas.

Internet usage in Hong Kong is rapidly gaining acceptance. To date, there is more than 90 Internet Service Providers (ISP) licensed in Hong Kong. Over 500,000 Internet subscribers, of which 300,000 are individuals, according to data published by Survey Research Hong Kong in April 1997. Four of the largest ISPs, Netvigator, Star, Asia Online and HK Supernet account for three quarters of the Internet business in Hong Kong. The Office of the Telecommunication Authority (OFTA) is responsible to grant licences to ISPs and to monitor that payment of interconnection charges are observed by ISPs accordingly. [Box 5]

Over 90 Hong Kong Internet Service Providers are here to deliver competitive Internet services and technology to more than 500,000 Internet users locally.

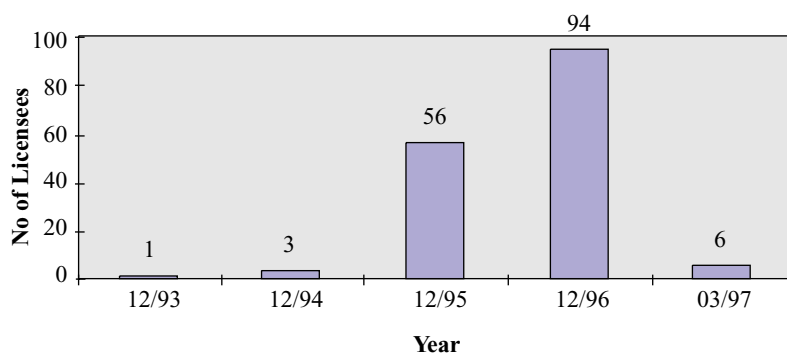
Box 5 Internet Service Providers in Hong Kong

Internet Service Providers Licensing

There are over 90 Internet Service Providers (ISPs) licensed in Hong Kong, one of the most crowded in the world. Generally, they offer a wide range of information and messaging services including information retrieval, electronic mail and access to the Internet network based in the United States. All of them own or operate a telecommunication system for customer access via the public telecommunication networks and a route for access to Internet. The ISPs are licensed by the Office of the Telecommunications Authority (OFTA) under the Telecommunication Ordinance.

The bulletin board service (BBS) does not require licencing. However, if the scope of the service is expanded to include messaging or electronic mail capability so that customers or subscribers to the service can communicate with one another and the service is offered generally to the public, then a licence is required.

Internet Service Providers



Payment of Interconnection Charges by ISPs

Under the tariffs approved by the OFTA in accordance with the Fixed Telecommunications Network Services (FTNS) Licence granted to Hong Kong Telephone Company Limited (Hong Kong Telecoms), Hong Kong Telecoms is entitled to levy an “interconnection charge” on customers using lines connected to the PSTN for the provision of services licensed as “Public Non-Exclusive Telecommunications Services (PNETS)”. Thus an ISP must pay an “interconnection charge” if the ISP provides PNETS services.

The “interconnection charge” on the lines connected to Telecoms’ network arises because there is currently only one major FTNS operator, i.e. Telecoms. Under the new competitive environment, when other FTNS operators can also offer the service, then ISPs will have a choice of operators. The charges of non-dominant FTNS operators (i.e. currently Hutchison Communications, New T&T Hong Kong and New World telephone) are not subject to approval by the TA.

To date, the PNETS surcharges, required for Internet connections and other value-added services that make use of Telecom’s network is HK\$78 per line per month plus 4.2 cents per minute.

With the increase application of Internet technology around the world, the Internet community in Hong Kong has been working actively in establishing a well structured Internet infrastructure. In November 1996, the dedicated circles of professional skills are formed to drive the Internet technology infrastructure and capabilities in the territory. The Hong Kong Internet Service Providers Association was formed to consider issues that may affect the development and deployment of the Internet in Hong Kong [Box 6]. The local academic institutions have also joined forces among themselves and with local ISPs in the delivery of Internet services. The Chinese University is coordinating the Hong Kong Internet Exchange (HKIX) project to interconnect local ISPs to allow the exchange of intra-Hong Kong traffic locally without routing through the US upgrading its links capabilities in ATM mode. [Box 7]. The Hong Kong Academic and Research NET work (HARNET) links up the campus networks of the seven tertiary institutions in Hong Kong to provide electronic communications to international academic and research networks. [Box 8].

Box 6 The Hong Kong Internet Service Providers Association (HKISPA)

In November 1996, the HKISPA was formed as a major group within the Hong Kong Information Technology Federation (HKITF).

The objectives of the group are: to consider issues that may affect development and deployment of the Internet in Hong Kong; promotion of the Internet industry infrastructure and fair market competition; formulation of policies in respect to regulations and governmental issues involving the industry; and formulation of a code of practice among the Internet service providers.

Box 7 The Hong Kong Internet Exchange (HKIX)

The HKIX is a cooperative project initiated, coordinated and operated by the Chinese University. The goal is to interconnect the ISPs in Hong Kong so that they can exchange intra-Hong Kong traffic locally without routing through the U.S. In fact, HKIX is a very important concept on Internet after the NSFnet backbone faded away because ISPs have to be interconnected to maintain full connectivity to the whole Internet. In Hong Kong, the situation is a little bit different. Many of the ISPs in Hong Kong have their own links to US. They have to interconnect locally in order to have faster and less expensive access to local sites.

In May 1996, the Chinese University announced that HKIX will be upgraded to Asynchronous Transfer Mode (ATM), after receiving a grant amounting to more than HK\$10 million, to support growing demands for Internet bandwidth and speed in the territory. The idea is to increase the capacity 100 times to support high-bandwidth multimedia applications and prepare for a substantially larger fraction of the people in Hong Kong to access the Internet. The grant is jointly funded by the Government's Industry Department and the University itself.

The new ATM hub should be operational in 1997. The Ethernet switch currently in use will be used alongside with the ATM switch, with an Ethernet connection between the two. Gradually all traffic will be routed through the ATM switch. The capacity will be up to 155 Mbps per link to the hub, and the total hub capacity will be 10Gpbs.

Currently, there are 30 ISPs connected to the HKIX, including internal backbone carriers such as AT&T, Global One, and Hongkong Telecom. The development of the Internet Exchange will place Hong Kong in a preeminent position in the region. HKIX will be the first ATM Internet exchange in Asia.

Box 8 Hongkong Academic and Research NETWORK (HARNET)

HARNET (The Hongkong Academic and Research NETWORK) is the wide area network which links up the campus networks of the seven universities in Hong Kong. HARNET is under the management of the University and Polytechnic Computer Centre (UPCC), a joint organisation of the Computer Centres of the seven institutions including the University of Hong Kong, the Chinese University of Hong Kong, the Hong Kong Polytechnic University, the City University of Hong Kong, the Hong Kong Baptist University, the Hong Kong University of Science and Technology and the Lingnan College.

HARNET provides electronic communications to international academic and research networks. HARNET supports high speed data communication between the UPCC member institutions locally in Hong Kong. Moreover, HARNET is connected to Internet via a T1 (1.544 Mbps) international link to US through a gateway installed at the Chinese University of Hong Kong. Through this HARNET - Internet connection, users are now able to connect online to thousands of computer networks in the world and gain access to various valuable computer facilities, such as library catalogues, databases, super-computers, etc.

The telecommunications environment in Hong Kong is amongst the world's most sophisticated systems. The local fixed telephone network is completely digitalised, with over 3.4 million exchange lines as at December 1996, representing a penetration rate of some 50% or about one line per two persons in Hong Kong. More than 307,000 of these exchange lines were dedicated facsimile lines.

There are recent developments in mobile telephony, value-added services and competitive fixed network services.

- (i) Mobile telephony
 - In cellular telephony four operators share over 1.2 million subscribers. Of the four existing analogue networks, two have been digitalised to provide better service to consumers and the analogue networks has been phased out in mid-1997, except a small capacity left for roaming with analogue networks in the neighbouring territories.
 - Personal Communications Service (PCS), the latest and most advanced mobile technologies available in the world, was first available in Hong Kong in September 1996. Six PCS licenses were issued, providing extra network capacity to meet the strong growth in demand for mobile services.
- (ii) Value Added Services
 - Hong Kong has completely opened up its value-added services regulatory regime. Companies are allowed to operate value-added services between the territory and any other administration. The previous requirement for a bilateral agreement before such services can be provided has been removed.
- (iii) Fixed Telecommunication Network Services
 - Since July 1995, local wire-line voice telephone services have been opened to competition, with three new licenses being awarded. While Hong Kong Telephone Co. Ltd. will continue to provide a universal service, the new entrants target slightly different market sectors such as business users, personal numbering, etc.
- (iv) Self-provision of external circuits
 - To further liberalize international services, the Self-Provided External Telecommunication System license has been made available to permit multinational companies and organizations to self-provide external circuits, such as using Very Small Aperture Terminal Satellite technology, to meet their own external communications needs.

- (v) Virtual Private Network (VPN) Services
- VPN services are intended to enable international communications within corporate groups and organizations. The Hong Kong Telecommunications Authority has issued guidelines for applications and invites applications for licenses to operate VPN services.

Hong Kong is also well placed to embrace new technology. According to a survey in World Link magazine, Hong Kong ranked 19th out of a total of 49 nations in this regard. While Hong Kong was way below the US and Finland in the top two positions, it placed well ahead of regional economies such as Taiwan (24th) and South Korea (26th) [Table 1]. In order to gain a more competitive edge in the “network society”, Hong Kong strongly needs to enhance its information technology.

Government’s plan for technology spending

In March 1997, the Financial Secretary announced in his 1997 budget speech to include a number of initiatives aimed at improving Hong Kong’s telecommunications and computing infrastructure. He confirmed that more than HK\$400 million will be spent over the next five years on phase one of the territory’s first science park project. A Planning Committee will examine the project in more detail and put it forward when the site in Tai Po becomes available in early 1998.

The Planning Committee, chaired by the Director-General of Industry, comprises 14 members including academics, government representatives and industrialists.

Improving IT awareness among local school children is also on the 1997 budget agenda. The Government will provide multimedia computers to all public-sector primary schools and set up Information Technology Learning Centres (ITLCs) in prevocational and technical schools, at a cost of HK\$300 million over the next two years. Each government or aided primary school will be equipped with 15 multimedia computers—a total of 8,250 computers in all. In addition, ITLCs, will be established in all 27 prevocational and 19 secondary schools, each fitted out with 41 computers, computer-aided design and manufacturing equipment and computer-assisted learning packages.

The Hong Kong SAR Government is committed to providing the best service possible to the public. To achieve, this, the Government spends considerable sums in the IT area.

Table 1 Network Society Rankings

Overall ranking	Number of phone for 1,000 people	Mobile phone usage per 1,000 people	TV penetration per 1,000 people	Cable TV connections % penetration of TV households	Satellite connections % penetration of TV households	PC penetration per 1,000 people	Internet hosts per 1,000 people	Computer use ranking
	(1994)	(1996)	(1994)	(1994)	(1994)	(1995)	(Jan 1996)	(1996)
1 United States	602	149.5	790	62.23	4.0	350	21.82	1
2 Finland	551	261.7	502	45.33	5.4	230	43.11	5 =
3 Norway	554	261.3	425	43.95	12.3	250	21.60	3 =
4 Denmark	604	241.2	550	57.43	47.7	220	10.07	7
5 Sweden	683	264.6	480	55.48	14.4	170	18.92	19 =
6 Canada	575	114.0	650	74.03	2.7	250	16.52	3
7 Switzerland	597	78.4	410	73.69	11.2	290	12.96	19 =
8 Australia	496	217.5	482	n.a.	n.a.	270	17.25	2
9 Iceland	557	157.2	318	35.61	n.a.	n.a.	33.05	19 =
10 Netherlands	509	54.2	480	93.49	5.1	200	12.62	8 =
11 New Zealand	470	118.3	510	n.a.	n.a.	230	15.14	5
12 Luxembourg	554	97.5	340	93.38	10.0	n.a.	4.92	19 =
13 Germany	483	60.6	550	40.36	25.7	170	5.85	12
14 United Kingdom	489	106.1	450	4.05	16.6	200	8.30	8 =
15 Belgium	449	34.7	486	92.16	7.6	150	3.26	14 =
16 Japan	480	101.4	641	22.99	16.9	140	2.20	16
17 Austria	465	62.5	480	33.51	31.6	120	7.06	17 =
18 Singapore	473	115.6	380	4.31	0	180	7.74	10 =
19 Hong Kong	540	169.7	359	5.64	0.1	150	3.74	14 =
20 France	547	33.7	580	5.16	4.9	160	2.46	13
21 Ireland	350	58.8	322	42.29	8.6	180	4.38	10 =
22 Israel	394	126.1	295	n.a.	n.a.	100	5.67	27
23 Italy	429	91.3	450	0	0.6	120	1.34	17 =
24 Taiwan	400	44.5	315	52.74	3.3	90	1.24	28
25 Spain	371	52.3	496	2.19	3.4	70	1.39	19 =

Source: *World Link*, quoted in South China Morning Post, 17 April 1997

Automated Trading Systems

In mid 1996, the Hong Kong's Securities and Futures Commission (SFC) formed a Working Group on Automated Trading Systems (ATS). ATSs which may be termed "proprietary trading systems", were defined broadly. They include any automated system that provides a trading mechanism for securities or futures contracts, but exclude the operations of Hong Kong's Stock Exchange and Futures Exchange. The Working Group was formed in response to the emergence and global use of ATS. Driving forces in this regard include technological advances and increasingly international character of markets, investors and market intermediaries. The Working Group provided its Report to the SFC in January 1997. The Report describes the operations of ATSs internationally and in Hong Kong. It also summarises the regulatory approaches that apply to ATS operations and developing regulatory trends. Finally, the report summarises the Working Group's views on ATS operations and the regulatory approach that should apply to them in Hong Kong.

The SFC has reviewed the Working Group's Report and believes the regulatory principles set out in the Report are necessary and appropriate in the context of ATS operations. As recommended by the Working Group, the SFC is now seeking additional views and comments on the Report of the Working Group.

*The Hong Kong's
Securities and Futures
Commission is working
towards an Automated
Trading System for
trading securities and
futures contracts.*

Some of the main principles of the Working Group's Report

- Fitness and properness of the ATS operator and cooperation with regulatory authorities.
- Maintenance of audit trails and transparency of trading and system operations.
- The performance of surveillance and regulatory functions, maintenance of security and control procedures and back-up arrangements.
- Risk management policies and financial standing of the ATS operator being consistent with accepted international practice.

Summary

*Technology is the solution
for keeping transaction
costs low, which is
essential for maintaining
Hong Kong's
competitiveness.*

Hong Kong has made progress in NII initiatives, but others have made much more progress. With intense competition amongst different markets, costs have become an important consideration and technology is the only solution for enhancing productivity under high wages and high rents environment in Hong Kong. Though transaction costs in Hong Kong, e.g. those involved in equity trading, are low by international standards, they are still higher than those in the US [Chart 1]. Our consumer electronic payments system is also an efficient one, at around one-quarter of the highest cost market, but still slightly more expensive than the payments system in the US [Chart 2].

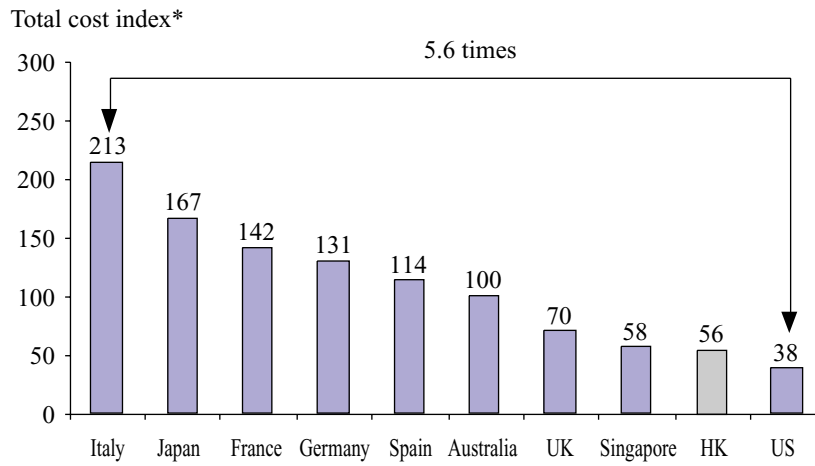
The purpose of this survey is to understand the progress achieved in the regional economies, and not to duplicate the work of the NII initiative in Hong Kong, which is outside the scope of this study. The following chapters will examine specifically recent developments of technology and its implications on financial market development.

Chart 1: The Cost of Equity Trade in Hong Kong is amongst the Lowest



Source: Financial System Inquiry Final Report, Australia 1997

Chart 2: The Consumer Electronic Payments System in Hong Kong is Efficient



* Comparative cost per payment transaction completed by Consumer Electronic Payments Systems (1992)
Source: Financial System Inquiry Final Report, Australia 1997

Chapter 3

The Architecture of Financial Systems

Introduction

“Financial markets are non-linear adaptive systems which can become very unpredictable under certain conditions. Technology increases both the efficiency and the complexity of the financial system. The paradox is that technology helps manage risk and increases risk at the same time.”

*John Mitchell, IBM
Financial Services
Consulting*

“The interactive network will be the ultimate market”

Bill Gates, “The Road Ahead”

Understanding of the development of financial markets and the impact of technology on those financial markets requires an appreciation of their nature. This chapter outlines the key characteristics of financial markets and highlights how each market’s ability to manage risks helps or hinders market development.

The Five Principles (the 5 P’s)

A financial market comprises five basic principles, which we will call the 5 Ps: **P**eople transact financial **P**roducts, under a financial **P**olicy framework, including a **P**rudential framework that governs the transactions, and operate through a transaction **P**rocess or technological **P**latform. The stock market is a good example of the basic nature of a financial market. A buyer deals through a stockbroker [**P**eople] to buy some shares [**P**roduct]. His share purchase is cleared through the Stock Exchange Central Clearing and Settlement System (CCASS) and payment is effected through the inter-bank clearing house [**P**latform]. The [**P**rudential framework] comprises supervision of the stock market by the Stock Exchange and the Securities and Futures Commission, while the banking system is supervised by the Hong Kong Monetary Authority (HKMA). The overall development of the market is shaped by the open and free market [**P**olicy] in Hong Kong. Different types of financial policy apply in other markets. For example, exchange control measures, high taxation or protectionist policies all hinder the development of financial markets.

The development of a sound financial market would need to consider the strengthening of all 5 components. Deep markets require highly sophisticated people and institutional skills, such as dealers, brokers, institutional investors, market makers, regulators, as well as ancillary service providers, e.g. lawyers, accountants, rating agency analysts, IT specialists and the like.

Similarly, financial markets depend on the existence of a range of financial products, from equity to bonds, derivatives and the more sophisticated instruments. All financial products are legal contracts, requiring a sophisticated legal framework to define and enforce property rights. Financial institutions are also legal contracts, such as a corporation formed under the Companies Act, or the powers of a stock broker as defined under the Securities Ordinance. Market activity is generally supervised along functional or institutional lines. For example, licensed banks are supervised by the HKMA under the Banking Ordinance, but their securities activities fall under the purview of the Securities and Futures Commission, so that a memorandum of understanding is required between the regulatory authorities to clarify regulatory boundaries.

Each financial market has its own processes and procedures, whereby a transaction in a financial product is cleared and settled to completion. For example, a cheque written on a bank is sorted and cleared through the Hong Kong Interbank Clearing Limited before the account of the payer is debited at his bank and the account of the payee is credited. These financial processes and procedures are increasingly being upgraded from manual paper-based systems to highly automated computerized systems. The efficiency and integrity of financial markets depend critically on the functioning of the technological platforms that underpin the **infrastructure of financial markets**.

This Report focuses on the efficiency and robustness of the technological platform, i.e. the financial technology infrastructure, that supports the growth of financial markets in Hong Kong. Because the scope of financial infrastructure is much wider, covering matters such as the legal, accounting, and ancillary services to support the financial services sector, this Report covers only the scope of financial technology infrastructure. In other words, it covers the impact of information technology on the financial system.

More specifically, this chapter analyses the conceptual design of the processes of financial transactions, which facilitates the introduction of information technology, while Chapter 4 focuses on the impact of technology on financial markets.

Financial Decision Cycle and Transaction Cycle

There are two important cycles in the nature of financial transactions that are amenable to computerisation. They are the financial decision cycle and the transaction cycle.

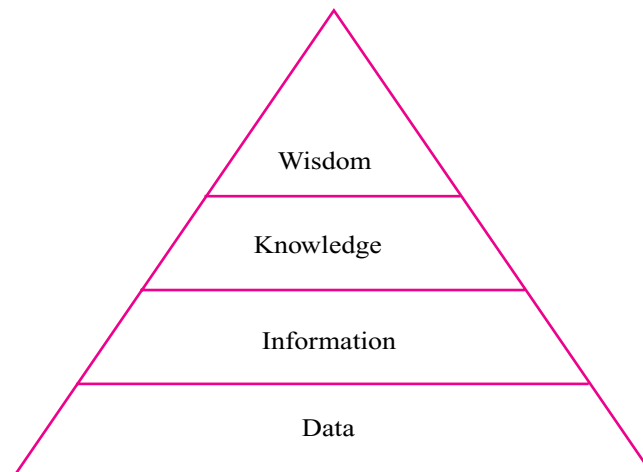
The Financial Decision Cycle

The Financial Decision Cycle is the cyclical process of receiving information for decision making purposes, analysing such information, formulating a decision to transact or not to transact, and after a decision has been made, executing the transaction. The transaction itself generates new information in the market, which causes the financial decision cycle to be repeated by the market participants.

Because information itself has a market value, we need to understand the organisation of information. Information has a hierarchy (Chart 1), and the more organised the information, the higher the level of information from raw data to wisdom (Lucky, 1991). Financial transactions involve the organisation, distillation, analysis and integration of information for decision purposes.

Chart 1 : Levels of information hierachy

Information has a hierarchy, from unorganised raw data to the most organised form—wisdom.



Source: Lucky 1991

Information has many interesting properties. Firstly, information or data can be shared, duplicated, divided and re-organised at very low cost. In contrast to physical goods, information does not have “asset specificity” or lumpiness. The transactions in physical goods can be highly expensive, since real goods have to be stored, transported and are not easily divisible. On the other hand, information can be transmitted easily, and with modern technology, moved with the speed of light across time and space.

Second, information also has value. New data, right or wrong, can affect market prices. Information also has a time value element—old information decays in value, while new information has a market premium.

Third, information sharing has public good characteristics. The more “know-how” is shared, the better off the market, as standards are raised. However, the greater the diffusion, the less the value of know-how to the elite that once possessed the scarce information. Diffused information also changes consumer behaviour. Schumpeter called entrepreneurship and innovation the “creative destruction” process, as new information creates value, and destroys the value of old information (Schumpeter, 1946).

These characteristics of information lie at the heart of the impact of technology on financial markets. Wealth can be created by those who can garner, harness and organise information, tapping the expertise and knowledge of individuals and selling these to others.

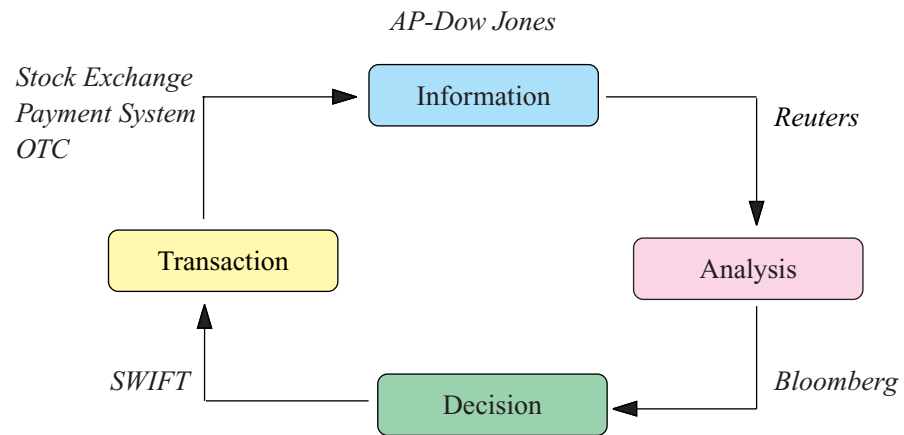
Chart 2 shows the Decision Cycle and the evolution of information services. In the early days of commerce, market news was provided through word of mouth, newspapers, and eventually news services and media, such as Reuters and AP-Dow Jones. Such information assists an investor or businessman to make financial decisions as to prices, quantities and quality of real or financial products. These news media also provide decision-making tools, such as financial advice by experts. The financial information business is worth US\$6.5 billion annually, dominated by three major players (New York Times, 1997). The number of financial data screens supplied by Reuters, Telerate and Bloomberg worldwide increased 37% between 1993-95 to 414,000.

Increasingly, the media industry also moved into the analytical industry. For example, both Reuters and Bloomberg today provide their clients with PC terminals that are bundled with software which would facilitate the analysis of complex information. This software helps their clients to make investment decisions, such as identifying arbitrage opportunities or suggesting derivative instruments that could help manage financial risks.

These media services today offer not just interactive information services, but also the transactions part of the cycle. Traditionally, the information services were segregated from the transactions part of the cycle. On receipt of news from a Reuters screen, for example, a dealer may telephone his broker to check prices and thereby confirm a transaction. Typically, the transaction may be confirmed by the back-office through telex or a S.W.I.F.T.¹ message, sent through the S.W.I.F.T. global inter-bank network. Increasingly, Reuters and electronic brokers are offering direct matching and confirmation of transactions on their proprietary electronic network. Such electronic order matching (electronic broking) is replacing manual (voice) broking in terms of intermediation transactions, as well as taking business away from the trading floor of traditional stock exchanges.

In the old days, information services mean only news services, but now they provide complex analysis and even complete the actual transaction accordingly.

¹S.W.I.F.T.-----Society for Worldwide Interbank Financial Telecommunications, owned by international banks. It operates the largest messaging network for funds transfer purpose.

Chart 2: The Financial Decision Cycle

OTC—over the counter transactions

The financial decision cycle is completed when the brokers or the stock exchange report the agreed price to Reuters, Telerate or Bloomberg, which then flash the price to their screens, for the next financial decision cycle to begin.

Binary nature of markets:

- *buyer and seller*
 - *payment leg and delivery leg*
-
-

The financial decision cycle forms an important component of the financial transaction cycle. Two separate financial decisions are undertaken by a buyer and seller until a transaction is struck at an agreed price and contract on terms. Thereafter, the transaction is brought to the stage of completion, when both parties are satisfied, namely, one party takes delivery of the goods bought, and the other party receives full payment. The transaction cycle therefore involves two legs, the delivery leg whereby legal title of the product is delivered to the buyer, and the payment leg, whereby payment by legal tender is transferred finally to the seller.

The financial decision and transaction cycles underpin all financial markets, from the simplest to the most complex. The more sophisticated financial markets have more products and more market participants, forming a complex network of different markets. Markets have become networks where buyers meet sellers, through intermediaries that help clear and settle transactions. As technology has improved, markets have become linked to each other through different channels, most commonly through the payments system.

Any network or structure has a distinctive architecture or topology. Failures in the market network often arise from structural weaknesses, or the linkages between two different structures, including possible failures in the foundations. Therefore, an understanding of the taxonomy of the key decision and transaction cycles would provide us with an appreciation where the weaknesses or risks in markets lie.

Consequently, building a strong financial infrastructure necessitates an understanding of the risks in financial markets.

Risks in Financial Markets

Every participant in a financial market faces numerous risks:

Counterparty risks	or sometimes called credit risks—the risk that the counterparty will not fulfill its part of the contract, such as payment or delivery of goods as promised.
Timing risks	Any financial transaction involves two principal parties, their agents and a time gap between contract agreement and contract settlement. The time difference between agreement (deal) and settlement to finality may introduce different elements of risks. Herstatt risk, which exists when transactions are settled between two different time zones, is an example of a timing risk.
Liquidity risks	the risk that one party will not be able to mobilise sufficient cash/legal tender to pay on date contracted. Liquidity risk should be differentiated from solvency risk, which is that one party is insolvent and will not be able to complete the contract.
Market risks	the risk of loss due to market changes, such as price, interest rate or exchange rate changes, that could be inflicted on either party during the transaction cycle.
Legal risks	the risk that the legal or regulatory framework does not protect one party fairly or sufficiently relative to one participant's understanding of the level of legal protection.

Herstatt risk arises because of the lack of simultaneity between payments systems in different time zones

Operational risks	the risk that the operational processes, including the telecommunications and technological platforms, fail or are disrupted, leading to losses.
Settlement risks	the risk that one of the settlement agents fails to deliver on time.
Systemic risks	the risk that the whole system which both parties use fails during the transaction process, when one party fails, so that other parties are unable to fulfill obligations when due.

Historically, different types of financial intermediaries and legal structures evolved over time to resolve or minimise some of the risks indicated above. In the British Corn Exchange, for example, the term “payment on the nail” was the first expression of *delivery versus payment* (DvP), since the seller would place the bag of corn on the large brass stand (the nail) at the same time the buyer would place the payment by coin. DvP avoided any chance of non-delivery of corn on payment on the part of the buyer and any fear by the seller that he would not be paid.

The Exchange was the physical meeting place of buyers and sellers, where the rules of transactions were agreed. Trade disputes were settled by the Exchange Council. As buyers and sellers sometimes were unwilling to travel long distances to visit the exchange, broker-agents quickly emerged to transact or negotiate on behalf of the principal buyers or sellers. The Exchange was a convenient place to exchange market information and to transact. Over time, the Exchange introduced designated warehouses, which became the custodians of trade merchandise. Transactions became standardised in terms of trade lots of agreed qualities (e.g. lots of 100 tons of cocoa grade A). Lawyers and accountants became located close to the Exchange to facilitate legal and accounting work. When payment evolved from coin to paper currency and then bills of exchange, banks and clearing houses were established close to the Exchange to facilitate payment or the provision of credit facilities.

As can be seen above, the major risks involved in financial transactions are counterparty risks, timing risks and operational risks. If counterparty credit risks are not a major problem, timing risks manifest themselves in the form of management of liquidity: the ability to mobilise cash to effect payment. In essence, the *asynchronous settlement lag* between delivery and subsequent payment creates major credit or liquidity risks that the counterparty will not be able to deliver goods on time or does not have the liquidity to pay on time. During that lag, any sharp market changes could induce severe solvency or liquidity risks on market

participants. Such market changes could be due to political shocks or natural disasters. In the modern environment of electronic trading, communication or system failures (operational risks) are also a major risk.

The Financial Transactions Cycle

The major challenge facing the development of financial markets is the non-synchronisation of different financial transactions cycles. Fundamentally, there are three basic transaction processes which underlie all commerce and payments, whether paper-based or electronic:

- Delivery versus Payment (DvP)
- Payment versus Payment (PvP)
- Transfer versus Payment (TvP)

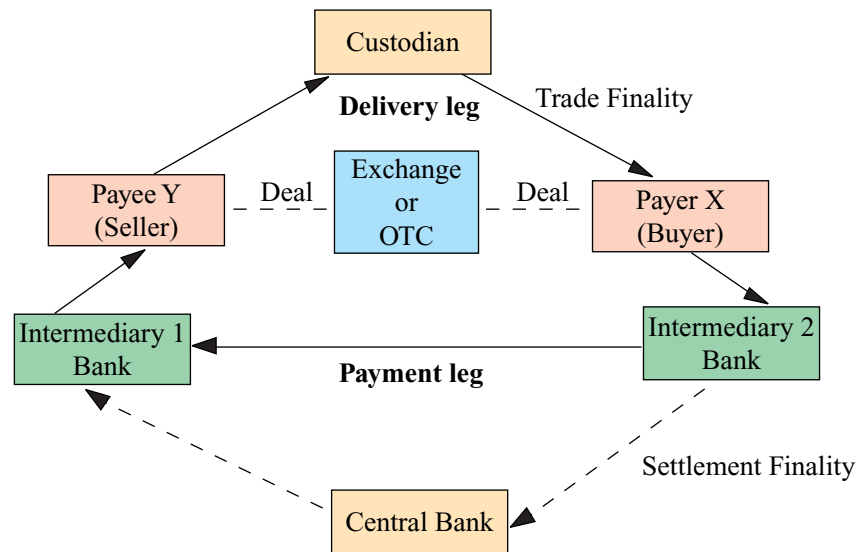
Delivery versus Payment

Because the stock market transaction cycle is different from the inter-bank payment cycle, an investor runs considerable credit and liquidity risks when he transacts in two different financial markets (with different transactions cycles). On the one hand, he is uncertain of the timing of bank receipts and payments, requiring him to maintain higher cash balances than necessary. On the other hand, he may be unsure whether his purchases of stocks or bonds would be delivered on time, so that he would be able to sell such assets to generate a continuous stream of liquidity. Where the investor is uncertain of both counterparty credit and the timing risk, the market is by definition inefficient and illiquid.

DvP, the ability to execute delivery and payment of a physical and financial product *simultaneously* removes the credit and timing risks associated with most transactions. When an investor has timing and delivery certainty, his liquidity improves. [Chart 3]

However, since financial products are *derivatives* of real products, being claims on property rights, there can be delivery of the property rights to real goods, without physical delivery of the physical goods. For example, a share certificate is a derivative of the real goods of a firm. Physical delivery of the share certificate would transfer the property right from one shareholder to the other, without physically dividing and transferring the underlying assets of the firm. This reduces the transaction costs of transferring *physical goods*.

