iN2015 IMAGINE YOUR WORLD

INNOVATION. INTEGRATION. INTERNATIONALISATION.

Report by the iN2015 Steering Committee

Singapore: An Intelligent Nation, a Global City, powered by Infocomm

About iN2015

Intelligent Nation 2015 (iN2015) is Singapore's 10-year masterplan to help us realise the potential of infocomm over the next decade. Led by the IDA, iN2015 is a multi-agency effort that is the result of private, public and people sector co-creation. From the people sector, individuals provided their ideas and views through focus groups and the Express IT! iN2015 Competition. The competition attracted thousands of entries from students and the general public on how they envisioned infocomm would impact the way they live, work, learn and play in 2015. In addition, hundreds of private and public sector representatives participated in numerous discussions to come up with ideas for transforming their sectors through infocomm, and how to translate these ideas into reality.

About this Report

This report provides an overview of the iN2015 vision, what it means for Singapore and what we can do to achieve the vision. The report begins by illustrating a few scenarios of how infocomm can enrich the way we live, work, learn and play in 2015. These scenarios draw on envisaged needs of businesses and individuals by 2015, and technology trends derived from IDA's Infocomm Technology Roadmap. To achieve the vision, we need to know where we are today. This report sets out this context by outlining complementary plans that iN2015 has taken into account both at the sectoral and national level, as well as the state of our infocomm capabilities today. We then outline the proposed strategies needed to help us arrive at the iN2015 vision.

Accompanying this main report are 10 other more detailed reports. Each report elaborates on how Singapore intends to use infocomm to transform our businesses and to add richness to our lives. Seven of the reports highlight what iN2015 will mean in key economic sectors such as manufacturing and financial services, as well as in emerging growth areas such as digital media. Three reports cover how infocomm infrastructure, manpower, and enterprises will be transformed in making the infocomm industry a continued engine of growth, and in supporting the needs of the other economic sectors by 2015.

Specifically, the accompanying 10 reports cover:

- Digital Media and Entertainment
- Education and Learning
- Financial Services
- Government (iGov2010)
- Healthcare and Biomedical Sciences
- Manufacturing and Logistics
- Tourism, Hospitality and Retail
- Infocomm Infrastructure, Services and Technology Development
- Enterprise Development for Singapore-based Infocomm Companies
- Infocomm Manpower Development

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Foreword

Dr Lee Boon Yang
Minister for Information, Communications and the Arts

In 1981, Singapore launched the National Computerisation Plan to tap the power of information technology for economic and social developments. The Plan also called for increasing computer literacy and the creation of jobs in this new sector. Twenty five years ago, not many Singaporeans were familiar with infocomm. Few had any idea of the opportunities offered by technology or how it could change our life. In fact, working with a computer was the preserve of just 850 professionals, who made up the country's total IT manpower then. To the rest of us, infocomm and computers were part of science fiction.

Today, infocomm has become an intrinsic part of just about everyone's life, in one way or another. Three quarters of our households own at least one computer. More than one in two households use broadband to surf the Net. Three out of four companies use the Internet for business mostly via broadband. Electronic gaming is now a national sport. Today we have a robust infocomm industry which contributes 6.5 per cent of Singapore's Gross Domestic Product, with more than 111,000 infocomm manpower supporting every aspect of our economy.

Our early investments in infocomm, which include the national broadband initiative Singapore ONE, have paid off. We have transformed Singapore into a connected and highly-efficient technology powerhouse. Infocomm is one of our strategic advantages in economic competition. Our strong standings in international competitiveness rankings year after year reflect this. However other countries are also recognising the strategic significance of infocomm. We cannot afford to slow down or we will be overtaken. The challenge now is to raise our infocomm competencies by several notches so as to stay ahead of competition.

This challenge brought the Public, Private and People sectors together last year to examine how we should proceed, how we can raise the bar to benefit and enrich Singapore's economy and our lives. We envisaged infocomm becoming even more accessible to everyone – to work, live, learn and play with. Indeed, by developing an inclusive digital society, we will ensure continued growth and vitality of our knowledge-based digital economy. This masterplan – Intelligent Nation 2015, or iN2015 – has been drawn up with precisely this vision in mind. It is a bold and exciting plan to prepare us for the future. I am confident that by harnessing the power of infocomm, we will achieve the vision of Singapore as a prosperous and vibrant global city with exciting and rewarding opportunities for all Singaporeans.

