

Chapter 2

The e-Transformation Journey of Singapore

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Introduction and Structure

Singapore is a success story of intelligently harnessing the ongoing technological revolution to accelerate development and transform a whole economy. Despite limited natural resources and unpromising initial economic conditions, Singapore compressed its development journey and moved from third world to first world economy, and positioned itself effectively for a global, knowledge-based, and innovation-driven economy. Its GDP per capita grew the fastest among the countries covered in this book, and among the world's fastest growing economies, from US \$6,500 in 1985, to US \$37,600 in 2008.

Among the most distinguishing features of Singapore e-transformation journey are: committed political and public service leadership, creating an environment for cumulative institutional learning, public-private collaboration, investment in a competitive information infrastructure, early attention to ICT literacy and user adoption capability, clear cyber policies, and dynamic governance based on results orientation and accountability. Singapore excelled in disciplined implementation and is currently striving to excel in innovation. Despite of leapfrogging to the frontiers of international best practices, Singapore continues to learn from its shortfalls and adapt its ongoing plans accordingly.

This chapter frames the e-transformation journey of Singapore in a way consistent with the e-development (e-transformation) framework set in Chap. 1. That is, it shows how ICT applications in the public sector or government have been planned and evolved, supported by the enabling components: information infrastructure, IT literacy and capability development (ICT human resources), ICT industry sector, and ICT governance and institutions (see Fig. 2.10). In reviewing the experience of

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Singapore, the chapter focuses on e-government applications, but not on the overall transformation of the economy in such areas as e-logistics, e-business, e-education, e-health or other sector applications. The aim here is to examine the experience of one sector in relative depth and the role of other e-development components as enablers of transforming that sector. Given the central role of government in Singapore's economic transformation and the ICT drive, it is the right focus. The lessons drawn from this experience are applicable to other sectors of the economy. As it shifts towards the future, the chapter concludes with a more holistic view of e-transformation, covering all enabling components of e-development, and extending its treatment of transformation to other sectors: media, education, health, small and medium enterprises (SMEs), transport, finance, tourism, trade and logistics.

The structure of this chapter is as follows. First is the introduction, country context, and the evolution of comprehensive ICT master plans in line with an evolving country development strategy. Second section is about establishing the institutions for governance, a key feature and success factor for this success story. e-Government is put in the context of public sector excellence and reform drive in Singapore. The following section briefly describes the strategic thrusts of successive e-government plans, their outcome-focused and stakeholder-centric applications, measures and practices. Next section describes the key enablers of the Singapore e-government programmes adopted within the Government and at national level: infrastructure, ICT literacy, capability development, stakeholder conversion and adoption, and governance. Next section gives a brief description of the progress made in ICT industry sector, since this sector is a partner in government transformation and enabler of overall economic transformation. The chapter then draws key lessons and conclusions from implementing these successive plans. The chapter concludes with a detailed description of the ongoing master plan (iN2015), a most ambitious and comprehensive transformation strategy towards an intelligent nation and global city.

Country Context

Singapore began its modest history as a place for maritime trade. After a period of British rule and transition to self-government, it separated itself from the Malaysian Federation in 1965 to become independent Singapore. Despite being an established trading post, Singapore faced daunting challenges in economic development at the start of its new life. In trade, it could no longer rely on its traditional hinterland after leaving the Federation. Unemployment was high and with the withdrawal of British troops, many job opportunities were lost. Urban slums proliferated, crime rates were high and only half the population was literate. Its multi-racial and multi-religious population also created natural fault lines which were an ever-present source of potential social instability.

Singapore's situation was compounded by its natural attributes. With a limited land area of about 600 km², Singapore faced immense challenges in land use

planning to house the needs of its nation state, develop sustainable and strategic industry clusters, and a robust infrastructure of transportation systems to support the growing economy.

Openness to the rest of the world was not a choice but a necessity dictated by its almost total lack of natural resources. Even after more than 45 years of growth and development, its leaders' consciousness of Singapore's precarious situation has not diminished and hence they abide by the belief that Singapore's continued survival depends on its ability to play a useful and valuable role in the world. Two strategic imperatives remain to undergird the nation state: economic development and domestic stability. This has formed the backdrop of Singapore's development and underpinned the foundations of governance—the openness, the emphasis on learning from, and establishing links with, the rest of the world, the push to stay relevant, its efforts to increase its international space and sphere of influence—based on connectivity.

Evolution of ICT Master Plans

The e-development progress can be summarised as follows. In the 1960s, the Government decided to use the competitive advantage of its then low-wage labour and its strategically located deep water port to develop its economy around the import of manufactured parts that would be assembled locally and re-exported as finished products—primarily computer components and consumer electronics. To accomplish Singapore's industrialisation strategy based on foreign investment and export orientation, it invested savings from the nation's retirement programme to build crucial infrastructure—port facilities, roads, airport, telecommunications, and industrial parks—that attracted additional private investment from transnational corporations that, in turn, built assembly facilities.

In the late 1970s, the Government realised that the island nation could no longer afford to compete with the much larger regional countries in labour-intensive industries. The only viable alternative for Singapore would be to move up the value chain and focus on capital-intensive and technology-intensive activities. Information technology (IT) was identified as one key technology that would help improve Singapore's economic performance by doing more with less—increasing labour productivity, making processes leaner and more efficient, and delivering better services to customers. In response to this, the Government leveraged their initial economic gains to deepen their capital, primarily through attracting investments in new technology, and to improve the quality of their educational system, increasing students' understanding of science and mathematics, so as to support a more productive, technology-based economy. The Government also began at this point to focus on technological innovation i.e., the application of technology to solve problems, increase efficiencies, develop new products and services, and create new knowledge.

Thus began Singapore's infocomm journey which has closely mirrored economic development and social needs. National infocomm masterplans and capabilities

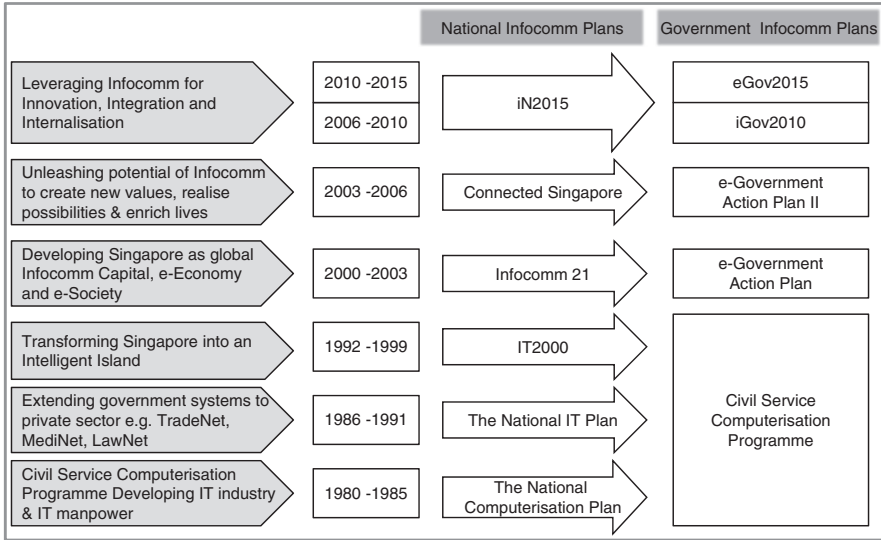


Fig. 2.1 Singapore ICT master plans, *Source:* IDA Singapore

over 30 years (1980–2011) not only focused on leveraging ICT as an enabler of economic competition and social development but also on building a globally competitive infocomm industry and a knowledge-based economy. Coordinated efforts arising from these masterplans have also emphasised infocomm manpower development, infocomm awareness and literacy of the populace and businesses, domestic and international infocomm infrastructure and connectivity, efficiencies in government agencies, as well as business transformation (Fig. 2.1).

Reflective of the changing technological, business and social climate, Singapore has progressed through five distinct national infocomm plans over those 30 years and in 2011 was midway through a sixth. It is useful to note that despite the ostensible differences seen in the couching of each successive national strategy, the Singapore government’s efforts to promote infocomm development have been characterised by progressive evolution as opposed to disruptive revolution. To a large extent national strategies preserved continuity in infocomm development while serving as a catalyst for further renewal. A large number of established programmes continued from one national strategy to the next, as to established institutional structures. Institutional organisation and the lapsing of established programmes were not generally timed to match unveiling of new national strategy. Each multi-year national strategy was not designed to be static nor did it exist as an exclusive self-contained policy guide. On a periodic basis, complementary strategies and policies were introduced during the lifespan of a national strategy to reinforce, refresh and occasionally refocus its basic tenets.

Establishing Institutions for Governance

The exigencies of nation building shaped the early development of public sector governance. Singapore's small size, lack of resources and tenuous security situation made it inevitable that the government would take the lead in developing the economy and the country. The 1965–1985 period saw the expansion and transformation of the civil service structure, as well as the establishment of values and approach to governance. The focus of Singapore's policy options and directions was “execution was paramount” and about getting things done in the most efficient way. Based on a highly rational and pragmatic approach style of governance, workability of solutions was the primary criterion for assessing policy alternatives. If the solutions were thought to work and fitted into the strategic long-term framework, they were implemented, even though they may not be politically correct or fashionable at the time. In the absence of other viable institutions, the public sector drove practically all aspects of the development of the Singapore economy and society. The public sector worked hand-in-hand with the political leadership to mould and shape the values and ethos of the Singapore society.

Institutions such as the statutory boards, reporting to parent ministries but have greater flexibility than government departments in day-to-day operations, became the main vehicles for the implementation of economic and social policies. These include the Economic Development Board (EDB), Housing Development Board (HDB), Monetary Authority of Singapore (MAS), and others.

Historically, the responsibility for developing ICT sectoral policies had been undertaken by separate government agencies. The IT, telecommunications and broadcasting sectors were governed by three sector-specific agencies under the purview of three different ministries:

- IT, including e-commerce, by the then National Computer Board (NCB) under the Ministry of Trade and Industry (MTI).
- Telecommunications, by the then Telecommunication Authority of Singapore (TAS) under the previous Ministry of Communications.
- Broadcasting, by the then Singapore Broadcasting Authority (SBA) under the former Ministry of Information and the Arts. SBA also regulated Internet content issues as Internet is considered a form of broadcasting.

In an effort to open up the government ICT market to the private sector and allow the civil service to utilise a wider pool of ICT resources from the ICT industry, the government restructured these entities, separating the regulatory and commercial activities. This led to the formation of SingTel (the corporatised arm of TAS), and Singapore Broadcasting Corporation (SBC) (the corporatised operator of the SBA).