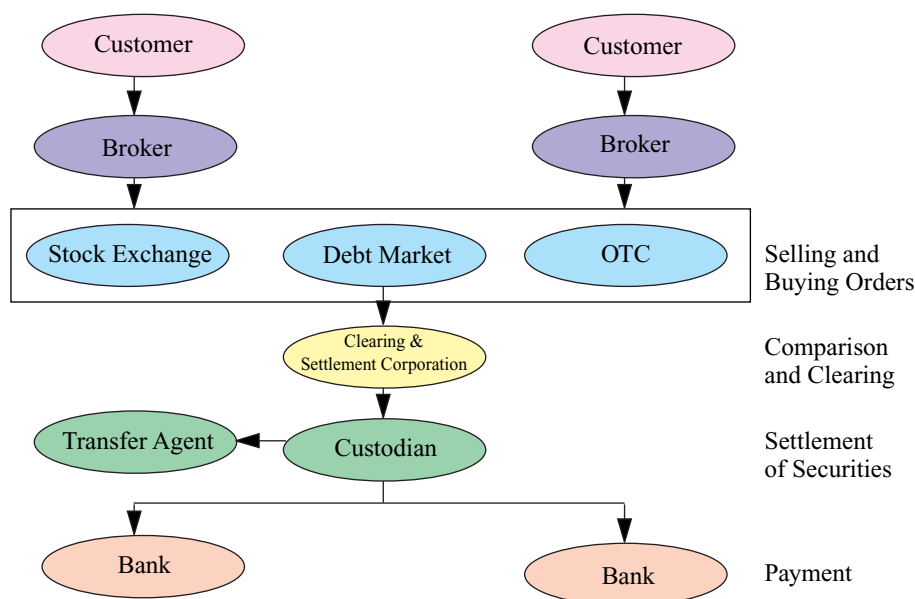
The Hong Kong Monetary Authority operates the Central Moneymarkets Unit system, which is now fully integrated with the funds transfer system and possesses real time DvP capability for debt securities settlement.

Chart 3: Delivery versus Payment Legs (DvP)

Transaction costs (and risks) can be further reduced by the *immobilisation* of the security, so that transfers are effected through *book-entry*. In other words, DvP can be achieved without physical delivery of the paper certificate, and rather by transfer of title across a centralised share register. A good example of immobilisation is warehousing of physical goods. The title to the goods is the Warehouse Certificate, the ownership of which can be transferred from one owner to another. Another example of immobilisation services is securities *custody services*, which banks and specialised financial institutions provide for their clients.

The lifecycle of a securities trade transaction has three phases: trade execution, trade clearance and settlement (Stehm, 1996). [Chart 4]

Chart 4: Hierarchy of Securities Market

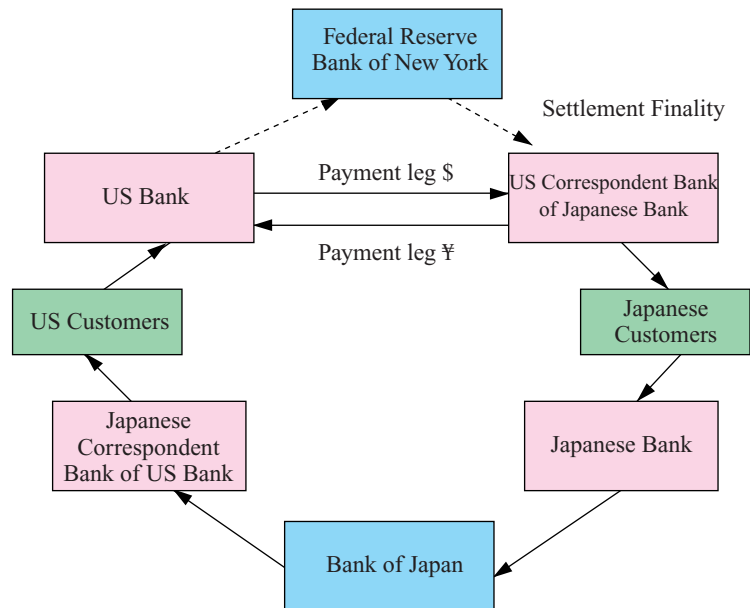


Payment versus Payment

Banks provide payment services, but all payments are related to an exchange of property rights, either a transfer of financial claims (security), physical goods (commercial transaction) or against another payment (such as a foreign exchange transaction). Since the foreign exchange market is the largest single market in world, trading roughly US\$1.3 trillion daily, PvP transactions are extremely important. Transaction costs in PvP can be further reduced if gross transactions are netted against each other, provided that the legal issues of netting can be resolved. [Chart 5]

Payment versus Payment (PvP)—to reduce or eliminate risk involved in foreign exchange transactions between different time zones.

The Exchange Clearing House Limited (ECHO), the first global foreign exchange clearing and settlement service launched in August 1995, claims that settlement risks can be reduced by as much as 97% by netting. So far, there are four major initiatives worldwide to introduce netting schemes in foreign exchange markets, FXNET, ECHO, Multinet and the Group of 20 (Bartko, 1996). These four major players have invested nearly US\$140 million to date on capital investment to develop robust risk reduction systems through netting.

Chart 5: Payment versus Payment Legs (PvP)***Transfer versus Payment***

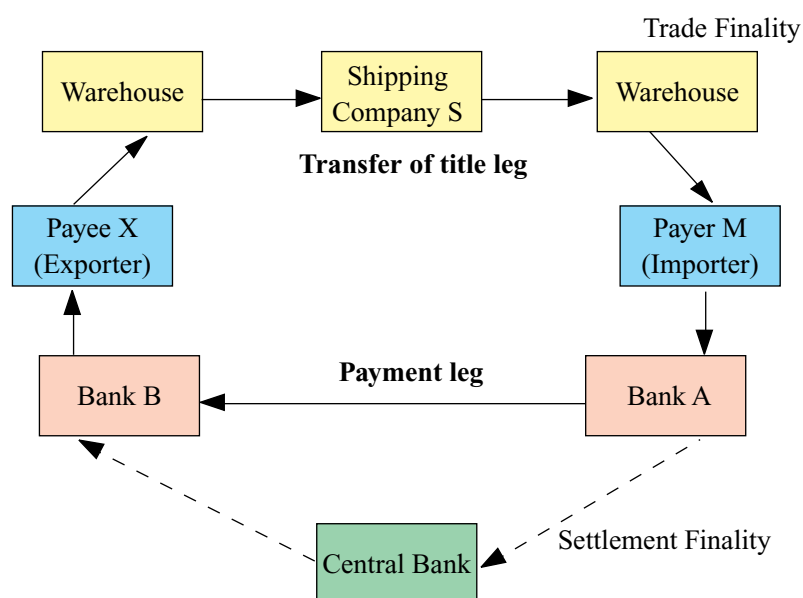
DvP and PvP typically involve very simple transactions whereby a single payment is made against the transfer of a single product. However, the ownership rights of a product may go through many hands before it is finally transferred from the ultimate seller to the ultimate buyer. This involves a complex series of transactions called Transfer versus Payment (TvP).

A typical TvP transaction is an international trade transaction between an exporter and an importer (Chart 6). The traditional international letter of credit (L/C) was invented to deal with the risks involved in such complex transactions. The credit and timing risks are handled as follows:

- Importer M issues letter of credit (L/C) through his bank A to the exporter X.
- X present L/C to his bank B to receive credit, and B advances credit to X against the L/C as collateral.
- Upon manufacture of goods, X delivers goods to Shipping Company S against a Bill of Lading (B/L). The B/L is presented to his bank B to evidence that X has fulfilled the delivery part of the contract.
- Bank B then remits the B/L plus L/C back to Bank A for collection of payment.

- Bank A pays Bank B on receipt of all documents, duly verified. Bank A debits the Importer according to terms of L/C, and Bank B pays the Exporter upon receipt of L/C proceeds.
- When ship arrives at destination, Importer M claims goods from ship upon presentation of B/L.

Chart 6: Transfer of title versus Payment Legs (TvP)



Property rights over goods may go through many hands before it is finally transferred from the ultimate seller to the ultimate buyer.

Even this simple trade example demonstrates the complexity of the transactions. In reality, even more participants are involved in the transactions, such as the insurers, shipping agents, warehouses, trucking companies, ports, customs, handlers and the like. At each stage of the transfer of property rights, obligations and liabilities are involved. The transfer of physical documentation can be extremely complex, both legally and operationally, resulting in delays, fraud and mistakes that are highly costly to eliminate.

Complex trade and financial markets demand a reduction in counterparty risks, operational risks and an agreed delivery or payment schedule. This accounts for the requirement to supervise or regulate intermediaries or participants in the transactions process. For example, regulation of financial markets require the licensing of brokers and minimum capital adequacy rules for those with access to key markets. Paper-based transactions were cumbersome, because the handling procedures were subject to fraud, delays or mistakes. Advances in computerisation

can speed up transaction and processing time and increase transaction volume, without sacrificing accuracy or reliability. However, because transaction cycles are determined by market practices and traditions, they are not synchronised with each other. In many instances, the non-synchronisation of transactions cycles, especially across time-zones, have led to market failures and contagion risks. For example, stock market transactions are settled on a T+3 basis, while cheques are cleared overnight. There is a timing gap in the morning, when CCASS has transferred title to stock transaction, even though the cheque relating to the share transfer may be returned overnight.

The asynchrony of different transactions and payment cycles can expose financial systems to large risks. Herstatt risk, whereby one currency is delivered in one time zone, while the other leg of payment is awaited in another time zone and currency, is currently the largest payment system risk in the global foreign exchange market. The inability of futures traders to raise sufficient cash to meet margin calls in the futures exchange because of a sharp fall in prices could trigger off problems in other financial markets.

The solution to remove asynchrony between delivery and payment is the institutionalisation of DvP, PvP, and TvP, which has been made possible through technology and the direct linkage of payment systems and securities clearing and settlement systems. The impact of technology on this is considered in the next Chapter.

In April 1997, the Hong Kong Monetary Authority (HKMA) and the Reserve Bank of Australia (RBA) have agreed that the Central Moneymarkets Unit of the HKMA will join RBA's Reserve Bank Information and Transfer System (RITS). This bilateral linkage will make cross system trading and holding of debt securities much easier.

Such linkages are still at a very preliminary stage of international discussions. Although central banks around the world are aware of the large settlement risks embedded in current cross-border transactions, there is little momentum to address this issue directly. The recent report by the Committee on Payment and Settlement Systems of central banks of the Group of Ten countries on Settlement Risk in Foreign Exchange Transactions (the Allsopp Report) recommended that central banks should foster satisfactory private sector action to control their foreign exchange settlement exposures.

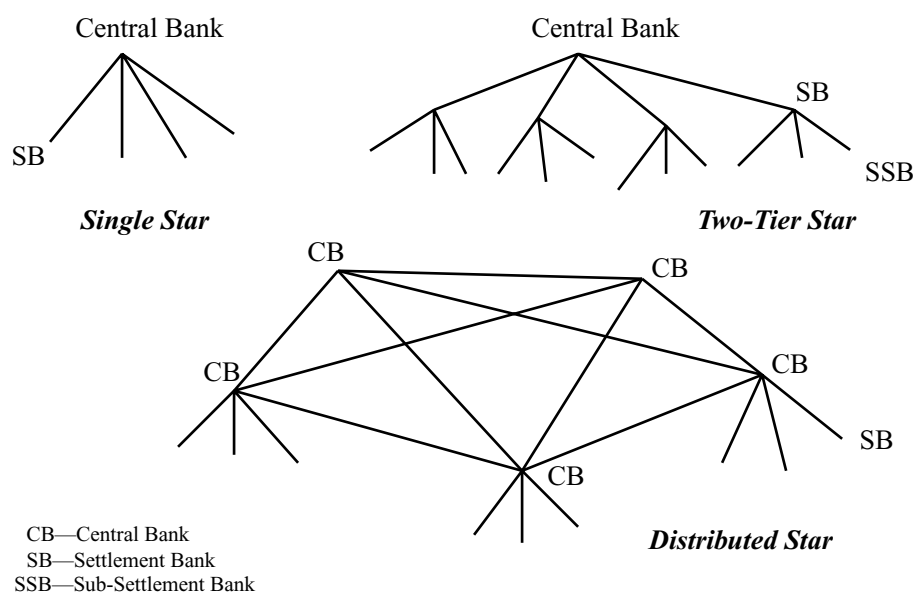
In the absence of concerted international efforts to foster linkages between different financial systems, there is a need to address the linkages between different domestic financial markets, so as to reduce risks.

The Topology of Financial Markets

A simple market with a central clearing and settlement system can be depicted as a **single star** topology, whereby each participant constitutes a node (or terminal) [Chart 7]. Each participant can transact to every other participant through the

central switch, which can also function as a netting or clearing centre. The single star topology is typical of a city-based cheque clearing house, where each commercial bank opens a single account with the central bank at the clearing house, e.g. Hong Kong.

Chart 7: Payment System Topology can be single star, two-tiered or even multi-tiered



In a country which has regional clearing houses, the topology of the payment system can be either two-tiered or even multi-tiered, with clearing done sequentially, first at local clearing, and then regionally, before ultimately settling across the central bank's books.

For example, even the design of the message flows between the banks and the central bank carries different operational and risk implications. The simplest design is a *V-structure*, where the sending bank sends the payment and settlement message to the receiving bank through the central bank. The settlement (final money) arrives together with the message. A *Y-structure* involves some message stripping with the settlement message being sent to the central bank, which confirms settlement before the payment message is sent to the receiving bank. This is the design adopted by the Hong Kong and French RTGS systems. Some queuing of messages and payment is done at the clearing house. The British CHAPS payment system adopts an *L-structure*, whereby the message is sent first to the central bank and only after the central bank confirms settlement is the payment message sent to the receiving

Design of Hong Kong's Real Time Gross Settlement System:

Settlement System:

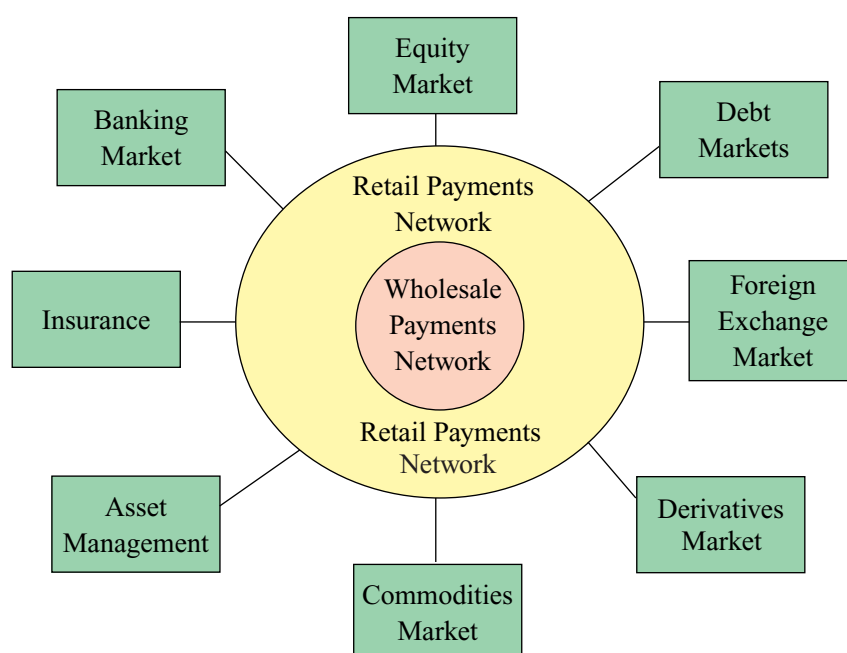
- *Y-shaped topology*
 - *Single-tier system*
 - *Real time settlement across the books of the HKMA*
 - *Intraday funding through same day repo*
 - *Queuing mechanism*
 - *Real time DvP and Pvp capabilities*
-

bank. The *T-structure* sends the full message to the receiving bank before confirmation of settlement by the central bank, so that a settlement lag occurs. Further details of different topologies can be found in Vital, 1995.

Modern telecommunications and network technology, however, enables market participants to simultaneously communicate with other participants. Complex financial systems could mean that there are distributed exchanges across the country or even internationally, that are linked in real-time with each other. Some clearing could be done at local centres, while others are done bilaterally or multilaterally at other centres in different time zones. For example, in the United States, 12 Federal Reserve Banks would clear payments in their respective regions, but since they are linked to each other through Fedwire on a real-time basis, the 12 banks act as if there was only one reserve bank. Each licensed bank therefore needs to maintain only one reserve account with the Federal Reserve Bank system, rather than 12.

The payment system topology discussed above applies to all kinds of financial products. For each group of financial products, there is a network of market participants that uses a particular platform to process that group of products. The “trade” network is ultimately linked to the “payments” network, since trade transactions have to be settled. Indeed, a financial system can be depicted as a group of different product networks with overlaps in participants who ultimately settle through the payments system [Chart 8]. As financial products become more complex and individual traders transact in a variety of products, the portfolio shifts can put considerable pressure on liquidity, as market participants require funds to ensure that they settle their transactions in finality, before executing the next transaction. Thus failure of one product network could spread to other product networks via the payments networks.

The product networks and payments networks in Chart 8 are not restricted to local operations. As communications improve, markets expand both geographically and in terms of time zones. For example, as long as investors are not constrained by legal or regulatory barriers, they would be interested to trade in stocks in neighbouring stock exchanges. Thus, markets tend to expand from a local region across international barriers. Similarly, the rise of international telecommunications has facilitated global financial markets.

Chart 8: The Topology of Financial Markets

Our approach of recognising financial markets as networks is gaining greater acceptance (Honohan & Vittas, 1996). There are three characteristics of networks which are relevant to the understanding of financial markets: externalities, structural redundancy and complexity. First, because networks have externalities (i.e. they are a public good), unregulated networks can be highly inefficient because of potential failure inflicted on participants. All participants have incentives to ensure that there are common rules and standards that maximise usage. Networks that are not well regulated will tend to fail.

Second, because of networking, failure of a node or segment could lead to failure throughout the network (the contagion argument). As a result, robust networks by definition have significant redundancy, or excess capacity, as well as duplication of lines or production capabilities, in the event of failure in one area [the need for backup].

Third, because networks tend to grow and are adaptive, it is difficult to predict the impact of intervention in one area on other areas. Financial systems and networks are therefore complex systems, that make regulatory design difficult to implement.

Indeed, financial markets are not single networks, but multiple networks with different nodes, hubs, connections, switches and operating cycles. Precisely because markets have different cycles and connections, they become vulnerable to inter-network failure.

The trend is that exclusive and closed networks will always lose out to open networks, because they are not convenient enough.

The best example of network externalities is ATM networks. In 1985, more than 40% of all 60,000 ATMs in the US were proprietary networks that restricted users to exclusive networks. By 1995, almost all of the 120,000 ATMs in the US belong to shared networks, where one card-user can have access to cash through any ATMs. Closed networks lost out to open networks, because consumers wanted maximum convenience, not limited access. Indeed, as users discovered, the value of the networks increases as it grows (Teitelman & Davis, 1996).

The growing size of networks also creates “convergence”, as users and producers adopt the same standards and practices. Convergence generates economies of scale, by reducing inefficiencies, eliminating unnecessary protocols and utilities. As Teitelmann & Davis recognises: “Convergence is part of the growth dynamic of networks: The drive for efficiencies create larger networks with stronger externalities. Networks converge to protect themselves.”

Another superb example of the economies of scale of networks is the S.W.I.F.T. story. From a co-operative venture of 200 banks in 1973, S.W.I.F.T. currently serves 5,000 financial institutions worldwide through its proprietary network covering 130 countries. In 1995, S.W.I.F.T. carried 603 million messages with a daily traffic of 2.3 million valued at an estimated US\$2-3 trillion daily (Schrank, 1996).

Retail card networks are also growing in size globally. The Eurocard/Mastercard network covers 10.6 million merchant outlets in 220 countries, with access to a global ATM of 124,000 machines (Red Book, BIS, 1993). Presently, Visa and its 20,700 member financial institutions serve over 13 million merchants and 561 million cardholders worldwide. Visa also operates the Visa Global ATM Network, with more than 323,000 ATMs in 109 countries.

The two major international depositories and settlement institutions in the international securities markets are Euroclear and Cedel. Their combined turnover in 1995 amounted to roughly US\$200 billion per business day. As transactions of securities markets accelerate in volume and value, the linkages between domestic clearing, settlement systems (or Central Securities Depositories, CSDs) and global CSDs become more and more important. The issues are not only complicated by different technical standards of operation, but also legal standards, regulations and design architecture.

Understanding the topology of financial markets highlights the issue that many markets are not efficiently or robustly linked with each other. Asynchronous settlements requires participants to maintain high liquidity and to time the transactions cycles in a way that the participant is always able to fulfill his contractual obligations. However, unanticipated shocks, such as a sudden market price movement, or non-delivery of value by another counterparty could result in market “gridlock”. The inability of one party to pay another leads to a chain reaction that escalates to other markets. Of course, to the extent that there are barriers between markets, failure in one could “shield” another market from contagion. However, since investors, issuers and market participants are already operating in different markets, the failure of one major market participant would increase both counterparty and liquidity risks, leading to a shock wave throughout different financial markets. Similarly, failure of operating platforms in one system would generate a high level of uncertainty and lack of information which would increase the demand for liquidity and hence shocks for other markets.

Since liquidity is fungible, and participants rely on liquidity in one market to fund transactions in another, it is vital that we look carefully at the financial technology infrastructure linking different financial markets.

Market liquidity and Standardisation

Information services, information technology, legal and other ancillary services all form part and parcel of the services that comprise the financial market. Markets function on the basis of efficiency and integrity. Efficiency is represented by the low transaction costs involved and the speed and accuracy of transactions, while integrity concerns the robustness of a transaction - the certainty that there is good legal protection, credit risks of market participants are low, and that the process of transaction would be honestly carried out with credibility and certainty. Business would migrate away from financial centres which did not deliver both efficiency and integrity.

Financial markets are judged not only by their efficiency and integrity, but also by their liquidity. The question of liquidity is related to product standardisation. Because information is accelerating in terms of quantity and quality, financial transactions become simplified when dealing with standard products and uniform practices and procedures. More complex transactions are priced off various standards. The market requires benchmarks and indices to “represent” its complex behaviour. Standardisation of information and products facilitates transactions and engenders liquidity. In more recent jargon, markets encourage “commoditisation”.

The liquidity issue is closely related to the question of standardisation of financial products, practices and procedures, including technology standards.

The evolution of global financial markets cannot be divorced from the standardisation of markets, products and processes. The fact that the US dollar is the major reserve currency encourages global trade, pricing and settlement in US dollars. As markets converge and integrate, there is greater harmonisation of trade practices, documentation, pricing and even prices. For example, the international bills of exchange documentation has been harmonised under the International Chamber of Commerce (ICC) Uniform Bill of Exchange rules.

Just as the US Treasuries yield curve constitutes the benchmark standard against which all US\$ yield curves are priced, there is today emerging legal, operational and computer standards in international financial markets. The OECD has suggested guidelines on how such standards should be fostered (see Box 1).

As transactions increase, clearing, settlement and payment will increasingly concentrate on hubs or networks which are recognised as robust, efficient and in compliance with internationally accepted standards. The Group of Thirty analysed five alternative models of clearing, settlement and custody of the global securities business (Group of Thirty, 1993). These are: the multi-access model, Worldclear, global hub, global CPU, and bilateral links.

Multi-access model: This is the present system of one or more CSDs in each country, with multiple local custodians, global custodians and market participants. The system offers a variety of channels for market participants, being flexible, adaptable and competitive. The major disadvantage is that multiplicity of processes and procedures does not allow participants easy access to some markets. Friction costs can be large because of different processing times and cycles, different laws and tax rules.

Worldclear: This is the centralised model, with a single global CSD to perform domestic, foreign and international business. Although it would co-exist with domestic CSDs, and enjoy massive economies of scale by reducing friction costs, the major disadvantage is that it concentrates risks in one single body. There would be large development costs in order to standardise all protocols and systems, and politically it would be impossible to agree on location, funding and legal status, as well as regulatory control.

Box 1 OECD Recommendations
The Process of International Standardisation

International standardisation should proceed according to the following principles:

- the standardisation process should be market driven and voluntary, based on an open process in which everyone with a stake in the issue can participate
- formal standardisation efforts should focus on aspects relevant for interoperability of products and services
- the contributions of industry-led consortia, fora and other ‘informal’ bodies in providing technical input into the formal standardisation process should be recognised and encouraged
- the importance of intellectual property rights as a means to protect investments in the development of new technologies should be recognised, but fair competition among market players should also be maintained
- government intervention should be limited to areas where regulation is essential—for example, where safety considerations are at stake
- users should be encouraged to organise themselves, so that they can play their appropriate role in the process
- government should promote the adoption of international standards in preference to national standards whenever possible; as users, governments should also act as role models in referencing internationally established standards in public procurement policies.

Global Information Standards & Infrastructure

- identify the targets to be met in terms of critical interfaces at an early stage
- draw up a credible implementation scheme including specific targets, timetable and distribution of tasks
- ensure that appropriate collaboration and consultation of interested parties are maintained throughout the development process
- monitor the development work to alert relevant bodies to progress achieved, possible delays and new standardisation challenges resulting from technological advance
- If necessary, launch and maintain special initiatives to gain the requisite consensus for rapid agreement on the timetables and goals that will promote the necessary changes

Role of Governments

- draw up guidelines on governments’ own role in the standardisation process
- interact with standardisation efforts in a non-directive way that safeguards their open and voluntary nature
- monitor the implementation of fair and non-discriminatory standards, so as to avoid possible distortion of free competition in the market

New Mechanisms

Since many standardisation bodies believe that their own programmes of reform are capable of meeting new challenges effectively and that further mechanisms and procedures are unnecessary, the group of experts from industry appointed by the OECD has made the following recommendations:

- interested parties should set up a central body to co-ordinate activities worldwide
- there should be a clear division of labour, including accurate and readily available specification of the responsibilities of committees and working groups
- standardisation work should be monitored so that information is readily available on who does what and where
- there should be more user participation in the choice of areas where standards are required, in the definition of priorities and in the assessment of results
- modern methods (network communication, for example) should be applied to the development of standards and the dissemination of specifications so that all interested parties can participate
- standardisers should adopt a code of conduct
- appropriate standards-related programmes should be provided in professional education

Source: Georges Ferne, “Compatibility for Data Transmission”, OECD Observer, June/July 1996

Global Hub: This assumes the creation of a single, global CSD that would be a central CSD for domestic CSDs. The Global Hub opens bilateral links with domestic CSDs, allowing transactions between the Hub and the domestic CSD. The domestic CSD would continue to act as custodian for domestic securities. As the Hub would not have any other participants other than domestic CSDs, it would not be seen as competitive to domestic business. It would reduce multiple interfaces, and enable clearing and settlement through the domestic CSDs via the Global Hub. However, the Hub cannot reduce pipeline liquidity risks and would concentrate risks in the Hub.

Global CPU: This model assumes that there is a central computer to process all the computer functions of the national CSDs, with the domestic CSDs providing the safekeeping, clearance and settlement functions. As a centralised processor, it may increase economies of scale, but would not reduce pipeline liquidity risks.

Bilateral links: Under this model, each domestic CSD would establish bilateral links with another CSD in pairs. Similar to Worldclear and Global hub, this model enables market participants to clear and settle through their domestic CSDs, thus eliminating multiple interfaces. However, it does not appear that pipeline liquidity risks would be eliminated.

In summary, the G30 Report concluded that “the development of a single global clearing facility was not practicable”. However, global “agreement on a set of practices and standards that could be embraced by each of the many markets that make up the world’s securities system was highly desirable”. In particular, there are obvious benefits for a smaller financial system to follow international standards, rather than devising standards of its own. The group’s nine recommendations, as amended by ISDA is shown in Box 2.

The next chapter looks at the impact of technology on financial markets and the importance of standardisation along with the Internet technology.

Box 2 G-30 Recommendations on International Securities Market Compliance Standards and International Society of Securities Administrators (ISSA) Revisions

G-30 Recommendations/ISSA Revisions

- Recommendation 1** All comparisons of trades between direct market participants (i.e. brokers, broker/dealers, and other exchange members) should be accomplished by T+0. Matched trade details should be linked to the settlement system.
- Recommendation 2** Indirect market participants (such as institutional investors and other indirect trading counterparties) should achieve positive affirmation of trade details on T+1.
- Recommendation 3** Each country should have in place an effective and fully developed central securities depository, organised and managed to encourage the broadest possible direct and indirect industry participation. The range of depository eligible instruments should be as wide as possible. Immobilisation or dematerialisation of financial instruments should be achieved to the utmost extent possible.
- If several CSDs exist in the same market, they should operate under compatible rules and practices, with the aim of reducing settlement risk and enabling efficient use of funds and available cross-collateral.
- Recommendation 4** Each market is encouraged to reduce settlement risk by introducing either Real Time Gross Settlement or a trade netting system that fully meets the “Lamfalussy-Recommendations”.
- Recommendation 5** Delivery versus payment (DVP) should be employed as the method of settling all securities transactions. DvP is defined as follows:
Simultaneous, final, irrevocable and immediately available exchange of securities and cash on a continuous basis throughout the day.
- Recommendation 6** Payments associated with the settlement of securities transactions and the servicing of securities portfolios should be made consistent across all instruments and markets by adopting the “same day” funds convention.
- Recommendation 7** A rolling settlement system should be adopted by all markets. Final settlement for all trades should occur no later than T+3.
- Recommendation 8** Securities lending and borrowing should be encouraged as a method of expediting the settlement of securities transactions. Existing regulatory and taxation barriers that inhibit the practice of lending and borrowing securities should be removed.
- Recommendation 9** Each country should adopt the standard for securities messages developed by the International Organisation of Standardisation (ISO Standard 7775). In particular, countries should adopt the ISIN numbering system for securities issues as defined in the ISO Standard 6166.

Source: G30/ISSA.

Chapter 4

Information Technology and Its Impact on Financial Markets

Introduction

“Electronic/information revolution will not replace physical commerce and industry. But it will radically change the way it is done. First, transaction costs are driven down to very low levels. That means that transactions which were previously only wholesale in nature can now be retail. Critically, it makes the location of the counterparty irrelevant.”

Tim Jones, Mondex project leader

Technology has been a major contributor to the development of financial markets. Although banking markets came into their own with the invention of double-entry bookkeeping in Italy in the 14th century, growth in the volume of financial transactions was constrained by the physical burden of paper-based transactions and the capacity to communicate information. Global markets first became a possibility with the electronic transmission of information, through the invention of the telegraph and telephone. Once information could be reduced into electronic form, large amounts of financial information, as well as value, could be processed and transferred across markets.

Technology has also allowed financial markets to transcend both time and space, but have not totally solved the question of risks. By linking local markets through networks, technology has created the global market. Technology has flattened the hierarchy of business by cutting out inefficient layers of middlemen, so that the producer can reach directly to the consumer. Technology therefore has “empowered” the individual consumer and producer, by increasing his access to information, his capacity to process that information and to reach out directly to other consumers and producers almost without restraint.

With the continued rapid advancement in technology in the recent years, the financial markets are posed to make quantum leaps in delivering new and higher value services. This chapter examines the key elements of technology development and their critical impact in financial markets.

The Convergence of 5 C's—Computing, Communication, Content, Cost, and Critical Mass

The French network pioneer Albert Bressand first identified that, what he called the “electronification of finance”, was made possible by the rapid development and convergence in **computing** and **communication** technology. These innovations have created the power, capabilities and price performance for new knowledge-based **content** in products, generating new institutions, and creating a global market. Because **costs** were brought down by improvements in speed and efficiency, there has been a radical change in transaction behaviour. However, knowledge-based economies depend on a **critical mass** of complementary technology, services and skills in order to generate competitiveness. Without open access to new information, knowledge and innovation, financial systems could lose their competitiveness rapidly in a global, borderless financial world.

The following paragraphs first survey the recent developments in technology effecting computing, communication, content and cost that shape the evolution of markets; next they look at the implications of technology advances in future financial markets; and finally examine the importance of the **critical mass** in the development of an international financial centre, where knowledge-based markets, built on highly sophisticated financial networks must be linked with global markets in order to survive or thrive.

Recent Developments in Technology

There are several key trends in the development of information technology (IT) and telecommunications that have impacted the growth of financial markets.

Computing The wide-scale introduction of the personal computer (PC) in the early 1980s brought the power of computing to the mass-market level, enabling individual access to data and computing capability significantly in advance of manual calculators. With the thousand-fold improvement in microprocessor chips in terms of memory, processing speed and cost, the combination of PCs and mainframes have been able to increase the ability of individuals to digest massive amounts of information and to execute financial transactions in bigger volumes, faster and more robustly. New technology like RISC (Reduced Instruction Set Computing) has continued to accelerate processing speed. The improvement in computing capacity enables human creativity to develop new products and services, while at the same time serving a wider market. This trend will continue in the foreseeable future.

“The coming era of digital personal communications is an era of converging technologies, converging products, converging media and converging industries.”