Preface

Innovation, Integration and Internationalisation.

These are the key themes to iN2015's vision of "An Intelligent Nation, a Global City, powered by Infocomm." They are simple themes, but they encapsulate what iN2015 sets out to do. Because at the fundamental, they represent the promise of infocomm for Singapore.

iN2015 sets out to deliver on this promise of infocomm for every individual and business in Singapore. To do this, infocomm must not only be easy to use, it needs to be intelligent enough to cater to the needs of every user. It needs to be intelligent enough to cater for the infocomm-savvy computer graduate or the elderly, who may have in the past, have had less interaction with infocomm.

But we cannot stop there. Singapore's success has always been due to our relevance in the global ecosystem and over the next decade, Singapore's world will become flatter. Already, other economies, starting from a number in Asia, are in high–gear to further use infocomm to better serve their citizens and key economic sectors. These efforts, be it in next-generation networks, manpower or digital inclusion, are expected to transform their societies and economies.

In the process, this will open up new needs, new services, new markets, new partnership opportunities and new capabilities accessible by infocomm. This is a tremendous opportunity for Singapore. Beyond the domestic benefits, iN2015 will keep Singapore plugged in to this global framework to fully realise the benefits of infocomm. Only then, can we realise our vision of "An Intelligent Nation, a Global City, powered by Infocomm".

The iN2015 vision is a lofty one and our journey will not be easy. Particularly because of the rapid pace of infocomm developments, new possibilities will be created and some assumptions that we make today may no longer be valid a few years or for that matter, a few months from now. The iN2015 plan is thus a living document that will be continually updated. It is our hope that the initial findings in this report serve as a starting point for ongoing discussion.

The good news is that our journey has already begun. We have world-class infocomm foundations built over a quarter of a century and as importantly, this vision is a co-creation effort that has involved a wide-ranging cross-section of our economy and society.

This document is the work of members of the iN2015 Steering Committee and the ten sub-committees – seven in key economic sectors, including the government, as well as three in the critical supporting infocomm-related areas of infocomm infrastructure, manpower and enterprises. The Committees have worked tirelessly over the past year and actively sought feedback extensively from other members of the public. iN2015 is therefore a co-creation effort by these members and Singaporeans as well. It is a plan that Singaporeans can look forward to help them achieve their vision for a vibrant infocomm sector in Singapore.

iN2015 Steering Committee

Mr Lam Chuan Leong

Chairman
iN2015 Steering Committee

Chairman
Infocomm Development
Authority of Singapore

Mr Chan Yeng Kit

Deputy Chairman
iN2015 Steering Committee

Chief Executive Officer
Infocomm Development
Authority of Singapore

"Singapore embarked on its first National Computerisation Plan 25 years ago, convinced that infocomm would increasingly be a key strategic enabler for our people and our economy. That foresight and faith has served us well. iN2015 reaffirms the strategic role of infocomm today and into the future. As we journey towards 2015, infocomm will become an even more important differentiator and enabler for Singapore."

Mr Frank Brown

Chairman
iN2015 Digital Media
& Entertainment
Sub-Committee

Director
Colorzip SEA Pte Ltd

"With a robust infrastructure, high-speed connectivity and strong intellectual property rights regime, together with its strategic geographic location, Singapore is well-positioned to take advantage of the tremendous growth opportunities offered by the digital media and entertainment space."

Mr Willie Cheng

Chairman
iN2015 Infocomm
Infrastructure,
Services and Technology
Sub-Committee

Chairman
Singapore Science Centre

"Ten years ago, many of us were satisfied with corresponding via physical mail, or searching for information using library catalogues or encyclopedias. Ten years ago, less than one in ten of us had a mobile phone and even fewer of us subscribed to access the Internet. Clearly, infocomm has fundamentally changed and differentiated the way Singapore lives, works, plays and learns today. It will continue to do so in the future. But only if we plan ahead, put in place the right environment and equip ourselves with the right competencies and mindset. This is why iN2015 is timely."