The NCB was a statutory board formed in 1981 to computerise the Singapore public service and to develop the IT industry as an engine of growth. As the principal IT solutions provider to the government, the NCB has helped ministries and agencies implement over 2,000 large-scale, mission-critical and multi-platform projects using its 1,400 strong professional staff. The creation of National Computer

Systems Pte Ltd (NCS) signified a major push by the government to spearhead development of the ICT industry and to use of ICT in the public sector, at a time when there was a lack of funds and ICT expertise. As the ICT industry began to develop and to ensure maximum return on investments, the NCB decided to incorporate the NCS in 1996. It was subsequently sold within a year of its corporatisation by way of a closed tender, to avoid any conflict of interest in the award of Civil Service IT projects. In 1997, NCS became a fully privatised, wholly owned subsidiary of SingTel and on 1 November 2003, NCS was renamed NCS Pte Ltd and subsequently known as NCS Group.

At the same time that the government moved to open its markets, a number of different government agencies—including Telecommunications Authority of Singapore (TAS), NCB, EDB and the then Singapore Broadcasting Authority (SBA)—were seen to have developed overlapping responsibilities with regards to ICT promotion, regulation and development. As a result, legislation was tabled to create a single, focused agency that would combine all government promotional and regulatory efforts involving the converging communications industries. The Info-Communications Development Authority of Singapore Act of 1999 officially disbanded TAS and the NCB, creating one new statutory board, the Info-Communications Development Authority (IDA). IDA was legally constituted on 1 December 1999. The rationale for setting up IDA was due in part to the government's strategic response to the converging IT and telecommunications markets and industries—a single agency was required to provide the integrated focus on strategy and policy for infocomm development in Singapore. The strategic goal of the IDA was to cultivate a vibrant and competitive infocomm industry in Singapore through its roles as the infocomm industry champion or catalyst, the national infocomm master-planner or architect, and the Government CIO.

In 2001, IDA was moved under the purview of an expanded Ministry of Information, Communications and the Arts (MICA) bringing it under the same supervising ministry as SBA. This move further provides the ability for many issues related to ICTs, broadcasting and the media to be resolved under the guidance of a single ministry and set the stage for a more integrated policy approach towards managing the converging ICT, broadcasting and media sectors.

Supporting the promotional and developmental role of the lead ICT agencies are the agencies under MTI: EDB; International Enterprise (IE) Singapore; Agency for Science, Technology and Research (A*STAR); and Standards, Productivity and Innovation Board (SPRING Singapore). MTI's main task is to set broad directions for growth while the agencies under MTI each have promotion roles and, in accordance with their own organisational goals and missions, supplement the efforts of the lead sectoral agencies to align and integrate the promotion of the ICT and broadcasting sectors with other national economic promotional programmes and plans.

The IDA works closely with these supporting agencies in the following ways:

- EDB: plan and execute strategies to make Singapore an ICT hub for businesses and investments.
- IE Singapore: help local ICT companies reach the overseas markets and become international players.

- A*STAR: cultivate local R&D in the ICT sector.
- SPRING Singapore: transformation of SMEs through the use of ICT; growth of local ICT industry.

Supporting the development of the ICT legal infrastructure are the Ministry of Law and the AGC. These agencies provide the legal perspective to support the establishment of the legal infrastructure for ICT sectors. They are instrumental in working with the lead agencies to put together the legislation that governs the ICT and broadcasting sectors today. In addition, the Intellectual Property Office of Singapore (IPOS) is responsible for providing the infrastructure, platform and environment for the greater creation, protection and exploitation of intellectual property.

“Reinventing Singapore” took place in the face of the recessions around 1986–2006, where the economic strategy for the nation shifted to include services as a pillar of growth to maintain competitiveness in the midst of rapidly changing international conditions, the coming of age of the post-independence generation of Singaporeans with new expectations as well as unparalleled level of mobility and access to information.

The push to IT and communications systems was critical to Singapore’s effort to establish the services sector as a leading growth sector. Concerted efforts went to the repositioning Singapore as a “Total Business Centre” to encourage growth of services and service-related activities. Manufacturing MNCs such as Caltex and Matsushita were encouraged to set up their Operational HQs (OHQs) in Singapore and the Singapore OHQ would undertake the whole spectrum of an MNC’s manufacturing operations support, which include purchasing, logistics, supply chain management, finance, R&D, etc. not only for Singapore but also for the region. Steps were taken to help develop local SMEs in their own right through the National Productivity Board and Small Business Bureau. At the same time, to complement measures to boost the SMEs, the government-linked companies (GLC) and statutory boards were identified for divestment to give private sector firms scope to take over. The Singapore Telecom, the national telecommunication authority, was the first statutory board to be converted to a private company, while other statutory boards like the Public Utilities Board, the Port of Singapore Authority, and the National Computer Board were subsequently privatised or corporatised.

Regionalisation efforts in the Association of Southeast Asian Nations (ASEAN) region were also initiated such as building industrial parks in the Indonesian islands of Batam and Bintan, encouraging firms to take their labour-intensive operations to Malaysia and Indonesia while retaining the higher-wage, higher value-added functions in servicing, distribution, financing and logistics in Singapore. This marked the start of the strategy to overcome the constraints of Singapore’s size and expand its economic space.

Search for new sources of growth, tapping on Singapore comparative advantage in services, has led to the re-examination of past ideas, age-old assumptions and values, one of which is the case for the development of the integrated resort/casino industry in the form of the Marina Bay Sands and Resort World at Sentosa (operations

begun in early 2010) to broaden the leisure and entertainment options to enhance Singapore's reputation as a premium "must-visit" destination for leisure and business visitors. Intelligent building, innovative infocomm and gaming technologies, multimedia/3D contents delivered via IPTV, mobile channels, etc. have been deployed to richly enhance customer experience. To support the industry while responsibly addressing the ill-effects that legalised gambling bring to society, the Casino Regulatory Authority (CRA) was set up under the Ministry of Home Affairs to ensure the proper management and operation of a casino, and remains free from criminal influence or exploitation, the gaming in a casino is conducted honestly, and to contain and control the potential of a casino to cause harm to minors, vulnerable persons and society at large.

e-Government and Public Sector Excellence

The public service has played a pivotal role in Singapore's modernisation process and continues to go through reforms in its relentless drive to anticipate change and to stay relevant. Not only does the Civil Service have to ensure that public services work effectively, efficiently and smoothly, it has to keep pace with citizen's rising expectations.

The public service in Singapore has always been perceived to be efficient and effective. The level of red-tape has been gradually reduced and the corruption level has also been substantially lowered. Singapore recognises that an efficient public service sector is important to the growth of the economy; to attract investments. Hence a series of reforms to curb corruption and to improve public service were undertaken in the 1960s. Having attained the status of a developed nation, Singapore still continues to improve its public service so as to keep pace with a rapidly changing and globalised world and to equip public officers with different mindsets, behaviours and skills to operate in a dynamic, fluid environment.

The Public Service in the twenty-first century (PS21) initiative was launched in 1995 in an important step to achieve a world-class public service sector. The basic rationale for the PS21 initiative was to build an adaptable public service that could assist Singapore in meeting the challenges of a rapidly changing global environment in the context of the Singapore economy, which is very much outward-oriented. The initiative is led by the Office of the Prime Minister and a government-wide task force whose members are permanent secretaries.

The establishment of an e-government, one that recognises the impact of infocomm technologies on governance in the Digital Economy and exploits these technologies in the workplace and in internal processes for the delivery of citizen-centric public services, was a key focus area within the PS21, Managing For Excellence (MFE) movement. The other focus areas to help public sector achieve sustainable excellence under the MFE Framework were Total Organisational Excellence, More Vision Less Bureaucracy; and innovative Public Organisations (Fig.2.2).

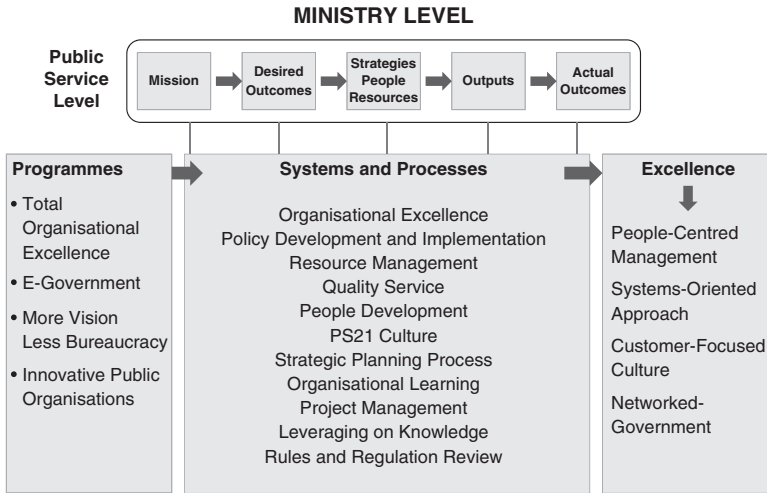


Fig. 2.2 Singapore's managing for excellence (MFE) framework

Evolution of e-Government Plans

Singapore's e-government has evolved in tandem with each National IT plan to bring about exciting changes to the way Singapore Government works, interacts and serves the public.

The focus of e-government in Singapore has evolved at each stage of planning and maturity:

1. *Civil Service Computerisation Programme (1980–1999)*

- Improving public administration through the effective use of infocomm technology
- Setting up data hubs—People Hub, Land Hub, Establishment Hub
- Consolidation of computing resources, namely Singapore Government Email System (SGEMS), Singapore Network (SGNet), Government Finance System (NFS)
- Provision of one-stop services such as TradeNet, LawNet, and MediNet

2. *e-Government Action Plan I (2000–2003)*

- Moving services online

3. *e-Government Action Plan II (2003–2006)*

- Delighted Customers, Connected Citizens, A Networked Government
- Focus was to deliver accessible, integrated and value-adding public services to its customers; and help bring citizens closer together

4. *iGov2010 (2006–2010)*

- The iGov2010 vision was to be an Integrated Government (iGov) that delights customers and connects citizens through Infocomm

5. *eGov2015 (2011–2015)*

- The eGov2015 vision is to be a Collaborative Government to facilitate more co-creation and interaction between the Government, the people and the private sector to bring about greater value creation for Singapore and its people
- Three strategic thrusts are (1) *co-creating for greater value*, where customers are empowered to co-create new e-services with the government; (2) *connecting for active participation*, where citizens are informed and involved to engage government on national policies; and (3) *catalysing whole-of-government transformation*, where whole-of-government collaboration is enhanced through innovative and sustainable technologies

Framing the strategic thrusts is an *outcome-focused* and *stakeholder-centric* Singapore e-government Framework where the maturity of e-government is measured progressively. The stakeholders are broadly grouped into (1) Employees, (2) Business and Customers, and (3) Citizens based on the engagement of each group with the Government in terms of its consumption of e-Government Services (Fig. 2.3).