*Eckhard Pfeiffer,
Compaq Computers*

Communications Advances in telecommunication has made the world closer, because networks of computers at the firm level are increasingly being linked together, so that networks can “talk” to each other. The de-regulation of the telecommunication industry in the 1990s has allowed global networks to become inter-linked, so that the expansion of LANs (Local Area Networks) and WANs (Wide Area Networks), with commonly agreed protocols have evolved into a global Internet [network of networks]. As competition among phone carriers intensified, telecommunication prices were driven down while services, line capacity and quality improved. As more and more systems utilise high quality fibre optic communications, the bandwidth of data communication has improved to provide multi-media capabilities.

Content Technology has allowed information to be shared widely, readily and quickly. It has created a knowledge-based economy¹. World-wide, information technology has quickly been absorbed into households [Table 1]. Consumers can have direct access to multi-media information through CD-ROMs or through Internet libraries. They are demanding not only knowledge content products, but also interactive services. Computer chips, with artificial intelligence, are integrated into “smart” products.

Table 1: Diffusion of Information Technologies, 1994

% of households

	US	Japan	UK	Germany	France
<i>The development and diffusion of information technology are central to the evolution of knowledge-based economy.</i>					
User Terminals					
Personal Computer	37	12	24	28	15
Video Cassette Recorder	88	73	84	65	69
Video Game	42	–	19	8	20
Fax	–	8	2	4	3
PC modem	15	–	4	3	1
Network Infrastructure					
Digital main lines ¹	65	72	75	37	86
House with cable	65	–	4	47	9
House passed by cable	83	–	16	56	23
House with satellite	–	27	11	20	2
– not available					
1. 1993					
Source: OECD					

In future, “smart” house would have burglar and fire alarms, appliances and lighting controlled from an outside phone or a keypad. Maps and directions are readily available in a smart car. Smart tires will adjust the tire pressure based on the road and weather conditions. These are just a few examples of the knowledge products and services.

In a knowledge-based economy, fixed assets are less important than the collective “brain-power” of a firm’s software, employee skills and access to knowledge.

¹Candice Stevens, “The Knowledge-driven Economy”, The OECD Observer, June/July 1996

Software companies like Microsoft depend on the creative power of its employees to make the company grow. In the knowledge-based economy, capital will become more and more a function of knowledge. To be successful, a company has to have the ability to attract, retain, and continually grow the capabilities of knowledge workers, and to provide the environment for innovation and creativity. The same is true for an industry, a financial system or an economy as a whole.

Miniaturisation In the past, computer terminals were located at fixed locations. However, with the development of powerful new microprocessor chips and lightweight material, as well as cellular phone technology, PCs and communication units have become smaller and more portable. With miniaturisation has come mobility. Transactions terminals are not tied to fixed locations, allowing even the most remote locations to have access to powerful databases and engage in market transactions. Americans have 39 million portable phones and 34 million pagers. Miniaturisation also made possible for smart cards to contain information and have processing capabilities.

Digitisation The digitisation of information, by de-materialisation of paper documents into electronic data, transformed the traditional ways of doing business. Old paper-based procedures became obsolete, eliminating the need to physically move paper evidence of property rights with every transfer of ownership. De-materialisation saved space, time and costs. Computerised book-entry systems allowed electronic trading of securities that handled volume which was unimaginable under paper-based systems. In the US, cash payments still account for the bulk of transactions, but the value of electronic transactions exceeds cash payments by about 250 times [Chart 1].

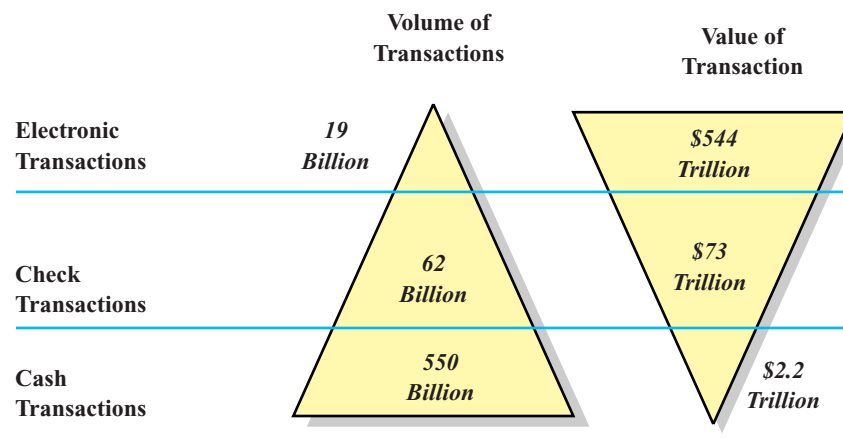
Digitisation also allows the production of high quality graphics and multi-media presentations, since content can now be integrated with computing and communication. Contents include text, voice and image, and can be interactive. The result is the evolution of an effective multi-media technology.

User-friendly Interface Until recently, data entry used to be limited to the keyboard, already an advance compared with paper data entry cards. The invention of the joystick, mouse, touch screen, light pen and direct voice input-output has made the computer much more user-friendly. Improvements in computing power, fuzzy logic and voice-interfaces enable us to point and click; listen and respond to voice; or just touch the screen to effect a command. This broadened the access of the computer to the less technical and less sophisticated users, thus immediately widening the market for computerised equipment.

Technology means that size and capacity are heading opposite directions; falling for the former and rising for the latter.

Client/Server Environment and Java Technology Until recently, PCs, fully equipped with a whole range of software, were usually used either as standalone devices or as terminals connecting to shared host computers. The power of PCs has not been fully utilised. This was wasteful of high cost software and equipment. Since the mid-1980s, client/server applications have been built to distribute certain processing from the shared host computer (server) to the user PCs (client), thus making possible more efficient use of the PCs. Advances are being made in the design of Network Computers (NC), which will reduce the need for storage in PCs, thus their costs. The invention of the Java programming software enhances such a paradigm. Java allows interactive applications to be run on different hardware platforms and it allows for creation of software components which are easier to debug, maintain, and replace. Increasingly, Java has become the industry standard. Consumer electronics makers are making microchips to run Java and over 10 million are expected to sell annually by the year 2000. Microsoft is working to make Windows programmes easily portable into Java, while IBM is also investing over US\$200 million (HK\$1,546 million) per year on Java.

Chart 1 : US Payments



In the US, high-valued payments are predominantly made on electronic basis.

Source: NACHA

Encryption Security has always been a serious concern to all users of computers and communication facilities. Simple password and access controls have been widely used to protect information from being accessed by intruders. However, data can still be tapped when it is passing through the communication lines. The practice of data encryption has been adopted to prevent such intrusions. In recent years, more and more sophisticated algorithms have been devised that make

encryption cracking more difficult. The latest encryption algorithm is as long as 1024-bit. Even though no encryption algorithm is 100% decryption proof, it could take years to break such an algorithm.

Message Standards Communication is facilitated if there are common message standards, with the recipient using the same data format as the sender. This requires agreement between sender and recipient on the structure of files and individual data formats. In the last three decades, two major groups of specific standards have emerged in the financial field, namely, S.W.I.F.T. and EDIFACT message standards for national and international standards organisations and user groups from commerce, industry and commercial services. On average, about 600,000 MT 100 S.W.I.F.T. messages are exchanged every day around the world. EDIFACT has two important advantages: global validity of the EDIFACT standards and the very extensive multi-industry range of transactions for which message types are available. There are currently 40 message types for use, such as payment order and credit and debit advice in banking or the invoice and order for commerce and industry. Another 160 message types are presently under development.

Standardisation facilitates the high-speed transmission of large volume of data.

Internet / Intranet / Extranet The Internet, often referred to as the network of networks, has gained global acceptance [Box 1]. It has established itself as the de facto standard for universal connectivity. Basically, any computer can be accessed by anybody anywhere in the world if the computer is “linked” to the Internet. The number of persons with accounts on Internet is estimated to jump from almost nil in 1990 to nearly 160 million by the year 2000. To ensure safety and security, organisations are also building Internet within the corporation, called Intranet [Box 2]. To allow data exchange with other commercial concerns under a secure and reliable environment, corporations are also building what is called Extranet [Box 3].

Multi-media Multimedia products, such as banking and shopping via computers and television, will become increasingly important for the consumers. One estimate suggests that Asia will consume roughly 25% of all global demand for multimedia products by 2000 (Asymetrix Asia, quoted in Asian Cyberspace, 1996).

The Web and the Global Markets

Markets need information to thrive. The hypertext linkage of information enabled users to exchange and transmit information through the Web, and to search, browse and extract information readily. Although the Internet was initially the brainchild of specialist users in research institutes and universities, its universal application, geographical reach, and low cost of usage quickly exploded as small businesses, conglomerates and even telephone companies, realised their commercial potential. As its inventors, Tim Berners-Lee envisaged, the Web is both a communication medium, a framework for computing knowledge and ultimately, a robust, scalable and adaptive infrastructure.

“In five years, every business in the world will need the Internet connection just as much as they need their voice net connection today”,

Dr James Clark, Netscape

Box 1 Internet

The Internet or Net is a global network of small local area networks (LAN) linking together over 50 million users for electronic mail and information exchange purposes. Originally designed by the US Defense Department in 1957, its use proliferated in universities and research institutes. But it took off after a British scientist, Tim Berners-Lee working in a Swiss laboratory invented the World Wide Web (WWW) in 1989, which allowed the user-friendly linkage of databases. After Marc Andressen of Netscape created the Web browser software Mosaic in 1993, where information could be accessed easily through graphics, the usage of the Internet enjoyed exponential growth. One estimate thinks that there will be over 100 million users by the year 2000.

Because LANs use leased lines for communications, the Internet allows usage at marginal or very low costs, attracting millions of users who search for information or products for consumer, entertainment or personal interest. Producers also realised the commercial value of the Internet by creating HomePages of information on their products, enabling Internet users to cut out the middleman.

Some of the benefits of Internet include:

- low entry costs for the consumer and supplier
- easily accessed around the world
- email is easier and faster than postage, enabling exchange of documents & graphics
- environmental friendly, less paper is used

However, security on the Internet is not yet proven. Although electronic commerce or finance, such as banking or shares trading, are already available, fraud or damage by hackers does exist. In the UK, the Securities and Investment Board (SIB) warned investors of credit risks posed by firms which are not authorised by the Financial Services Act Regulator or any other Government Authorities and yet offer financial trading of stocks. In Asia, the average Internet user is young, well-educated and has a higher than average income. 61% users have higher education and 33% are professionals. For example, 46% of Hong Kong users are aged between 20 and 29 with a median personal annual income of around HK\$220,800 (US\$28,380) and predominantly male. Only 8% are females which seems to follow the international trend. Unlike the US senior citizens, Hong Kong retirees rarely use or surf on the Internet for recreational purposes.

Because the Internet is evolving rapidly, its future shape and form is uncertain. For example, most people envisage the Internet as linking PCs to PCs. However, depending on the bandwidth available, the easiest interface may be from a

multimedia TV/Web to supplier to Web TV. Cable TV and telephone companies, as well as satellite providers are competing against each other to provide such user-friendly interfaces and services, from Video-on-demand to Homebanking.

Box 2 Intranet

Intranet can be thought of as an exclusive form of Internet. Microsoft's Bill Gates defines Intranet as "the merger of traditional corporate LANs with Web-type capabilities, making use of past investment while adding the powerful searching and publishing facilities which have emerged with the arrival of the Internet. Directory security, groupware and business applications will all reside on the Intranet." In other words, a staff of a firm can access its core IT systems through the Net via a telephone line, modem, the right type of computer equipment and security access codes.

The benefits of Intranet include:

- ability to access private company information on the net, e.g. announcements, newsletters, telephone directories
- strengthen communications between employers and employees
- ability to store, extract, and update the company's database
- save company money, being environmentally friendly
- satisfy employees as information becomes more visible and transparent
- enables virtual employees, i.e. the option of working at home or anywhere around the world, without being physically at the office

Installing Intranet will require tight security since Intranet will become a significant corporate tool that is user friendly and easy to access. Secure Intranet also avoids excessive Net traffic, which may cause overloads due to high usage.

The Delphi Intranet Report suggests that Intranets have moved beyond information sharing platforms to become strategic business development networks. Whereas the use of Intranets were nonexistent in 1994, 37% of organisations surveyed already have 75% of their desktops linked to an Intranet. 97% of companies surveyed intend to use Intranet as a medium of collaboration, seeking business partners.

To date, two-thirds of Fortune 500 corporations and thousands of other companies have already established Intranets.

*Extranet – the third wave
of Internet Evolution.*

Box 3 Extranet

Extranets, a term coined by Marc Andressen of Netscape fame, can be thought of as part of a company's *Intranet* made accessible to other companies to facilitate business links with suppliers, customers, and support services on a secure basis. It is a new form of business-to-business marketing. Example of software products which support Extranets include Lotus Notes and Netscape Communications.

Extranet is an improvement over *Internet*, because access to information and security can be controlled. In other words, participating users can determine who and what are accessed. Extranet also gives the industry the flexibility to incorporate additional users and organizations over time. It is easy to install, setup, and maintain.

Security and privacy can be obtained either by ensuring transmission lines were privately owned or leased or by using the Internet with password authorisation. Companies are reluctant to trade through Internet because they cannot verify the suppliers' or the customers' credentials or credit ratings, which may cause instances of fraud. Extranet users employ the same data security and protection measures, enabling secure transmission and transactions.

Companies like IBM, Hewlett-Packard, Sprint Communications and Texas Instruments have already installed Extranet. Internal information such as "Purchase Order Management, Order Tracking, and Product Development" are easily accessed by their strategic partners. People can shop and transact right at home once they are given access to the Extranet.

Technological Trends

These advances in technology point towards certain key trends that generate new financial services. Some of them are outlined below:

From narrow band to broadband The invention and deployment of fibre optic cables in place of the copper cables have allowed the quantum increase in capacity for electronic communications. The quantity, hence quality, of information delivered along any communication channel depends on the bandwidth (or transmission capacity). The higher the quality of data transmission, such as multi-media, voice, video, animation and three-dimensional images, the wider the bandwidth. Currently, Internet text and telephone use narrowband, requiring a traditional data rate of 56 or 64 Kbps (under 1 Mbps). Normal quality television or video conferencing requires a wideband of 1.5 Mbps, while the highest quality imaging would require broadband of 10 Mbps and above.

In the United States, fibre optic cables currently link the main telephone network, but the final linkage to homes still uses copper wire. US telephone companies do not see full conversion to all-fibre cables until 2010 or 2015. Efforts are also being taken to install fibre cables to home, including Japan, Singapore, Malaysia, and Hong Kong.

From single media to multimedia With the availability of transmission capacity from narrowband to broadband, applications can include voice, image, video, in addition to the traditional text, making the services richer in functionality and more user-friendly.

From mass to customised communications With the advances in circuiting technology and the deployment of Internet technology, communications can be customised and interactive.

From insecure to secure Advances in cryptographic technology and the adoption of standards have formed a basis for secured communications and message exchange, allowing electronic commerce to become a reality.

From closed network to open network The arrival of Internet has accelerated the adoption of communications standards based on open network.

“An Evolution”

Development	Operations Centres	Standards Used	Systems/ Infrastructure	IT Environment
1970 Local 1974 Herstatt 1980	Each branch independent	Paper (SWIFT)	Paper based clearing systems	Batch
1981	Centralised in Ops.Ctrs. per country	Local formats and SWIFT	Electronic clearing (CHIPS, SCC) ACH's	On-line integrated systems
1991 Global	Global operations centres	SWIFT & EDIFACT	Global multi-currency solutions	Client server architecture applications. Internet

Evolution to quality services.

Source: Jörg Auer, 5th Int'l ACH Conference, 21-23 May 1997

These trends suggest clearly the arrival of a viable technological environment that will have far-reaching impact to the economy, including the financial markets.

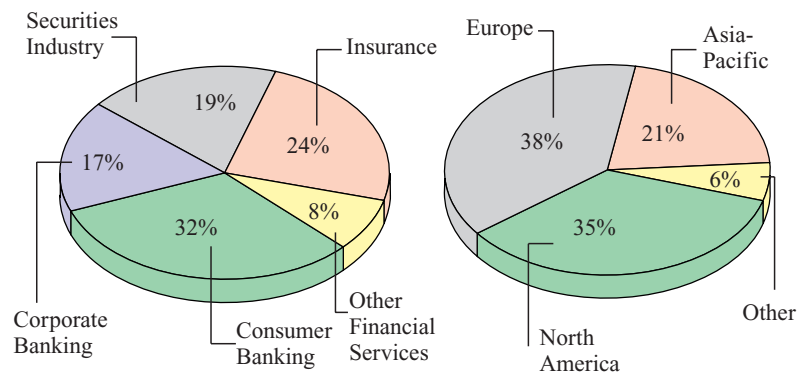
Impact on the Financial Markets

*"Banks are dinosaurs.
Give me a piece of the
transaction business and
they're history"*

Bill Gates, Microsoft

Information technology spending in financial institutions has increased sharply. In 1996, spending on information technology in the financial services sector totalled over US\$150 billion (HK\$1.2 trillion) globally and is expected to continue to grow at a fast pace [Chart 2]. Such large expenditures mean that information technology has become crucial for firms in the financial services.

Chart 2: Financial Services Industry spends much on Information Technology
Global Total in 1996: US\$150.9 billion

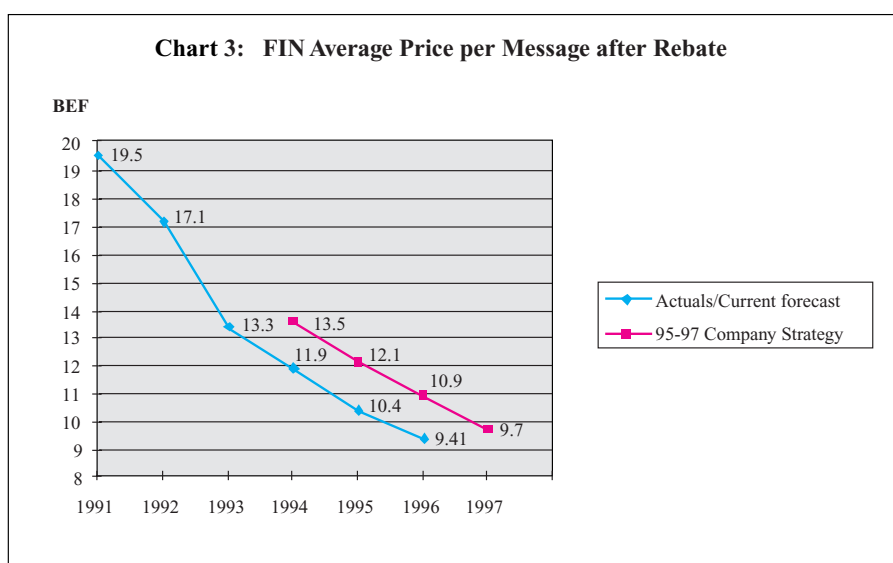


Source: Financial Technology International, 28 April 1997

This section considers the areas where technology has influenced the growth of financial markets.

Costs

The most vivid illustration of the impact of technology on financial markets is cost. According to American Banking Association, the cost of an ATM transaction



is US\$0.27 (HK\$2.1) versus US\$1.07 (HK\$8.3) per transaction provided by a banking branch. Costs have come dramatically down as innovation has brought down dramatically computing and communication costs [Chart 3]. The costs of information processing per millions of instructions per second (MIPS) has fallen from US\$100 (HK\$770) on mainframe in 1975 to 1 cent using a Pentium-chip PC (Economist, 1996). Moore's Law, enunciated over 30 years ago, stated that the cost of a given amount of computer power drops 50% every 18 months. Such dramatic decline in computing power expands the market size in intelligent products that uses computing power.

The lowering of costs has been helped also by the deregulation of the telecommunication industry worldwide. The cost of a transatlantic telephone call was US\$250 (HK\$1,933) in 1930 (in 1990 dollars) and only \$2 (HK\$15.5) in 1996. As the transmission mechanism involved high fixed costs in cables, transmitters and satellite, greater usage lowered marginal costs. Today, internet cross-border telephone calls are considerably cheaper than calls through licensed telephone companies, offering increasing competition in the telecommunications business. Such dramatic reduction in costs make products such as teleconferencing more and more affordable at the retail level, linking more and more smart appliance through the Internet.

*Technology drives
transactions cost down.*

Virtualisation

As information shifts from paper form to machine-readable format, and then from analogue to digital, physical information became virtualised, in the sense that action can take place even when the actor is physically in another time zone or geographical location. The virtualisation of information, work processes and procedures has transformed traditional work behaviour and relationships, as well as the structure of organisations.

“The virtual corporation is an entity with research, development, design, marketing, financing, legal and other headquarter functions, but a few or no manufacturing facilities; a company with a head but no body.”

Richard Rosecrance

Virtual workers are people participating in one location or country’s economy while physically residing in another. This has removed the necessity of shifting highly skilled workers physically to another location when foreign direct investment is made. For example, the US computer industry utilises cheaper labour in Malaysia or Thailand for the manufacture of computer chips. The knowledge-based skills, such as chip designers and quality controllers, can still reside in the US, where they can supervise production through direct multi-media communications as if they were present at the factory site. The classic example of a Virtual Economy is Hong Kong, whose companies employ more than 3-4 million workers in Southern China, larger than its domestic work force. Another example is that Citibank has relocated its global financial software development and maintenance centre to Bangalore, because software programming skills are plentiful in India. Suites of computer programmes are written in India, based on specifications developed in the US.

In the financial industry, virtualisation has transformed the concept of branch banking. Banks who operate on the Internet need not maintain many branches that are physically located in the neighbourhood of customers. The First Security Bank, operating solely on the Internet, was the first to be granted a bank licence to start business in the US. Stockbrokers are now moving on to the Internet to provide direct stock quotes and which trades can be executed directly on the Internet.

Decentralization /networking

Earlier mainframe technology required massive amount of fixed investments in computers and telecommunication networks. This argued for centralized computing. The development of the PC, laptops, smart cards and mobile phones has allowed small enterprises to reach the global market cheaply and quickly, giving new competition to the large multinationals. Even highly centralized, bureaucratic corporations will decentralize and decompose into smaller and more flexible clusters of work units. Organizational structures will flatten, removing layers of intermediate management. Back-office functions become integrated with the front-line service providers, so that the organisation as a whole is closer to the

needs of the consumer. The “centre “ becomes molecular in structure, with each unit being connected through an Internet or Intranet to provide a total business solution and offer “one stop shopping”. The Internet has become a global network where computation and information storage takes place throughout the net, being used where it is most needed. It is both flexible and innovative, without the cumbersome inflexibility of centralised computing.

Internet has also levelled the playing field. Big is no longer beautiful. Competition can come from the smallest business because it can have access to markets which were previously dominated by large corporations with huge distribution networks. Small businesses can seek alliances and partnership skills through the Internet. The small businesses can also ally themselves into fluid groups that can compete with larger organisations. Flexibility and creativity, as well as speed of delivery, empowers small businesses on the Internet to compete also on costs. Smaller units do not require the huge operating overheads of large conglomerates.

In the financial industry, the Internet allows smaller financial institutions to compete with larger institutions by reaching out directly to the consumer, which is becoming more and more computer-literate. These smaller banks and stock brokerages may provide specialised products and services, that are directly tailored to the needs of their customers. Through the Internet, they can have access to the same clearing houses and custodians as the larger institutions.

Disintermediation

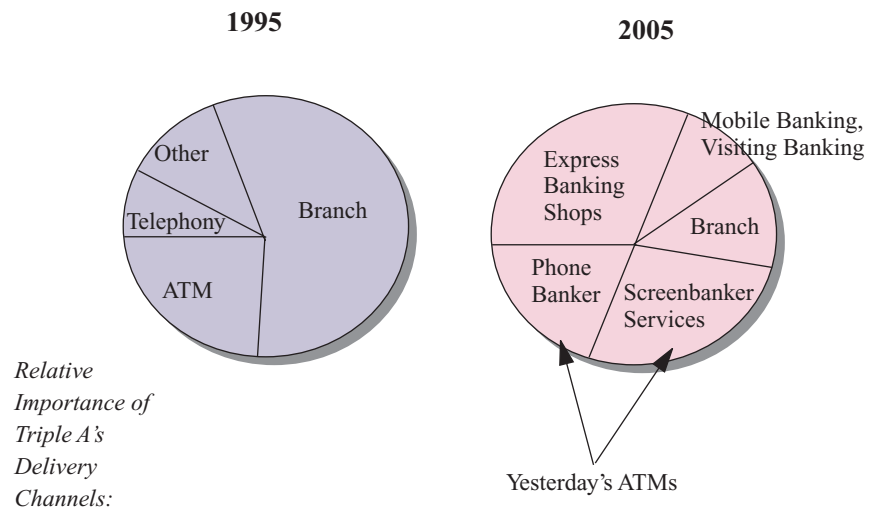
Since consumers and producers can interact based on the knowledge obtained on the Internet, the middleman functions are becoming redundant. The intermediation function will have to be re-designed to create and add value to the products or services offered to customers.

For example, the US giant retail department store Wal-mart achieved critical mass and low selling prices through bulk purchase from manufacturers by demanding consignment sales and small margins. With Internet, manufacturers can put up their products on the Web and allow customers to shop directly. Shopping on the Web is cheaper and more convenient for the consumer since they can have access to product information direct on the Internet from their homes. It is estimated that by 2000, 32% of online shopping will be for computer products, 24% for travel, 19% for entertainment and 25% for miscellaneous consumer goods.

*Internet: Network of
networks*

In the financial industry, discount brokers have existed for several years. Innovation allows new intermediaries to occur, by either under-cutting fees charged by traditional intermediaries, or by-passing the intermediaries altogether. Screen-based trading, for example, totally obviates the need for floor-based trading. Banks do not need many branches, because most customer transactions can be done on the ATMs or through phone-banking [Chart 4].

Chart 4: Relative importance of the new delivery channels



Innovation

Technology creates markets

The rapid transmission and availability of new information through the Web drives new products and services. Innovation is the key driver to reform, because products and services are continuously being made obsolete by new competition.

For example, Microsoft dominated the desktop operating environment software with DOS and Windows 3.X. It had to continuously innovate by introducing Windows 95, and Windows NT. In the early 1980s, WordPerfect dominated the PC word processing market, while Lotus 1-2-3 had the spreadsheet market, which were both DOS-based. Once graphical user-interface (GUI) appeared with Windows, PC users quickly switched to Microsoft Word and Excel, which were Windows-based.

Competition has worsened because the late-comer effect has endowed new players with rapid access to new technology, without old intellectual baggage and bad habits. Late-comers are able to catch up fast with good access to markets, skills and resources.

In the financial industry, software producers like Microsoft are teaming with credit card companies to enter into the Internet shopping business. The banking sector can no longer believe that its market share will be secure with a group of loyal customers. As AT&T enters into the credit card market with the Universal card, banks are beginning to realise that new players can exploit their dominance in certain sectors by introducing new services that would undercut them in both prices and convenience.

With quicker access to more and better information, technology also brings about better evaluation tools and techniques for data screening, decision support, pricing, risk management and portfolio structuring. This enables financial entities to provide valuable, comprehensive and sophisticated services.

Instantaneity

Instant data retrieval under virtual production enables key decisions and action to be taken with no time lags. Enquiry, analysis, decision, execution and reporting are all done in real-time. Gone are the days when the customer had to wait for days before he had an answer on product quality or the delivery status. A responsive firm will have to respond to consumer queries quickly and directly. Otherwise, other competing firms will be able to offer a better and faster service.

Product life cycles have also been shortened considerably. In the past, major products took several years from the stage of conceptualisation to production and marketing, before competitors could respond. Computerisation and telecommunications enabled the Japanese management innovation of “just-in-time” production and minimal inventory costs. Manufacturers are designing and producing goods on a real-time basis. Marketing outlets monitor consumer demand on a real-time basis, so as to reduce inventory and order-delivery lags. Just-in-time techniques have integrated the whole production to marketing cycles, which was physically impossible under manual processes.

In the financial industry, financial innovation in the trading room and payment services meant that the global foreign exchange market has become the largest market in the world, with a daily turnover of \$1.3 trillion, or roughly one-quarter of annual world physical trade turnover. Real-time settlement for large payments

*Instantaneity gives
business a competitive
edge.*

were made possible by the computerisation of high value inter-bank payment systems. The volume of securities trading has also escalated with computerised stock clearing and settlement systems. Program trading has been in practice for more than a decade, with stock trades being executed by the computer based on instant market data feed.

*24-hour global trading
made possible through
technological advance.*

Globalisation

Global telecommunications, with growing universal standards in computing has meant that geographical boundaries are now meaningless to international network connections. The virtual corporation operates without border constraints, as designing, manufacturing, distributing and marketing are located where it is best suited economically and managerially. The virtual corporation reaches out to global consumers through the Net.

Because the virtual corporation can draw on expertise around the world, each corporation may not need the resources to develop its own technology. However, strategic partnerships, alliances and joint ventures based on technology have to be formed for competitive survival. These alliances distribute the risks of venturing into new grounds and using new technology. Services will have to be provided on-site 24 hours a day and seven days a week. Products will have to be tailor-made for local conditions, but production, design and distribution could be done globally.

The financial industry is already developing along these lines. Mergers have already occurred in the major financial centres, as universal banks have brought in niche players to ensure that they obtain strategic technology and market access. Trading is done on a 24-hour basis, with key offices in key financial centres monitoring the major markets. Saloman Brothers, for example, transfers its global book when the New York office closes, to Tokyo and then London.

Banks are also beginning to look at the potential for Internet banking. Software houses, such as Microsoft, are looking at the payment potentials.

Critical Mass—the 5th “C”

To maintain and generate competitiveness, effective deployment of technology is necessary but not sufficient. It requires attaining a **critical mass** of complementary technology, services and skills in order to generate competitiveness. Without open access to new information, knowledge and innovation, financial systems could lose their competitiveness rapidly in a global, borderless financial world.

As can be seen from Table 2, Hong Kong has a critical mass in supporting services for the financial sector, which accounts for its success as an international financial centre. The importance of maintaining critical mass in supporting services in knowledge industries, a prime component of the financial sector, cannot be overstated.

Chapter 5 reviews the evolution of Electronic Commerce and Electronic Payments to examine how these would have an impact on Hong Kong's future development as an international financial centre.

With the service sector accounting for 84% of GDP, Hong Kong possesses the critical mass in supporting its status as an international financial centre.