Ms Chong Chiet Ping

Chairman
iN2015 Manufacturing
& Logistics
Sub-Committee

Senior Vice-President
Global Operations
Asia Pacific & Japan
Hewlett-Packard
Asia Pacific Pte Ltd

"In this intensely competitive world, infocomm is key in providing a seamless and virtual connection of the physical, financial and information flows that will propel Singapore's drive towards a highly integrated supply chain nerve centre and high-end manufacturing hub. iN2015 allows us to envision new ways of deploying infocomm towards this end."

Mr Ho Meng Kit

Deputy Secretary (ICM)
Ministry of Information,
Communications & the Arts

"iN2015 is not only about enhancing economic competitiveness. It is also about how infocomm can be embraced to create a more inclusive society and to enrich the lives of every individual in Singapore. This includes not just the tech-savvy amongst us, but also those of us who are currently less comfortable or have less access to technology, including the elderly, needy and persons with disabilities."

Mr Lee Kwok Cheong

Chairman
iN2015 Infocomm Manpower Development Sub-Committee
(Infocomm Competency Council – ICC)

President
Singapore Computer Society

Chief Executive Officer
Singapore Institute of Management

"While infocomm usage becomes more pervasive, it is highly likely to go from being merely utilitarian to becoming a valuable differentiating factor to help an organisation stand-out in an increasingly competitive world, if used efficiently. And for this to happen, we need people who are able to see infocomm systems as one piece of an organisation's overall business strategy. People who can create, adapt, even actively embrace, the opportunities to do things better and faster using infocomm innovations. People capable of designing infocomm tools to enhance an organisation's ability to meet its current and future targets."

Ms Leong Wai Leng

Chairman
iN2015 Tourism, Hospitality and Retail Sub-Committee

Deputy Chief Executive Officer
Raffles Holdings Ltd

and concurrently
Chief Executive Officer
Raffles International Ltd
(until 31 Oct 2005)

"Infocomm can create new possibilities in the tourism, hospitality and retail sector, particularly in the key areas of improving vistors' and customers' experiences, and enhancing the competitiveness of the sector. It is timely to embark on a long term plan to embrace and realise the possibilities that technology can offer."

Mr Lim Hup Seng

Chairman
iGov2010, Project Steering Committee

Deputy Secretary (Performance)
Ministry of Finance

"Capitalising on our strong foundation, we are now moving on to the next phase of our journey – to be an "Integrated Government" (iGov) that will deliver an even higher level of service that will delight our customers and connect our citizens.

Under this phase, we will focus on reviewing our current business and operating models, and to make changes that will significantly raise our level of service to customers, by leveraging infocomm technologies and best practices."

Mr Stephen Lim

Chairman
iN2015 Enterprise Development For Singapore-based Infocomm Companies Sub-Committee

Chairman
Singapore infocomm Technology Federation

Chief Executive Officer & Managing Director
SQL View Pte Ltd

"Singapore's infocomm industry is ready for the next leap; to be innovators and creators of infocomm products and services. iN2015 is a timely master plan conceived by Government and Industry. It will also require the same partnership, in brains and hearts, to realise this bold vision. Let's embrace the journey with agility, gusto and passion and realise the incredible returns in the next decade."

Mr Jackson Tai

Chairman
iN2015 Financial Services Sub-Committee

Vice Chairman & Chief Executive Officer
DBS Group Holdings & DBS Bank

"Singapore as a financial centre is suddenly at the crossroads of a resurgent China and India; it is the new hub for Asian capital flows. Against this background, it is imperative that Singapore firmly establish itself as a trusted gateway to a new, emerging Asia, and as a showcase for innovative financial services. iN2015 presents a framework for leveraging Singapore's thriving infocomm to ensure Singapore's prospects in the financial markets and at the crossroads of Asia."