For Government-to-Employees (G2E), the guiding principles are about leveraging ICT for efficiency in government processes, equipping public officers with the relevant ICT tools and skills, and information sharing among government agencies. The G2E implementations have included ICT Trainings, Government Intranet/Email/Network, Common Applications such as Human Resource, Finance and Procurement, as well as Process Re-engineering. The key benefits reaped are operational efficiency and cost reduction for the government.

The G2E Maturity Framework (see Fig. 2.4) paints the stages that Singapore used in the evaluation of its G2E service delivery. The “whole of government” approach was the pacer as the public service undergoes its reforms, moving from computerisation to process automation and efficiency to an integration of services across agencies. The ultimate goal is to effectively extend a “no wrong door” policy to the end-users (citizens, residents, businesses, visitors) where the “multiple agencies, one government” tagline is put into action. Here, the customer needs are well mapped to the e-services rendered by the various government agencies that he does not physically get “referred” or “passed” from one government agency or department to another. In addition, key performance indicators (KPIs) to each G2E maturity level were identified and monitored as part of the overall progress for public service reforms (see Fig. 2.5).

For Government-to-Business and Customers (G2BC), the guiding principles are customer-centricity with the Government behaving like a service provider and about better service experience, not just moving from manual processes to e-processes. The G2BC implementations included the electronic information or services for the businesses and customers; and aggregation and/or integration across multiple agencies such as the Online Business Licensing System (OBLS), the Central Provident Fund Mandatory Retirement Account System, the one-stop OneMotoring.com.sg portal for motorists, e-Filing for Taxes, One Stop Change Of Address Reporting

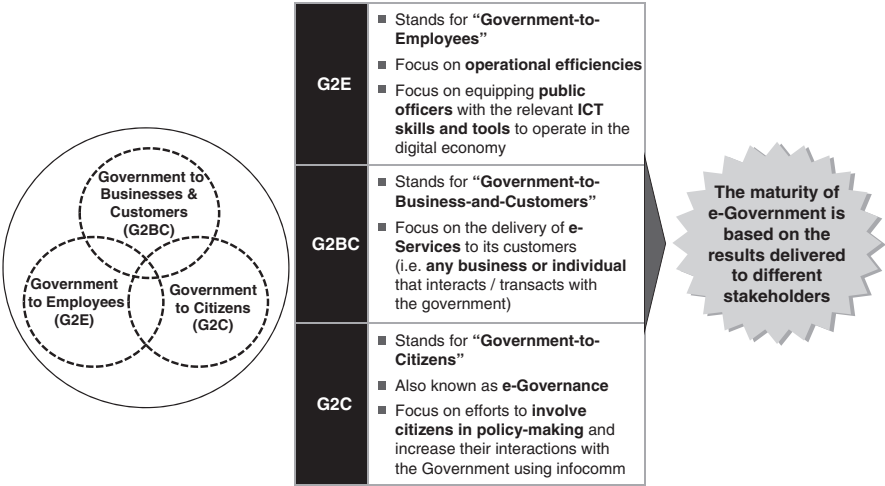


Fig. 2.3 Singapore e-government framework

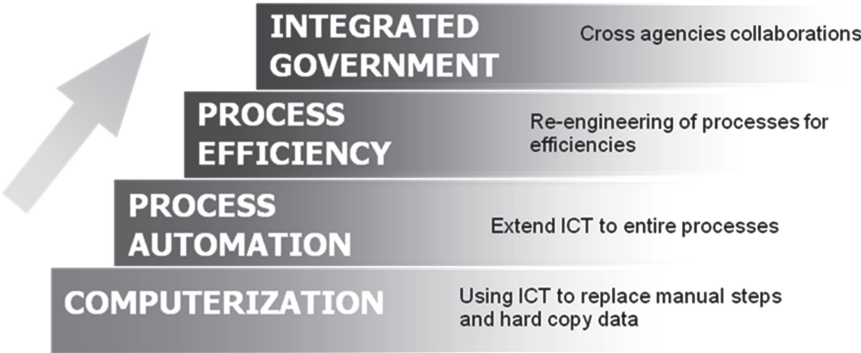


Fig. 2.4 Singapore's G2E maturity framework

Levels	KPIs
Computerization	<ul style="list-style-type: none">% of government data digitizedPC adoption among public agenciesBasic ICT Literacy levels of public officers
Process Automation	<ul style="list-style-type: none">Number of processes automatedResponse time of automated processes
Process Efficiency	<ul style="list-style-type: none">Reengineering of processesCustomer satisfaction levels of agenciesReturn of Investment from ICT investments (savings in manpower, reduction in response time)
Integrated Government	<ul style="list-style-type: none">Number of common data basesNumber of common systems (Email, HR, Finance etc.)Number of cross agencies processes (e.g. centralized procurement)

Fig. 2.5 KPIs for operational efficiencies

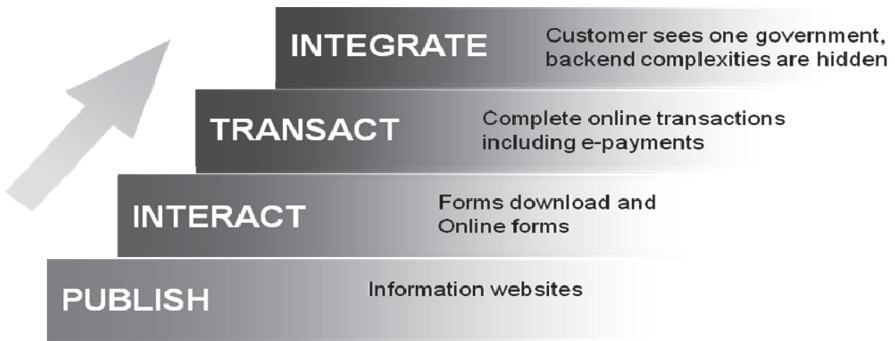


Fig. 2.6 Singapore’s G2BC (e-services) maturity framework

Levels	KPIs
Publish	<ul style="list-style-type: none">■ Number of informational websites by agencies■ Information on government services available online
Interact	<ul style="list-style-type: none">■ Electronic forms■ Online queries and responses
Transact	<ul style="list-style-type: none">■ Number of e-Services<ul style="list-style-type: none">➢ Online submission of data➢ Online payments➢ Online responses (e.g. issuance of licenses)■ Adoption of e-Services (ratio of online versus counter services)■ Customer Satisfaction of e-Services
Integrate	<ul style="list-style-type: none">■ Cross agencies one-stop shops■ Adoption of e-Services (ratio of online vs. counter services)■ Customer Satisfaction of e-Services

Fig. 2.7 KPIs for e-services

Services (OSCARS), Online Passport Applications, Military Service Portal for National Servicemen (NSPortal), and Schools—Joint Admission Programme.

The key benefits reaped are easy and convenient online access, elimination of or reduced counter visits, reduced cost to customers, and reduced overall turnaround time. The G2BC Maturity Framework in Fig. 2.6 shows the stages from which Singapore has progressed from publishing of information content to online interaction and transactions to integration of e-services, presenting a “One Government” front to the end-users with tracking of KPIs for each level of maturity (Fig. 2.7). This wave of development has resulted in 100% of all government services in Singapore that are feasible to be provided electronically are already online.

An example of an innovative e-government application to facilitate government to business transactions and achieve “many agencies, one government” vision is the online application system for integrated services (OASIS)—OBLS (see <https://licences.business.gov.sg>). Starting a new business often required multiple regulatory approvals

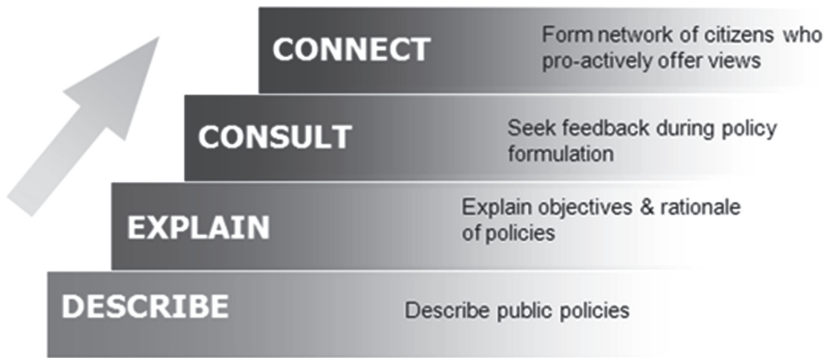


Fig. 2.8 Singapore's G2C (e-governance) maturity framework

and licences involving a tedious, complex and time-consuming process. To start a public entertainment outlet required licences approved by at least seven agencies regulating business registration, use of premises, food hygiene, liquor distribution, fire safety and tax collection. The project was initiated arising from feedback from business entrepreneurs and pro-enterprise panels regarding the problems associated with application of business licences. The project was then undertaken by MTI and IDA with about Singapore \$10 million funding from MOF. Task forces were formed to review and re-engineer the processes involving 154 licences from 30 agencies. About 25 licences were either removed or reduced significantly in scope, 82 licences were simplified, rationalised and integrated for implementation into the OBLS portal. The OBLS implementation saw 80% of new start-ups applying for and obtaining the required licences online through OBLS. The average licence processing time reduced from 21 to 12.5 days, with 43 licences processed within 3 days, 42 licences processed within 7 days, and new business registration reduced from 5 days to 2 h. This has resulted in an estimated savings of Singapore \$11.4 m in the first year.

For Government-to-Citizens (G2C), the guiding principles are informed citizenry and value opinions of citizens. The G2C implementations included public consultations, e-referendum, e-voting, new media to explain government policies. The G2C implementations include Reaching Everyone for Active Citizenry @ Home (REACH) Portal, public consultations by more than 40 agencies seeking online feedback on various topics, including National Budget, Healthcare, Education, Religious Affairs, National Security, Telecommunications and ICT, Media and Broadcast, Labour, Sports, Transportation and Public Housing. The key benefits reaped are having a greater sense of ownership by citizens as well as better decisions and implementation of policy by the government.

The G2C Maturity Framework in Fig. 2.8 shows the stages from which Singapore has taken to progress in e-governance from describing public policies to explaining and consulting on policy details and feedback to connecting with citizen networks to gather proactive views for policy formulation. Some rules of the game include having all feedback sent to the relevant agencies, and every agency is committed to reply to feedback within stipulated time (Fig. 2.9).