Table 2: Current Performance Indicators of 14 major Service Industries

Services	Value added (1995)		Employment (1996)	Other Indicators (as of 1996 unless otherwise specified)
	(HK\$ bn)	(% of GDP)		
Air Transport Services	18.6	1.8	23,000	<ul style="list-style-type: none"> • one of the world's busiest airports • aircraft movements increased 5.8% to 159,000 • handled over 1.56 million tonnes of cargo, valued at HK\$593.8 bn • 29.6 million passengers passed through the terminal • 66 airlines provided scheduled services to Hong Kong, operating some 1,400 direct trip scheduled services weekly between Hong Kong and over 100 cities
Banking Services	81.9	8.0	80,000	<ul style="list-style-type: none"> • 182 licensed banks with 1,476 local branch offices • 368 deposit-taking institutions and 157 representative offices of overseas banks, coming from over 40 countries • 80 of the 100 largest banks in the world had a presence in Hong Kong
Computer and Related Services	2.4	0.2	9,000	<ul style="list-style-type: none"> • growth rate of the local computer market in 1995 (11%) compared favourably with that of Singapore (11%) and Taiwan (9%) • 70% of the custom software used in Hong Kong was locally developed (1994)
Film Entertainment Services	2.2	0.2	6,000	<ul style="list-style-type: none"> • 116 local films and 298 foreign films screened, generating HK\$657 mn and HK\$1.2 bn respectively in cinema receipts • more than HK\$340 mn worth of videotapes, laser discs and other compact discs were exported • ranks first in the world in terms of per capita production

Services	Value added (1995)		Employment (1996)	Other Indicators (as of 1996 unless otherwise specified)
	(HK\$ bn)	(% of GDP)		
Financial and Fund Management Services	16.7	1.6	55,000	<ul style="list-style-type: none"> • world's seventh and Asia's second largest in terms of stock market capitalisation • Hang Seng Index rose 34% in 1996, the second biggest increase in the Asia-Pacific region after Taiwan • 583 listed companies, with total market capitalisation of HK\$3,476 bn (+48%). Average daily turnover of the Stock Exchange of Hong Kong was HK\$5.7 bn • important centre for raising capital for China: 23 Chinese state-owned enterprises raising more than HK\$26.9 bn • the Hong Kong Futures Exchange recorded a 13.9% increase in total turnover. This compared favourably with the 6.9% drop in the Singapore International Monetary Exchange, and the 2.6% decrease in overall volume of the Chicago Mercantile Exchange • outstanding amount of Hong Kong dollar debt securities was HK\$281.4 bn, or 24% of GDP • one of the world's most liquid government debt markets: about 25% of Exchange Fund papers changed hands daily • leading fund management centre in Asia: 87 authorised fund houses and home to the Asia-Pacific Headquarters of over 35 international fund houses
Import and Export Trade Services	186.0	18.3	524,000	<ul style="list-style-type: none"> • eighth largest trading economy in the world • handled HK\$2,933 bn in goods, representing an increase of 3.5% in total value over 1995 and 431% higher than the figure for 1986 • offshore trading services and other trade-related services generated about HK\$70 bn in total receipts in 1995, an increase of 22% over 1994

Services	Value added (1995)		Employment (1996)	Other Indicators (as of 1996 unless otherwise specified)
	(HK\$ bn)	(% of GDP)		
Insurance Services	13.4	1.3	25,000	<ul style="list-style-type: none"> highest number of authorised insurance companies in Asia: 223 authorised insurers of which 123 were incorporated overseas 6 of the world's top 10 insurance companies have branch offices or subsidiaries in Hong Kong Asia's fifth and world's 24th highest premium income. Gross premium income increased by 12% to HK\$43.8 bn in 1995 (annual average growth rate between 1991 and 1995 was 19%) 19 insurers operated nearly 60% of Hong Kong's 15,000 occupational retirement schemes, covering about 10% of the workforce and investing about one-third of Hong Kong's retirement funds highest number of qualified actuaries in Asia (108)
Land Transport Services	27.3	2.7	140,000	<ul style="list-style-type: none"> served more than 10 million passenger journeys a day cross-border land traffic between Hong Kong and China registered a growth of 11% in passenger traffic and 5% in vehicular traffic the Cross Harbour Tunnel is one of the world's busiest four-lane road tunnels, used by an average of 124,000 vehicles per day Hong Kong has the busiest roads in the world, registering a vehicle density of 273 vehicles per kilometre of road at the end of 1996
Maritime Transport Services	18.0	1.8	55,000	<ul style="list-style-type: none"> one of the world's busiest and most efficient ports first in container throughput: handled 13.3 mn TEU of cargo in 1996. Throughput tripled since 1989 and is likely to triple again by the year 2016 200 shipping lines serving the port shipping register recorded a 7.8 million gross registered tonnage

Services	Value added (1995)		Employment (1996)	Other Indicators (as of 1996 unless otherwise specified)
	(HK\$ bn)	(% of GDP)		
Professional Services	27.4	2.7	79,000	<ul style="list-style-type: none"> 9,100 professional firms, including 1,300 accounting and auditing firms; 1,100 solicitor and barrister firms; 2,200 engineering firms; 300 architect firms and 3,000 management consultant firms
Real Estate Services	100.0	9.8	74,000	<ul style="list-style-type: none"> one of the world's most active real estate markets: average of about 840 transactions in property every day 1.8 mn registered property owners (+4.1%) 4,500 registered estate agency companies, slightly lower than the figure of about 4,700 in 1995
Telecommunications Services	26.2	2.6	38,000	<ul style="list-style-type: none"> among the world's highest telecommunications usage: 54.8 telephone lines per 100 population and 17.6 radio pagers per 100 population. Four local fixed telephone operators provided over 3.4 mn telephone lines ranks second in the world in terms of facsimile lines per 100 business lines: 307,000 dedicated facsimile lines compared with 13,000 in 1986 one of the world's highest penetration of cellular phone services: over 1 mn mobile phones average of 268 minutes of International Direct Dialing calls per Hong Kong person, compares with 60 minutes for the US, 53 minutes for Australia and 13 minutes for Japan

Services	Value added (1995)		Employment (1996)	Other Indicators (as of 1996 unless otherwise specified)
	(HK\$ bn)	(% of GDP)		
Tourism, Convention and Exhibition Services	n.a.	n.a.	80,000*	<ul style="list-style-type: none"> gross tourism receipts totalled HK\$84.5 bn number of visitors reached an all-time high of 11.7 mn about 700 conventions with international participation were held, with average number of delegates for each meeting at about 115 second most popular convention venue in the region outside Japan: among international meetings recognised by the Union of International Associations that took place in Asia, 8.5% were held in Hong Kong average per capita expenditure for overseas participants for convention or exhibition was HK\$24,286 in 1995, approximately three times that of a vacation visitor growing popularity as a venue for large-scale trade shows: utilisation of the exhibition halls at the Hong Kong Convention and Exhibition Centre was 67% in 1995
Wholesale and Retail Services	50.6	5.0	294,000	<ul style="list-style-type: none"> about 70,000 wholesale and retail establishments
TOTAL	570.7¹	56.0²	1,482,000	

* 80,000 people were employed in jobs dedicated to serving visitors/tourists and another 280,000 in businesses which may have a considerable proportion of their customers being visitors/tourists

^{1&2} both figures exclude tourism, convention and exhibition

Source: "Hong Kong at Your Service: Final Report of the Government Task Force on Services Promotion", The Hong Kong Government, 1997

Chapter 5

Electronic Commerce and Electronic Payments

New Directions in Electronic Finance

In the financial sector, two key trends are emerging: electronic commerce and electronic money. The path towards globalisation and electronic financial markets has not been linear. Growth in financial markets has been exponential, mainly because of the advent of technology. Chart 1 shows the key trends in global financial markets. The Eurodollar/Eurobond markets took off in the 1960s with the arrival of Euroclear, the first computerised book-entry debt clearing and settlement system. By the 1970s, as the US\$ floated and the whole world entered a flexible exchange rate regime, foreign exchange market volume increased. Growth in the OECD equity markets created opportunities for the development of automated equity clearing and settlement systems. The 1980s witnessed the Mexican debt crisis, and also the London Big Bang, and financial deregulation generated a flood of funds from the OECD markets. In the 1990s, deregulation in telecommunications, innovations in financial products, including derivatives, created a truly global financial market. As Internet commerce was invented and took off, the world is likely to witness global electronic commerce and electronic payments in the 21st century.

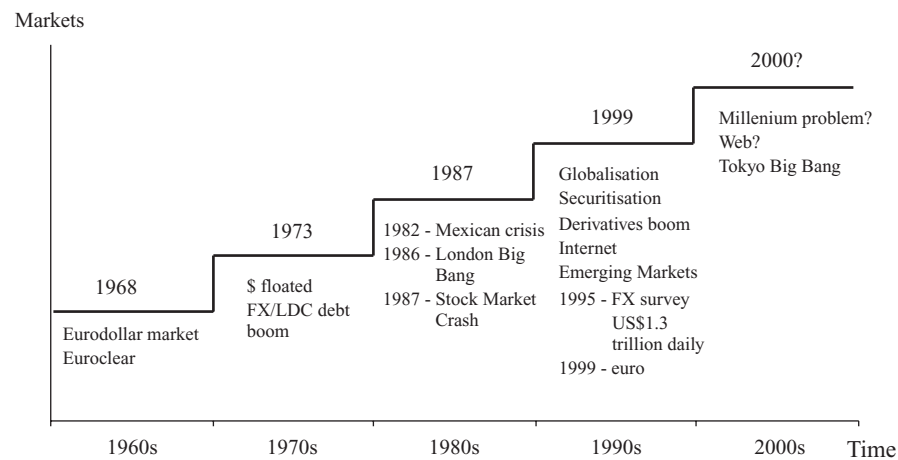
The pattern of financial markets has also changed with time. Chart 2 illustrates how markets have deepened in terms of geographical span, types of products, different players and sophistication of value-added services. In terms of markets, the mature markets in the OECD have now extended to newly emerging markets of Asia and Latin America. The core products of deposits offered by banks have widened to equities, mutual funds and derivatives, moving away from Exchange traded products to OTC (over-the-counter) transactions. In terms of players, disintermediation has resulted in trading more and more at the individual level. Value-added services have become more and more sophisticated with improved computer analytics, from services provided previously only to the large houses towards the retail investors.

"We are heading towards an Information Marketplace, in which people and their interconnected computers will buy, sell and freely exchange information and information work"

Professor Michael Dertouzos, MIT Lab for Computer Science

"As electronic commerce will involve multiple industries at the same time, the regulatory system may need to be reviewed. Finally, in order to actually implement electronic commerce, a new management must be developed."

Mamoru Ishida, NTT

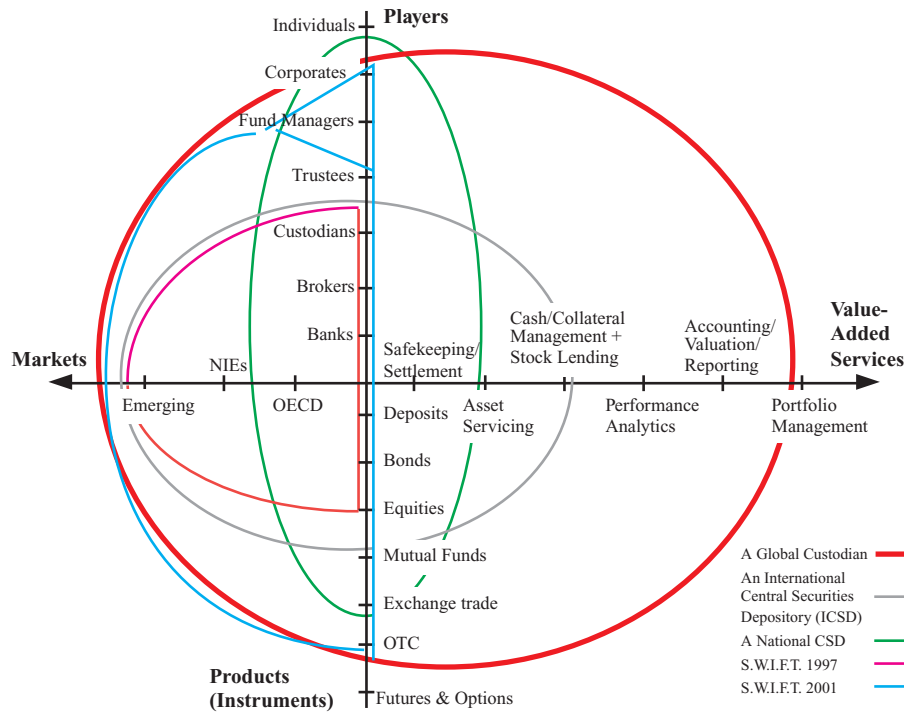
Chart 1: Global Trends in Financial Markets

Electronic Commerce

Electronic Commerce is a breakthrough to lower the costs of operations for businesses.

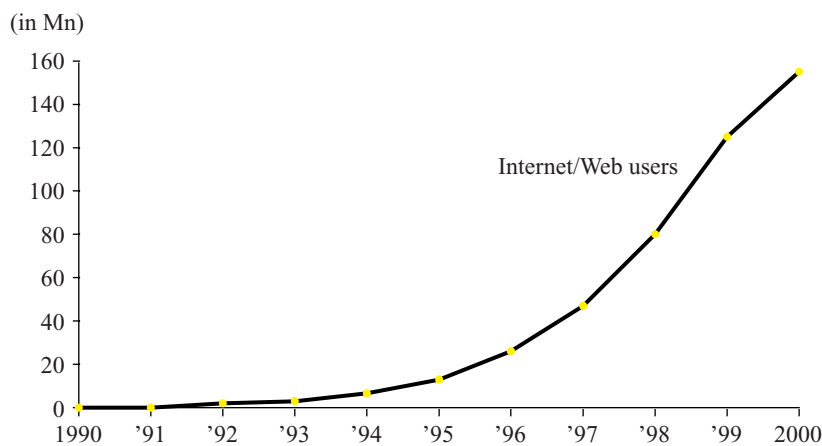
Electronic commerce is defined as business conducted through electronic networks, avoiding high-cost paper-based transactions. Electronic commerce can be wholesale business, such as computerised dealing and trading in foreign exchange markets, or retail, such as buying and selling on the Internet. Electronic commerce has been made possible by the large number of PCs connected to either an Internet or Intranet. The US is the leader in electronic commerce, with 24 Internet connections per 1,000 people in early 1996, compared with five in Europe and two in Japan (Economist, 28 September 1996). On-line advertising revenue was US\$3.5 million (HK\$27 million) in Europe and US\$2.6 million (HK\$20 million) in Asia in 1996, but is expected to grow to US\$13.7 million (HK\$106 million) by 1997 in Europe and US\$10.9 million (HK\$84 million) in Asia (ASWJ, 1997). Electronic commerce can involve either trade in goods or services. Commerce on the Internet is estimated to produce retail sales of US\$4 billion (HK\$31 billion) by the year 2000. The number of Internet/Web users increased from almost zero in 1990 to 14 million in 1995 and is expected to expand by more than 10 times since then to almost 160 million by 2000 [Chart 3].

Chart 2: Global Market Expansion in terms of Geographical Span, Product Types, Players and Sophistication of Value-added Services



Source: Adapted from Kirby, SWIFT, November 1996

Chart 3: Internet banking: On the verge?



Sources: Morgan Stanley Research estimates; Booz, Allen & Hamilton, quoted in Institutional Investor, August 1996

Electronic Commerce on the World Wide Web

Along with the growth in the Internet market, there will be a rise in the number of teleworkers, which, in turn, implies that there is a great potential for electronic commerce.

Various estimates calculate the global electronic commerce market amounts at around US\$370 billion (HK\$2.9 trillion) in 1995, and the figure will probably double by 2000 [Chart 4]. Forecasts of electronic commerce by 2005 vary from US\$1.6 trillion to US\$2.2 trillion (HK\$12.4 trillion to HK\$17.0 trillion). The share of electronic commercial transactions is estimated to rise from 5% of total transactions in 1995 to 16% in 2000 or nearly one-fifth by 2005. The share of electronic financial payments will grow from 15% currently to one-fifth by 2000 and probably one-third by 2005.

Recent surveys suggest that the Internet Market is growing faster than expected. The US already has 40 million Web users in 1997, nearly one-fifth of all adults. The users are divided 60:40 in terms of gender and tend to be higher paid and better educated than the average population. 45% of Web users are aged 40 and over. About one quarter have already bought or used the Web to buy products or services. In Japan, there are about 7 million Internet users (Business Week, 1997). In the UK, there are already 3.5 million Internet users and it is estimated that by 2005, some 40% of households will use home banking facilities through the Internet.

Electronic commerce will therefore grow as a result of the growing number of teleworkers, i.e., workers or entrepreneurs who prefer to operate out of their homes, instead of commuting daily to work. There are more than 50 million small office/home offices (SoHos) in the US, Europe and Japan. It has been estimated that by 2000 more than 30 million people in the US and 55 million people will "telecommute". In 1995, there were only 1.25 million teleworkers, about half of which worked in the UK (FT, 1996).

Since electronic commerce is a wide field, this chapter will look only at electronic commerce in the area of financial services. Specifically, we will examine whether the trend of electronic processing of financial services, such as stock trading, towards the retail level, would have implications on Hong Kong.

According to a recent survey by Ernst & Young, the number of financial services companies using the Internet to process transactions is expected to surge, from 13% of the surveyed financial services companies to 60% in 1999. A growing number of institutions are starting their experimentation of Internet transaction processing, especially those in the US.

An example where non-traditional intermediaries have reached out to the retail market is the Fidelity International Liquidity Network (ILN). Fidelity is one of

the largest mutual fund managers in the world, and has traditionally been a user of stock-broker services rather than a provider. The ILN is a combination of a computer matching and order routing system, whereby investors may submit orders to buy or sell, where these could be matched against orders from other customers, including Fidelity's own retail customers.

On the Internet, another trend is that financial conglomerates are emerging to provide the whole lot of services all under one roof. Brokerage companies such as Charles Schwab now allow customers to obtain investment information, buy/sell securities and mutual funds, and even to access a cheque account electronically—all done via the Internet. Charles Schwab offers these services under the brandname of "e.Schwab". These discount online brokerage business is booming; in March 1997 the firm claimed that about 700,000 of its accounts (one-sixth of the total) had conducted at least one online trade during the past year. It is estimated that assets worth US\$111 billion are already managed by e.Schwab, and that the figure will rise to \$474 billion by 2000 (Economist, 10 May 1997). This kind of service is becoming more popular and competitive as well. Already more than 30 discount brokers are offering online trading accounts at rates that match or undercut e.Schwab.

In Hong Kong, electronic services for the speeding up of financial services include work on Tradelink [Box 1] and Electronic Trade Confirmation (ETC). Tradelink facilitates trade-related services, but is not integrated with the payment leg. In the securities market area, the Hong Kong Securities Industries Group (HKSIG) is working on the elimination of paper in stock market transactions, which would not only save labour costs, but also reduce the elapsed time between telephone (dealers) and hard copy (clerical) confirmation of trade deals. Once ETC has been achieved at the wholesale level, it should be easier to extend such services, if needed, to the retail level.

The preliminary findings of the HKSIG indicate that there are regulatory, tax and computer obstacles before a paperless trading environment can be achieved. This is an area where greater public sector-private sector cooperation could help resolve some of the difficulties that the HKSIG may face in achieving greater efficiency in paperless trading.

Electronic Commerce & NII

The vision of electronic commerce is to enable companies to increase productivity and adaptability to changing markets. Electronic commerce will provide an integrated collection of low-cost and reliable services to handle tremendous

Discount brokers are offering online trading accounts at very competitive rates. These electronic services speed up the process of financial tradings by eliminating labour and time costs associated with paper tradings.

Box 1 Tradelink

Tradelink targets at the 60,000 to 70,000 manufacturers and traders in Hong Kong—to free them from the long queues at Government counters and to move almost all their Government-related documentation from paper to electronic processing. By eliminating the exchange of paper documents, Tradelink's electronic trading services will reduce the associated costs, which are estimated to be HK\$77 billion, or five per cent of total trade, in a year.

The Tradelink system is a specialised system designed to provide two main types of services to importers, exporters, carriers, freight forwarders, banks, manufacturers, both local and overseas, as well as to the Government:

- passing of messages between directly or indirectly connected users; and
- an interface to the Government for its processing of trade related documentation.

Hong Kong's key players in the international trade cycle established Tradelink a decade ago. The Hong Kong Government became a major shareholder in December 1992 with a 48% stake. Other shareholders include trading companies, shippers, freight forwarders, ocean carriers and banks. Tradelink is tasked to fund and manage the Community Electronic Trading Service (CETS) in Hong Kong. The initial services of the CETS will be centred on statutory trade documents required by the Government. Tradelink would have the exclusive right to handle these documents for a period of seven years. In other words, the Government will only accept applications/lodgements for such electronic documents through Tradelink during this period. At the end of its exclusive period, Tradelink will transfer the assets required for the operation of the exclusive services to the Government at zero value.

Tradelink's first product, the Quota Licence service was launched in January 1997 and another product, Import & Export Trade Declaration service was first available in April 1997. Initially usage will be on a voluntary basis, but Government receipt counters for Quota Licence will be progressively closed by the end of 1998 and those for Trade Declarations a year or so later. The Hong Kong Government, as those in most other world trading centres, is committed to phasing out paper submissions of trade information.

More services are in the pipeline and total penetration is expected to be around March 2000. For example, Tradelink is developing quota balance enquiry services for customers using its Quota Licence system. It is planning to provide access to the Tradelink services via the Hexagon System, a financial services electronic link provided by the Hongkong Bank. Later, additional services would be introduced for documents such as certificates of origin, dutiable commodities permits and cargo manifests. The implementation of a Chinese EDI service for lodgements of trade declarations is also being examined. (Electronic Data Interchange (EDI) is the computer-to-computer exchange of business information in standard formats).

Tradelink may, if it decides to do so, also offer other commercial EDI services. It is also ready to open up its network for connection with other EDI systems, such as CargoNet and Internet, to make the Tradelink project a truly community project. Users within the business community can access Tradelink's services either directly or through a third party EDI service.

To encourage the adoption of electronic trading, the Government will, where possible, revise Government charges, so that Tradelink's handling charges and revised government charges will add up to no more than Government charges for paper submissions.

volumes of business and technical transactions, as well as and to amass, analyse, and control large quantities of data. Organizations will be able to improve efficiency and accuracy, and reduce costs, while providing faster, more reliable, and more convenient services.

For example, in the US, companies will be able to reengineer their business processes, and then use the National Information Infrastructure (NII) to realise the productivity potential of their current and future information technology investments. Smaller firms will be able to enter and participate at lower costs, and with other companies. New ways of doing business and new forms of economic activities will create a new commonplace, providing telecommuting services, global sourcing arrangements, new training and education capabilities, and disaggregated alliances or networks of companies.

Benefits of Electronic Commerce Applications of the National Information Infrastructure

An advanced NII that supports electronic commerce applications will provide benefits in a number of areas:

- **Reduced costs to buyers** from increased competition in procurement as more suppliers are able to compete in an electronically open marketplace;
- **Reduced errors, time, and overhead costs in information processing** by eliminating requirements for re-entering data;
- **Reduced costs to suppliers** by electronically accessing on-line databases of bid opportunities, on-line abilities to submit bids, and on-line review of awards;
- **Reduced time to complete business transactions**, particularly reduced time from delivery to payment;
- **Creation of new markets** through the ability to reach potential customers easily and cheaply;
- **Easier entry into new markets**, especially geographically remote markets, as the playing field becomes more level between companies of different size and locations;
- **Better quality of goods** as specifications are standardised and competition increases, better variety of goods through expanded markets and the ability to produce customised goods;

*Electronic commerce
benefits all parties
concerned.*

- **Faster time to market** as business processes are linked enabling virtual elimination of time delays between steps;
- **Optimisation of resource selection** as businesses quickly form cooperative teams to better tailor capabilities to work opportunities. Teaming may happen at either the company or individual level, creating a just-in-time ‘virtual’ resource for delivery of the right human and business resources for a job, skilled labour from routine activities to customer service and more complex duties;
- **Reduced inventories and a related reduction of risk of obsolete inventories** as the demand for goods and services are electronically linked through just-in-time inventory and integrated manufacturing techniques;
- **Ability to undertake major national programmes** such as national health care where the cost and personnel needed to manage a manual or disjoint automated system could be prohibitive or unreasonable;
- **Reduced overhead costs** through uniformity, automation, and large-scale integration of management processes which enable flatter, wider, and more efficient processes; and
- **Reduced use of ecologically damaging materials** through electronic coordination of activities and the movement of information rather than physical objects.

Before firms are able to provide electronic commerce to their customers, they need to computerise their own internal processing. Increasingly, as firms seek higher productivity through technology, they are moving towards Straight-through Processing (STP). STP would enable firms to re-engineer their internal processes, without the intervention of paper documentation, thus achieving considerable savings [see Box 2].

How is Electronic Commerce Used?

Many companies in several industries have experienced the benefits and realised the need to use electronic commerce to survive. Large US companies such as Sears, General Motors (GM), and Wal-Mart have championed electronic trading practices for their suppliers. Indeed, in some industries EDI (Electronic Data Interchange) has become a virtual necessity for doing business. Some estimates suggest that 95% of *Fortune* 1,000 companies use EDI in one way or another (Economist, 10 May 1997). Companies, such as General Electric, are experimenting with EDI over the Internet. The GE Trading Process Network allows

Box 2 Straight-through Processing

Few transactions are fully automated. Typically, electronic messages from one system are printed out and transmitted through paper to another system. These messages are then rekeyed, often supplemented by manual repair or investigation, before they are further processed. Obviously, such high rate of manual processing is not an efficient way of handling a huge and rising transaction volume. Errors and delay are also more likely as a result of re-keying. The idea of straight-through processing (STP) is to help eliminate these structural costs and operational risks. STP means that information, once entered, can flow freely across automated and integrated systems. The information is readily processable and the whole transaction cycle can be completed without resort to paper or manual intervention.

A building block for STP is 'clean' or structured messages, which carry information in standard formats and sufficient details. Receivers of 'clean' messages can readily process the relevant information via machine-readable methods. The other premise for STP is a global network offering linkages and data transfer between different institutions, and among various systems in the same institution. In the financial industry, SWIFT operates the largest network, providing international messaging standards and information services for banks and other financial institutions.

STP implies a high degree of integration, which in turn requires that standard rules are adopted and respected industry-wide. SWIFT, for example, has provided standards regarding the contents of messages. It is now developing additional standards for greater uniformity in how messages are handled. The operational information provided by SWIFT is electronically stored in a range of integrated and centralised directories, such as the Standard Settlement Instructions (SSI) Directory. Any deal with SSIs can be automatically picked up and whisked through to the back office for processing and settlement, while those with no SSIs go on to a queue for manual checking.

According to a study by SWIFT, the overall 'real' cost of processing each transaction in terms of manual repairs, investigations or delay amounted to over 100 times the actual underlying cost of the carrier's messages. The study also suggests that the total cost of STP-impactable activity (e.g. manual input and investigation, stock reconciliation and data repair) in the securities industry is in the range of US\$3-6 billion (HK\$23-46 billion) per annum. In this respect, SWIFT-related benefits are estimated to worth over US\$1 billion (HK\$7.7 billion) to the international securities industry. An example of recent STP initiatives by SWIFT is its permission for electronic trade confirmation (ETC) vendors to participate in its global network. This will facilitate domestic and cross-border settlement of securities.

The benefits of STP are uncontroversial - reduced costs, improved customer service, enhanced risk and liquidity management. However, implementing STP would also require huge investment. A recent survey by Braxxon Technology suggested that each of the world's top 50 investment banks needs to spend at least US\$80 million (HK\$620 million) to replace their existing trade settlement systems for bonds and equities—a total bill of US\$4 billion (HK\$31 billion). Another practical consideration of STP is how to ensure adequate internal control, if manual validation and authorisation cheque are no longer required in STP.

GE's suppliers and purchasing offices to exchange bid and offers on products and services with each other. Some examples of the benefits of electronic commerce are given below:

Many companies, organisations, government bodies and operations areas have realised the importance of EDI and have been successful in developing and incorporating it into their operation processes.

(I) *Wal-Mart Stores, Inc.*

In the 1980's, Wal-Mart Stores, Inc., experienced explosive growth in sales, rising to number one in the US retail business. Despite its rapid growth, Wal-Mart's investment of half a billion US dollars in computer and satellite communications networks, enabled the company to monitor sales trends at the cash terminal and to reorder stocks and maintain inventory to meet demand on a just-in-time basis. By empowering its individual stores to order directly from suppliers, even overseas ones, Wal-Mart stores reduced inventory restocking time from an industry average of six weeks to 36 hours. Moreover, by tracking every sale to see what was selling and what was not, Wal-Mart stores were more able to keep their stores well-stocked while maintaining tight inventories and low prices.

(II) *Clearinghouse for Interbank Payment Systems*

Over the past decade, the banking and financial industries in the US have invested heavily in automation and networking technologies to handle and process electronically an ever-increasing number of financial transactions. For example, the New York Clearinghouse for Interbank Payment Systems (CHIPS) coordinates daily bank-to-bank transactions worth nearly US\$2 trillion (HK\$15.5 trillion) while the nation's network of more than 75,000 Automated Teller Machines (ATMs) handles more than US\$6 billion (HK\$46 billion) transactions per year.

(III) *The US Customs Service*

The US Customs Service, one of the leaders in the federal government for adoption of EDI, processes 94% of all customs declarations electronically and collects 60% of all duties electronically nowadays. By moving from paper to electronic declarations, Customs reduced error rates from 17% to 1.7%, a whole order of magnitude. In addition, it saves an estimated US\$500 million (HK\$3.9 billion) in processing costs each year while increasing annual productivity by an estimated 10%.

(IV) US Treasury Department

The US Department of the Treasury aims to bring financial management of both collecting money and making payments into the information age, through several initiatives:

- Taxpayers with simple tax returns can now file by telephone and download tax forms from the Internet. The US Treasury is now working on ways to allow taxpayers with home computers to file their returns directly via their computer modems.
- Cut 40% of the paperwork required in the thrift savings institutions' quarterly reports.
- Simplified 70% of the Office of Thrift Supervision's regulations and reviewed and simplified all of the Comptroller of the Currency's regulations.
- Cutting business taxpayers' paperwork by switching to electronic tax collection. More than 64,000 employers, depositing over US\$300 billion (HK\$2.3 trillion), have voluntarily joined the programme.
- Expected to save US\$500 million (HK\$3.9 billion) over the next five years for the government and US\$400 million (HK\$3.1 billion) for the banking industry through delivery of tax payments electronically.

(V) Barclaysquare

Barclaysquare is an Internet-based Website, whereby customers of Barclays Bank can access a Webpage, with key suppliers' icons presented in the square page (hence, Barclaysquare). For example, by clicking the partner supermarket icon, the customer can order products and request that the amounts be debited to his Barclays Bank account. Such Homepages generate strategic partnerships between banks and the retail companies. If a utilities icon is on the Homepage, the customer is also able to pay his utilities bill conveniently.

(VI) Immigration

Historically, the procedures used by foreign nationals who applied for legal permanent residence or entry into the United States required several phases of data entry, time-consuming mailings of forms, and several appearances by the foreign nationals at a US consulate. In October 1996, the US Government's Immigration and Naturalization Service and the Department of State developed an electronic data sharing system called DataShare whereby the two agencies can exchange data and track an applicant's visa and petition for legal residence or entry at every step of the process. The

DataShare system transfers data on applications filed so the data no longer need to be re-keyed at each phase of the process. The application information moves electronically with the case as it is being processed. This will save time and money, provide customers with better service, and enhance basic enforcement efforts.

Currently, three US consulates in Ciudad Juarez, Mexico; Frankfurt, Germany; and Georgetown, Guyana; are piloting the system. For the next three to five years, depending on funding and other resource constraints, the goal of the US Federal Government is to expand DataShare worldwide to fully automate the visa process for all applicants.

(VII) Licensing

The US Federal Government's Department of Commerce has reduced grants processing time across the department by 25 percent. It has simplified forms, encouraged electronic filing, and coordinated data sharing with other statistical agencies to reduce respondent burdens, thereby saving the private sector hundreds of thousands of dollars in time and money.

Barriers to the Use of Electronic Commerce—US Experience

Many companies and government agencies use electronic commerce to facilitate internal operations and interact seamlessly with their trading partners, but they usually require highly structured, previously established agreements on communications, data formats, and security. The resulting costs create economic barriers to widespread use of electronic commerce applications by small- and medium-sized companies. Other barriers to electronic commerce include real or potential problems with scalability, interoperability, and ease of use.

Developing and implementing electronic commerce is a top priority throughout the US government, but many public and private investments are concentrated on short-range payoff. There is insufficient long-range investment in the standards and technologies needed by industry to develop the next generation of electronic commerce. For example, collaborative engineering and agile manufacturing may require sharing high volumes of very complex data. High-speed communications,

transaction management, and the management of many interrelated versions of data are needed to support these requirements and to seamlessly integrate research, design, engineering, production, marketing, and sales.

In September 1994, the Council on Competitiveness and the Information Infrastructure Task Force's Committee on Applications and Technology held a conference to discuss the barriers to the development and deployment of six NII applications, including electronic commerce. The Electronic Information Management and Electronic Commerce panel identified five obstacles to the adoption of electronic commerce applications:

- *The difficulty in reengineering the business process.* Testbeds and pilot projects are revealing that it takes much longer than expected to position an entire organisation to benefit from electronic information management and commerce. Reengineering paper-driven processes and convincing people to use the new systems regularly are slowing the pace of implementation.
- *The significant resources required.* The investment to convert information into a useful electronic format and to develop new methods to conduct paper-based processes electronically may be relatively modest for a large organisation, but can be a major barrier for smaller ones. Still, large organisations may be saddled with significant hardware, old software and electronic and paper documents that do not meet the new required formats and standards. Organisations may not be able to afford to replace these and must adapt them to the new business processes.
- *The resistance to change.* For electronic information management and electronic commerce, users are finding resistance both within their organisations, and among customers and suppliers.
- *The difficulty in using complex electronic information systems.* The growing availability of electronic information from around the world is creating a crisis of rising expectations. Users want to be able to gather such electronic information and to make use of it readily, but they often lack the necessary software tools to do so. They need tools to access networks, and to locate and use the electronic information systems that these networks link.
- *The lack of security on existing networks.* The absence of security management and user authentication is one of the most challenging issues

Although the widespread of EDI is highly desirable for the economy's well-being, there are still limitations in the system that businessmen are not ready to accept. Also, another obstacle to the promotion of EDI is the short-termism amongst entrepreneurs.

related to distributed network environments. Security management ensures that no one can tamper with, or intercept information transmitted along the network. User authentication verifies the identities of parties on both sides of an electronic transaction. The Internet, however, has evolved as an open networking environment, and information is, in general, exchanged without security management or user authentication.

How does the US Government Help Accelerate Electronic Commerce?

The US government is determined to accelerate the use of electronic commerce by setting deadlines and goals for the progress and by identifying various principles for the government as a guide to support the development.

The US Administration has pushed the development and implementation of electronic commerce by issuing a Presidential Executive Memorandum in 1993 outlining federal goals for “Streamlining Procurement Through Electronic Commerce”, requiring:

- | | |
|----------------|--|
| March 1994 | Define the architecture for the government-wide electronic commerce acquisition system and identify executive departments or agencies responsible for developing, implementing, operating, and maintaining the federal electronic system; |
| September 1994 | Establish an initial electronic commerce capability to enable the federal government and private vendors to electronically exchange standardised requests for quotations, quotes, purchase orders, and notices of awards and begin government-wide implementation; |
| July 1995 | Implement a full-scale federal electronic commerce system that expands initial capabilities to include electronic payments, document interchange, and supporting databases; and |
| January 1997 | Complete government-wide implementation of electronic commerce for appropriate federal purchases, to the maximum extent possible. |

In July 1997, the US President’s Information Infrastructure Task Force unveiled the final report on “Framework for Global Electronic Commerce”, which outlines the strategy for fostering increased business and consumer confidence in the use of electronic networks for commerce. The report suggests five principles to guide government support for the evolution of electronic commerce:

Box 3 Reengineering Government Services Through Information Technology

In 1993, the Clinton Administration identified IT as “the engine of economic growth”. The idea of incorporating electronic commerce was to enhance the federal government’s information services system, as well as to transform the “paper-based” government to an “electronic” government.