Mrs Tan Ching Yee

Chairman
iN2015 Education & Learning Sub-Committee

Second Permanent Secretary
Ministry of Education

"We need to start from young, to develop the habits of lifelong learning, re-learning, unlearning, and to acquire new competencies and mindsets. Infocomm is a strategic enabler in making the learning experience an engaging and fulfilling one. We will build upon our strong infocomm foundations, make our educational institutions showcases of exemplary infocomm usage, and create a virtuous cycle of widespread usage, industry innovations and new export opportunities. iN2015 is our blueprint to realise our vision for the Education and Learning sector."

Professor Tan Chorh Chuan

Chairman
iN2015 Healthcare & Biomedical Sciences Sub-Committee

Provost and Deputy President
Professor of Medicine
National University of Singapore

"Infocomm has tremendous potential to facilitate improvements in the healthcare sector. Applications like the personal e-health record will make it much easier for each individual to proactively manage his health, while electronic medical records will enable healthcare providers to ensure well-integrated and quality care. In addition, well-linked and comprehensive medical records can greatly facilitate clinical research that results in improved medical care. iN2015 will be a significant effort towards realising these benefits for our healthcare system."

Executive Summary

An Intelligent Nation, a Global City, powered by Infocomm.

In this vision of Singapore in 2015, infocomm will be harnessed extensively to enable:

- **Innovation**: The capacity to create, whether it is a new item or a new way of doing something, will have to be a key differentiating capability of Singapore's economy of the future. Infocomm can play a big role in pointing the way to fresh, exciting possibilities and be an essential aid in realising them. Singapore's infocomm enterprises and talent, together with a first-class infocomm infrastructure, can support and enable innovation in all the country's economic sectors and society;

- **Integration**: Success in the future will depend on the ability to harness resources and capabilities across diverse organisations and geographies, speedily and efficiently. Here, infocomm can provide the bridge within organisations and businesses, and between individuals, sectors, communities and geographies; and

- **Internationalisation**: As a small country, Singapore needs to be well plugged into the globalised economy. Infocomm will be crucial in making this possible, facilitating access to the world's resources, and opening doors for the export of the country's best ideas, products, services, companies and talent.

In so doing, the Steering Committee behind iN2015 hopes to enrich Singaporeans' lives, enhance the country's economic competitiveness and boost the growth of the infocomm industry here.

Through iN2015, the Committee aspires to achieve these targets for Singapore:

#1 in the world in harnessing infocomm to add value to the economy and society

2-fold increase in value-added of infocomm industry to S$26 billion

3-fold increase in infocomm export revenue to S$60 billion

80,000 additional jobs

90% of homes using broadband

100% computer ownership in homes with school-going children

Beyond these lofty targets though, what does iN2015 mean for each individual and business?

In Singapore's 2015, imagine when visiting the doctor means staying at home and where learning can truly take place beyond the classroom, at each individual's own pace, place and time.

In 2015, imagine a business environment where working overtime does not mean working late; where you never forget a business contact, and where speed of execution is taken for granted.

In 2015, imagine a Singapore that is the location chosen by global infocomm businesses, due to an unparalleled quality of business environment, infocomm infrastructure and manpower here.

These are just some of the possibilities.

The iN2015 vision is based on anticipated social needs, as well as the economic goals of Singapore's key sectors. By converging these needs with the knowledge that computing, storage and bandwidth will become increasingly affordable, the Committee proposes four strategic thrusts to realise this vision. They are:

- Spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of infocomm;
- Establish an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure;
- Develop a globally competitive infocomm industry; and
- Develop an infocomm-savvy workforce and globally competitive infocomm manpower.

Spearhead the Transformation of Key Economic Sectors, Government and Society through more Sophisticated and Innovative Use of Infocomm

The Committee recognises that infocomm alone will not be sufficient to transform the country's economic sectors. Neither will infocomm on its own change mindsets on how integration can yield benefits, how new opportunities can be realised by accessing international markets, or the extent to which service quality can be raised in an industry. However, infocomm can be a critical enabler in achieving all of these.