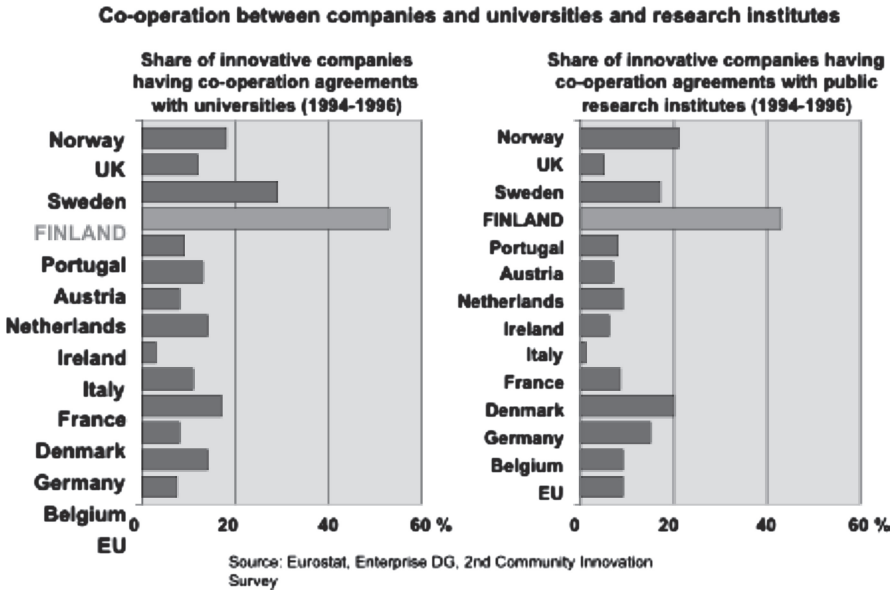


Fig. 2.9 KPIs for e-governance

Key Enablers for Successful e-Government in Singapore

The key enablers of the Singapore e-government Framework adopted within the Government and at National Level are: Infrastructure, ICT literacy, capability development, stakeholder conversion and adoption, and governance (Fig. 2.10).

- *Infrastructure*

In terms of shared infrastructure and services, Singapore has implemented a shared Government-wide computing infrastructure and suite of services on a Standard Operating Environment (SOE) for desktop (i.e., operating system, core applications), messaging (email system) and network (intra- and inter-organisation computer networks) and enabled for its government agencies and public service. It consists of Government-wide Common Services and Hosting environment for Government Agencies' Web Sites, Applications and e-Services (SHINE) to enable secure hosting for rapid deployment of online services. SHINE is operated on a Public-Private Partnership (PPP) model. Besides the eGov services, the shared e-services technical infrastructure provides common services such as e-Payment Gateway, Single Sign-On/online authentication via SingPass, etc. In terms of common data sharing across government agencies, the single instance of critical databases are maintained by respective data custodians: People Hub (Citizen Data) by Ministry of Home Affairs, Establishment Hub for Corporate and Business Data by Ministry of Finance, and Land Hub for Geospatial Land Data by Ministry of Law, Vehicle Hub (Vehicle-Owner Data) by Ministry of Transport, etc. The whole Public Service Infrastructure is securely housed in the Government Data Centre.

	Within Government	National Level
1 Infrastructure	Govt Infrastructure and Services	National Infocomm Infrastructure
2 IT Literacy	Public Sector	Citizens and Business
3 Capability Development	IT Champions & Project Managers	IT Manpower & Infocomm Industry
4 Stakeholder Conversion & Adoption	Change Management	Customer Adoption
5 Governance	IT Governance & Management	IT Legal Framework

Fig. 2.10 Key enablers for successful e-government

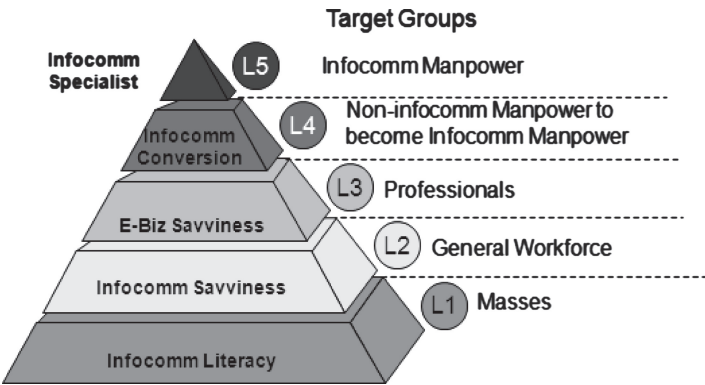


Fig. 2.11 Singapore’s infocomm training framework

• *IT Literacy*

Using the Infocomm Training Framework, IDA has identified infocomm training needs for different segments of the Singapore population and comprised five levels (L1–L5) of infocomm training programmes to meet Singaporeans’ specific needs in infocomm skills. From promoting an e-lifestyle to workforce training to capability development, the framework focused on different levels of infocomm competency to enhance quality of life and to improve employability (Fig. 2.11).

IDA then worked closely with the private sector, community groups and other government agencies to provide opportunities for infocomm skills training. Various initiatives and strategic partnerships were put in place to increase the infocomm literacy level of both the workers and the general public, including:

- Level 1—National IT Literacy Programme (NITLP): training for the non-infocomm literate to equip them with basic computing and Internet skills to improve their quality of life and enhance their employability. Targeted at workers, home-makers and senior citizens.

- Level 2—The Infocomm Competency Programme (ICP): to train workers in the essential infocomm skills for the competitive workplace.
- Level 3—The E-Business Savviness Programme (EBSP): to develop a pool of skilled manpower with e-business skills and knowledge and able to champion e-business transformations within companies, thereby benefiting the industry with enhanced infocomm expertise of the workforce.
- Level 4—Strategic Manpower Conversion Programme (SMCP): to convert non-infocomm professionals to become infocomm professionals.
- Level 5—Critical IT Resource Programme (CITREP): for infocomm professionals to upgrade their skills in critical, emerging and specialised infocomm areas, thus accelerating the development of these skills that were urgently required by the industry.
- Level 6—Infocomm Training and Attachment Programme.

- *Capability Development*

The Singapore Government needs both IT champions and project managers to see through e-government implementation. The IT Champions are usually forward-looking senior management (e.g., Ministers, CIOs) who embrace change, evangelise technology and passionate about e-government; and they are primary agents of e-government adoption and reform within the government. On the other hand, the Project Managers are working-level officers who collaborate with solutions providers to turn e-government initiatives into reality; and they serve as the bridge between private-party vendors and internal government end-users.

At national level, there is a need to build capabilities in the broader infocomm sector and the e-government industry to meet the challenges of e-government development, and this involves building the whole ecosystem such as the schools and Institutes of Higher Learning, professional bodies, etc. An example is the National Infocomm Literacy and Upgrading Roadmap where there are courses or programmes such as e-Business knowledge for non-IT Professional, Conversion programmes for non-IT Professionals to IT Professionals, as well as courses to deepen skills for current IT Professionals.

- *Stakeholder Conversion and Adoption*

The need for good change management or stakeholder transition for successful e-government cannot be stressed enough. Change Management is important as many e-government initiatives involve significant changes to business processes as technology alone cannot achieve significant improvements, and human beings are resistant to change by nature. Hence, change management is a systematic approach to guiding an organisation in dealing with change and it involves everyone from top management to bottom worker, tackles the issue of transiting from State A to State B, and eases the introduction of changes and brings about a smooth transition.

The appreciation of the different types of customers and hence adopting different approaches to manage change for each type of customers would increase the success rate for e-government implementation (See Fig. 2.12). For example, IDA saw increased adoption through CitizenConnect Centres which are located near to

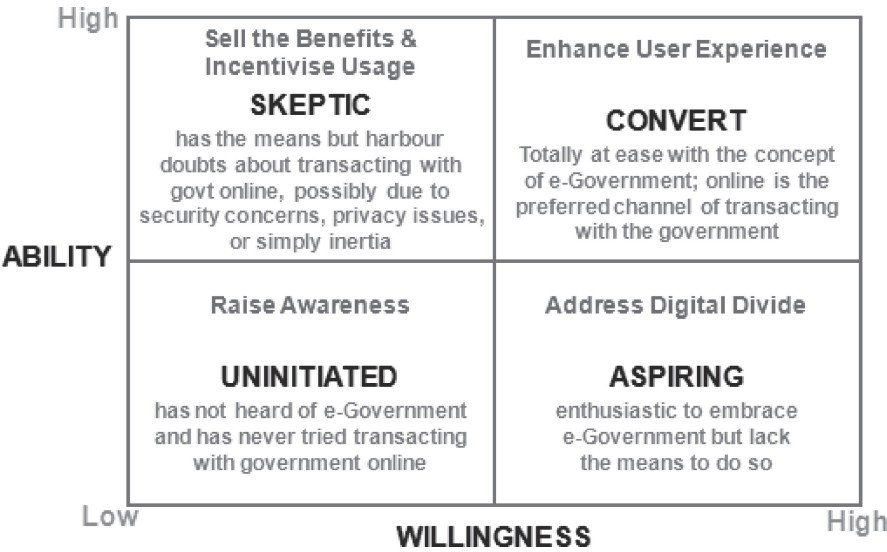


Fig. 2.12 Customer adoption—use different approaches for different customers

homes/workplaces, and provide internet access to Government websites, as well as personalised help by CitizenConnect officers to search for Government information and transact with Government online at no charge,

• Governance

According to Peter Weill, MIT Sloan Centre for Information Systems Research, IT Governance is a framework of accountability and decision rights to achieve desired behaviour in the use of IT. The key components of IT Governance and Management include:

- Leadership and Governance Structure
- Laws, policies, Standards and Best Practices
- Funding and Procurement
- Benchmarking and Performance Measurement

The leadership and governance structure has been discussed earlier.

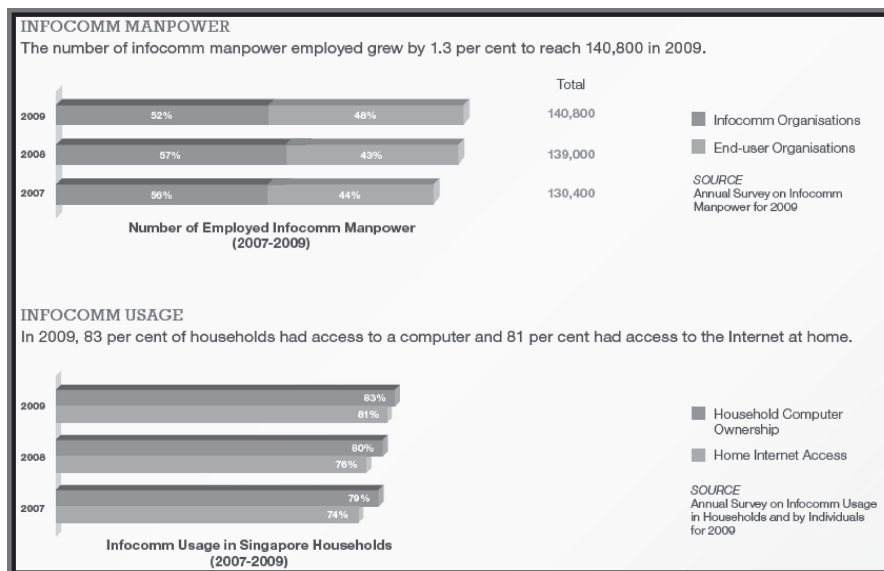
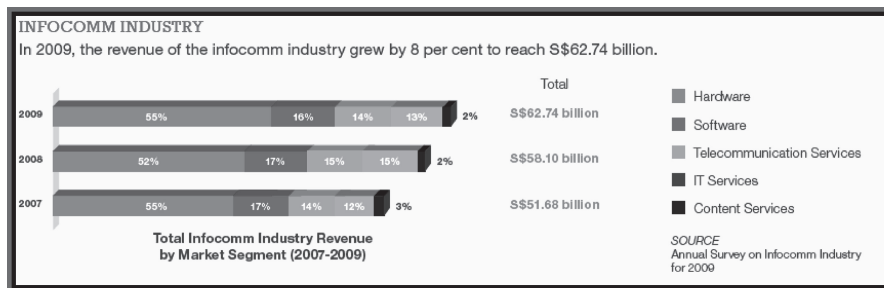
At the national level, Singapore has a conducive legal and policy environment that is crucial to build confidence when engaging in electronic transactions. Its existing legislations were studied to ensure that suitable legal frameworks are in place to create an environment conducive fore-government implementation. Examples include the offer and acceptance of contracts made electronically and the authenticity of the contracting parties (Electronic Transaction Act), Computer Misuse Act, Use of electronic records as evidence in courts (Evidence Act), and Intellectual Property Issues, etc. Annex 1 discusses the key cyber laws that govern the adoption of ICT-enabled practices.