Seven initiatives were listed to inaugurate an “electronic” government:

- 1) *Integrated Electronic Benefit Transfer* would deliver government assistance (e.g. welfare benefits, veterans’ benefits) much faster to the citizens.
- 2) *Integrated Electronic Access to Government Information and Services* would make information more easily accessible regardless of geographical location. For example, allow personal computers access to electronic bulletin board systems, databases, and agency directory services.
- 3) *National Law Enforcement/Public Safety Network* would improve communication and coordination across different regions / levels of law enforcement authorities and public safety agencies. Consequently, saving time and money.
- 4) *Intergovernmental Tax Filing, Reporting, and Payments Processing* would reduce the current existing administrative costs for filing tax returns. Taxpayers’ burden to fill in tax forms could also be reduced as the Internal Revenue Service (IRS) has on file most taxpayers’ tax information from employers and financial institutions.
- 5) *International Trade Data System* would ensure the nation’s competitiveness in global markets were maintained by disseminating international trade data.
- 6) *National Environmental Data Index* would allow easy access to environmental information.
- 7) *Government-wide Electronic Mail* would allow government employees to communicate to one another in different agencies.

- **Private sector to take the lead.** Governments should encourage industry self-regulation and private sector leadership wherever appropriate.
- **Avoid undue restrictions.** Governments should refrain from imposing new and unnecessary regulations, bureaucratic procedures or new taxes and tariffs on commercial activities that take place via the Internet.
- **Any necessary governmental involvement should aim at supporting and enforcing a predictable, minimalist, consistent and simple legal environment for commerce.**

- **Recognise the unique qualities of the Internet.** Existing laws and regulations that may hinder electronic commerce should be reviewed and revised or eliminated to reflect the needs of the new electronic age.
- **Global view.** The legal framework supporting commercial transactions should be consistent and predictable regardless of the jurisdiction in which a particular buyer and seller reside.

Recommendations were set out to outline what the US government can do in order to create the best possible environment for the growth of electronic commerce.

Following these principles, nine recommendations have been set out to foster the Internet as a non-regulatory, market-driven medium; to ensure a transparent and harmonised global legal environment and to allow competition and consumer choice to shape the marketplace:

- i) To declare the Internet as a **tariff-free** environment. Advocate for **no new taxes** on the Internet.
- ii) To allow **electronic payment systems to evolve** without premature government involvement.
- iii) To create a **Uniform Commercial Code for Electronic Commerce**. Such a code should encourage governmental recognition of electronic contracts; encourage consistent international rules for acceptance of electronic signatures and other authentication procedures; promote the development of alternative dispute resolution mechanisms; set predictable ground rules for exposure to liability; and streamline the use of electronic registries.
- iv) To **protect intellectual property** over the Internet. Clear and effective copyright, patent, and trademark protection is necessary to protect against piracy and fraud.
- v) To maintain **privacy and integrity of personal information**.
- vi) To safeguard, in partnership with the industry, **security** in the electronic marketplace, such as the development of public key infrastructure that will enable trust in encryption.
- vii) To foster **fair competition** and strive for **interoperability** among national telecommunications systems.
- viii) To **eliminate non-tariff barriers** which limit free trade across the Internet such as content restrictions, discriminatory telecommunications regulations, standards requirements, or anti-competitive compulsory licensing requirements.

- ix) To enable market forces to drive the **development of technical standards** and other mechanisms for interoperability on the Internet.

The federal government is also helping to accelerate the development of critical technologies that will support electronic commerce, covering at least eight federal agencies:

- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Labor
- Department of Treasury
- General Services Administration
- National Aeronautical and Space Administration
- Securities and Exchange Commission

Electronic Commerce to take off in Asia

According to research company International Data Corp (IDC), electronic commerce, individual Internet usage, and Intranet deployment are set to take off in Asia/Pacific in 1997. The value of electronic commerce in the region will grow from US\$5.7 million (HK\$44 million) in late 1995 to US\$2.2 billion (HK\$17 billion) by the year 2000, representing 328% annual growth over the five years.

In addition, the number of devices connected to the Internet are expected to double each year—climbing to 55 million by the year 2000, up from 1.7 million connections today. Also, Intranet deployment is expected to occur over the next two years. Many industry segments will benefit from increased sales, including those industries providing systems and PC servers, server software, browsers, firewalls, Internet access devices, routers and switches, and professional services.

Several factors, according to IDC, have the ability to drive the Internet market in Asia/Pacific: high PC market growth, price declines due to intense competition, and the expansion of digital backbone networks. The factors capable of inhibiting market growth are likely to be lack of local Internet content and services, regulation and censorship issues, and monopolies or restrictions on Internet service providers (ISPs).

In Singapore, the government is to introduce new laws to support electronic commerce on the Internet and set up a certification body for secure transactions on the Internet. In July 1997, the Prime Minister Goh Chok Tong announced

Various characteristics of the Asian region drive the expansion of the Internet market and hence imply a huge potential for electronic commerce.

Singapore's first certification authority for Internet commerce—"Netrust" was formed. The authority would issue certificates to individuals and organisations to facilitate communication and commerce over the Internet. Security of the transactions in a major challenge facing electronic commerce, which refers to the paperless method of undertaking commercial transactions over computer networks. The establishment of Netrust would foster confidence in electronic commerce as participants can be assured of the identities of their counterparties over the Internet. The Singapore government would be introducing legislation to support digital signatures and digital transactions to give electronic transactions the full benefit of the law. Netrust is a joint venture between the NCB and the Network for Electronic Transfers (Nets).

In Hong Kong, the centralisation of trade finance services through the application of image processing and networks has enabled Standard Chartered Bank to achieve considerable productivity gains with lower costs, improved risk control and higher quality service (Box 4). It is an example of how technology can be utilised to accelerate electronic commerce from the wholesale level towards retail services.

Box 4 Standard Chartered reengineers trade finance services

Trade finance services are a key income source for banks, but traditional operations have been manpower intensive, and heavily paper-based. To stay competitive, banks in Hong Kong have begun to restructure their trade finance systems and procedures to improve their service quality and delivery times. Standard Chartered Bank has centralised its Hong Kong trade finance operations through computerisation, vastly improving staff productivity, product effectiveness and internal controls.

Traditionally, trade finance service is decentralised at the branch level, requiring a large number of bills offices, with different levels of expertise, varying standards, procedures and controls. Centralisation of trade bills offices into one platform would achieve a dramatic reduction in costs and improve customer service. Transaction processing is centralised at a single *Hub* to gain economies of scale and increase productivity, while the delivery of services is decentralised to individual *Spokes* (at branch level) in order to improve customer service. 200 staff now worked in the *Hub* and *Spokes*, achieving the same volume of work that would have been done by 500 staff under the old arrangements. Centralisation of procedures also facilitates the adoption of a predictable and consistent standard throughout the bank.

Technology supports efficient and cross-border processing of trade finance services. Imaging technology allows documents to be scanned in at each Spoke and processed through the Hub, enabling better credit control and detection of fraudulent or defective bills. This is especially useful for electronic transmission of bills of lading, which must, until now, be on paper in order to be legally valid. Staff at each Spoke, including those from overseas branches, can have real time access to the centralized trade finance system. Heavy investment are also made in developing network and telecommunications systems, as a step towards a completely paperless trading system.

Standard Chartered Bank, for instance, introduced POISE, Purchase Order/letter of credit Invoice Electronically delivered, and Vista. POISE provides an electronic interface between the bank's and the client's computer (usually PC) that takes purchase order information and processes it completely electronically. The bank can take that information and add value through financing, or by providing reconciliation service. Vista is a fully integrated electronic system offering a comprehensive suite of cash management, trade finance and custody functions. Vista delivers account information directly to the customer's PC and allows him to initiate and transact business from his own desktop. It also offers full multi-banking, cross-border and cross-currency facilities.

These trade reengineering initiatives are expected to support the bank's objective of doubling profits within three years. Success in POISE and Vista would be major stepping stones to the development of the Bolero project world-wide. (see Box 5, The Bolero Project)

Box 5 The Bolero Project

Trade documentation is still largely paper-based. The UN has estimated that inefficient exchange of trade documentation costs roughly 7% of total world trade or roughly US\$400 billion annually. The Bolero project is designed to be the first global electronic registry for the exchange of negotiable trade documents, involving not only land, sea and air transport trade. This will reduce fraud, improve efficiency and cut costs, achieving electronic transfer of title versus payment.

The Bolero Association Ltd is a self-administrating organisation with 140 members, including 40% banks, and the rest shippers, traders and trade agents. The project to dematerialise bills of lading will involve a secure central depository system, developed and operated by a joint venture, formed by SWIFT, the international bank-owned cooperative that runs the world's largest messaging system, and the Through Transport Club (TTC). The TTC was formed in 1970 to insure risks associated with multi-modal container transport, whose members include shippers, freight forwarders, and terminal operators and port authorities. Since 1992, the TTC has three regional operational centres in London, New Jersey and Hong Kong.

The Bolero service will be governed by the Rule Book, a multilateral contract for all users. The Rule Book provides a common and fair legal framework so that functionally, Bolero service is like exchanging paper documents.

The Central Registry provides the database where users store and exchange electronic documents. Users will communicate with the Central Registry from a front end application through public or private networks. Security of the system is managed by the Registration Authority, which physically registers the users, and the Certification Authority, which issues certificates to verify digital signatures.

Bolero is expected to benefit the whole trade community: importers, exporters, carriers, customs authorities, banks and forwarders through:

- improved operational efficiency and cost control
- wider valued added services
- improved tracking of goods and documents
- better risk management and reduction of fraud

The Bolero system will be delivered in phases, beginning in early 1998. Phase I will automate trade documentation for four major container trading routes between Asia-Pacific and Europe and US and intra-Asia-Pacific. Later phases will expand services to other routes and other users. A draft Rule Book will be available in the second quarter of 1997.

Electronic Money

Electronic payments constitute roughly 15-16% of global payments, valued at roughly US\$5.2 trillion (HK\$40 trillion). In 1995, approximately 40% of salary cheques world-wide were deposited electronically. In the 14 OECD countries, there were 119 billion non-cash payments in 1993, 35% were electronic, 62% excluding the US (Humphrey, 1996). On average, persons in these 14 countries held US\$1,133 (HK\$8,800) in cash, and initiated 61% of their noncash transactions electronically (through ATMs etc). Between 1987-93, changes in high electronic-

Statistics show that electronic money is becoming more and more popular [amongst the OECD countries], and that it is obvious that electronic payments are very much cheaper than other channels of transactions.

use countries reduced paper-based transactions per person by 10% and increased electronic transactions by 30%. As Table 1 indicates, the use of electronic payments is much cheaper: the Internet costs US\$0.01 (HK\$0.077) per transaction, while it costs 100 times more for a transaction made in a traditional branch.

Table 1 Cost per transaction by channel

	Channel	Cost/Transaction (in USD)
Branch	Full-service	\$1.07
Telephone	Average	\$0.54
ATM	Full-service	\$0.27
PC Banking	3rd party software	\$0.015
Internet	World wide web	\$0.01

Source: American Banking Association, Booz Allen Hamilton quoted in Financial Times, September 1996

Electronic money comprises two broad groups: smart cards, which are substitutes for currency, and Internet-based systems, which are substitutes for cheques, and are used for electronic payments, such as paying of utilities bills and non-cash based general payments.

Groups and Examples of the New Payment System

		Examples	
Technology	Substitution	Circulating only within the banking network	Circulating within and outside banking network
Smart Card	Cash	<ul style="list-style-type: none"> • Visa International: "Visa Cash" • Electronic Payment Services: "SmartCash" 	<ul style="list-style-type: none"> • Mondex International: "Mondex"*
Internet	Cash	<ul style="list-style-type: none"> • CyberCash: "CyberCoin" 	<ul style="list-style-type: none"> • Digicash: "e-cash"
	Cheque	<ul style="list-style-type: none"> • ChequeFree: "ChequeFree Payment Services" • FSTC: "Electronic Cheque" 	-----
	Credit Card	<ul style="list-style-type: none"> • CyberCash: "Credit Card Service" • First Virtual Holdings: "Internet Payment System" 	-----
	Electronic Fund Transfer (EFT)	<ul style="list-style-type: none"> • Intuit: "Quicken" • Microsoft: "Money" • Meca Software: "Managing Your Money" • Cardinal Bancshares: "Security First Network Bank" 	-----

*Mondex International plans a service on the Internet

FSTC: The Financial Services Technology Consortium

Source: Mitsuo Yamaguchi, 5th Int'l ACH Conference, 21-23 May 1997

Examples of Electronic Money

(I) Smart cards

Smart cards are growing as a worldwide alternative to cash. SGS-Thomson Microelectronics of France, a semiconductor maker, estimates that by the year 2000 more than 3.6 billion cards will be in circulation. Smart cards are already common in Europe and Asia, where some 400 million were shipped in 1995. Asia in particular holds great promise for smart cards because of the region's size and demographics, its lack of infrastructure and a drive to have the latest technology.

Smart cards are very convenient substitutes for cash and are becoming more and more popular.

The way a smart card works is that electronic value is stored on an embedded encrypted microchip. The microchip allows smart cards to serve as more than simply plastic money—it can store verification codes, passwords, fingerprints, photos, passports, medical records and more. Around the world, the key smart card initiative is the adoption of the ISO 7816 standard for their interfaces. This means that a PC equipped with a standard smart card reader will accept any of a consumer's payment cards and extend their choice of payment mechanisms into cyberspace. The current drive for smart cards may well be driven by the desire to reduce fraud and lower authorisation costs, but they will also make life much easier for consumers in the on-line world.

Smart cards are the preferred implementation for payment systems because of pressures from:

- Consumers, who have been using plastic cards already and are very familiar with the card format.
- Payment schemes, who are attracted by all of the familiar characteristics of smart cards: security, portability and capacity.

Given the advantages, the public sector is likely to be smart cards' best customer. Governments are planning to use them to distribute social security benefits, health care payments and food vouchers. China, with 1.2 billion inhabitants, is considering embedding chips into national identification cards. Germany's health care system has issued 60 million smart cards that include patients' names and addresses, as well as key medical information, such as allergies and medical history. Another major reason why governments are switching to smart cards is their desires to cut expensive frauds.

Smart payment cards can be broadly classified into three types, based on the particular function of money that they model most strongly.

(i) *Value access cards*

This category includes existing credit, debit and charge cards which, in essence, allow their holder to initiate transfers from one store of value (e.g. a bank account) to another store of value (e.g. a retailer's bank account). There is no problem in extending the use of these cards into the Internet as standards such as Secure Electronic Transaction (SET) come on-stream.

(ii) *Stored value cards*

This category includes schemes such as Proton and Visa Cash. These cards, which may be disposable or reloadable, pre-authorise access to the store of value thus saving the effort of authorising at point of sale. They may be:

- fully accounted, such as Proton, so that records of all transactions are eventually brought to a central point for reconciliation;
- partially accounted (such as phonecards) where records of individual transactions are not kept but gross transaction totals are reconciled in order to detect the existence of fraud or counterfeiting.

These cards are popular with non-banks. Some telephone companies are even inviting retailers into schemes to accept telephone cards as payment for goods and services at point-of-sale.

(iii) *Means of exchange cards (electronic purses)*

The only current example is Mondex, the electronic purse developed by NatWest and Midland in the UK. A means of exchange scheme is one in which value is transferred from person-to-person and can be used without the intervention of a third party (i.e. a bank). In the case of Mondex, one can call up a Mondex-equipped telephone to send money directly from his Mondex card to another person's Mondex card. The recipient can immediately spend the money. More accurately, means of exchange cards can be regarded as electronic cash, which requires no clearing, settlement or authorisation, and is thus cheaper than electronic money.

The three classifications are distinguished by the varying degrees of overhead they apply to the underlying infrastructure. Means of exchange cards, for example,

apply a minimal overhead, and that means they can handle smaller transactions most cost effectively.

INFRASTRUCTURE COSTS

Value access cards Cards & Devices Accounting Authorisation

Store of value cards Cards & Devices Accounting

Means of exchange cards Cards & Devices

Box 6 Smart Card Technologies in Hong Kong

- Smart Card Technologies have been investigated by a number of commercial and servicing sectors in Hong Kong which include bank groups, the mobile phone operators, transportation, Mass Transit Railway Corporation (MTRC), the Jockey Club, the Hospital Authority and Hong Kong Telecom.
- The Hongkong Bank and Hang Seng Bank are involved in the Mondex card project, which was launched in designated shopping malls in October 1996. Initially, the maximum amount that could be stored in a consumer's card is HK\$3,000. Besides, Visa Cash cards was launched on a pilot trial basis by Standard Chartered Bank and Bank of China in August 1996. Visa Cash cards are issued initially as disposable cards with a value of HK\$200 and accepted by some 1000 merchants. Reloadable Visa Cash cards, which can store up to \$3,000 and which combine with the functions of existing ATM cards, were launched in April 1997.
- The SMARTONE GSM mobile phone smart cards will be developed to serve as a payment or a bonus point and discount card.
- The Transportation Department has been actively looking into the introduction of Electronic Toll Collection Systems to ease the traffic congestion of major roads in Hong Kong.
- The MTRC has been actively engaged in developing a contactless smart card system to replace the current magnetic stripe card system being used for many years. The contactless smart card system is developed to support MTRC, railway, buses and ferry ticketing systems.
- The Jockey Club has a pilot project of using ISO 7816 cards to replace the existing magnetic stripe prepayment cards for horse race betting and lotteries.
- The Hospital Authority has launched a new optical memory (OM) based patient card project to replace the current magnetic stripe cards. The OM cards can provide higher storage capacity (4-6 Mbits) than smart cards (8-64 Kbits). The cards are used for common data, such as holder's demographics, clinical data (text form) on diagnosis, treatment, medications and investigations' results and image and voices.
- Hong Kong Telecom has looked into the development of ISO standards smart card for use in prepayment card systems.

(a) Mondex

Mondex, Visa Cash and MasterCard Cash are various types of smart cards.

Mondex uses a smart card to store electronic cash, which can be used to pay for goods and services in the same way as cash, but with some key benefits over traditional cash. Because it is electronic, Mondex value can be sent and received instantly across phone and computer lines, making it an ideal vehicle for paying for goods and services on the Internet. As with cash, Mondex payment transactions do not need authorisations or signature and just like cash Mondex value can be moved directly between individuals. Benefits are delivered to all interested parties:

- Banks gain the benefit of reduced cash handling charges and the ability to provide new services over electronic delivery channels.
- Retailers similarly benefit from reduced cash handling charges (and attendant problems such as theft and fraud) and gain the ability to offer cash-based services with no bad debt or collection problems.
- Consumers benefit from a simple and easy to use alternative to notes and coins with no associated transaction fees. Mondex cardholders can load money onto their cards at a new generation of cash dispensers (Mondex ATMs), payphones and homephones. Up to five currencies can be stored simultaneously on Mondex cards and in due course, Mondex will facilitate multi-currency payments.

The microcomputer chips on Mondex cards have been programmed to function as an “electronic purse”, which can be locked using a personal code so that only the card’s owner can use the value on it. Just like cash, once the card is lost or stolen, the value is lost. However, the 16-digit identity number stored on the chip may help locate the card’s rightful owner.

Mondex value is originated by an “Originator” in the same way as banknotes are issued by the note-issuing bank. The issue of Mondex value creates new liabilities on the part of the originator (in the same way as the issuing of banknotes creates new liabilities on the part of the note-issuing bank). Member banks participating in the Mondex scheme may “purchase” Mondex value from the originator (in the same way as they would draw cash from a note-issuing bank).

First pilot tests of Mondex cards started in Swindon, UK in July 1995. The Hong Kong and Shanghai Banking Corporation Limited has purchased the rights to Mondex in the Far East including Hong Kong, China, India, Indonesia, Macau,

the Philippines, Singapore, and Thailand. Mondex started pilot tests in Hong Kong in 1996 and is being launched throughout Hong Kong in 1997.

Mondex is poised to play a key role in the commercial development of the Internet by allowing consumers to pay for electronic goods and services with electronic cash as easily and spontaneously as they buy physical goods and services with physical cash. Mondex meets the acceptability requirements by providing a card that can handle five different currencies at any one time. Because Mondex security resides in the chip on the card, not the network, it allows money be moved safely over any 'unsecured' network, including the Internet. Each time a Mondex card is used the chip generates a unique 'digital signature' which can be recognised by the other Mondex card involved in the transaction. This unique signature is the guarantee that the cards involved are genuine Mondex cards and that the transaction data is unmodified.

(b) *Visa Cash*

Visa Cash is a multi-purpose stored value card targeted to replace the use of cash in small value transactions. The Visa Cash system is similar to electronic cheques. The issue of electronic value under the Visa Cash system merely involves a change from deposit liability to stored value liability in the balance sheet of the issuing bank (in the same way as a transfer from savings account to cheque account) which does not affect its level of overall liability. Payments made by the Visa Cash system is cleared through the Visa Cash clearing and administration system (in the same way as the cheque clearing system). There is no cardholder transfer in the Visa Cash system, which is a major distinction with Mondex.

The Visa Cash Programme utilises an 'open' system, which means that each financial institution will have its own roll out plans, and all cards will conform to a committed standard and a shared operating platform.

(c) *MasterCard Cash*

MasterCard Cash is a smart card that provides consumers with stored value, credit and/or debit functions all on one card. It is, actually, a stored value functionality added to a MasterCard ATM card, debit card or credit/debit card. Owners of MasterCard Cash cards can reload their card by inserting it into retrofitted ATMs, terminals in the participating bank branches or in some payment terminals at specific merchant outlets.

MasterCard has so far one sole pilot for its stored value card, held in Australia in March 1996. Nevertheless, there are also plans to introduce MasterCard Cash into South Africa. In the US, the MasterCard Cash will be involved jointly with the Visa Cash in the New York smart card pilot.

Box 7 Visa Cash in the world and Hong Kong Visa Cash

Visa and over 60 member financial institutions have launched 18 Visa Cash programmes in 13 economies around the world, including Hong Kong and Taiwan in Asia. 11 additional programmes will begin in eight more countries in the next 18 months. As of January 1997, there were 4 million Visa Cash cards around the world, 40% of them were reloadable.

There are three kinds of Visa Cash cards—disposable, stand-alone reloadable and feature reloadable (where the Visa Cash function is a function on an existing Visa bank card).

International market research has shown over 75% of all Visa Cash users prefer or want to have reloadable Visa Cash card. Reloadable cards can be replenished at Visa Cash terminals of ATMs. To “unload” a reloadable Visa Cash Card at the ATM is to transfer value from the card to an account specified by the cardholder. Reloadable Visa Cash is a further step towards the multi-function chip card and, eventually, the relationship card which offers anytime, anywhere banking in the digital era and using micro-financial/personal data management tool.

In Hong Kong, the Bank of China Group and Standard Chartered Bank launched disposable Visa Cash in August 1996. Over 100,000 Visa Cash cards were issued and over 500,000 Visa Cash transactions were generated totaling HK\$15 million. The average transaction value is around HK\$30 (global average transaction value is about HK\$34). In April 1997, the service is extended to the issuance of feature reloadable Visa Cash cards, which offer stored value along with current ATM card functions.

(II) Internet-based Payments

Another type of electronic payment is Internet-based payment. It refers to the online banking and financial services on the Internet.

Both banks and non-banks have focused on the development of online home banking and financial services on the Internet. ‘Virtual banks’ provide services ranging from balance cheque, funds transfer, bill payments, to loans applications, trade finance services, up-to-the-minute cash management reports, etc. Along with the growth of electronic commerce on the Internet, Internet-based payments systems are also developed for processing the payment leg of the transaction cycle. First Virtual was one of the first commercial entities to provide an Internet-based credit-card payment service, whereby customers supply their First Virtual ID numbers (which corresponds to their credit card numbers) to the merchant over the Internet and the actual credit card settlement is done monthly over a private network. NetChex is another system which offers consumers a secure way to write an electronic cheque on the Internet. Before an electronic cheque is transmitted across the Internet, NetChex replaces the consumer’s bank account information with a shadow account. Upon receipt of the electronic cheque, NetChex authenticates

the cheque and replaces the shadow account with consumer and merchant account information. The authenticated transaction is then transferred to the appropriate banking system for processing.

Internet-based payment systems have also developed to support the handling of small purchases as little as fractions of a cent. Cybercash offers payment services for credit card payments, as well as micropayments in the form of electronic cheque and electronic coin services. Digicash (Ecash) is a software-based electronic cash system for use through the Internet, which provide both privacy and security. Under the Digicash system, banks are responsible for 'minting' and validating cyber coins, and exchanging real money for ecash. Customers spend the coins with anonymity and the merchant then sends the coins back to the issuing bank for deposit in an encrypted envelop. Another service, Millicent, can handle transactions that are as little as one or fractions of a cent in a cost-effective manner. It is based on decentralised validation of electronic cash at the merchant's server, thus avoiding additional communication to a central server or additional encryption or off-line processing.

There are, however, considerable security problems for electronic payments across the Internet. Messages on the Net can be 'overheard' or intercepted by third parties. One of the latest security systems involves security "keys", which are used for decoding. The public keys serve both as "telephone numbers" and destination points when sending messages, while private keys act as gatekeepers for opening them. In the system, national and international authorities will have to act as security guards to manage the system's keys. In addition, Visa International and MasterCard International Inc. agreed, in February 1996, upon a technical standard for the secure payment for electronic commerce over the Internet. The technology blueprint, dubbed Secure Electronic Transactions (SET), allows software developers for the Internet's World Wide Web to incorporate a standardised system for accepting credit card payments and provide encryption that scrambles sensitive information. The SET specification, SET1.0, was finalised in April 1997 and the protocol was published on the web sites of Visa and Mastercard at the end of May 1997. The first software using SET is expected to be available in late 1997. This move will significantly help speed up the development of electronic commerce over the Internet.

Since there are still security concerns for this kind of payment system, urgent needs are called for the development of a security system in order to encourage more people to use the service.

Box 8 Secure Electronic Transactions (SET) Standards

In physical commerce, a buyer holds a card that the seller recognises. Similarly, the buyer recognises the merchant's payment logo. Both buyer and merchant can be confident that a transaction can be completed. In the virtual world, such mutual recognition or authentication will be made possible by the use of SET standards. SET standards also ensure the integrity and confidentiality of payment information.

The SET standards require:

- *Message encryption*
To ensure confidentiality
- *Digital signatures*
Messages are signed using an encryption technique based on public and private keys ensuring both integrity and authentication.
- *Digital certificate for each party involved in payment*

The cardholder's digital certificate is a virtual card, the equivalent of a physical card. It is unique and delivered for a pre-determined period of at least one year. The merchant's certificate has the same effect as a window logo and furthermore it represents the relationship with their bank.

A fundamental SET principle is that each party in the system is certified beforehand by a superior certification authority. Just as in the physical world cardholder and merchant are certified by their banks, these banks in turn may be certified by a country-level authority, which in turn has been certified by a brand authority.

Once a party has been certified through this chain, they are trusted and branded. At this point the superior certification authority can step out of the transaction. Future transactions can now take place directly between the trusted and branded parties.

The success of electronic commerce clearly depends on the security of transactions (delivery versus payment) on the Web. The eCOMM consortium of French banks, France Telecom and Visa International is working on the dual security using both the Chip Card and SET standards to design, test and promote electronic commerce through high security standards on the Internet. (Vaquin, 1997)

Electronic Money—security and regulatory issues and implications for monetary policy

Already some 300 American banks have Internet sites; this number is expected to triple by 1997 and double again by 1999. But owing to the concerns about security on the Internet, only a few are offering more than information and simple inquiry facilities. The main concerns are that the electronic money scheme should have:

- adequate safeguards against counterfeiting or tampering, and effective means of detecting and measuring fraudulent value;

-
- adequate safeguards against money laundering activities;
 - adequate control procedures to ensure accurate recording of electronic money issued and outstanding;
 - sufficient audit trails to minimize the cost and inconvenience arising from disputes and system default; and
 - appropriate and effective contingency plan to cover major system breakdown or significant compromise of the scheme (for example, due to a major fraud).

It is increasingly well understood that cryptography can greatly reduce the transactional security gaps that exists in Internet commerce. However, many cryptographic protocols for secure electronic transactions require at least one Trusted Third Party to the transaction, such as a bank or a certification authority (CA). The roles and responsibilities of consumers, service providers with the Trusted Third Parties, especially in the eCommerce and eMoney era, require new definitions by the law. Unless the law is updated to take account of these new relationships, the uncertainties of transactions using eCommerce will be inhibited, causing perhaps unnecessary litigation.

In addressing risks such as loss, fraud, insolvency, and privacy concerns, a recent report of the G-10 working party on electronic money reveals that most G-10 countries are relying on existing laws and regulations rather than enacting comprehensive new measures specifically aimed at electronic money. On supervisory issues, some of the G-10 countries are considering a more specialised supervisory framework specifically for non-traditional issuers of electronic money while others are relying on market incentives.

Card-based electronic money schemes can be regulated through approval requirements before any scheme can be promoted or used. The regulation of network-based electronic money schemes, on the other hand, is difficult as electronic value could be originated and made available to local residents by overseas operators through the Internet. Regulatory enforcement by local supervisors may be difficult due to territorial restrictions. It is considered that this is an area where supervisory cooperation among central banks is most important.

Until recently, we do not have a well-established part of law which is specifically directed towards electronic commerce and electronic payment. Together with the lack of international agreement on these matters, it is difficult to run an effective supervisory system.

Box 9 Security of Electronic Money

One of the major concerns in the evolution of electronic money and electronic commerce is security. Security risks occur not only for the consumer, but also the merchant, the financial institution or the network involved. A Task Force on Security of Electronic Money, established by Committee on Payment and Settlement Systems (the Sendrovic Report, August 1996) examined the risks and security features of electronic money products.

The study distinguished between card-based systems using smart-cards (such as stored-value cards) and software-based systems, providing electronic money services through standard computer hardware, using specific software. The risks associated with electronic money products center around fraud, duplication of devices, alteration or duplication of data or software, alteration of messages, theft, and repudiation of transactions with an intention of financial gain. Other risks include sabotage, malicious disruption (hacking), and breakdowns or malfunctions in software, hardware and networks by accident or otherwise.

In the UK, the British government has developed policies regarding encryption services to ensure and safeguard the integrity and confidentiality of information transmitted electronically over public networks. An integral part of this proposal involves a voluntary system for licensing and regulation of 'trusted third parties' (TTPs). TTP responsibility would include encryption key management and development of digital signatures along with data integrity and retrieval. Because TTPs must be highly trusted by the community as a whole, it has been suggested that banks themselves should act as the TTP.

Security measures to ensure the integrity, confidentiality, and authenticity of data require *preventive, detection and containment measures*.

Preventive measures include tamper-resistant devices, encryption, on-line authorisation, digital signatures and passwords. Other measures include requesting verification on expiration dates, number of transactions executed, and remaining balance on the device.

The state of cryptography is still evolving. Simple encryption enables easier usage but may not be so secure. Complex algorithms, such as keys with at least 128 bits are much more secure but are not yet widely available. Another critical safeguard is the tamper-resistance tolerance of the smart card or electronic purse (device). Such tamper-resistance features can be extremely costly.

Detection measures which entail transaction verification procedures within a certain time-frame, constant monitoring by a central system, limiting of funds transferable, and ascertaining any unusual transaction patterns through analytical studies.

Containment measures includes specifying a time-frame and a ceiling on the amount of funds available on the device, requesting verification of the holder of the device through registration, maintaining a hot list of suspect devices or users and disabling of devices. If fraud is too wide-spread, the system may have to be suspended.

Although there are various forms of security no single measure guarantees total security. There are a wide range of options, involving trade-offs in terms of cost, functionality, speed and reliability. Generally, an integrated, overall risk-management approach to security, including independent security assessments, would comprise an important component of the security of electronic money.

Box 10 Regulation of stored value cards in the US

Stored-value Card Types	Prohibits Unsolicited Issuance of Card	Initial Disclosures of Fees, Terms and Liability Exposure	Notice of Changes in Terms Initially Disclosed	Transaction Receipts/ Periodic Statements of Account Activity	Liability Limits for Lost or Stolen Cards	Error Resolution Procedures
Value under \$100	No	No	No	No	No	No
Off-line Unaccountable (No record kept of individual transactions)	No	No	No	No	No	No
Off-line Accountable (Record kept of individual transactions)	No	Yes	No	No	No	No
On-line Systems	Yes	Yes	No	Yes (receipt) No (periodic statements)*	Yes	Yes (except for annual notice)

* Balance and transaction history upon request in lieu of periodic statements

The popularity of electronic cash (e-cash) also raises several concerns to central banks in relation to the monetary implications:

- Whether the ability to control money supply will be affected. This however is not a particular problem for Hong Kong because as in the case of other fixed exchange rate regimes, we do not control or target money supply in our monetary policy operations. Specifically relating to banknotes, the amount of notes issued is primarily determined by public demand for such notes in Hong Kong.
- As the value floating in the Internet could grow very high, its “bank backing” could be proved suspicious.
- Whether and how electronic money should be captured in the definition of money supply.