Under iN2015, the transformation of seven key economic sectors, including the government sector, will be enabled through a set of initiatives:

- In the **Digital Media and Entertainment** sector, the Committee proposes to establish Singapore as a key player on the global stage and to draw high value-added media and entertainment activities to the island. To make this possible, a Digital Assets Marketplace programme has been recommended. The infrastructure and services needed for the development of services to hub and trade digital assets for various distribution platforms will be put in place. This marketplace will be one important piece of the country's broader national efforts to jumpstart the interactive and digital media sector.

- Using infocomm, the **Education and Learning** sector seeks to deliver a more engaging learning experience to meet the diverse needs of learners. Here, the EdVantage programme seeks to make the dream of "classrooms without walls" a reality. This includes providing each student with a personalised infocomm device, to serve as a doorway to textbooks, lessons and projects and catalysing the development of learning applications and content. This will be supported by a seamless and pervasive broadband infrastructure.

- Programmes in the **Financial Services** sector aim to transform Singapore into a trusted gateway to Asia and an innovative hub for financial services through infocomm. Among them is the use of infocomm for front-end fulfilment of wealth management services and for straight-through processing.

- Under the iGov2010 action plan, more personalised **Government** services will be implemented across a wider range of access channels, in particular the mobile platform. Another key effort will be to implement a standard infocomm operating environment across the entire public sector. This will allow the sector to reap substantial cost savings, improve productivity and facilitate inter-agency and inter-personal collaboration.

- The proposed programmes in the **Healthcare and Biomedical Sciences** sector aim to transform every patient's experience and the delivery of healthcare services, making them more personalised and integrated. One initiative, the Health Information Exchange, will enable the exchange of healthcare data across healthcare providers, offering doctors a holistic view of each patient's medical needs. Another, the Integrated Healthcare Continuum, will enable patients with chronic diseases to manage their health at home, assisted by technology.

- Building on Singapore's reputation as a logistics and manufacturing hub, programmes in the **Manufacturing and Logistics** sector will focus on using infocomm to entrench Singapore's position as a high-value manufacturing hub and a supply chain nerve centre. Initiatives include setting up the TradeXchange – a platform for all trade documentation and new value-added services for the trading and logistics community.

- Infocomm will also be used to improve the experience of visitors to Singapore before, during and after their trip, and enhance the growth and competitiveness of the **Tourism, Hospitality and Retail** sector. The main focus is the Digital Concierge Programme. This will allow visitors to access personalised, location-based information and carry out transactions on-demand, anytime, and anywhere. The Committee also recommends other initiatives to boost the sector's efficiency and productivity through the use of technology to integrate supply chains.

Apart from boosting Singapore's economic competitiveness, infocomm will be used to enrich the lives of every individual here. One programme "Infocomm for the Community", is being set up specifically to raise the infocomm literacy of society. It includes teaching the elderly such basics as text messaging and instant messaging, so that they can be plugged into the communications channels that their children and grandchildren use. Another, NeuPC, will provide computers and internet connections to children who cannot afford it. The target is to achieve 100 per cent computer penetration in households with school-going children by year 2015.

So be it new ways of learning, more convenient access to healthcare and government services, or simply, a richer, more immersive entertainment experience, the new conveniences envisioned will be readily accessible by all in Singapore.

All these efforts will be supported by national-level initiatives identified by the Committee in three areas – *infocomm infrastructure, infocomm enterprises* and *infocomm manpower*.

Singapore's infocomm infrastructure will be substantially upgraded to enable the online delivery of a whole new generation of services and applications and possibilities unimaginable today.

The infocomm competency of the general workforce and capabilities of our infocomm manpower will be critical factors in Singapore's ability to implement and harness the benefits of technology.

The presence of globally competitive infocomm enterprises will be necessary, not only to attract quality infocomm manpower, but also to accelerate the spread of technology diffusion in the rest of the economy.

Establish an Ultra-high Speed, Pervasive, Intelligent and Trusted Infocomm Infrastructure

Here, the Committee has proposed two focus areas – one related to the development of the next-generation infrastructure and another targeted at encouraging new applications and services delivered by the new infrastructure. Both are critical.