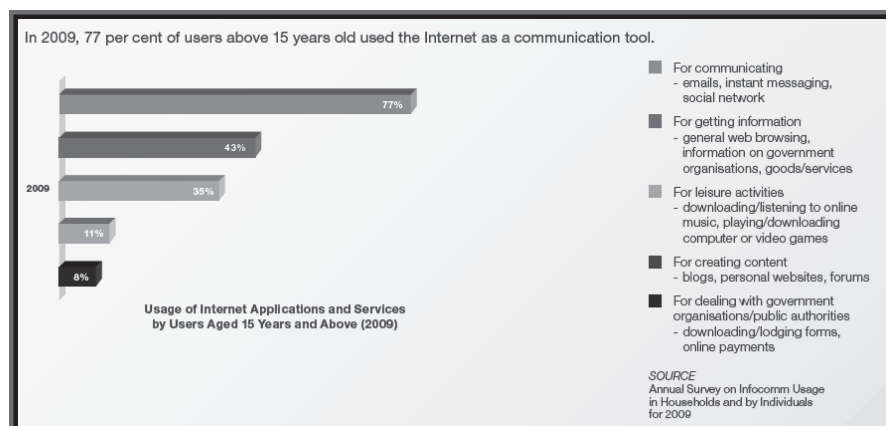
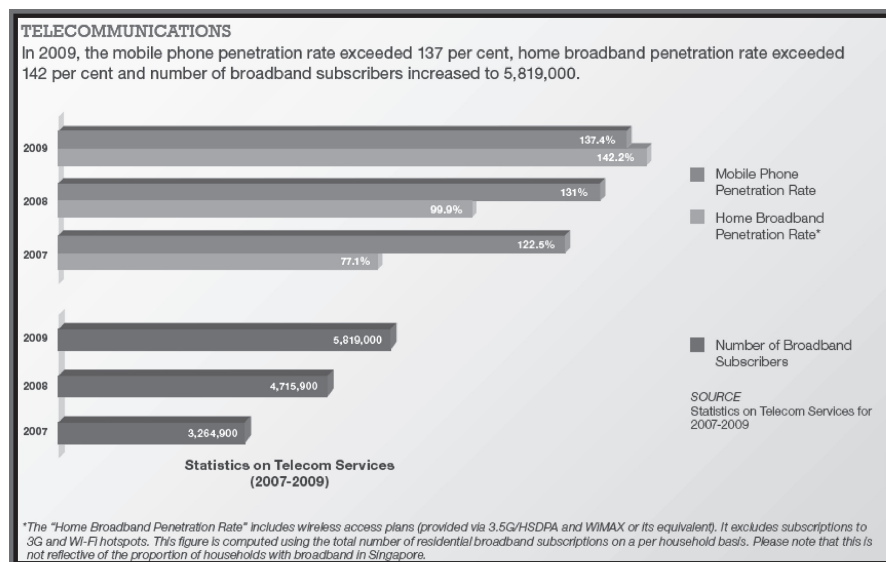
Singapore Infocomm Industry in 2010

Despite the global economic downturn in the 2008 and 2009, the infocomm sector in Singapore has shown resilience and registered growth in 2009. The infocomm industry revenue grew by 8% to reach Singapore \$62.74 billion, while export revenue increased by 14.6% to reach Singapore \$40.44 billion, constituting about 64% of total infocomm industry revenue.

The number of employed infocomm manpower also grew by 1.3% to reach a total of 140,800 jobs in 2009. Infocomm is very much a part of the daily life of our people in Singapore today. In 2009, 83% of households have access to a computer at home, 80% of households have access to broadband, and 95% of households with school-going children have access to computers.

Overall, 78% of enterprises use computers, 75% use the Internet and 69% have broadband access. Mobile phone penetration is at 137%, or more than 6.8 million mobile subscriptions.





In addition, Singapore continues to receive international recognition for its infocomm development and usage. It has topped the Waseda University e-Government Ranking for three consecutive years from 2009 to 2011, consistently ranked among the top three in the e-government indices of the World Economic Forum Global IT Report from 2009 to 2011, and ranked second for overall Networked Readiness in 2010 and 2011, respectively. In the United Nations e-Government Survey 2010 of 192 countries, Singapore was ranked eleventh for the e-Government Development Index and ninth for the e-Participation Index.

Key Lessons

While the basic pillars of ICT strategies adopted by countries around the world are more or less consistent, the varying level of economic success achieved by countries through ICT achievements lie in the execution of these strategies. This is where Singapore has excelled. Possible factors that have helped to facilitate and allow for continuous, stable execution of ICT programmes and initiatives are highlighted below. Some of the lessons that can be learnt from Singapore's ICT development journey are highlighted as follows:

1. Stable Political Leadership

The political context in Singapore is especially critical because the public service leadership is accountable to the Cabinet, which is made up of Ministers from the same political party that has ruled the Nation since 1959. The political leadership's confidence in winning elections meant that they were able to adopt a decision-making approach that addressed long-term solutions and sustainable policies in all aspects of the nation's development, rather than short-term political popularity. Their confidence set the tone for rationality, systemised thinking and meritocracy in the development of the civil service, and the strength of the political leadership significantly influences the values and principles of the public sector. It is this political stability that has enabled Singapore to progress and evolve through its national IT plans and related policies, thus preserving continuity in infocomm development and providing catalyst for future renewal.

2. Industry Collaboration—Getting the Private Sector To Do More

The dual aspects of private-sector leadership and government involvement have been mutually reinforcing. As the vital role of the private sector in national, regional and international ICT development has been well established, there was no need to reinvent the wheel. So Government intervention was mainly used to create the initial supply push in terms of creating the opportunities and providing conducive working partnerships.

While government retained its traditional role of owner and operator of key ICT assets and infrastructure in the early years, there was active industry participation in government projects through tenders, calls for collaboration (CFC), competitive dialogues and technology trials. In 2007, excluding the SOE tender, more than 290 companies were awarded 653 contracts worth a total value of Singapore \$820 million. In terms of contract value, local companies secured 64%, with the rest going to MNCs (IDA, 2008). The government worked with industry on technology trials, such as the Government Technology Experiments and Trials Programme (TREATS). In 2009, the Singapore government has carried out more than 20 technology trials under the TREATS Programme, many of which have led to procurement.

CFC are issued regularly to bring together various players in the industry to innovate in government-funded trials. CFC have been issued for mobile payment, involving handset manufacturers, banks and service providers coming together to develop a first-of-its-kind mobile payment infrastructure in Singapore. Collaboration between industry and schools has also enabled the use of broadband for an enhanced teaching and learning experience. Through the facilitation of the government, constant

dialogue and experimentation, new infocomm solutions were developed and adapted for innovative use, with government taking the lead role in most instances. This was the *modus operandi*, while the Government concurrently focused its effort on developing a vibrant ICT sector that would eventually be able to take the lead in delivering innovative government services.

After two decades of strategically deploying policies, programmes to nurture and grow the infocomm industry, the industry has evolved as an important engine of growth for the country. Singapore also boasts a pool of more than 90% of Fortune 1,000 technology companies that have made Singapore a key node in their global network and innovative local enterprises that produce ingenious solutions and quality services that have made their marks in both the domestic and international markets.

With a dynamic, innovative and competent pool of infocomm companies, Government has gradually shifted from planner, implementor and owner of infocomm and its assets, to that of master-planner, facilitator, providing the catalyst and conducive environment in which infocomm is able to thrive, grow and diffuse. Through innovative partnerships with the private sector, the government is able to now tap on innovation of the private sector, protect against technology obsolescence and create further employment in the development, implementation and delivery of IT projects. In doing so, the government is further catalysing the growth of the infocomm industry.

3. The Pace of Telecommunications Liberalisation and the Importance of Competition

One of the underlying drivers of ICT adoption is the cost of telecommunications infrastructure and the extent of Singapore's connectivity to the region. Singapore's telecommunications market was fully liberalised (down to basic telephony services and lifting the cap on foreign ownership of telecommunications companies in Singapore) only in 2000, although certain telecommunications services (e.g., mobile phone services, Internet access provision) had been opened up several years earlier. This phased approach gave regional competing economies an edge in attracting internationally competitive telecommunications players into their markets and to lay submarine cables to establish a network of connectivity to the region. Prior to liberalisation, infrastructure cost had been one of the factors that led companies to consider establishing their regional headquarters in countries other than Singapore. After four years of liberalisation, the telecommunications market in Singapore is now highly competitive (with IDD call charges to popular destinations falling by more than 60%, for instance), and this has led to greater innovation and availability of services in the market.

While the government-led, strategic supply-push approach in propelling Singapore's development of many of its physical infrastructure such as its airport and seaport, had worked well, it appears that this approach did not have the same impact in its attempt to jumpstart broadband diffusion. The government's intervention appeared to have played a part in the initial slow uptake of broadband due to the lack of competition and price constraints. Operators complained of regulatory and administrative burdens, and these regulations also reduced the flexibility of operators to develop targeted service packages.

However, after that initial slow start, a significant increase in competition between broadband providers (within different modes of access) and lower underlying cost

structures (due to market liberalisation) significantly boosted broadband subscription. The 2003–2004 surge in broadband subscription attests to the effectiveness of competition in bringing about greater demand and market maturity, and thus higher penetration. Continuous effective competition was essential to sustaining the industry's growth as it allows new services that are being planned for the future to catch on at a much faster rate.