Electronic Commerce Regulatory Bodies

The ability to exchange payments worldwide is becoming increasingly important to banking, corporate and government executives as they recognise intensifying economic dependency on foreign trade. As today's economies in the West is moving more towards globalisation, the Cross-Border Council of the National Automated Clearing House Association is set up with the mission to establish the framework for the efficient exchange of cross-border, batch-oriented, electronic, corporate and consumer payment transactions. The Council consists of international members from a variety of corporations, value-added suppliers, associations and financial institutions. The goal is to develop an agreed set of principles, rules and standards for participants in order to effect cross-border electronic payments. To date, cross-border Automated Clearing House (ACH) linkages are connected between Canada, America and Mexico. The US/Canadian annual cross-border volumes amounted to a total of US\$780 billion (about HK\$6 trillion) northbound (36,227,000 transactions) and US\$642 billion (about HK\$5 trillion) southbound (9,250,000 transactions).

China is developing its Real-time Gross Settlement system, called China's National Advanced Payment System, which is expected to be launched in 1999.

In the case of Hong Kong, the Hong Kong Inter-bank Clearing Company Ltd., established in 1996, is responsible for the Real-time Gross Settlement (RTGS) system in the territory. At present, there is no cross-border linkage with any regional or Western ACHs, but plans to link with China's ACHs are underway.

Nowadays, technologies are rapidly advancing the Internet as a major marketing channel—yet, security and payment processing infrastructure is immature. Safe and secure payment and payment-related activities are critical for wide-spread use. The Internet Council, sponsored by the National ACH Association, provides a structured arena for banking industry and business stakeholders to advance the cooperative development of the payments system and on-line commerce. The Internet Council's mission is to expedite the evolution of commerce on the Internet and other open systems by: facilitating the development of secure and reliable payments and payment-related activities; addressing business issues related to technical developments; providing a forum for and establishing liaisons among the full range of stakeholders; and promoting education regarding the Internet and electronic commerce. The Council is currently addressing issues on: digital signature/certification rules; risks associated with Internet initiated financial transactions; Internet/payment system; and micro-payments catalogue.

Figure: Top World Economies for Electronic Commerce**Global e-commerce potential (1=low, 5=high)**

	Market size	technology penetration	political climate	overall	comments
SUPERPOWERS					
United States	5	5	5	5	To maintain position, must drop crypto restrictions.
CONTENDERS					
Germany	4	4	5	5-	Germany, UK lead the change.
United Kingdom	4-	4	5	4+	Government initiatives position Japan to overtake them.
Japan	4+	4-	4+	4	
Canada	2	4+	5-	4	
GATEWAYS					
Singapore	5-	4-	4	4+	Singapore's bid to become an "intelligent island" will fail unless it abandons on-line censorship.
Netherlands	2+	5-	5-	4	
Belgium/Luxembourg	3	4-	5-	4	
Hong Kong	4	4-	3+	4	Hong Kong's position is uncertain.
SPRINTERS					
Finland	2	5	5	4+	Simple, innovative public policy is a collective strength. Scandinavia has liberal crypto policies and is pushing for smart cards. New Zealand is deregulating telecom.
Sweden	2	5	5	4+	
Denmark	2	5-	5	4	
Norway	2	5-	5	4	
New Zealand	1+	5	5	4-	

Source: Financial Technology International, 30 September 1997.

Conclusion

Electronic commerce and electronic money are clearly waves of the future. Hong Kong has an excellent environment for both trends to prosper. As a virtual economy with the globe as its market, Hong Kong must seize the initiative to assist Hong Kong businesses to use electronic commerce and electronic payments as the driving force of the future. The low tax, free trade, open markets, fair laws, sound regulatory framework and robust infrastructures are all ideal grounds for the adoption of eCommerce and eMoney. Like other economies, there is a good case for the Hong Kong SAR Government to examine how the legal, regulatory and infrastructural framework can be adjusted to foster electronic commerce and payments. What specific laws and regulations, for example, hinder the implementation of STP or prevent the implementation of eCommerce & electronic payment, subject to public policy considerations? For example, in what ways can the Government assist the recognition of digital signatures and help facilitate security standards. Can the Government use its own public services as a catalyst for widespread implementation of eCommerce & electronic payment as a norm for Hong Kong?

Chapter 6 shows the results of a survey on the existing financial technology infrastructure in Hong Kong.

Chapter 6

Survey Results

Introduction

*Stock-taking of the
existing financial
technology infrastructure
in Hong Kong.*

The Informal Working Group commissioned a study on the existing financial technology infrastructure in Hong Kong. The survey compared the technologies employed in existing systems, their future plans and comments on infrastructural issues.

A questionnaire was developed which asked a number of general questions about the products, their features, history and markets. These were followed by technical questions regarding the operations, system and technology architectures, and requested, where available, statistical data. The respondents were requested to offer suggestions and comments about the infrastructure and to describe their future plans. The questionnaire was sent to two organisations represented on the Informal Working Group to complete and their feedback was used to refine the questionnaire. The full questionnaire is in Appendix IV.

The survey was sent to 23 companies which were selected to represent a cross-section of suppliers of these systems to the financial services sector, and to customers. They comprised both locally based and overseas companies and represented systems in the areas of trading systems, clearing and settlement, electronic banking, credit cards and information provision.

In some instances the organisations were the sole providers of the systems, such as the exchanges and clearing houses, whilst others were competing providers of products, such as banks, credit card companies and information providers. From the 23 organisations, 15 replied concerning 23 systems. The replies were analysed and follow-up discussions were held, where appropriate. The survey results covering 12 broad areas are summarised in the following section.

Survey Result

(I) Interbank Clearing

The interbank clearing system is provided by the Hong Kong Interbank Clearing Limited (HKICL) to licensed banks in Hong Kong.

It consists of three main streams:

CHATS	-	Low volume, high value payments between banks
Paper cheque	-	cheques including cashier's order
ECG	-	Direct debits and credits

At present, payments are presented to the clearing house at different times during the day. These payments are amalgamated and the net amounts advised to banks along with the details of the individual transactions at day-end. Once the amounts to be settled between banks are known, corresponding entries are posted to the accounts of settlement banks with the Management Bank.

Within the total value of interbank payments, CHATS accounts for more than 70%. The CHATS system has been migrated to the Real-time Gross Settlement (RTGS) system which went live in December 1996. In RTGS environment, each payment is settled individually and irrevocably in real-time, instead of being accumulated and netted from receipts and settled at day-end. All settlement accounts of the banks will be maintained with the Hong Kong Monetary Authority (HKMA).

There will also be an on-line interface between RTGS and the Central Moneymarket Unit (CMU) to enable banks to obtain liquidity to facilitate payment flows through intraday repurchase of Exchange Fund Bills and Notes.

Each member bank has to install a Member Bank Terminal (MBT) at its office to use the CHATS or RTGS service. Member banks have to start up the MBT and log on to the Inter-Bank Fund Transfer Processor (IFTP) at the Clearing House during the normal working day. Subsequently they are able to construct fund transfer transactions and send them to the Clearing House for settlement. At day-end, the IFTP of the Clearing House sends cutoff reports to all member banks for reconciliation. The banks can then log off their MBTs from IFTP of the Clearing House and shut down the systems.

The interbank clearing service used to be provided by the Hongkong and Shanghai Banking Corporation Limited. From 1996 onwards, the clearing responsibility has been moved to HKICL, a newly formed company jointly owned by HKMA and the Hong Kong Associations of Banks (HKAB). The clearing functions are

sub-contracted to The Hong Kong and Shanghai Banking Corporation Limited, but HKICL progressively took over the clearing functions since the first half of 1997.

Box Hong Kong RTGS

To meet international standards and minimize settlement risks, Hong Kong's large-value interbank payment system cut over to a Real-time Gross Settlement (RTGS) system on 9 December 1996. Important issues relating to the implementation of the RTGS system are as follows:

- a) compliance with international standards;
- b) final settlement across the books of the HKMA;
- c) a single tier system in which licensed banks maintain settlement accounts with the HKMA;
- d) while no daylight overdraft is allowed, banks can obtain intraday liquidity through intraday repurchase (repo) with the HKMA;
- e) allow domestic and international linkages to facilitate real-time delivery versus payment (DvP) and real-time payment versus payment (PvP).

The operator of the new payment system is the Hong Kong Interbank Clearing Limited (HKICL), a company jointly owned by the HKMA and the HKAB, set up in May 1995.

Under the new RTGS system, the HKMA performs the following roles:

- (a) settlement institution**
180 licensed banks now maintain Settlement Accounts directly with the HKMA and settle across the books of the HKMA;
- (b) operator of CMU**
the HKMA continues to operate the book-entry debt clearing and settlement system, which is now fully integrated with the funds transfer system and possesses real-time DvP capability;
- (c) provider of intraday liquidity and lender of the last resort**
in line with its role as the lender of last resort;
- (d) overseer of the payment system**

The RTGS offers two technological platforms for member bank terminals (MBTs): a mini-computer (AS400) or a Personal Computer (PC). About half of the banks use AS400 and the other half use PC.

Systems Performance:

The performance of the RTGS system has been stable and satisfactory. The computer system processed an average daily throughput of 12,413 CHATS transactions (involving HK\$317 bn), 246 CMU secondary market transactions (involving HK\$13 bn) and 499 intraday repo transactions (involving HK\$26 bn) on weekdays.

(II) Electronic Funds Transfer at Point Of Sale

One Electronic Funds Transfer at Point Of Sale (EFTPOS) system was included in the study. It is a debit card processing service which allows consumers to purchase

goods at point-of-sale using their ATM cards, or credit cards with ATM function. The service is operated on a network which is linked to the ATM networks of different banks.

To use the service, a consumer has to present a debit card to the merchant's cashier who will then process the debit card transaction through a special purpose EFTPOS terminal. The card transaction debits the consumer's bank account immediately. A terminal-produced receipt is supplied to the consumer after the transaction. This receipt can be used by the consumer to reconcile against bank statements.

Funds are held temporarily in a suspense account at the cardholder bank during the processing day. A daily interbank settlement procedure is run whereby the suspense account is cleared and funds transferred into the merchant's nominated reimbursement account.

The EFTPOS service provider also operates a service for the payment of domestic bills via telephone. In this system, bill payment is made by telephone call using a tone phone linked to a Voice Response System, which sends transactions to the debit card authorisation system. After making the payment phone call, a debit is made instantly to the nominated bank account. A reference number is given to the consumer for reconciliation. Similar to the EFTPOS system, the funds are held in a suspense account and credited to the merchant's nominated bank account in the overnight settlement process. Users of the phone payment service need to register at special purpose terminals and nominate bank accounts to be debited, using their debit cards. They are also required to register their bills via a tone phone prior to making actual payments.

(III) Automatic Teller Machines

The survey covered two bank ATM (Automatic Teller Machines) systems and one ATM message switching network provider.

This is a service offered to the general public. Bank customers can use plastic cards with magnetic strips to access various banking functions at dedicated terminals. These functions usually include:

- Cash withdrawal
- Cash deposit
- Cheque deposit
- Account transfer
- Cheque book request

- Account balance inquiry
- Statement request
- PIN change

The cards capable of using the ATM services include dedicated ATM cards, credit cards and debit cards issued by the banks.

ATMs of different banks are linked together, either through the proprietary network of a bank group, or through third party ATM switching networks. When a customer uses a card at an ATM terminal of a bank different from the card issuer, the ATM switching network will route the transaction to the card issuing bank. This means the customer can access ATM terminals of a group of banks by a single card. However, the two largest ATM networks in the territory are still non inter-operable.

The ATM switching network connecting ATM terminals of different banks also provides settlement figures among the banks at day-end, for the settlement on the net posting day.

These ATM networks are also linked globally to ATM networks in other countries, in particular the networks operated by the credit card companies, and vice versa. Overseas travellers holding cards issued from banks in other countries can also access the ATM service at the appropriate terminals here. The coverage now includes China, mainly in the Guangdong Province.

In addition, the ATM networks are linked to the electronic fund transfer point of sale (EFTPOS) network. Holders of most ATM cards can make payments electronically at retail shops. (See Section 3.1.2)

ATMs were first introduced to Hong Kong in the early 1980s. In 1983, banks started to connect ATM terminals and networks of different banks. These networks were connected to the EFTPOS network in 1986. There are an estimated 2,100 ATMs in Hong Kong, with transaction value of HK\$16 billion annually.

(IV) Credit Cards and Charge Cards

Services from two card companies were surveyed.

These companies both operate private worldwide communication networks for online authorisation and the clearing and settlement between issuers and acquirers.

One of these services is offered to the card holders directly while the other is offered mainly via card issuing banks. Both companies offer different kinds of cards such as consumer cards, corporate cards and gold cards. One of them also offers co-branded cards to various organisations.

Credit cards and charge cards are operated in similar ways except that the bill of a charge card has to be paid in full on a monthly basis, while a revolving credit is provided to a credit card.

Apart from the basic payment service, additional benefits are also offered to the card holders. These benefits may include purchase protection, hotel reservation service, emergency cashing, insurance and 24-hour emergency card replacement.

Cards from both companies can be operated on their ATMs worldwide. The card issuing banks of one of these credit card networks also allow the use of the credit cards on their own ATMs. Furthermore, these cards can also be used to access the FETPOS services.

Both services were originated from USA in the 1950s. In the mid-1970s the magnetic stripe was standardized on all the cards. One of these two services was introduced to Hong Kong in 1978, while the other was introduced in 1986. Hong Kong has an estimated 5 million card holders, with an annual turnover of HK\$77 billion. Cards per capita, at 0.8 per person, is second highest in the world after Japan, with 1.8 cards per person.

(V) *Retail Store Purchasing Cards*

The purchasing card system from one gas company is studied.

It is a service provided to the private car owners and company fleets to purchase fuel at gas stations on credit.

The cards are accepted electronically in the forecourts of gas stations. The customers just key in the PIN, the amount of the purchase and optionally, the kilometre reading to get the cars filled. The purchases are then recorded automatically and the transactions are transmitted to the back office electronically. At the end of the month, the customers receive statements and fuel economy analysis reports and the bills are then paid.

It is a proprietary system and has no linkage to other systems. It was developed in the mid-1980s and has changed from off-line mode to on-line mode in 1996.

(VI) Electronic Banking and Telephone Banking

The study also covered electronic banking services from two banks and telephone banking service from one bank.

The electronic banking services are provided mainly to corporate customers. Customers can link a personal computer up into the bank's computer system to carry out:

- Account enquiry
- Deposit transfer
- Documentary credit application
- Foreign exchange dealing
- Time deposit placement and roll-over
- Remittance request
- Cheque book and statement ordering

One of the two systems also offers functions such as:

- Import/export services
- EDI services
- Market information
- Securities dealing and positions monitoring
- Electronic mail
- Financial analysis
- Unattended operation

More details about the services listed above are provided by one of the banks:

- ***Account enquiry***
Apart from the accounts held within the bank group, balances on accounts with over 350 third party banks worldwide can be integrated through the service. This is achieved by integration with the SWIFT network.
- ***Payment services***
The system is linked to various payments and clearing systems worldwide to provide both batch payments and single payments. This includes Hong Kong Dollar Autopay, CHATS/RTGS, BACS and CHAPS/RTGS in UK, ACH, CHIPS and FEDWIRE in USA, and SHIFT in Singapore. Debiting of the users' third party bank accounts is also allowed.

- ***Import/export services***
Reporting on import and export combined positions, import DC history summary, import bill details, import loan details, import outstanding summary, import account positions, export bill details, export DC details, export outstanding summary and export account position, and on-line acceptances of discrepancies are provided.
- ***Market information***
It includes spot rates from over 20 countries in 40 currencies, share market information from over 21 stock exchanges worldwide, domestic interest rates, local market commentary, precious metal reports and so on. The information can be downloaded or viewed on-line in near real-time.
- ***Financial analysis***
It allows for the reconciliation of payments, transfers and all transactions, a full bank 'management information system', a complete cash flow reporting system that will report by the date and the customers' general ledger codes, and the facility to import or export all this data to the customer systems.
- ***Unattended operation***
It provides the facility to automatically collect data from the bank and convert it to a pre-defined file format for the automatic updating of the end user systems.

Most of these services are provided on-line in real-time. However, off-line mode operations are also offered as an alternative. In all the cases, the user must enter user ID, password and session password to gain access to the services.

Some of these services also allow data to be imported from or exported to the customers' systems, eliminating the need for re-keying. Specific computer file formats are defined to facilitate this data exchange.

The telephone banking service is available to individual customers of the general public. It provides similar functions to the basic electronic banking services, which include:

- Deposit transfer
- Balance inquiry
- Fixed deposit placement

- Foreign exchange and bullion dealing
- Cheque book and statement request

Customers can dial up with an ordinary tone-dialing telephone into the bank's computer system to perform these banking functions. The bank's computer system will guide the customers to initiate those transactions with computerised and pre-recorded voice. Customers, by pressing the phone-buttons to input their password and codes of transaction, will access the services needed.

One of the two electronic banking services under study was introduced in 1985. Since then, products and features were added in, and the user interface was upgraded. The other one was introduced in 1994. The telephone banking service was introduced in 1991.

(VII) Electronic Money

The survey also studied one electronic money scheme. The electronic money is based on smart card technology. Monetary value is stored in the microprocessor inside the smart card. This value can be transferred from one card to another. A single card can store up to five different currencies at any one time. A card can also be locked and unlocked using a security code and an interface device. When locked, the value on the card cannot be transferred.

As a result, banks will be able to distribute and receive electronic money as part of their retail banking operations. Merchants will be able receive electronic monetary value and remit their takings remotely to the banks. Consumers will be able to use it in place of cash and other payments products to pay for goods and services.

Devices which interface with the smart cards include point of sale (POS) units, ATMs, specially designed telephones, portable card processors (wallets) and balance readers. Cardholders can use these devices to:

- transfer value between two cards
- transfer value between a cardholder's account and the card
- display the balance of value on the card
- display transaction log
- lock and unlock the card

Point of sale units can range from small low cost portable units to integrated POS systems for large retail chains. Each unit would typically contain a smart card, two card readers, a keyboard and a screen. The amount payable will be transferred

from the consumer's card to the retailer's card when the consumer's card is inserted into the card reader in the point of sale unit.

The scheme was invented by British banks in 1990. American, Asian, Australian and Canadian banks are all joining the scheme. The pilot commenced in Britain in 1995 and to-date more than 10,000 cards are in circulation. The soft launch in Hong Kong will commence in the fourth quarter of 1997.

(VIII) Autopay (Direct Debit or Credit) Service

The services are offered to financial institutions and corporate customers in all business sectors. The services are divided into autopay-out and autopay-in.

- Autopay-in service allows customers to make payments to regular creditors or employees on one nominated date or periodically within a specified period. A direct debit authorisation form must be signed by the debtor before the service can be effective.
- Autopay-out service allows customers to collect payments, in settlement of bills, on one nominated date or periodically within a specified period.

Customers can submit autopay instructions in three ways:

- ***Paper list***
Payment or collection details are filled in on an Autopay list with pre-defined format. The submitted list must be accompanied with an authorised signature and company chop.
- ***Diskette or tape***
Payment or collection instructions are generated from the customers' back office systems following the Machine Readable Input (MRI) format and are transferred to diskettes or tapes. Alternatively, the MRI instructions can be prepared on PCs with software provided by the bank. The diskettes or tapes are submitted together with a paper form where authorised signature and company chop are required.
- ***Electronically via telephone dial-up***
Instructions are entered on a PC and submitted through the electronic banking system of the bank.

Provided that the instructions are submitted before cut-off time, they are same day processed on a batch basis after normal working hours. Forward dated payments are also supported.

Instructions are captured into the system and then capture reports showing details of all submitted items are generated and awaited customers' collection in paper form or electronically depending on the submission method.

Payments or collections that require cross-bank settlement are passed to ECG (Inter-bank Electronic Clearing System) for clearing. If there are no rejections within a pre-defined period of time, the collections or payments can be assumed to be successful. Funds are normally available two days after submission, but the second party banks are given up to four working days to reject the payments or collections.

The system was developed in the early 1970s and has been regularly reviewed. The latest review with the objective of streamlining electronic delivery of instructions was completed in early 1996.

(IX) Securities Trading and Clearing

The trading and listing of securities, debts and warrants are provided by the Stock Exchange of Hong Kong Limited. The Stock Exchange also provides services in trading and clearing of stock options, and provides market data in various formats.

The central clearing and settlement system for listed securities in Hong Kong is developed and operated by Hong Kong Securities Clearing Company Ltd. (Hongkong Clearing). In addition to securities clearing and settlement services, Hongkong Clearing also provides electronic money settlement services, depository services, common nominee services and share registration services. Ordinary shares, preference shares, registered and covered warrants, debt securities and rights issues listed on the Stock Exchange are presently accepted in the central clearing and settlement system.

(a) Equity Trading

The Hong Kong securities market is a fully electronic exchange with an order driven trading system, Automatic Order Matching and Execution System (AMS). Exchange trading members have trading terminals installed at the Exchange's trading hall and second terminals at their offices for on-floor and off-floor trading respectively.

After signing on to the system, the traders can perform various transactions including order input, trade input, odd lot order input, odd lot trade input, market enquiry, order enquiry and information page enquiry.

When an order is matched, a trade confirmation will be displayed on the broker's terminal and printed on his printer. The trading information will also be broadcasted to other trading terminals. The trades concluded will be transmitted online to the Hongkong Clearing for settlement purposes.

At the end of the trading day, traders sign off after they have completed all their tradings. The traders also download all their trade records into their back office systems for further processing.

The trading information will be available through the Exchange's Teletext system or through information vendors who have subscribed to the real-time datafeed from the Exchange. The system also obtains stock options prices from the options trading system TOPS, and index futures and options prices from Hong Kong Futures Exchange. The appropriate securities information is transmitted to the options market and Heng Seng Index Services Ltd.

Trading analysis reports are generated at the end of each month for analysis and research purposes by the Exchange and also for publication to the market.

(b) Options Trading and Clearing

The Hong Kong options market is also a fully electronic exchange with an integrated trading and clearing system, TOPS. Trading members have trading terminals installed at their offices for off-floor trading.

After signing on to the system, a member can input the details of the order received from a client. The order is captured into the central order book and queued for order matching.

If the market does not have counterpart orders for matching, the member can initiate a quote request and market makers will provide quotes. Market makers are obligated to provide quotes to maintain market liquidity.

When the order is matched, a trade confirmation is transmitted and printed at the printer located at the member's office. The trade information will be immediately updated to reflect the latest market situation.

During trading hours, members are allowed to input exercise instructions for their options contracts. At the end of the trading day, exercised

instructions will be assigned to generate exercised trades. The exercised trades are then transmitted to Hongkong Clearing to effect settlement.

Trading members can also admit to the Stock Exchange Options Clearing House (SEOCH), a wholly-owned subsidiary of the Exchange, for the clearing and settlement of options contracts. SEOCH only deals with clearing members for daily settlement, margin collection and other clearing processing.

Fund transfer instructions generated by TOPS are manually despatched to the banks, which have a daily settlement arrangement with the SEOCH for members' premium and margin payable and receivable, to effect settlement between 8:00am to 9:00am every morning.

TOPS also interfaces with CCASS, the clearing and settlement system of the stock market operated by Hongkong Clearing, for the settlement of exercised options contracts.

Members have two types of connection to TOPS. Members with more sophisticated trading requirements have the option to procure a server to act as a User Device (UD) at their own costs. The UD allows local connection of multiple trading terminals and it also provides real-time price feed and trade feed for electronic interface with member's in-house front office and back office applications. The interfaces are based on a specification published by the Exchange and members can either procure off-the-shelf software or develop their own in-house system for integration with TOPS.

Members who have a simple operation and choose not to own a UD are allowed to install a PC connected to the Exchange. The PC emulates a TOPS trading and clearing terminal and also receives trade data, settlement prices margin parameters and TOPS reports downloaded at the end of each day.

For members with in-house User Devices, a back office message associated with a matched trade is transmitted to the User Devices for electronic capturing by members' in-house back office system.

Members can also receive downloaded TOPS reports or raw data files captured into their back office systems for further processing. Every month the members also receive reports, such as fee statements, cash account transaction details, security movement and trade statistics, for reconciliation and back office processing.

(c) Central Clearing and Settlement

The Central Clearing and Settlement System (CCASS) of Hongkong Clearing is a computerized book-entry clearing and settlement system serving brokers, custodians, stock lenders, stock pledgees and clearing agency.

Trades, once executed in the Exchange, are transmitted to CCASS in a real-time manner, enabling the Compliance Department of Hongkong Clearing, using this data together with other settlement positions, to carry out on-line real-time broker surveillance functions.

All exchange trades are to be settled in CCASS either under the continuous net settlement (CNS) system or the isolated trades system. Under the CNS system, Hongkong Clearing substitutes itself as the settlement counterparty and becomes responsible for the settlement of such trades. Settlement is electronically recorded as increases or decreases in participants' stock account balances, without the physical movement of share certificates.

CCASS participants are required to establish a designated bank account with their designated bank and authorise Hongkong Clearing to raise debits and credits to this account. CCASS generates Direct Debit Instructions, Direct Credit Instructions, and Electronic Payment Instructions for money settlement at the end of the day for all transactions settled by delivery versus payment in CCASS and submits them to the Clearing House of the Hong Kong Association of Banks for overnight processing.

(d) Depository, Nominee and Share Registration

CCASS participants can deposit or withdraw share certificates to and from the CCASS Depository.

The common nominee receives the benefit entitlements of the shares on behalf of CCASS participants and makes the appropriate distributions in accordance with their shareholdings held in CCASS. The common nominee responds to corporate events including shareholders' meetings, rights issues, cash offers and warrant conversions in accordance with participants' instructions.

HKSCC Registrars Limited, a wholly owned subsidiary of Hongkong Clearing, provides a comprehensive range of share registration services including initial public offerings, share placements and post new issue requirements, including maintenance of a shareholders' register and communication with shareholders regarding corporate actions.

The computer assisted trading system was launched to the Exchange in 1986 to computerise the chalk board system. The trading system simulated the chalk board where traders could transfer the clients' orders onto the screen. Traders then negotiated with each other over internal telephones. After a deal was struck, traders input the trade details to the trading system.

The Automatic Order Matching and Execution System (AMS) was launched in November 1993 to enable Exchange members to perform automatic trading. This gives members better control of their trading activities and the market transparency has been greatly enhanced.

Trading rules were enhanced and approved by the Securities and Futures Commission (SFC) in 1995 to enable members to trade through second terminals located in their offices as well as in the trading hall. The AMS Second Terminal System went live in January 1996.

The issuance of the market consultation papers and the formulation of product specification and market structure of the stock options market started in 1993. In 1995, the market was launched after installing the trading and clearing system, membership enrolment, market simulation trials and obtaining the approval from the SFC. By February 1996, 10 options classes had been introduced. The stamp duty exemption for options market making was also implemented in 1996.

Hongkong Clearing was incorporated in 1989. Its members include the Stock Exchange and five banks. It was designated as a recognised clearing house in May 1992 by the SFC under the provisions of the Stock Exchanges Unification Ordinance, which has now been repealed and replaced by provisions in the Securities and Futures (Clearing House) Ordinance. The ordinance established the foundation essential for safeguarding the integrity of the CNS system and CCASS.

In 1992, the SFC approved the HongkongBank, agents for Hongkong Clearing, as a satisfactory institution for providing facilities for the safe custody of securities documents. Hongkong Clearing was also designated as an eligible foreign custodian by the Securities Exchange Commission of the United States and approved to be depository by Britain's Securities and Futures Authority this year. In 1996, Hongkong Clearing introduced its in-house depository thereby ending its agency relationship with the HongkongBank.

(X) *Futures Trading*

Futures contracts are traded in the Hong Kong Futures Exchange (HKFE). The products traded include Hang Seng Index (HSI) Futures, Rolling Forex, Stock futures, Three-Month HIBOR Futures, Gold futures and HSI Options. Both the open-outcry system and the computerised system, Automated Trading System (ATS), are used as the trading methods. ATS is only used for the trading of Rolling Forex contracts.

ATS is an order placement and matching system in real-time. Members submit orders and/or quotes from Trading Workstations at members' premises to Central Marketplace Systems through HKFE-ATS network for auto-matching. It generates a virtual marketplace with a price picture which includes the information about orders, prices and trades. The details will then be distributed to all members or other systems such as information vendors by specific feeds. Immediately upon the matching of orders, trade details will be transmitted to the Clearing System where the trade will be registered, cleared and settled.

The Clearing System handles deals from ATS as well as from open-outcry trading. For deals traded in ATS market, the Clearing System obtains the deal messages from ATS in real-time. For deals traded in the open-outcry market, registration staff have to enter deals into the system at the trade floor. In the latter case the system produces daily trading statements to floor trader for trade verification and position change requests after market-close. The registration staff can then enter position changes and trade allocations for both markets into the system according to the members' instructions. The clearing process is then executed in the daily batch and clearing reports are printed. Furthermore, members can retrieve their clearing reports and check their trade positions by means of remote access to the system.

The Futures Exchange also maintains a Price Reporting System. This system provides real-time price and trade information to the traders as well as to the public. The spot price of the underlying instruments feeds into the system which also accepts the real-time quotations and deal prices from the markets. The system processes the price information, formats it, and transmits it in real-time to price reporting media such as the display wall-boards, video display monitors, instant voice response system for telephone inquiry and data transmission broadcast line. The system is also equipped with a module for calculating the theoretical indicative price of options series traded in the market.

(XI) Financial Information Provision

The survey studied two financial information providers. Each financial information provider manages a global network to provide real-time price quotes, financial news, corporate and industry data, commentary, statistics, indices and research to the users. The information covers equities, money markets, currencies, municipals, bonds, commodities, mortgage-backed securities and derivative products.

The major users of the service are investment professionals such as fund managers, traders, brokers, dealers, institutional investors, securities analysts and individual investors. Other users include manufacturers, government agencies, import/export companies, shipping companies, airlines, hotels, educational institutes, newspapers, and TV and radio stations.

In addition to the financial information, these services also provide analytical tools, options price modelling and portfolio management tools. One provider under study also provides transaction products for the subscribers to make business transactions with their counterparts in areas such as foreign exchange trading.

The subscribers to the services normally use dedicated PC-like terminals or ordinary PCs to receive and manipulate the information. The users may also receive the information as raw datafeed and process it by their own systems.

For transaction services, each subscriber needs a password to log-on. Once logged on, every conversation will be recorded in two tickets, one for the dealer and the other for the back-office. There is also an on-line journal which records the latest conversations. It is the responsibility of the users to log-off their terminals when unattended.

These providers also disseminate the information via TV and radio. Apart from online information, one provider also publishes a monthly magazine.

(XII) Electronic Data Interchange

One Electronic Data Interchange (EDI) system was studied in detail, and one other in outline only.

The first EDI service allows companies to send and receive business documents such as orders and invoices, electronically over a telecommunications network. The documents being exchanged are structured according to established formats so that compatibility between trading partners is ensured.

The service is provided jointly by a local trade organisation and an international computer vendor. This service gives the members of the organisation a one-stop solution for EDI implementation, including the global network access, end user software, option of PC-bundle, training, message support, applications consulting and EDI roll-out programme.

The service adopts the message standard of EANCOM/EDIFACT, which is a detailed implementation of a subset of the UN/EDIFACT international EDI standard. All EANCOM messages, totally 27 at present and 19 more in 1997, can be supported by the service. Furthermore, in order to make EDI implementation easier in Hong Kong, the organisation has set up an EANCOM messages development sub-committee to coordinate with the industry users to define the Hong Kong subset of EANCOM for local implementation. Seven messages have been defined, including:

- Despatch Advice
- Invoice
- Purchase Order
- Purchase Order Change
- Purchase Order Response
- Price/Sales Catalogue
- Remittance Advice

Two types of software are provided to the subscribers. One is true EDI software which connects to the back office system of the company and has the message mapping capability. This system can support all EDI message types based on international standards (EANCOM/ EDIFACT and ANSI). The other one is a low cost start up software specially developed for small and medium sized companies, which has a user interface for data entry but has no connection to any back office system. Only four message types, that is Purchase Order, Purchase Order Change, Purchase Order Response and Invoice, are supported.

The service was originated from a retail EDI pilot in 1992. The request for proposal was sent to international VANs in 1994 for the provision of an industry-wide EDI service in Hong Kong. The service was then launched in 1995.

The second EDI service will allow garment manufacturers to apply to the Government for Export Licences and Trade Declarations. It is based on UNEDIFACT standards and utilises an X.400 network to link members to the system. Consideration is being given to extending network linkages to other EDI systems in Hong Kong, such as CargoNet and EZ*Trade, and to the Internet.