4. Balancing Investment in “Soft Infrastructure” is equally important

The pace of broadband adoption in Singapore is illustrative of this. By most accounts, Singapore got the “hard infrastructure” right. That is, the physical networks were rapidly rolled out in the compact island. However, despite the government's earlier efforts in the late 1990s to improve broadband penetration through incentives and other funding schemes, there was limited success in spurring penetration and adoption. The initial slow take-up may be attributed to the lack of “killer applications” available on the network and the lack of and/or tight control over internet content.

The local content providers faced fierce competition from the US and other English-speaking rivals. Moreover, the country's small size made it difficult for local content providers to enjoy economies of scale. The lack of local content, coupled by the various controls employed by the authorities to control access to Internet content contributed significantly to the somewhat low adoption rates.

On the other hand, there were areas in the “soft infrastructure” side where Singapore did well and are noteworthy. High emphasis was given to education and awareness. Accompanying the involvement of the community groups and schools, significant investments were also made to support specific adoption programmes among low-income households, different ethnic groups and late adopters.

5. The Willingness to Innovate and Take Risk

The ability and willingness to take risk, innovate and secure the first mover position clearly has its advantages. Singapore's bold moves in earlier years resulted in a large number of systems being deployed, some more successful than others. For example, in the late 1990s, an initiative to deploy interactive multimedia kiosks in areas of high pedestrian traffic did not result in a viable business model that could be sustained. However, after the turn of the century, a new generation of kiosks providing bill payment and other ancillary services has found a niche area to thrive in. Another example of the risk-taking nature of innovation was the National Library Board's decision to use radio frequency identification (RFID) to electronically tag library books. Although RFID was a relatively untested technology at that time, the library's highly computerised and automated borrowing and return system has turned out to be a success. Library members are able to borrow and return books, and even pay fines for overdue books, through an entirely automated system.

As Singapore's technology deployment capabilities (to operate and adapt technologies) are now close to the world frontier, focus is now on developing capabilities to create new technologies (to innovate and pioneer new technologies). A budget of \$750 million was set aside in FY2007 to develop R&D capabilities under the purview of A*STAR to intensify industry development efforts and catalyse greater commercialisation of technologies by leveraging multi-disciplinary capabilities of

Science and Engineering Research Council's (SERC) Research Institutes (RI). However, despite financial support, innovation remains an uphill task. The Singapore system has often been criticised as one with too many rules and too harsh a stigmatisation of non-conformist behaviours. These characteristics are said to stifle Singaporeans' ability to innovate, think independently, take risk and engage in entrepreneurship. Many have also criticised the system for producing a generation of instruction followers and managers without the enterprising and innovation spirit. The society's intolerance for failure is seen as a further hindrance to risk-averse mindset characteristic of the average Singaporean.

The innovation infrastructure also has a large lifestyle component, the development of which takes place within the parameters of the country's larger political and social objectives. A slow, conservative and incremental approach to greater political and social openness typically adopted and preferred by the Government puts Singapore at a disadvantage compared with some other Asian cities which are able to adopt a far more experimental approach to setting social limits.

However, as part of its efforts to encourage innovation, the government has attempted to loosen up the regulatory environment and the government's grip on the social and political lives in Singapore. Committees have been set-up to identify areas where the government may be able to lighten rules and regulations so as to make it easier for individuals to start and operate a business. Schools are revamping their curricula to inculcate a stronger innovation mindset in students. Various public campaigns have been launched to raise awareness of the fruitfulness of innovative pursuits.

Despite its commitment to research and development, and increasing public and private expenditure on R&D, Singapore still lags behind. A recent study by EIU (2008) that measures how competitive and complete a country's IT industry and environment is, ranked Singapore twelfth out of 66 economies in research and development. While Taiwan had one patent registered for every 2,000 people, Singapore had only one patent for every 47,000 people. In the latest Global Information Technology Report (2007/2008) by the World Economic Forum, Singapore was ranked 23 in its capacity for innovation behind other developed countries like US, UK, Japan and Korea.

6. *Having a headstart in establishing the National Resource/Data Hubs*

Where governments in most countries lament the challenges in performing data unification and sharing among its agencies to enable service delivery, Singapore had a headstart in setting up the Data Hubs (People, Establishment, Land) since 1994 to support e-services across government agencies. Despite the initial pains of unifying the People Data, Company/Business Data, and Land Data, in terms of setting data standards and unique identifiers (IDs), formulating the data management, governance and legal framework to capture, maintain and propagate the data, the appointed authorities bit the bullets and pushed through to see the Data Hubs properly set up and maintained. These Data Hubs have since been the bedrock for government e-services to thrive on at the "whole-of-government" level, enhancing productivity and integrity. For example, after an applicant has logged in to an e-service, say "to file his income tax" using his SingPass, the Personal Data Service can auto-populate the online e-form

with his personal data such as Name, Address, Gender from the People Data Hub, without him having to key in his particulars. This saves times and ensures data consistency and accuracy during online transactions, while at the same time provides ease of access and enhance customer experience in dealing with the government.

7. Need for Dynamic Governance

Dynamic governance is about how a governance system can remain relevant and effective by continuing changing, innovating and adapting to new and emerging needs in a changing environment. The capacity and capabilities to change, in short dynamic governance, are crucial for sustained and sustainable growth and e-development, and the critical success factors as seen in Singapore are:

- Having committed political and public service leaders with vision and high aspirations for Singapore to set the tone for many e-developments in public sector strategies, structure and systems.
- Creating an environment for continual learning via institutional learning, where people are consciously learning and seeking to apply new ideas and explore different ways of doing their work better, or observing different systems and their outcomes, and incorporating their new learning and knowledge into the system to improve performance, or sensitive to new citizen or customer requirements and learn new knowledge and skills to meet these emerging needs; and effective execution via systems based on commitment to making pragmatic policy decisions, rewarding people on merit and performance, building strong institutions with structures and systems to sustain action, evaluating policy options on helicopter qualities, analysis, imagination and realism, and having a strong results orientation and accountability.
- Creating innovative processes, agile structures and systems by embedding dynamic capabilities in the change management programmes, integrating change capabilities into operational and management processes, as well as being deliberate in introducing process redesign with strategic intent, supported by effective feedback mechanisms for continuous learning.

Fast Forward Twenty-First Century: Intelligent Nation, Global City

While early investments in infocomm have paid off significantly, to stay ahead of the competition and raise its infocomm competencies will require a bold perspectives and renewed vigour. In 2006, the Government brought together expertise from the Public, Private and People sectors to envision how infocomm can be made even more accessible to everyone—to work, live, learn and play—thus enriching the lives of Singaporeans, enhancing the country's economic competitiveness and boosting the growth of the infocomm industry here.

Intelligent Nation 2015, or iN2015, is Singapore's infocomm masterplan to prepare the nation for the future. The plan outlines its vision to turn the country into "An Intelligent Nation, a Global City, Powered by Infocomm." Innovation, integration

and internationalisation are the basis of this masterplan. The capacity to innovate and create new business models, solutions and services will enable Singapore to be more competitive in a globalised environment. Equally important is the ability to integrate resources and capabilities across public and private institutions. The masterplan sets bold targets for 2015:

- Singapore to be No. 1 in the world in harnessing infocomm to add value to the economy and society
- Achieve a two-fold increase in value-added¹ of the infocomm industry to Singapore \$26 billion
- See a three-fold increase in infocomm export revenue to Singapore \$60 billion
- Create 80,000 additional jobs²
- Have at least 90% of homes using broadband
- Ensure 100% computer ownership for all homes with school-going children

The iN2015 Masterplan is not only about economic competitiveness. It explores ways to ensure that the elderly, less-privileged and people with disability can also enjoy connected and enriched lives or self-improvement and life-long learning. This is to bridge the digital divide and create opportunities for all.

To achieve the targets, the masterplan outlines four key strategies:

- To establish an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure
- To develop a globally competitive infocomm industry
- To develop an infocomm-savvy workforce and globally competitive infocomm manpower
- To spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of infocomm

Building Next Generation Nationwide Infocomm Infrastructure

The Next Generation Nationwide Broadband Network (Next Gen NBN) capable of ultra-high speeds of up to 1Gbps and beyond will be a strategic enabler for virtually infinite possibilities for innovative services such as interactive IPTV, software-as-a-service, high-definition video conferencing and other bandwidth-intensive applications. The infrastructure will also be IPv6 compliant and will enable an exciting host of new broadband-enabled services and applications, such as immersive learning experiences, telemedicine, high-definition TV, immersive video conferencing and

¹ Value added of the infocomm industry refers to the contribution of the industry to the gross domestic product (GDP). Value add comprises the compensation of employees, operating surplus, the consumption of fixed capital and the excess of indirect taxes over subsidies (Definition from the Singapore Department of Statistics).

² Of the 80,000 new jobs, 55,000 jobs are expected to be infocomm jobs in both infocomm and user sectors. The remaining 25,000 jobs are supporting jobs in infocomm industry.

grid computing. As at June 2010, the Next Gen NBN has covered about 35% of homes and buildings in Singapore and is on track to reach 60% coverage by the end of 2011, and 95% coverage by 2012.

OpenNet, the appointed Network Company, commenced its commercial operations of offering wholesale fibre services in April 2010, while Nucleus Connect, the appointed Operating Company, commenced offering co-location and inter-operability testing services in May last month. Many downstream operators, such as Retail Service Providers and Application Service Providers are in talks with both companies on procuring their services. Complementing the wired network is the Wireless@SG network with more than 7,500 hotspots offering free Wi-Fi services with speeds of up to 1 Mbps. To date, there are close to 1.6 million unique wireless broadband subscribers clocking an average of approximately 10.1 h monthly. Together with their partners, the operators have rolled out a variety of enterprise services such as facility monitoring, cashless payment systems, location-based services and digital advertising.

As the Next Gen NBN is being rolled out to provide an open-access environment to encourage the development of more services, it is deemed important to enable different service providers to easily interconnect with one another so that information from their subscribers can easily reach subscribers from another service provider's network. This is hence enabled by the Singapore Internet Exchange or SGIX which was commercially launched in June 2010. SGIX is a neutral Internet Exchange which provides local and foreign telecoms service operators a neutral and highly efficient Internet traffic exchange facility to exchange their Internet traffic. SGIX will serve as a central point of Internet traffic exchange, thereby also attracting foreign telcos to interchange their international Internet traffic through Singapore, and strengthening Singapore's position as an attractive infocomm hub.

Alongside the deployment of national infocomm infrastructure, programmes are developed to facilitate the delivery and adoption of new services that meet market needs. The Lighthouse Series is a series of industry forums and workshops aimed at informing and engaging industry players to use the Next Gen NBN to deliver new and innovative services, while the BEACON series focuses on educating enterprises, consumers and government end-users on the benefits and possibilities of Next Generation services.

Developing a Globally Competitive Infocomm Industry

The presence of a vibrant infocomm industry fuels the growth of other economic activities and in turn adds jobs to the economy. Singapore's excellent infocomm infrastructure has made it a preferred destination to anchor shared IT services. Global infocomm-user MNCs like UOB, BNP Paribas International Private Bank and Daimler have chosen Singapore to set up IT hubs to support their worldwide business operations. IDA has also attracted infocomm MNCs such as Equinix, Salesforce.com and Amazon Web Services to Singapore. Besides infocomm investments, these MNCs provide innovative platforms, generate sophisticated demand

for infocomm services, and create high-value ICT jobs and business opportunities for infocomm local enterprises (iLEs).

To drive the development of more innovative infocomm solutions, IDA collaborates with MNCs like Cisco, Platform and Oracle to set up innovation centres in strategic and emerging technology areas. As at June 2010, there are seven such innovation centres with a total investment of almost \$80 million. As part of its efforts to infuse innovation and new business models and capabilities, IDA works with its wholly owned subsidiary, Infocomm Investment Pte Ltd (IIPL), to attract world-class global infocomm start-ups and entrepreneurs to use Singapore as a development and engineering base. Since 2008, it has attracted some 40 start-ups from countries such as the United States, Israel, Sweden, China, Germany and Finland, bringing more than \$50 million in project investment.

One key focus of the industry development efforts is to spur infocomm innovation by helping iLEs create IP that is commercialisable. The Infocomm Local Industry Upgrading Programme (iLIUP) promotes strategic and mutually beneficial partnerships to enhance the capabilities and competitiveness of iLEs as they tap on the expertise and network of the MNC partners. Since 2006, iLIUP has helped 165 iLEs to develop more than 230 new or enhanced products/solutions, and trained close to 1,100 infocomm professionals. The Technology Innovation Programme (TIP), in partnership with SPRING, aims to encourage Singapore-based infocomm enterprises to use technology to develop or improve products, processes or business models as part of overall business strategy. IDA and SPRING have supported more than 30 enterprises, generating infocomm investments of over \$20 million. The Technology Enterprise Commercialisation Scheme or TECS is another scheme that IDA has partnered with SPRING since 2009. TECS has supported 16 start-ups based on strong technology IP and a scalable business model, generating \$9 million in project spending towards technical development of products or services.

To help more local Singapore companies make inroads into overseas markets, IDA has in place various internationalisation programmes. “Made-in-Singapore” infocomm solutions have earned a good reputation for being of high quality. To extend this mindshare internationally, the Infocomm Singapore Brand was created to help iLEs market their products and solutions overseas. The brand has seen good take-up by iLEs and is used extensively at international trade events such as GITEX, Mobile World Congress and imbX. The Overseas Development Programme (ODP) serves as a platform for iLEs to team up with leading infocomm MNCs to establish an international presence. Tapping on the business networks, products and services of lead partners, iLEs can reach a bigger market. Since 2006, 126 iLEs in partnership with 15 MNCs have benefited from this programme.

IDA International was established in February 2009 to provide e-government consultancy to foreign governments and to support the implementation of infocomm solutions overseas. IDA-I has provided local companies market connections to countries as far as the Caribbean, Africa and South America which are interested to adopt and adapt Singapore’s experience in using ICT solutions to provide world-class public services. In addition, the Global Business Development Centre of Excellence or GBD COE, a joint effort by IDA, IDA International, IE Singapore,

and SiTF, continues to help the Singapore infocomm industry scale up global business development and increase business opportunities in overseas markets. The GDB COE activities are stepping up to develop more promising new markets, provide advisory on market knowledge and possible business structure models, and enable more effective go-to-market activities.

Developing Infocomm-Savvy Workforce and Globally Competitive Infocomm Manpower

In developing infocomm-savvy workforce and globally competitive infocomm manpower, IDA has set themselves the target of creating 80,000 additional jobs by 2015. As of 2009, it has reached the half-way mark, with more than 41,000 additional jobs created. It has seen a continued growth of employed infocomm manpower, with a growth of 1.3% growth in 2009 to reach a total of 140,800 jobs.

IDA has adopted a multi-pronged approach for competency development with programmes like Techno-Strategists for professionals to acquire hybrid skills in various sectors like Financial services, Healthcare, Hospitality and Retail. The iLEAD programme was launched to train and develop infocomm professionals in emerging areas such as Cloud computing, Green IT, ICT Security and network engineering. Through its competency roadmap, ICT job roles are reviewed and included in the National Infocomm Competency Framework (NICF), and aligned with Enhanced Critical Infocomm Technology Resource Programme (CITREP) training courses. The NICF 2010 has a total of 250 job roles with more than 70 organisations having signed up to adopt NICF. Together with the Workforce Development Agency, industry partners and institutes of higher learning, four Infocomm Continuing Education and Training or CET Centres for professionals have been set up to pursue professional upgrading. There was collaboration with the local universities and 34 industry partners to nurture industry-ready undergraduates through industry attachments and professional certification and upgrading.

In the area of developing a pipeline of infocomm talent, IDA has organised various student outreach programmes on infocomm career possibilities, infocomm clubs at schools, and national infocomm competitions. The National Infocomm Scholarship and Integrated Infocomm Scholarship were also setup, with a total of 181 and 52 scholarships for the two programmes, respectively awarded in 2010.

Hence in achieving an infocomm-savvy workforce, IDA continues to engage in various initiatives to attract talent to study infocomm, provide students in our universities and polytechnic institutions with a world-class infocomm education, and upgrade our infocomm professionals in their careers.

Transforming Key Economic Sectors, Government and Society

Singapore has seen, on the business front, the infocomm usage growing steadily across the enterprises. In 2010, household computer ownership has reached 83% and mobile phone penetration is now at 137.5%.

Singapore leads in e-government globally, and infocomm continues to bring about changes in the way the Government serves and interacts with citizens. The iGov2010 vision is to connect with citizens through infocomm. Through the annual e-gov perception surveys, we see an increase in satisfaction with the quality of e-gov services and information. Continuing with its e-gov journey, IDA is currently formulating the next e-gov masterplan. The next wave of e-gov will see new models of collaboration with the private and people sectors, leveraging emerging technologies and social trends.

The nine sectors identified in the iN2015 masterplan for sectoral transformation through infocomm are: digital media & entertainment, education, financial services, healthcare, manufacturing & logistics, land and transport, tourism, hospitality & retail, government and society. Their progress as at 2010 is as follows:

- In the Digital Media and Entertainment space, IDA has put in place the Digital Marketplace Programme, which aims to establish Singapore as Asia's trusted hub for managing and distributing digital content by attracting key media service providers, content owners, and aggregators. It has attracted eight industry projects to hub content and services in Singapore as well as implemented two accelerator projects such as the world's first content fingerprinting contextual advertising and iScreener online platform for the Asia Television Forum. With the Connected Games Programme, two Games Resource Centres have been launched—the Nanyang Polytechnic Games Resource Centre in collaboration with Sony Computer Entertainment focuses on building Playstation development capabilities while the Unreal Technology Lab at Singapore Polytechnic provides training and access to the Unreal Engine.
- In Education, IDA has various programmes that aim to foster an engaging and transformational learning experience through the innovative use of infocomm. The six FutureSchools are collaborating with 15 industry players to develop 50 new products and services for learning, with some products starting to be piloted in the classrooms this year. The Experimentation@Schools programme will catalyse the development of innovative ICT tools in areas like Collaborative Learning and Learning on the Move. To support MOE's third ICT masterplan, the Learning Digital Exchange was implemented to provide quality digital resources for all teachers.
- In the Healthcare sector, the vision of integrated health services is being increasingly enabled through the innovative use of ICT. There are several ongoing programmes designed to equip healthcare providers across the continuum with the tools and electronic healthcare information to improve the quality and continuity of care. These programmes include the National Electronic Healthcare Record initiative and new initiatives in the primary, intermediate and long-term care sectors.
- For Small Medium Enterprises (SMEs), there are various initiatives to make infocomm accessible to them. The SME Infocomm Resource Centres have assisted more than 7,000 SMEs to learn and adopt infocomm. Through the SME Infocomm Package, IDA has supported some 4,000 SMEs to establish their first web presence. IDA has also supported more than 100 SMEs with a total of \$6 million in grants to transform their businesses with infocomm, through the TIP jointly administered by IDA and SPRING. Earlier in 2011 the iSPRINT

programme, a \$25 million initiative, was introduced by IDA in collaboration with SPRING and IRAS (which caters to SMEs' different infocomm needs). Moving forward, IDA will look at initiatives that provide sectoral assistance to SMEs in sectors such as logistics, tourism and education.

- For the Transport sector, the Infocomm@AirHub Programme promotes integrated and intelligent processes to reduce costs and improve productivity. IDA signed an MOU on the e-freight@Singapore programme in Jan 2010 with CAAS and four international and local trade associations. To enhance Singapore as a leading Air Logistics Hub, it aims to establish e-messaging standards and platforms for data exchanges and interconnect more than 100 stakeholders across the air logistics supply chain. To elevate Singapore as a global destination for aerospace maintenance, repair and overhaul (MRO), it is looking at streamlining processes across up to five extended MRO value chains and catalysing the development of applications for optimal deployment of resources.
- For the Financial sector, IDA's Next Generation e-Payment Programme will quadruple the number of contactless Point-of-Sales (POS) terminals from 5,000 to almost 24,000 by end 2011. This represents a joint investment of \$16 million by IDA and the industry. By leveraging the huge base of over six million CEPAS cards currently used for public transport, this initiative will bring greater convenience to consumers by enabling seamless use of CEPAS cards for payment in various cash-based segments such as food courts, provision shops and convenience stores. When fully deployed, the terminals are expected to generate over 94 million e-payment transactions a year, converting a significant number of cash-based payments to e-payment. In the longer term, this network of contactless terminals will form a key supporting infrastructure for future innovative services, such as Near Field Communication-enabled mobile e-payment.
- In the Tourism, Hospitality and Retail sector, the Digital Concierge Programme aims to catalyse the growth of mobile services ecosystem in Singapore by encouraging the development of transactional, location-based and mobile commerce services for consumers and enabling businesses to target their customers more effectively through the mobile channel. IDA awarded six companies in April 2010 through the Digital Concierge Call-for-Collaboration to jointly invest a total of \$10 million over the next two years to develop and deploy common mobile shared services and enablers. These include a directory of businesses, location positioning integrated with the telcos and remote payment. All enablers will be accessible by businesses and third-party mobile service developers alike, allowing them to bring to market a wide variety of transactional, location-based and mobile commerce services.
- In the area of trade and logistics, the TradeXchange was commissioned in 2007 to facilitate the exchange of information within the community. It provides a neutral and secure multi-party collaborative platform to integrate trade and logistics processes. A Call-For-Collaboration was recently awarded to four consortia involving 22 companies in the trade and logistics sector. Industry and government will jointly invest \$6.3 million on projects to integrate key processes in marine cargo insurance, freight management and trade financing through TradeXchange as the multi-party collaborative platform. Through such integration,

companies will enjoy greater operational efficiencies, clearer supply chain visibility, faster shipment turnaround and increased productivity. For instance, suppliers can electronically apply for financing directly from their procurement systems to banks connected to TradeXchange.