Summary Statistics

	No. of Systems Studied	Transaction Volume and Value	Number of Users or Installations
Interbank Clearing	1	About 600K transactions per day, amount to about HKD 250 billion. CHATS accounts for around 1.25% of the transaction volume but 73% of the value.	186 member banks
Electronic Funds Transfer at Point of Sale	2	Around 43,000 transactions per day with average value about HKD 2,000 per transaction.	8700 EFTPOS terminals installed. Almost all household can use the services.
Automatic Teller Machines	ATM system of 2 banks 1 ATM switching network	Around 3 million transactions per day from the two major ATM networks. The Figures from one bank indicates an average transaction value of HKD 1,400.	Around 2000 ATM terminals installed by the two major ATM networks across HK, Macau, and other cities in the Quandong province.
Credit Cards and Charge Cards	2	–	16 member banks, 1.2 million cards issued, 53000 merchants accept the card in Hong Kong. (figure from one system only)
Retail Store Purchase Card	1	About 10,000 transactions per day, with average value HKD300	About 50,000 customers and 600 card terminals
Electronic Banking and Telephone Banking	3	More than HKD 8 trillion per annum. (figure from one electronic banking system only)	–
Electronic Money	1	–	Nil. Soft launch in 4Q97
Autopay Service	1	17.5 million instructions processed in a quarter	instructions from 11,000 customers
Securities Trading and Clearing	3	Securities: <ul style="list-style-type: none"> • no. of trades 45000 • turnover HKD6000M Stock options: <ul style="list-style-type: none"> • no. of trades 360 • no. of contracts 6400 • premium traded HKD 9M • value of options traded in terms of underlying share value HKD470M (all are average daily figures)	Securities: 450 members 847 terminals in trading floor 416 second terminals Stock options: 90 members 150 terminals Clearing: 150 users 787 terminals
Futures Trading	1	7000 transactions per day HKD1.4 million per transaction	134 brokers 60 ATS terminals
Financial Information Provision	2	–	Around 1700 terminals installed in Hong Kong. (figure from one provider only)
Electronic Data Interchange	1	2.7 million characters per day	–

	Operating Hours	Market Penetration
Interbank Clearing	Mon-Fri 09:00 - 16:30 Sat 09:00 - 12:30	–
Electronic Funds Transfer at Point of Sale	24 hours a day, 365 days a year	Cover 1 in every 4 shopkeepers in Hong Kong.
Automatic Teller Machines	24 hours a day, 365 days a year	–
Credit Cards and Charge Cards	24 hours a day, 365 days a year	20%-25% by each of the two cards systems.
Retail Store Purchase Card	24 hours a day, 365 days a year	35%
Electronic Banking and Telephone Banking	One electronic banking system operates 24 hours a day, 365 days a year. Another electronic banking system operates from 7:00 to 23:00 from Monday to Friday, and 7:00 to 17:00 on Saturday, with no service on public holidays. The telephone banking system operates near 24 hours a day with 1/2 hour close-down for daily batch processing, and 365 days a year.	30% - 40% for one electronic banking system, 3% for the other. 35% for the telephone banking system.
Electronic Money	24 hours a day, 365 days a year	Expect 40% penetration at the end of 10 years.
Autopay Service	Batch processing after normal banking hours from Monday to Saturday.	65% market share
Securities Trading and Clearing	Markets are open from Monday to Friday except public holidays, with trading session from 10:00 to 12:30 and 14:30 to 15:55. AMS and TOPS operating hours are 9:00 to 17:00 Operating hours of the information services are 6:00 to 17:30 for the real-time datafeed, 8:00 to 19:00 for teletext feed, and 10:00 to 22:00 for email. The clearing system is online from 7:00 to 19:30.	99.5 % of the trades in securities concluded on the Stock Exchange is settled in CCASS. 38% of the total issued share capital of the admitted stocks is under the custody of the CCASS Depository.
Futures Trading	HSI Futures, Stock Futures and HSI options are traded from 10:00 to 12:00 and from 14:30 to 15:55 or 16:00, Monday to Friday. HIBOR Futures is traded from 9:00 to 15:30 Monday to Friday, but ends at 12:30 on the last trading day of spot month. Gold futures is traded from 9:00 to 12:00 and 14:30 to 17:30, Monday to Friday. Rolling Forex is traded from 8:00 to 3:00 or 4:00, following the New York daylight saving hours, Monday to Friday.	–
Financial Information Provision	24 hours a day, 365 days a year	50% to 90%, depending on market sectors. (figure from one provider only)
Electronic Data Interchange	24 hours a day, 365 days a year	Less than 10% of the members

	Relative importance of HK to the Global Market	Expected Growth
Interbank Clearing	Local service	–
Electronic Funds Transfer at Point of Sale	Local service	Grow to one in every three shopkeepers by mid 1997
Automatic Teller Machines	–	–
Credit Cards and Charge Cards	As indicated by one card company, Hong Kong accounts for 2.2% of the total number of cards issued in Asia Pacific, and 1.7% of the gross dollar volume. Another card company indicates that the Asia Pacific region accounts for 11% of the pre-tax income.	One expects a growth in market penetration from the current 20%-25% to 50% in 3 to 5 years. The other expects a growth from the current 20% to 35% in 5 years.
Retail Store Purchase Card	Local service	Target and actual about the same at 35% penetration
Electronic Banking and Telephone Banking	One system is a global service with Asia Pacific accounts for a large percentage of the total base. The others are local services.	One electronic banking system is expected to have a 15% growth in the next 18 months. The other one is expected to triple its market share in 3 years. The telephone banking system is expected to increase the market share from 35% to 50% in 3 years.
Electronic Money	–	–
Autopay Service	Local service	penetration rate maintained at 65%
Securities Trading and Clearing	Trading is available to Exchange members and their clients are both local and international. 5% of the information vendors are from overseas. CCASS participants must have established business in Hong Kong.	–
Futures Trading	–	–
Financial Information Provision	Around 3% in terms of revenue or number of terminal worldwide	5% growth rate (figure from one provider only)
Electronic Data Interchange	Local service	–

	Charging Mechanism
Interbank Clearing	Usage base with a monthly minimum
Electronic Funds Transfer at Point of Sale	A certain % of transaction value payable by the merchants to the service provider. Card issuing bank pays a flat subsidy charge for each transaction processed.
Automatic Teller Machines	ATM cards holders are charged an annual fee. For transactions across different banks using an ATM switching network, the cardholder bank is charged a service fee for each cash withdrawal. The fee is shared between the ATM provider and the network operator.
Credit Cards and Charge Cards	One service charges the member bank a weekly fee for connectivity and a usage fee based on number of transactions. One service charges the card holder a joining fee and an annual fee.
Retail Store Purchase Card	Charge the card holder based on pump prices
Electronic Banking and Telephone Banking	Initial set-up fee plus monthly service fee are normally required for the electronic banking services. The telephone banking service is free of charge.
Electronic Money	Retail customers will pay no fee during soft launch. Subsequent fees will probably take the form of flat fee or a transaction fee for each deposit or withdrawal. Merchants will not pay any fee during the soft launch. Subsequent fee will probably be a percentage on the amount of value deposited.
Autopay Service	Fee per instruction Fee depends on submission method; paper list is charged the highest while submission through electronic banking system is charged the lowest.
Securities Trading and Clearing	The Exchange charges <ul style="list-style-type: none"> • monthly membership fee, subscription fee to the teletext system and 2nd terminal, and trading tariff (an amount per trade) from the members • transaction levy (a percentage of the transaction value) from both the buyers and the sellers • listing fee and issue fee from the issuers. Hongkong Clearing charges <ul style="list-style-type: none"> • stock settlement fee (a percentage of the trade value) from the brokers on both sides of a trade
Futures Trading	–
Financial Information Provision	Basic real-time information and news services charged at a flat rate per terminal. One provider also charges a flat rate per location. An additional transaction fee is also charged to the aggressor of the dealing system.
Electronic Data Interchange	EDI membership entrance fee plus annual fee. Network registration fee plus network usage based on traffic volume.

Technology Comparison

In general, most of the systems under study employ proprietary and rather old-fashioned technologies. They have limited interconnection, and the system architecture is not readily open for further easy interconnection.

System Architecture

Out of the 23 systems studied, only two of them are in batch mode operation. The majority of them are real-time online systems, or a combination of real-time operations and batch operations. In most of these systems, financial transactions are processed online in real-time, whereas the accounting, reporting and database maintenance functions are carried out in batch.

For systems that require monetary settlement, only the RTGS of HKICL has a real-time settlement capability. The other six systems require the settlement in daily batch mode.

Linkage to Other Systems

Apart from providing the linkage to other in-house systems of the service providers, for instance, the banking systems of the banks, some systems also provide linkage to third party systems.

One group displaying inter-system linkage is between the ATM networks, the EFTPOS network and the global networks of the card companies. This enables the cards issued by different banks and card companies to be operated on ATM machines of different banks and the EFTPOS terminals, except that the two ATM networks are still not interoperable.

The other group of inter-system linkage is between the systems in the Stock Exchange and that of Hongkong Clearing for the clearing and settlement of securities. The systems of Hongkong Clearing are also linked to the banking system of a large commercial bank for monetary settlement.

On the other hand, only five systems provide interfaces for the end users to link the systems to their own back office systems.

Platform

Eighteen out of the 23 systems provide their services on a central mainframe host. Four provide the services on mid-range platforms including DEC VAX and AS/400. The other one relies on the third party network of a computer vendor to provide the service and thus does not have a host or server.

Nine out of 11 systems use PCs as the end user terminal or workstation. The other two offer Unix, AS/400 and VAX.

Four systems also require front end processors or interface servers, with three of them on Unix and one of them on AS/400.

Application Infrastructure

Thirteen systems are using online transaction processing. Seven systems are also using database systems.

Networking

Three systems run on Bisync links, four systems run on asynchronous connection, and two systems run on frame-relay.

For the upper layer protocol, SNA is the most common, which is used by seven systems. TCP/IP is used by four systems.

Most of the systems, 12 out of 17, use low line speed ranging from 2400bps to 19.2Kbps. Seven systems use higher line speed from 64Kbps to 1.5Mbps.

User Interface

Twelve systems provide an end user interface on computers, mostly PCs. 11 of them provide a text only menu-based system, with only three of them providing a graphical user interface (GUI).

Four systems provide user interface on telephones with voice response systems, and five systems provide user interface on ATMs. Dedicated card readers are also used in three systems.

Standards

There are only two international standards clearly supported by these systems. One is ISO8583, which is supported by the ATM, EFTPOS and credit card systems. The other is UN/EDIFACT, which is supported by the EDI network service as well as an electronic banking system.

Security

Access control by password or PIN is the most common security measure incorporated by these systems. Replies on 11 systems explicitly mentioned the

use of the technique. Some of the other replies only mentioned the use of host-based security or add-on security package to the operating system, which are expected to be incorporating password type of access restriction as well.

The replies on 12 systems mentioned the use of encryption to protect transaction messages or PINs, and replies on four systems mentioned the use of authentication code or electronic signature for the message integrity checking. However, only four of them mentioned the technique and algorithm being used. Among these four, only one is using public key cryptography, the other three are only using secret key cryptography to encrypt the PIN or message. No one has mentioned about the management of encryption keys.

It is suspected that the encryption techniques employed by most of the systems rely on the secrecy of the internal design of the system, rather than the proper management of secret information, i.e. the cryptographic keys, by the end users. There is also no sign of interoperability of the security features, for example, the use of public key certificates, which means cross-system end-to-end security is difficult to implement.

Future Plans and Comments on Infrastructure

Respondents were asked to supply information regarding their future plans, and to offer any comments of a more general nature regarding the infrastructure in Hong Kong, in its widest context.

The vast majority of respondents stated that they planned more functions, features and other changes in response to their marketing requirements. In many cases, the future plans were very specific to the respondent and items described were not mentioned by others. Those which were mentioned by more than one respondent, with the number of occurrences, are shown below in summarised form.

	Description of planned changes	#
1	Upgrade platforms and/or telecommunications facilities. In most cases, this would be, specifically, to UNIX based client/server architecture with TCP/IP network.	8
2	Provide more data as a value-added service, and it was frequently mentioned that this would be distributed in real-time, over a network.	6
3	Smart card related changes, recognising the need to compete in this new area.	6
4	Internet related changes, mentioning the use of Internet as a new delivery channel.	5
5	Developing links to members/participants systems, often providing or enabling host-to-host links.	4
6	Integration with EDI/electronic commerce, with an acceptance of open standards and non-proprietary new message formats.	4
7	Adapting to stored value cards, requiring changes to ATMs and other cards.	4
8	Introducing TV/home banking related services, being different delivery channels for existing products.	3
9	Develop links to interbank payment system, primarily for DvP and PvP, for reasons of both reducing risk and increasing liquidity.	3

There are a wide range of responses regarding infrastructural concerns and suggested changes are also provided by the respondents.

	Comments on Infrastructural Issues	#
1	Must move to open standards/networks, typically, TCP/IP, UN/EDIFACT.	5
2	Concern at raising line charges, and, in general, telecommunications charges should be kept as low as today.	4
3	Secure and easy interconnectivity is very important, as there is a need to link to other networks, especially in China.	4
4	Shortage of skilled labour was quoted in addition to the need to upgrade language skills, particularly Putonghua and English.	3
5	Must introduce DvP, not only as a risk reduction method but to free up liquidity.	3
6	Should lower stamp duty/registration charges, to encourage retail investors and dematerialisation.	3
7	Need to open up telecommunications industry so that new services, at lower tariffs, can be enjoyed.	2
8	Need to keep down reporting requirements, indicating a concern that, with the opening of networks and standards, there will be an increase in supervision and control.	2
9	Concern at over-regulation, which is a similar concern to item 8 above.	2
10	Worry at the threat of increased competition if moving to open standards, expressing the fear that proprietary standards and networks will be under threat.	2
11	Promote legislative changes, in particular regarding foreign exchange and dematerialisation, reflecting a view that there will need to be Government support for legislative changes if some of the benefits of new technologies are to be realised.	2
12	Government should promote Hong Kong as a financial centre, support the development of a robust IT industry and promote education of financial services in general.	2

It is also clear from the responses that some organisations have given the matter considerable thought from the perspective of the broader infrastructural implications, and others have missed the point completely. For example, one suggestion was for Hong Kong to clear USD payments, as in Singapore; another was to speed up the cross-border flow of goods and services. A concern was expressed about the continuous, immediate and real-time access to sources of financial data and economic statistics.

Summary of Findings

Current Status

The results indicate that the systems provided by the participants in the financial services sector are, generally, mature, well established with good penetration of their chosen markets. There are, however, marked differences between the different classes of systems, i.e. sole providers and competing providers of services, and within this latter group, between local and overseas based providers of services.

With regard to the sole providers, typically the clearing companies and exchanges, their systems are reasonably up-to-date in functionality but, to a lesser extent, in technology. The functions are dictated by the need to offer services to the international community and are therefore world class, the systems are stable, and perform to internationally acceptable standards of control, availability, resilience, etc. These providers have all, recently, upgraded some, or all, of their systems in response to initiatives from equivalent organisations overseas and they continue to look there for sources of new ideas.

The competitive providers fall into two classes, as mentioned above. Those which are based overseas make little or no distinction between the Hong Kong market and any other, and so the systems are the same as offered elsewhere, i.e. up to full international standards in terms of features and, to a lesser extent, technology, although this is consistent with the technologies employed overseas.

The situation with regard to competitor suppliers which are locally based is, however, significantly different. These systems are, typically, old fashioned in technology terms, relying heavily on host based systems and dumb terminal access, using proprietary, and old fashioned, telecommunications networks and protocols. The functionality has seen little change since first introduced and reflects only the features which could be easily provided at the time. A prime example is the ATM

In sum, systems provided by sole providers are up to international standards and up-to-date in functionality but, to a lesser extent, in technology, whilst for the competing providers who are based overseas, things look pretty much the same. And for those competing providers based in Hong Kong, they offer much older-fashioned systems both in terms of technology and functionality.

network where the two competing suppliers have done little since the services were introduced to bring the features up to the level of those offered overseas, or made possible with the more recent capabilities of the technology, for example, no touch screens are in use.

Another interesting phenomenon is the quite extensive use of telephone to provide services, utilising voice response technology for giving instructions and information, and telephone keys for entering data. This is in widespread use because of the very high penetration of telephones in the general population, and the fact that local calls are free.

It is also interesting to reflect on what applications are currently not offered in Hong Kong. Three stand out as prime examples as they are now widely used in other parts of the world, notably in North America and Europe.

In Hong Kong, strong potential appears in areas like electronic banking, Internet home banking and debit cards.

- Electronic Banking for retail customers, whereby retail customers can perform banking transactions from their own computers sending instructions to their bank over the telephone lines. This is now well established in USA, whilst in Hong Kong there is a view that telephone banking will be sufficient.
- Internet home banking is now well established in both North America and Europe with about 2,000 banks having web sites, two thirds in North America.
- Debit cards. Although debit cards are present in Hong Kong via the EPS system and there are plans to significantly increase the number of shops which accept EPS, the fact is that it has been in place for some considerable time without having any noticeable effect on the number of cheques issued. Overseas, debit cards, and a sister product, giro, are now extensively used in Europe and, increasingly in USA, for the issuing of credit transfers rather than debit transfers. There are dramatic reductions being seen in the use of cheques in all countries where debit cards and giro have been introduced.

With regard to market share, in all areas where there is competition, for example, credit cards, ATMs, Electronic Banking, Information Services, there is good penetration of the chosen markets and suppliers are looking forward to incremental growth, albeit that some of the increments will be quite large, particularly where a supplier is coming into an already established market. However, most see steady growth rather than dramatic increases in customers. Again, this is entirely consistent with Hong Kong's relative state of maturity in financial services.

Plans for the Future

Many of the respondents have mentioned that they are forecasting an upgrading of their systems with the introduction of new technology, with an almost equal split between migrating to client/server architecture with open standards and protocols, TCP/IP, to the other direction of introducing new technology on top of existing proprietary host-based systems and networks.

Much of the technology change is to support new features, determined as a result of customer demand. However, a significant number of respondents are making the changes in order to support the linking of their systems to other systems, either by linking networks, or by providing host-to-host connectivity. A further reason for change is the need to position themselves to benefit from new technologies, for example smart cards.

There are some very revealing differences in attitudes towards interoperability and hence willingness to move towards open standards. The sole suppliers recognise that they must be able to communicate via many different methods and are accepting the need to move towards interoperability. The credit card companies have been moving this way for years and they continue to cooperate in such areas as developing common standards for secure payments over the Internet.

However, the local ATM suppliers have no plans for interoperability. Also, local suppliers of services where they have a relatively large market share are not interested in moving towards open standards, presumably as this is perceived to be a threat to their business stream, whilst, naturally enough, other suppliers of those services with smaller market share are far more likely to be supportive of moves in this direction.

There are few examples of innovative developments being planned, with the notable exception of developments regarding electronic cash and electronic purses. These innovations are imported.

There seems to be a desire to retain the status quo for as long as possible. For example, there is reluctance to move away from 'phone banking' despite a suggestion that the Government should be lobbying on their behalf for the continuance of free local calls, notwithstanding Hongkong Telecom's warning that this cannot continue for much longer, plus experience from overseas.

This reluctance to accept inevitability, and therefore not to consider innovation is disturbing. Few seem to have appreciated that the Internet is here to stay and that it has the potential of altering the way they do business in fundamental ways.

Some companies believe that supply creates its own demand, and therefore by inputting more advanced technology into their systems, they will attract more consumer demand. However more reckon that demand creates its own supply, and hence if the service is not demanded, there is no reason to provide it. This attitude implies that these companies prefer the status quo for as long as possible.

Those that have recognised the importance of this new technology appear to be looking for this as a way of changing the way in which products are delivered to customers, and are keen to cooperate, possibly as a means of leap-frogging a generation of product development in electronic banking.

Hong Kong relies heavily on import of technology, made possible by its open infrastructure. However, the lack of local breed could be a disadvantage since that means Hong Kong will be a follower, rather than an innovator.

There is a sense coming through from the survey that local financial institutions are rather conservative in their approach towards introducing new technologies. This, in itself may not be so worrying but, when viewed in a different context it should cause some alarm. This other context is the degree of control that financial institutions in Hong Kong have over their use of IT. Although the question was not specifically asked in the survey, very few banks in Hong Kong have the ability to initiate new ideas in IT without having to go to some other countries for approval. The three note issuing banks have their head offices in other countries; one does not even have its **regional** head office in Hong Kong. The only major high street bank headquartered in Hong Kong is the Bank of East Asia (ruling out Hang Seng as major IT issues will still be decided by HongkongBank in London). Many of the other foreign high street banks have their systems development groups outside of Hong Kong with only a supporting role kept here.

The positive side of this is that initiatives for change will come from overseas, typically the US and Europe, and will reflect the Head Office view of what is important and what is not. The bad news is that these initiatives from overseas are unlikely to be implemented in Hong Kong first, or even second. The likely sequence is the home country first; the US, Europe or Japan as the second and third; the regional head office the fourth; and then, maybe, Hong Kong. The other bad news is that, because of the fact that decisions are usually taken overseas, and because of the inherent conservatism of the financial institutions in Hong Kong, there is, almost inevitably, a lack of people with the innovative and technological skills available within the financial services sector in Hong Kong to take advantage of new technologies. There is also little incentive for local software companies to try to develop new software products for the financial services sector as they know that decisions will be taken elsewhere. This lack of available skills could place us at a serious disadvantage in the future.

Chapter 7

Conclusions and Recommendations

Overview

Hong Kong is the leading example of a service-oriented virtual economy, with the service sector accounting for 84% of GDP, compared with 72% in the US and 60% in Japan. It has become the leading designer, integrator, packager, facilitator, financier and marketer of manufacturing activities in China and the Asian region, because of its free market heritage.

Hong Kong has one of the finest telecommunications infrastructures in the world. Its openness to technology and high income, highly educated work force suggests that it has the potential to strengthen its premier status as a virtual economy and a virtual international financial centre. By improving its financial technology infrastructure, and strengthening education in the global networked world, Hong Kong can become the first Financial Supercity, where multimedia electronic commerce and payments are a reality.

The RTGS project has given Hong Kong a competitive edge in strengthening the robustness of Hong Kong's financial infrastructure, as well as linkages with other payment systems in both OECD markets and also regionally. Achieving this strategic step, ahead of others in the Region, has given Hong Kong an edge in securing the first bilateral linkage of our debt clearing system, Central Moneymarkets Unit (CMU), with the Australian bond clearing system (RITS). This will be the first leg of the Asiaclear network. Once the regional payments and clearing and settlement systems are linked together, this will facilitate greater development of regional financial and capital markets, with Hong Kong as one of the key hubs.

The IWG has looked carefully at the implications for developing Hong Kong's financial technology infrastructure in improving Hong Kong's international competitiveness. Clearly, financial markets will drift to those centres where the transaction costs are lowest, transactions are most secure (robust in terms of non-failure of systems and freedom from fraud), and delivered in real time (Delivery versus Payment or Payment versus Payment).

"The virtual state could emerge only when the mobility of capital equaled and then exceeded the mobility of goods".

"Like the headquarters of a virtual corporation, the virtual state determines overall strategy and invests in its people rather than amassing expensive production capacity. Imperial Britain may have been the model for the nineteenth century, but Hong Kong will be the model for the twenty first century".

*Professor Richard
Rosecrance, UCLA*

Technology is also pushing the whole market (including financial markets) into both electronic commerce (eCommerce) and electronic payments (eMoney). Unlike neighbouring economies, such as Singapore and Japan, Hong Kong has not, until recently, conducted its own NII (National Information Infrastructure) initiative. The IWG's work is the nearest equivalent, confined to the finance area.

eCommerce and eMoney

With the finest telecommunications systems in Asia, high diffusion of the Internet and high per capita income, Hong Kong is already emerging as the premier testing ground for eCommerce and eMoney in Asia.

Because of rising costs in wages and rents, a primary area where Hong Kong can extract additional productivity is through the use of technology and improved management, taking the form of electronic commerce and payments (eCommerce and eMoney). At the corporate level, the world is now moving towards what is popularly called straight-through processing (STP), whereby all financial transactions are electronically processed in one pass, from the point of first "deal" to final settlement and confirmation. Currently, financial transactions undergo wasteful multiple processing via paper and re-keying of data into computer-readable form at different stages of processing, subjecting the process to error and risks. For example, STP in equity trading is not possible currently, because some of the documentation requires the affixing of stamps for revenue collection purposes. Therefore, the securities firm must print the buy/sell ticket into paper form, and after the document is stamped, the data is re-keyed into the computer for further processing.

STP requires:

- A robust financial infrastructure that links the main exchanges together, including direct computer linkage with the payment system;
- Co-operation with the regulatory authorities and the tax authorities in ensuring that electronic data and electronic signatures are acceptable for document filing and official acceptance purposes;
- Uniform computer protocols and message standards that are in compliance with international standards;
- Co-operation between the different participants to ensure that common practices are established.

At the retail level, the growing affluence and computer sophistication of the Hong Kong consumer, coupled with the need for convenience, reliability and speed, is moving the market towards rapid acceptance of eCommerce and eMoney. With more than 500,000 Internet users and Web usage growing rapidly by the day as more and more services are available either through the Internet or through cable/TV Web systems, eCommerce will grow. Similarly, VisaCash, Mondex and other forms of eMoney are already at varying stages of testing or launching in Hong Kong. Hong Kong will be a major testing ground for eCommerce and eMoney in Asia, being one of the most fertile grounds for their adoption.

From the above, a picture emerges of the emergence of a Virtual Supercity, with the finest fibre optic cabling infrastructure in the world to put eCommerce and eMoney into practice. The actual implementation of STP and the development of eCommerce and eMoney may require considerable changes from existing practices, as some of the present requirements are technically impracticable in electronic means while new requirements also emerge. It would be useful to conduct a consultant study to identify the technical impediments, as well as the new technical requirements, for the implementation of STP in Hong Kong, which in turn would facilitate the rapid growth of eCommerce and eMoney.

FinNet - making Hong Kong the Financial Technology Supercity

Internet or Web technology has demonstrated that electronic commerce will dominate trade and finance in the 21st century. A robust, secure, and cost-effective **technology platform** is the backbone for enhancing the productivity of people; supporting the delivery and development of services; facilitating the research for policy formulation; and supporting the effective prudential supervision work. As a first step in that direction, the IWG recommends that the financial sector establish **FinNet**, a secure Intranet built for financial transactions throughout Hong Kong amongst all financial institutions and authorised users, to facilitate electronic exchange of data and STP in transaction, clearing, settlement, custody and other financial areas.

Initially, FinNet can comprise the simple secure submission of banking regulatory data to the HKMA by the authorised institutions. FinNet can also form the base network on which data for Mandatory Provident Fund (MPF), for example, can be built. The MPF is likely to have 2-3 million accounts and the data enquiry, record-keeping and administrative issues will be considerable if there is no industry wide secure Intranet to facilitate “virtual” or distributed administration of MPF funds and record-keeping. A centralised MPF computer is likely to meet huge resistance.

FinNet—the Intranet linking the financial institutions and the regulators together to enable a secure platform for data submission, and eventually straight-through processing.

We can see also a case for FinNet to be widened to insurance companies, securities brokers, fund management industry and institutions regulated by Securities and Futures Commission, so that data can be exchanged on a secure platform, that would allow STP to be conducted smoothly.

Many countries have identified the establishment of information technological infrastructure network as a critical building block to achieve competitive advantage. The US Information Superhighway initiative, the Singapore IT2000 Vision, and the Malaysian Multimedia Super Corridor are examples of these plans. Earlier this year, the City of London announced the creation of a City Net to unify its multiple networks to facilitate secure and efficient financial transactions.

Despite the high profile initiatives, no single economy has thus far attained their objectives in any significant way. For example, the US Fedwire remains a closed network for the sole purpose of payments, operating on proprietary technology. In Singapore, the Monetary Authority of Singapore operates a network (MASnet) that uses proprietary technology to link licensed banks and Central Provident Fund participants together, facilitating transactions such as account enquiry, funds transfer and the like.

In Hong Kong, the existence of multiple networks with different proprietary protocols make the provision of integrated multi-media services on a secure basis difficult. This would make the case for achieving STP, so that financial transactions would be seamless for the investor or the intermediary. For example, the clearing and settlement system at the SEHK and the HKFE and the Options Exchange are not networked, making the long contemplated cross margining difficult.

Despite these difficulties, Hong Kong is in a very good position to leap-frog the others to leadership, because it possesses:

- a well developed physical infrastructure, with a fully digitized network, fibre cables to more than 1,500 commercial buildings, 5 submarine cables and 14 satellites connecting Hong Kong to the world;
- a wide range of choices for communications services, including robust dial up network, packet switching (X.25) network, high speed dedicated circuits for T1, T3, FDDI and ATM connections. The rates are also among the lowest in the world; and
- a strong presence of major IT hardware and software expertise.

Hong Kong can put in place FinNet with the clear objectives of:

- being available to all licensed financial institutions in order to provide a level playing ground;
- keeping the cost low to allow participation of small institutions and service providers in order to encourage competition and innovation in financial services;
- facilitating straight-through-processing of financial transactions in order to reduce cost and enhance productivity;
- linking to other international financial centres to facilitate the globalisation of financial services.

To achieve these objectives, the Hong Kong SAR Government should take up the leadership to construct the FinNet. The exact design of FinNet is beyond the scope of the IWG, but in broad terms, the network design should adhere to the following design criteria:

- a) use international standard-based design with specifications fully open for licensed financial services providers to develop services on the network;
- b) allow access to the network using publicly available communications services in Hong Kong and globally;
- c) use non-proprietary communications protocol to ensure interoperability between and among systems;
- d) be highly robust in its availability and reliability; and
- e) be fully secure and allow for authentication and non-repudiation of financial transactions.

Current technology used by the Internet, together with the necessary security features, can meet all the design criteria identified above. Such internationally accepted technology should be adopted to construct the FinNet. It is expected that with current network technology and communications infrastructure being fully available in Hong Kong, the FinNet could be established within a six-month time frame.

The FinNet should be constructed with current international technology on Internet and with security features incorporated. The Hong Kong SAR Government should play a leading role in its establishment and make necessary changes to the law, the regulatory framework and standards.

The FinNet can easily incorporate three initial applications to substantiate its viability and credibility. The three applications include:

- a) creating a central registry/bulletin board of all published rules and regulations on finance available to all parties connected to FinNet;
- b) effecting electronic submission of returns by the authorised institutions to the Hong Kong Monetary Authority, the insurance companies to the Insurance Authority, and the licensed dealers to the Securities and Futures Commission; and
- c) implementing electronic loan purchase application and approval at the Hong Kong Mortgage Corporation—this is an application on electronic workflow.

By constructing the FinNet successfully Hong Kong can become the pioneer of the world's financial technology.

The results of these three applications would prepare the ground for integration of other existing and new financial services.

Constructing FinNet and the measures of the Government in “Strengthening Government Services through eCommerce” would ensure that Hong Kong remains in the forefront of financial technology in providing electronic commerce and electronic payments. It may be the first in the world to achieve DvP, PvP and TvP electronically, the first Virtual Financial City. Such a Vision would put Hong Kong as the centre to provide financial and other services for China and the Asian region.

Under the concept of FinNet, there is a natural case for the various Exchanges and clearing houses to be securely linked to each other, e.g. CCASS with the HK Futures Exchange clearing and settlement systems, and for these to be linked to RTGS. This will allow banks, securities houses and their customers to have seamless transactions between equity, bonds, derivatives and foreign exchange. A Working Group has already been formed comprising representatives from HKICL, HKMA and Hongkong Clearing to study feasibility for DvP for CCASS share transactions. Implementation of other linkages should also be studied. The IWG recommends that expert consultants are appointed to examine the technical issues so that bottlenecks that prevent such seamless flows are removed.

Bolero and Tradelink

One of the most interesting areas of recent development is the Bolero project, currently being led by SWIFT, the international interbank network operator. Bolero is a joint venture between SWIFT and the Through Transport Club (TTC), a club of international shippers and forwarding agents. The intention is to remove the inefficient paper-based processing of trade documentation, such as bills of lading, airway bills and letters of credit, by building a computerized central registry probably based in Europe. Tradelink is moving in this direction, by helping to process statutory trade documentation. However, Bolero may bypass such development by using the secure SWIFT network, and the creation of a worldwide Central Registry and Rule Book.

It is strategically important to support the work of Bolero, to ensure that the electronic facilitation of trade financing and secure Transfer versus Payments, forms one of the important platforms for EDI and STP in Hong Kong, the city having the largest container port in the world.

Strengthening Government Services through eCommerce

The Hong Kong SAR Government is committed to providing the best service possible to the public. To achieve this, the Government spends considerable sums in the IT area. Re-examination of Government-wide services infrastructure would include a review of regulatory, licensing, data reporting requirements through electronic means, so that obstacles of eCommerce and STP are minimised. This would involve a pro-active Government policy to allow for full electronic commerce for the consumer, as well as for the business firms to access Government information and for the Government to deliver services electronically.

One example of progressive government is the 1994 Canadian Government discussion paper: *Blueprint for Renewing Government Services Using Information Technology*. The paper proposes “a government-wide electronic information infrastructure to simplify service delivery, reduce duplication, and improve the level and speed of service to the public at a lower cost to the taxpayers.” Using new technology, the Government would be able to reduce the bureaucracy, improve openness and transparency, and remove obstacles and bottlenecks to STP and electronic commerce. Achieving STP would also reduce the growing pressure on public employment, thus releasing new manpower into an economy that is already at full employment level. However efficient the Hong Kong Administration is, there is considerable scope for savings through technology in delivering service to the public.

By providing public services electronically, not only will the quality of the services be improved, but also there will be a considerable reduction in provision costs.

In January 1997, the Hong Kong SAR Government started to look at the strategy for its use of Internet and related technologies. This initiative aims at the development of an integrated strategy for the Government on its own use of Internet and related technologies to improve the quality, speed and effectiveness of public services, and to enhance dissemination and collection of public information. Achieving electronic public services through Internet technology would help facilitate eCommerce and transactions with the public. Examples include the linking of public and university libraries through digital networks, provision of public services through cyber-kiosks and facilitating tax submissions, licensing and public payments through secure electronic means.