- Beyond enhancing the economic competitiveness of the nation and the infocomm industry, the iN2015 vision is also about enriching lives through infocomm. IDA has three digital inclusion initiatives that bring infocomm to the public:
 - The NEU PC Plus Programme for needy students has benefited around 9,000 needy households through the provision of affordable computers, broadband access and software.
 - The Silver Infocomm Initiative tackles the digital divide by honing our senior citizens' IT proficiency, while addressing their needs for affordability and accessibility to infocomm training and computer resources. As at 2010, over 18,000 senior citizens have attended such training activities.

The Infocomm Accessibility Centre has provided for the disabled community, tailored IT training to almost 3,000 people with disabilities, including the use of assistive technology tools to help them maximise their potential in school, at work and in everyday life.

The global infocomm landscape continues to evolve and present new opportunities as Singapore continues on its iN2015 masterplan journey. Responding to the fast evolving environment, several strategic areas like Cloud Computing, Business Analytics and Green ICT, which have emerged recently in 2010–2011, will be considered by IDA for incorporation into the iN2015 programmes.

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Appendix I: Legal and Regulatory Policies

Telecommunications Act

The Telecommunications Act of 1999 (The Telecoms Act), passed by Parliament in tandem with the IDA ACT, provided much of the legal basis for IDA's actions as industry promoter and market regulator.

The Telecoms Act empowered IDA with the right to provide all telecommunications services within Singapore and gave it the authority to transfer that right to operators through its power to issue licences. IDA was also able attach conditions to licences, and it modifies those conditions where necessary.

Apart from licensing, the Telecoms Act also gave IDA three general options through which it could implement regulations. IDA could issue:

- “Codes of practice” and “standards of performance” that apply to all licensees offering services;
- “Directions” to specific licensees, instructing them to alter their behaviour and giving them a time limit for compliance; and
- “Advisory guidelines”.

IDA also had the authority to allocate radio communications spectrum for both public sector and private sector uses. IDA collaborates with the Media Development Authority (MDA), the broadcast regulator, for the latter to assign frequencies to broadcast after IDA has decided on the national spectrum allocation for broadcasting service and cleared the technical operation for broadcast transmitters.

Beyond policy and regulation, IDA was tasked to promote the development of info-communications within Singapore. In general, its promotional activities can be grouped into three categories: (1) outreach to residents and companies to promote the use of information and networking technologies; (2) promotion and development of Singapore’s info-communications industry itself; and (3) outreach beyond Singapore’s borders to stimulate investment and provide an outlet for exports. IDA pursues these, in part, through organised and well-funded programmes to proactively subsidise and sponsor the development and adoption of new technologies, applications, services and business models. Initiatives and promotional activities range from technology fairs and expositions to providing seed money for research and development efforts.

Electronics Transactions Act

The Electronic Transactions Act, administered by IDA, was passed in 1998 as an enabling legislation to remove the uncertainty around the legality of contracts that are formed electronically, to give recognition to electronic signatures and to clarify the liability of network service providers that merely carry traffic. It establishes the voluntary licensing of certification authorities as trusted third parties in the online world to provide the basis for other trust relationships to be established. The Electronic Transactions (Certification Authority) Regulations stipulate the requirements for a certification authority to obtain a licence in Singapore, and the accompanying Security Guidelines for Certification Authorities (IDA 1999) stipulate the technical security requirements that must be met. There are also provisions in the Electronic Transactions Act that enable government agencies to easily implement electronic systems to transact with the public without the need to amend their own parent legislation.

Computer Misuse Act

The Computer Misuse Act, administered by the Ministry of Home Affairs and the Singapore Police Force, was passed in 1993 to deal with increasing incidents of computer crimes that were not readily caught by the provisions under the existing

Penal Code. Before its enactment, criminal acts involving computers did not clearly fall under traditional crimes such as theft or criminal breach of trust, thus making it difficult for the public prosecutor to bring charges against offenders. The Act thus created new offences, specifically unauthorised access and modification of computer systems. In 1998, the Act was further amended to address new attacks that had evolved with the spread of the Internet (e.g., denial-of-service attacks). It also recognises that some computer systems are critical to Singapore (e.g., the system for banking and finance, emergency services and public services) and thus metes out harsher punishment for offenders who gain unauthorised access to such systems.

In 2003, the act was amended again to make provisions in two specific areas. The first is for the Minister of Home Affairs to be able to authorise a person or an organisation to take steps necessary to prevent or to counter a threat to national security, essential services, defence, or foreign relations of Singapore, where there are reasonable grounds to believe that such a threat exists, before the offence is committed. The provision also grants added protection for the informants of such threats. The second area is for certain offences under the act to be compounded, thus allowing the police greater flexibility in taking action in incidents of minor offences. The act, since its enactment in 1993, has been extra-territorial in nature—that is, it applies to any person, regardless of nationality or citizenship, both outside and within Singapore. In particular, it will apply if the computer, program or data relating to an offence is in Singapore. The act does not require every computer crime to be reported. However, the MAS has required that all incidents involving financial institutions to be reported to it.

Public Key Infrastructure and Licensing of Certification Authority

The Electronic Transactions Act (Cap 88) (ETA) and the Electronic Transactions (Certification Authority) Regulations (ET(CA)R) provided for a voluntary licensing regime of CAs and empowered the Controller of Certification Authorities (CCA) to regulate and license the activities of CAs in Singapore. The Director-General (Telecommunications) of the Infocomm Development Authority of Singapore (IDA) is the CCA. As CAs perform a trusted role in verifying the identities of parties in electronic transactions, the CCA seeks to provide the assurance that the CAs' responsibilities are met and that these services are made available with high integrity, security and service standards. Only CAs that meet the standards set up by the Controller are licensed. There is currently one licensed operating CA in Singapore—Netrust Pte Ltd as of 14 June 2002.

A licensed CA enjoys the following benefits:

- Evidentiary presumption for digital signatures generated from the certificates it issues. With the presumption, the party relying on the signature merely has to show that the signature has been correctly verified and the onus is on the other party disputing the signature to prove otherwise. Evidentiary presumption hence

assures online merchants of the security of their transactions when they use such signatures to validate electronic contracts and transmit them over the Internet (or by other electronic means).

- Limited liability under the ETA. The CA will not be liable for any loss caused by reliance on a false or forged digital signature of a subscriber as long as the CA has complied with requirements under the Act. The CA will also not be liable in excess of the reliance limit amount specified in the certificate, even if it failed to observe some of its obligations.
- Licensing of a CA by the Controller is an indication to the public that the CA has met stringent regulatory requirements and is therefore trustworthy and deserving of consumer confidence.

Personal Data Protection

Singapore has both a strong common law tradition as well as appropriately structured statutory provisions to regulate use of personal data. Under the general law, confidential information may be protected under a duty of confidence. Personal information is also protected under sector-specific laws such as the Banking Act, Statistics Act, the Official Secrets Act and the Statutory Bodies and Government Companies (Protection of Secrecy) Act. There is, however, no overarching legislation for the protection of personal data in Singapore.

In February 2002, the National Internet Advisory Committee (NIAC) released a draft “Model Data Protection Code for the Private Sector” which is modelled on internationally recognised standards. The IDA and the National Trust Council (NTC) conducted a public consultation on the code. Based on comments from the industry and members of the public, the Model Code was fine tuned and released in December 2002 for private sector adoption.

The Model Code is a generic code that is available for adoption by the entire private sector. It applies to any private sector organisation that collects and installs personal data in electronic form, online or offline, using the Internet or any other electronic media. In the e-commerce area, the NTC has aligned its trust mark programme with the principles of the Model Code.

Intellectual Property Rights

In order to strike a balance between the protection of rights for owners of creative works and increased public access to intellectual property, Singapore ensured that its intellectual property and copyright laws are harmonised with the underlying principles in global laws on intellectual property rights (IPRs). For example, IPRs are accorded the standards of protection as prescribed by international agreements such as the World Trade Organisation’s Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, and the Berne and Paris Conventions. The lead agency

for IPR protection in Singapore is the IPOS. The Infocomm Development Authority of Singapore (IDA) provides support in the info-communications aspects.

While the Internet has extended the reach of providers of information and other forms of content, it has also changed radically the ease to reproduce, distribute and publish such information and content. This has posed new challenges for intellectual property protection. The Copyright Act (Cap 63) was amended in August 1999 to reinforce Singapore's commitment to provide a strong and conducive IPR regime to encourage the growth of a knowledge-based economy and promote electronic commerce and creative innovations. The amendments aimed to:

1. Improve copyright protection and enforcement measures for copyright owners in the digital environment, thus promoting the use of the Internet for business. For example, the amendments—
 - Extended copyright protection to multimedia and interactive productions which qualify as intellectual creations;
 - Clarified that copyright owners enjoy protection against the making of electronic and transient copies of their work; and
 - Provided the conditions allowing an additional avenue whereby copyright owners may require Internet Service Providers to “take down” materials which may be guilty of copyright infringement, even before the owners initiate enforcement proceedings against the actual infringes.
2. Promote legal certainty in the usage of the Internet by clarifying the rights and obligations of copyright owners, intermediaries such as network service providers, and users such as educational institutions. For example, the amendments allowed end-users to browse materials made available on the Internet. The amendments also spelt out when intermediaries such as Internet Service Providers are exempted from liabilities.

Spam Control Framework

Spam is a complex, multi-faceted issue. As such, Singapore adopts a multi-pronged policy approach to address spam related concerns from users. This approach serves as a concerted effort by the public and private sectors to address the issues and curb spam in Singapore. This includes public education (including the use of appropriate technology measures), industry self-regulation, anti-spam legislation and international cooperation. The three major Internet Service Providers (ISPs), Pacific Internet (PacNet), SingNet and StarHub, under the facilitation of IDA, have come together to set up anti-spam guidelines. These guidelines serve as guiding principles to be adopted jointly by the three ISPs to help reduce e-mail spam for their subscribers. The DMAS launched an E-mail Marketing Code of Practice for its members. It also set up a Consumer Communications Preference Programme to allow e-mail users to register their preference not to receive unsolicited commercial e-mails. IDA and the Attorney-General's Chambers of Singapore (AGC) have completed joint consultations on a legislative framework to control e-mail and mobile spam in

Singapore. The proposed legislative framework seeks to balance the legitimate interests and concerns of different groups such as consumers and ISPs on the one hand, and marketers on the other.

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