From a high level perspective, re-engineering the Government through technology is amongst the tasks in developing a community-wide information infrastructure, which included broadband physical infrastructure and applications, regulatory environment and facilitating functions such as education and development of computer literacy. The Information Infrastructure Advisory Committee (IIAC) was established in March 1997, under the Office of the Telecommunications Authority (OFTA), to develop information infrastructure in Hong Kong, mainly focusing on the development of physical infrastructure while accepting ideas and inputs on potential applications. A number of task forces and working groups have been formed under the IIAC, gathering various expertise from service providers, infrastructure builders, users and consumers, content producers, government and regulators. In July 1997, the Government reiterated its commitment to develop the information infrastructure necessary to propel Hong Kong into the 21st century, through proposing the establishment of an Information Infrastructure Co-ordination Office (IICO) to co-ordinate existing activities and develop policy targets.

Development of the information infrastructure is an important strategy to maintain and expand Hong Kong's role as a leading financial centre.

The building of a secure Intranet, using Web technology, linking government bodies together, with proper controls, might facilitate true STP for the consumer and the businessman, thus reducing costs in Hong Kong considerably. In the development of Intranet within the Government, it will be important to consider the interconnectivity, interoperability and harmonisation with other networks, in order to achieve STP for the whole economy. The work of the IICO and the IICA should help deliver better public services using technology.

In the 1997 Policy Address, the Government has reiterated the need for a Bureau Secretary to lead and coordinate the work throughout the Government organisation involved in information technology and the related areas of broadcasting and telecommunications. This Bureau will also be responsible for coordinating overall information technology development in Hong Kong and will:

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- a) formulate policies to facilitate the establishment of an open, common interface information infrastructure, accessible throughout the SAR;
 - b) lay down an appropriate regulatory framework to remove obstacles to interconnection between networks, and enhance Hong Kong's external information communications links;
 - c) develop a policy for accelerating the use of IT applications using the common interface in the public and private sector; and
 - d) commission pilot projects that make innovative use of the developing infrastructure.

Education

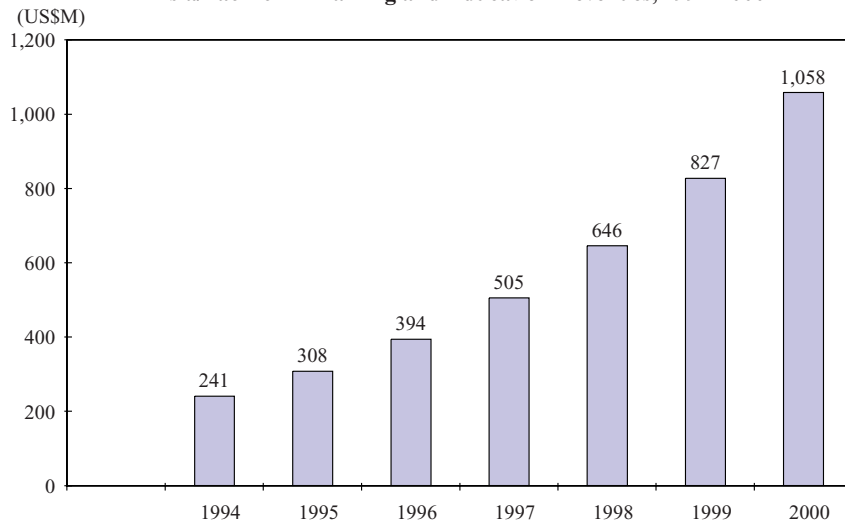
The Government has already taken considerable actions in the field of education:

- assistance will be offered to all public sector secondary schools to access the Internet from the 1996/97 school year onwards;
- multi-media computer systems will be provided to public sector primary schools with access to Internet starting late 1997;
- the syllabuses for Computer Literacy (for Secondary 1 to 3) and Computer Studies (for Secondary 4 to 5) will be revised to further enrich their content;
- Information Technology Learning Centres will be established in prevocational and secondary technical schools to promote the use of IT in technical curriculum later in 1997;
- the syllabus for Design and Technology will be revised to incorporate understanding and use of IT-related technologies such as computer-aided design and computer-aided manufacturing. The revised syllabus for Secondary 4 and 5 will be implemented from 1997/98 school year; and
- the Vocational Training Council administers the New Technology Training Scheme (NTTS). Grant and aid are offered under the scheme to firms in Hong Kong which send their staff for local and overseas training in new technologies useful to their businesses.

Following a recent review of the NTTS, the limits of grant for both local and overseas training have been removed to make the Scheme more attractive. The percentage of training cost that can be met by the NTTS has also been raised from 50% to 75%. The NTTS covers services as well as manufacturing industries. Examples of new technology courses relevant to the services sector are those relating to IT, wholesale/retail and the import/export trade. Efforts will continue to be made to increase utilisation of the NTTS by the service industries.

According to our survey, there is a lack of people with the innovative and technological skills available within the financial services sector in Hong Kong to take advantage of new technologies. There is also little incentive for local software companies to try to develop new software products for the financial services sector as they know that decisions will be taken elsewhere. This lack of available skills could place us at a serious disadvantage in the future.

Asia/Pacific IT Training and Education Revenues, 1994-2000



1995-2000 CAGR=28.8%

Source: International Data Corporation

The establishment of a Financial Services Institute would help develop our own local breed who understands the particular needs of Hong Kong.

It is of utmost importance to enhance public understanding of the potential of eCommerce and ePayments through education and training. We understand that the Government and interested parties in the private sector are exploring the idea of establishing a Financial Services Institute which would provide a focused and co-ordinated programme of human resources development for the financial services

sector as a whole. It will be important that the proposed institute, if established, should also cater for the future needs of the financial infrastructure. It should produce practitioners who are kept up-to-date in terms of IT and systems designs and should ensure that our systems are always on the leading edge.

Standards/Security/Legal framework

Attractiveness of financial markets is not only based on their efficiency but also their liquidity and security of transactions, which in turn depend on the financial technology infrastructure. Standardization of products and processes, as well as the legal framework, will facilitate transactions and engenders liquidity of markets. To promote Hong Kong's status as an international financial centre, it is imperative that it adopts international standards and best practices in all transactions.

As in the case of physical trade, it is useful to introduce some kind of Uniform Commercial Code for electronic commerce as well. Such a code should lay down agreed terms and conditions which govern commercial transactions via the Internet. It is also imperative to establish rules and norms that validate and recognise contracts formed through electronic means, sets default rules for contract formation and governance of electronic contract performance, defines the characteristics of a valid electronic writing and an original document, provides for the acceptability of electronic signatures for legal and commercial purposes, and supports the admission of computer evidence in courts and arbitration proceedings.

Security has always been a serious concern to all users of computers and communication facilities. The practice of data encryption has been adopted to prevent such intrusions. In recent years, more and more sophisticated algorithms have been devised that make encryption cracking more difficult.

The choice of platform involves consideration of security versus costs. Internet has the advantage of being cheap and flexible, as there is no need for a prior network connection. The Internet also opens to many more and smaller firms, providing a level playing field. However, there are concerns about security and reliability for using the Internet. The routing of messages is decided by the Internet Service Providers and it is not impossible that, for example, a message originated from Hong Kong is first sent to the US before it is sent back to Hong Kong where the addressee is located. The number of 'intermediation' can be very large and that leads to time lag and security issues. Thus the use of dedicated networks may be preferred under some circumstances, especially when we are considering a community-wide network. We should not underestimate the implication of possible loss of security control.

The Administration has a major role to play in facilitating eCommerce and eMoney by making the law, the regulatory framework and standards more market friendly.

Privacy is another concern. Measures should be taken to protect consumers from improper use or disclosure of personal information and from improper alteration or destruction of personal information.

With the proliferation of hi-tech products, the legal framework has to be commensurate with the development in order to play an effective regulatory role. The popularity of the Internet would change the world into a borderless state. Legal authorities of different jurisdictions may have difficulties to apply laws due to territorial restrictions. This is an area where supervisory cooperation among central banks should be worked on. In Hong Kong, the popularity of electronic banking, including the use of the Internet, has already called for attention from the regulators. A Study Group on electronic banking was formed comprising the HKMA and other regulators to keep up their knowledge and skills with market development.

Service quality is one of the many key elements in positioning Hong Kong as an international financial centre. Issues concerning the effect on the money supply; legal framework; security of transaction; protection of privacy; and the effect on sovereignty are all readily discussed among financial institutions, Government, and service providers toward the spread of new payment systems in the future. By establishing a quality financial infrastructure of incorporating solutions to the above issues with the adaptation of global standards, training of internal operations, and cooperations of quality assurance within the financial communities around the world will enable the delivery of robust financial services.

With a quality financial infrastructure being in place in Hong Kong, cross-border payments linkages with Asian and Western Automated Clearing Houses will be on the way for an end-to-end straight-through processing as short-term and long-term solution in the future. The Government's role is to review, in consultation with the industry groups, the legislative and regulatory framework to facilitate the implementation of STP and eCommerce and eMoney, such as the acceptance of digital signatures, minimum security standards and the protection of intellectual property rights relating to eCommerce developments. Consultancy studies in this area is recommended to enhance system security and efficiency of the financial market.

Recommendations

As a free port, and a free and global market, Hong Kong always adopts policies of minimal governmental intervention and allows the private sector to play a leading role in new initiatives. The Hong Kong SAR Government should avoid undue restrictions but create a fostering environment and infrastructure where necessary. Government-wide services infrastructure should be re-examined, with the aim of improving quality, efficiency and cost of delivery of public services. This could include a study of how Government regulatory, licensing and data reporting processes can be streamlined to facilitate eCommerce and transactions with the public sector. Hong Kong should promote STP within the Government, which essentially facilitates eCommerce in Hong Kong.

The financial sector is an integral part of the whole economy. Some of the infrastructural requirements for enhancing financial markets are also shared by the wider community. Human resources development, for example, will involve education throughout various levels of the educational system, cultural change among the wider community, and human resources development in information technology and financial services sector. The Financial Services Institute now being explored can take care of the needs of the financial market in particular and the economy in general.

Indeed, financial services contribute considerably to Hong Kong's economic growth, not only through the direct income generated from such services, but also indirectly through its facilitating and intermediary role in other economic sectors. A secure and efficient financial infrastructure facilitates information delivery, transactions, clearing, settlement and custody. In relation to these, there is a case for some Government expenditure in hiring consultant studies in the following areas:

- Identification of technical impediments as well as new technical requirements for the implementation of straight-through processing in Hong Kong, with special emphasis on the area of eMoney.
- Study of the impact of electronic banking and its implications for supervisory policy to ensure that this keeps in step with new technology.
- The creation of a secure network, FinNet, that would facilitate straight-through processing for the financial sector as a whole. FinNet should be so designed as to provide a focal point where all participants in the financial

There is a case for the Government to play a central role in providing the financial infrastructure, the legal and prudential framework and the leadership in providing government services using eCommerce and eMoney. This also requires the full support of the private sector.

Vision of Hong Kong as a Virtual Economy in the 21st Century.

market can exchange information with each other. The network design of FinNet should be highly flexible to allow for further DvP, PvP and TvP linkages with regional economies and other international financial centres.

- The linkages between the key securities and futures clearing houses (HKFE Clearing Corporation Ltd., Hong Kong Securities Clearing Co. Ltd. and the SEHK Options Clearing House Ltd.) and the RTGS payment system to ensure robust clearing and settlement in a seamless manner.
- Examination under the coordination of the proposed Infrastructure Technology Bureau of how the legal, regulatory and infrastructural framework can be adjusted to foster electronic commerce and payments and STP, and exploring ways that the Government can assist the recognition of digital signatures and help facilitate security standards; this is better proceeded with the participation of both public bodies and private sector.

The above recommendations incorporate a fundamental viewpoint of Hong Kong as a Virtual Economy—that the trend of eCommerce and eMoney is irreversible, and that Hong Kong should facilitate these trends so that we will be at the forefront of product and service innovation bringing about increase in productivity. In essence, Hong Kong would use information technology to keep itself competitive as a Virtual economy.

This direction must be done with the full support of the private sector, but the Government also plays a central role, in providing the financial infrastructure, the legal and prudential framework and the leadership in providing government services using eCommerce and eMoney. This requires vision and leadership at the highest level.

It is further recommended that the Hong Kong SAR Government oversees the implementation of the various recommendations arising from the consulting studies commissioned in the near future, to enable that the vision of Hong Kong as a Virtual Economy to be realised in the 21st Century.

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Glossary

Assured payment system	A mechanism whereby a seller delivers securities in exchange for an irrevocable commitment by the buyer's bank to make an unconditional and irrevocable payment to the seller's bank.
Bandwidth	The amount of information that can be transmitted per second through a given channel (such as copper phone lines or optical fiber). Copper phone wire (also called twisted pair) is considered low bandwidth through it is capable of carrying up to six million bits per second. The capacity, or bandwidth, of optic fiber is currently unknown. Some experts believe that it will soon be possible to deliver 1,000 billion bits per second through a fiber channel.
Beneficial ownership/interest	Entitlement to receive some or all of the benefits of ownership of a security or financial instrument (e.g. income, voting rights, power to transfer). Beneficial ownership is usually distinguished from "legal ownership" of a security or financial instrument.
Bilateral netting	A netting between two parties.
Bit	A binary digit (one or zero). The smallest unit of information that a computer can read.
Book-entry system	An accounting system that permits the transfer of ownership of securities through accounting entries, without the physical movement of paper certificates.
Broadband	Wide bandwidth that that allows very high speed communications.
Broadband ISDN	Integrated Services Digital Network. A wide area network technology that allows for the transmission of voice, video, and/or data at rates of up to 150Mbps (megabytes per second).
Browser	A software programme (such as Netscape) that can read and navigate HTML documents on the World Wide Web. Browser applications can be run on a PC or Macintosh or other platforms.
Byte	A string of eight adjacent bits. Sufficient to represent one alphanumeric character.
Caps	Quantitative limits on the funds transfer activity of individual participants in a system; limits may be set by each individual participant or may imposed by the body managing the system; limits can be placed on the net debit position or net credit position of participants in the system.

CD-ROM	Compact disc-read only memory. A storage format that can hold in excess of 600Mb of text, graphics and hi-fi stereo sound data. 600Mb is equivalent to about 250,000 pages of text to 20,000 medium-resolution images.
Central bank credit facility	A credit facility provided by the central bank to its account holders, either in the form of unsecured advances, or secured overdrafts (also known as lombard loans) or the of traditional facility of rediscounting of bills. In some cases the facility can be drawn automatically at the initiative of the account holder, while in other cases some degree of central bank discretion is involved.
Central securities depository	A facility for holding securities which enables securities transactions to be processed by means of book entries. Physical securities may be immobilised by the depository or securities may be dematerialised (so that they exist only as electronic records).
Certificate	The piece of paper which evidences the property right or obligations of the issuer or holder.
Chaining	A method used in certain settlement systems for processing transfers. It involves the manipulation of the order in which transfers are processed to increase the number or value of transfers that may be settled with available securities and funds balances (or available credit lines).
Clearance	The term ‘clearance’ has two meanings in the securities markets. it may mean the process of calculating the mutual obligations of market participants, usually on a net basis, for the exchange of securities and money. It may also signify the process of transferring the property right to securities on the settlement date.
Clearing system	A mechanism for the calculation of mutual positions within a group of participants to facilitate the settlement of their obligations on a net basis.
Client-server	A computing architecture that distributes processing between clients (desktop PCs that request information from the server) and servers (usually computers with a greater hard-disk space that store data and programmes shared by many clients).
COLS	Commercial online service providers. Examples include CompuServe, Asia Online, America Online and Microsoft Network. Online service providers may offer Internet access. They are known for their value-added services such as online news, travel information, bulletin boards, stock quotes and home shopping, available only to members.
CommerceNet	A non-profit consortium of more than 200 member companies and organisations worldwide whose mission is to accelerate Internet-based electronic commerce. The consortium has six affiliates worldwide including CommerceNet Japan, Korea and Australia. For more information, visit http://www.commerce.net .

Confirmation	The process by which a market participant notifies its customers of the details of a trade and allows the customer to positively affirm or question the trade.
Counterparty	One party to a trade.
Credit risk/exposure	The risk that a counterparty will not settle an obligation for full value, either when due or at any time thereafter. Credit risk is generally defined to include replacement cost risk and principal risk.
Credit transfer system	A funds transfer system through which payment orders move from (the bank of) the originator of the transfer message or payer to (the bank of) the receiver of the message or beneficiary.
Custody	The safekeeping and administration of securities and financial instruments on behalf of others.
Daylight credit (or daylight overdraft, daylight exposure, intraday credit)	Credit extended for a period of less than one business day; in a credit transfer system with end-of-day final settlement, daylight credit is tacitly extended by a receiving participant which accepts and acts on a payment order, even through it will not receive final funds until the end of the business day.
Debit transfer system (or debit collection system)	A funds transfer system in which debit collection orders made or authorised by the payer move from (the bank of) the payee to (the bank of) the payer and result in a charge (debit) to the account of the payer; for example, cheque-based systems are typical debit transfer systems.
Default	Failure to complete a funds or securities transfer according to its terms for reasons that are not technical or temporary, usually as a result of bankruptcy. Default is usually distinguished from a 'failed transaction'.
Delivery	Final transfer of a security or financial instrument.
Delivery versus payment system	A securities settlement system that provides a mechanism that ensures that delivery of the property right occurs if and only if payment is received.
Dematerialisation	The elimination of physical certificates or documents of title which represent ownership of securities so that securities exist only as accounting records. Typically, this involves removal of paper transactions towards electronic transactions and record-keeping.
Discharge	Release from a legal obligation imposed by contract or law.
e-cash	A software-only form of electronic money. Designed (by Digicash) for secure payments from any PC to any other workstation, over e-mail or the Internet.
EDI	Electronic data interchange. A method by which two organisations can complete business transactions, such as processing sales orders and invoices, electronically. With its shared standards, EDI helps organizations conduct operations faster, improve service and often lower costs through reduced paperwork handling. EDI can be accomplished using leased lines, the Internet or a value-added network.

Electronic commerce	Electronic commerce is simply the exchange of goods, services or property between entities conducted through an electronic medium. Defined this way, electronic commerce has existed since the invention of the telegraph. What has changed today is the advent of standards-based, ubiquitous computing networks. Thus today's electronic commerce is defined as a way of conducting business through the medium of such networks.
e-mail	A way to send messages to other users or groups over an electronic network such as the Internet.
Encryption	A technology that encodes information traveling over a computer network. Encrypted information can only be accessed if the receiver has the appropriate key to unlock the code.
Equal access	Regulation requiring a network to provide interconnection to other networks at guaranteed quality and at non-discriminatory prices.
e-zine	An electronically produced and delivered magazine (ie, over the Internet).
Fibre optic	A media used to replace coaxial cables and twisted wire pairs, consisting of a transparent fibre cable used to carry light signals over long distances at high speeds. Digital electronic signals are converted into light by light the Internet to protect internal company data.
Failed transaction	A securities transaction in which the securities and cash are not exchanged as agreed on the settlement date, usually because of technical or temporary causes.
Firewall	A security barrier erected between a company's computer network and the Internet to protect internal company data.
Final transfer	An irrevocable and unconditional transfer which effects a discharge of the obligation to make the transfer. The terms 'delivery' and 'payment' are each defined to include a final transfer.
FTP	File transfer protocol. Allows people to transfer files across a network.
Gridlock	A situation that can arise in a funds or securities transfer system in which the failure of some transfer instructions to be executed (because the necessary funds or securities balances are unavailable) prevents other instructions from being executed, with the cumulative result that a substantial number of transfers fail to be executed on the scheduled date.
Haircut	The difference between the market value of a security and its collateral value. The haircut is intended to protect a lender of funds or securities from losses owing to declines in collateral values.

Hit	A measure of usage, determined by the number of times a user accesses a Web site.
Home page	The central or initial document seen by visitors to a Web site. Many Web pages can be linked to a home page.
HTML	HyperText Markup Language. The programming language that underpins the Web. used to define and describe the page layout of documents displayed in a World Wide Web browser. HTML documents are interpreted by Web browsers and presented to users as multimedia documents with hyperlinks. Uses of the Web do not need to know HTML. However, HTML is used by individuals or companies to create Web pages.
HTTP	HyperText Transfer protocol. The underlying system whereby Web documents are transferred over the Internet. Used as a prefix to an Internet address that indicates to a Web browser that an HTML page is located at that address.
Hypertext	An interconnected network of text information, wherein any given word or phrase may link to another point in the document or to another document.
Immobilisation	Placement of certificated securities and financial instruments in a central securities depository to facilitate book-entry transfers.
Internet	A global computer network made up of smaller networks joining more than 50 million users worldwide, enabling electronic communication through telephone lines for personal, educational, research, and commercial uses. Also known as 'the Net'.
Intranet	The use of Internet and Web technologies within an organisation to ensure that the closed net facilitates security and internal workflow and project management. With an Intranet based on Internet and Web technologies, the company is easily able to link to the external Internet.
Irrevocable transfer	A transfer which cannot be evoked by the transferor.
Issuer	The entity which is obligated on a security of financial instrument.
Legal ownership	Recognition in law as the owner of a security or financial instrument. Registration of a security or financial instrument usually confers legal ownership on the person or entity named, even in those cases where the legal owner has obtained the registration on behalf of another (e.g. custodian, trustee, broker).
Liquidity risk	The risk that a counterparty will not settle an obligation for full value when due, but on some unspecified date thereafter.
Loss-sharing agreement	An agreement among participants in a clearing or settlement system regarding the allocation of any losses arising from the default of a participant in the system.

Margin	Margin has at least two meanings. In the futures/commodity markets, margin is a good faith deposit (of money, securities, or financial instruments) required by the futures clearing system to assure performance. In the equities markets, margin is a sum of money deposited by a customer when borrowing money from a broker to purchase shares.
Matching (or comparison, checking)	The process used by market participants before settlement of a transaction to ensure that they agree with respect to the terms of the transaction.
Marking to market	The practice of revaluing securities and financial instruments using current market prices. In some cases unsettled contracts to purchase and sell securities are marked to market and the counterparty with an as yet unrealised loss on the contract is required to transfer funds or securities equal to the value of the loss to the other counterparty.
Modem	MOdulator-DEModulator. The component in a computer that performs the process of converting/reconverting computer digital signals into waveforms for transmission over telephone lines.
Moore's Law	Law named after Gordon Moore, co-founder and chairman of Intel, which predicts/predicted the exponential growth in computing power capability. It states that as the density of transistors on silicon doubles every 18 months, processor performance also doubles every 18 months. This means that every 18 chips shrink in size, computing power doubles and prices drop.
Mosaic	The original World Wide Web browser programme developed at the National Centre for Supercomputing Applications at the University of Illinois, USA. Its release in 1993 sparked the explosive growth of the Web and helped boost interest in the Internet. Many software programmes similar to Mosaic, such as Netscape, have been developed since Mosaic's release.
Multilateral netting	A netting among more than two parties.
Multimedia	The combinations of technologies that support the multisensory capabilities of a system's users. Multimedia typically involve a combination of graphics, sound, text and video.
Net credit or net debit position	A participant's net debit or net credit position in funds or in a particular security is the sum of all the transfers it has received up to a particular time less the transfers it has sent; if this sum is positive, the participant is in a net credit position, if the sum is negative, it is in a net debit position. The net credit or net debit position at settlement time is called the net settlement position. These positions may be calculated on a bilateral or multilateral basis.
Netting	An agreed offsetting of mutual positions or obligations by trading partners or participants in a system. The netting reduces a large number of individual positions of obligations to a smaller number of positions. Netting may take several forms which have varying degrees of legal enforceability in the event of default of one of the parties.

Net settlement	A settlement in which a number of transactions between or among counterparties are settled on a net basis.
Net settlement system	A system in which transfer orders are settled on a net basis. It is common for such systems to distinguish between types of transfer orders and settle some, such as payment orders, on a net basis and settle others, such as securities transfer orders, on a trade-for-trade basis.
Nominee	A person or entity named by another to act on his behalf. A nominee is commonly used in a securities transaction to obtain registration and legal ownership of a security.
Novation	The satisfaction and discharge of existing contractual obligations by the substitution of new obligations.
Obligation	A duty imposed by contract or law. It is also used to describe a security or financial instrument, such as a bond or promissory note, which contains the issuer's undertaking to pay the owner.
Payment	The satisfaction and discharge of a monetary obligation by the debtor's unconditional transfer of a claim on a party agreed to by the creditor. Typically, the party is a central bank or a commercial bank.
Position netting	The netting of instructions in respect of obligations between two or more parties which neither satisfies nor discharges those original obligations. (Also referred to as payment netting in the case of payment instructions).
Principal risk	The risk that the seller of a security delivers a security but does not receive payment or that the buyer of a security makes payment but does not receive delivery. In this event, the full principal value of the securities or funds transferred is at risk.
Provisional transfer	A conditional transfer in which one or more parties retain the right by law or agreement to rescind the transfer.
Real-time	The processing of instructions on an individual basis at the time they are received rather than at some later time.
Registration	The listing of ownership of securities in the records of the issuer. This task is often performed by an official registrar/transfer agent.
Replacement cost risk	The risk that a counterparty to an outstanding transaction for completion at a future date will fail to perform on the settlement date. This failure may leave the solvent party with an unhedged or open market position or deny the solvent party unrealised gains on the position. The resulting exposure is the cost of replacing, at current market prices, the original transaction.
Same-day funds	Money balances that the recipient has a right to transfer or withdraw from an account on the day of receipt.

Settlement	The completion of a transaction, wherein the seller transfers securities or financial instruments to the buyer and the buyer transfers money to the seller. A settlement may be final or provisional.
Settlement risk	The risk that a party will default on one or more settlement obligations to its counterparties or to a settlement agent.
Settlement system	A system in which settlement takes place.
Smart card	Card that stores electronic money on an encrypted microchip. Examples include Mondex and Visa Cash.
Substitution	The process of amending a contract between two parties so that a third party is interposed as an intermediary creditor/debtor between the two parties and the original contract between the two parties is satisfied and discharged.
Systemic risk	The risk that the inability of one institution to meet its obligations when due will cause other institutions to be unable to meet their obligations when due.
TCP/IP	Transfer Control Protocol/Internet Protocol. The standard language networks use to communication with each other over the Internet. It is a set of communications protocols developed for the Defense Advanced Research Project Agency (DARPA) to bring together dissimilar systems.
Trade date	The date on which a trade/bargain is executed.
Trade netting	A legally enforceable consolidation and offsetting of individual trades into net amounts of securities and money due between trading partners or among members of a clearing system. A netting of trades which is not legally enforceable is a position netting.
Trade-for-trade (gross) settlement	A settlement in which a number of transactions between counterparties are settled individually.
Trade-for-trade settlement system	A settlement in which individual transfer order is settled separately.
Transfer	An act which transmits or creates an interest in a security, a financial instrument or money.
Unwind	A procedure followed in certain clearing and settlement systems in which transfers of securities and funds are settled on a net basis, at the end of the processing cycle, with all transfers provisional until all participants have discharged their settlement obligations. If a participant fails to settle, some or all of the provisional transfers involving that participant are deleted from the system and the settlement obligations from the remaining transfers are then recalculated. Such a procedure has the effect of allocating liquidity pressures and losses from the failure to settle to the counterparties of the participant that fails to settle.

Usenet	This electronic bulletin board system began in 1981, allowing information relating to a particular subject to be entered by a participant on a local host computer and to be read by users everywhere on the Internet. More commonly referred to today as newsgroups.
URL	Uniform Resource Locator. The way in which any resource is identified within a Web document or a Web browser. Most URLs consist of the service, host name, and directory path. An example of an URL: http://www.ac.com .
Variation margin	The amount which is paid by a counterparty to reduce replacement cost exposures resulting from changes in market prices, following the revaluation of securities of financial instruments that are the subject of unsettled trades.
Virtualisation	The ability to reduce many forms of knowledge to a representation of ones and zeros that may be transmitted at almost no cost at the speed of light. As a result, many people can share this knowledge simultaneously, which often replaces physical capital.
Virtual reality	A way of enabling people to participate directly in a real-time three-dimensional environment generated by the computer. There are three types of virtual reality immersion. The first type occurs when the user remains outside the imaginary world and communicates by computer with characters inside. The second, more advanced type requires a flying mouse to enter the virtual world. The third, and most advanced form of virtual reality, and audio systems providing binaural sound. Through interaction with this virtual world, the user can change plots and characters, and introduce real-world unpredictability.
WAN	Wide Area Network. A computer network covering more than a single site (which is a LAN or local area network). Potentially a global network.
World Wide Web	The multimedia portion of the Internet developed in the late 1980s by Tim Berners-Lee at the European Centre for Nuclear research (CERN). The Web allows text as well as graphics files residing on an Internet host to be viewed by remote users. Today, the Web consists of millions of documents, thousands of sites and hundreds of indexes.
World Wide Web Consortium (W3C)	An industry consortium hosted by the Laboratory for Computer Science at MIT. The W3C seeks to promote standards for the evolution of the Web and interoperability between Web products by producing specifications and reference software.

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Financial Technology Infrastructure for Hong Kong: Questionnaire

GENERAL QUESTIONS

- 1 Please list the products or services which you provide to members of the financial services industry. Quote the name of the product/service, and give a one sentence description of what it does.
- 2 For each of the products/services mentioned above, please describe in, say, one page of free text, with a simple block diagram or flow chart, if necessary, the basic features of the product/service.
- 3 Please describe in, say, half a page, the history of the development.
- 4 How would you categorise your customer base? For example, are they stock brokers, insurance agents, foreign exchange dealers, payments departments, cables rooms, etc.
- 5 If your product/service is sold internationally, please indicate if it is global or regional, and the relative importance of Hong Kong to your customer base, ie by percentage of number and whatever other measure you deem important, for example percentage by revenue, or profitability, etc. Please also indicate how this has changed over the past five years, and your predictions for the next five years.
- 6 Please indicate the degree of penetration of your target market that you have achieved, and your estimate of final penetration and time it will take you to achieve this. For example, you wish to achieve a 50% penetration of dealing rooms, have achieved 35%, and expect to achieve your target in the next 18 months.
- 7 Please indicate what, if any, changes to the financial services infrastructure would assist you in achieving your targets. For example, is there a specific piece of legislation creating a barrier? Is there a resourcing problem regarding availability of suitable qualified staff; is there a language problem; do you need more expatriate staff? Do you think that changes to the communications infrastructure would help, for example would a common network help or hinder? Are there changes to fiscal policy which would assist? Please think as widely as possible on this issue.

OPERATIONAL QUESTIONS

- 8 Please describe, in, say, one page, the basic workflow of the system. For example, describe sign-on and authentication, initiation of transactions, sign-off and end of day reconciliation processes. Also, please describe what, if any, additional tasks have to be performed at end of week, month, etc.
- 9 What are the operating hours of the system; eg from 09:00 to 16:30, Monday to Friday, except public holiday; available 24 hours per day, 365 days per year.
- 10 Describe the charging mechanism for customers...flat fee; usage based; time based; etc. Please supply details.

SYSTEM ARCHITECTURE

- 11 How would you describe the system. For example, is it “real-time” or batch? Is it a messaging system? Is it an information repository providing real-time data feeds? Is it a “multi-media” system. Does it provide sophisticated modelling or analytical tools?
- 12 How does the user interface with the system and provide his input? For example, is it via a relatively simple set of instructions, or is it via a graphical user interface with many menus and selection options? Does the system interface directly with the customer’s own back office, or front office systems? Do you provide the interface, hardware and/or software, or can the customer write his own, to your specification?
- 13 Once the user has entered his data, does your system provide all the functions necessary to respond to the user’s requirements, or does the system then link up with other systems? If so, are these systems also owned and operated by you, or are they from third parties? Please give details.

TECHNOLOGY ARCHITECTURE

- 14 Please describe the platform that the system operates on, at the mainframe, or server, and at the user, or client end. Please also describe any intermediate processors which may be involved. Please cover both the hardware and operating systems. Is any special hardware device needed, for example a smart card reader?
- 15 Please describe the application infrastructure used. For example, if it utilises a data base management system, please specify which product or products are being used. If the system is an on line transaction processing system, please specify which transaction processing monitor is used.
- 16 Please describe the telecommunications environment. For example, what communication protocols are used, eg TCP/IP, SNA, X.25? How are the remote user devices connected, eg dial-up or leased lines? What line speeds are supported?
- 17 Describe the messages which are sent. Do they conform to a recognised standard, eg EDIFACT, or SWIFT? How many different formats are there? Are they fixed length or variable, and what is the maximum message length?
- 18 Please describe what measures are incorporated regarding security, integrity, authentication, etc.

STATISTICS

- 19 Please describe, for Hong Kong, and the rest of the world, if appropriate, the number of transactions per day, and the average value of those transactions, if relevant. Please also describe, again for Hong Kong and the rest of the world, the number of customers, the number of users, the number of terminal devices and the approximate time, each day, that those terminal devices are in use for actual transacting.

FUTURE PLANS

- 20 Where you are able to, please describe any future plans you may have regarding new services, changes in technology, new delivery mechanisms, etc.
- 21 Please describe any concerns, or observations, which you think may be relevant to this study.