A next-generation infrastructure opens up a whole new world of economic and social possibilities for Singapore and entrenches our position as a leading infocomm nation. Conversely, without a next-generation infrastructure, Singapore is constrained in what can be done to enhance our lives and improve the country's competitiveness. But infrastructure alone is insufficient. Without an environment that encourages new and innovative applications, this next-generation infrastructure will merely deliver incremental improvements to this generation's services and applications.

In the area of infrastructure, the Committee recommends the development of a next-generation National Infocomm Infrastructure (NII) that is *ultra-high speed, pervasive, intelligent and trusted*.

It will comprise wired and wireless complementary networks that are accessible everywhere on the island. The target is to achieve over 90 per cent household broadband internet penetration. And it will provide individuals with speeds of gigabits per second in every home, school and business and megabit speeds wirelessly elsewhere on the island.

To enable the creation of entirely new applications and services, nation-wide enabling platforms, policies and standards in the areas of identity, security, privacy, location, payment and inter-operability will also be established.

The planned network will enable and accelerate many of the new capabilities envisioned for Singapore's economic sectors.

In the Education and Learning sector, for instance, learners – both adults and children – will be ble to access multimedia information, video-conferencing and new learning resources anywhere, beyond classrooms and lecture halls. Using their personalised devices, they will also be able to customise their learning to the pace they want, whenever they want and wherever they are.

In the second area of focus, the Committee has recommended the creation of an environment for the innovation, commercialisation and export of new applications and services.

Besides developing policies and manpower to ensure the flourishing of new services, the Committee has proposed the creation of physical testbeds and showcases in areas such as downtown Singapore and Fusionopolis[1].

Besides facilitating the creation of new applications and services, the creation of new business models such as the provision of infocomm resources like computing, storage and software on-demand, will also be encouraged.

Develop a Globally Competitive Infocomm Industry

In the area of infocomm enterprises, iN2015 will focus on enhancing the competitiveness of the infocomm industry.

The Committee recommends that this be achieved through creating *depth* in capability, as well as *diversity* in the infocomm industry structure. The Committee believes that greater depth will come through a focus on infocomm solutions as well as greater access to intellectual property, while diversity will be made possible through nurturing more local enterprises and attracting a pool of infocomm technopreneurs.

These focus areas were proposed in light of current trends.

While the infocomm industry has shown healthy growth over the years, the industry today is dependent on a few major players – less than two per cent of infocomm local enterprises earn more than $500 million in total operating receipts[2], while around 96.5 per cent earn under $50 million each.

In addition, there is also a heavy concentration on more "downstream" activities such as system integration, marketing, distribution and support.

To achieve greater depth and diversity in the industry, these strategies have been proposed:

- Strengthen the development of the industry's domain and technology capabilities
- Embark on a concerted international branding and marketing of "Made-by-Singapore" infocomm products and services
- Nurture the expansion and growth of local infocomm enterprises
- Develop sectoral solutions for export
- Attract and nurture a vibrant pool of infocomm technopreneurs and start-ups

Develop an Infocomm-savvy Workforce and Globally Competitive Infocomm Manpower

Quality infocomm manpower will be critical to realising the desired results of the previous three strategic thrusts outlined. In the area of manpower, the Committee proposes a focus on raising the infocomm competencies of the general workforce and developing globally competitive infocomm manpower.

1 To be ready by mid-2007, Fusionopolis is a uniquely designed development in Singapore featuring a work-live-play-learn environment that serves as a vibrant hub for research, technology, media and business.

2 Total operating receipts comprise end-user sales in Singapore, original equipment manufacturer (OEM) sales, other reseller sales in Singapore and export sales.

These efforts will be critical to the successful harnessing of infocomm in the key economic sectors, as well as to the growth of local infocomm enterprises. The strategies proposed here are to:

- Develop an infocomm-savvy workforce and business leaders who can innovatively and strategically use infocomm technologies to sharpen their economic competitiveness;

- Develop globally competitive infocomm techno-strategists with the necessary domain and technology depth, and a critical pool of infocomm technologists, to create and exploit infocomm intellectual property; and

- Build a pipeline of professionals for the industry. This will be done by attracting top talent locally and from abroad, and nurturing the best and brightest students to take up infocomm as a career.

Conclusion

Taken together, the proposed four strategic thrusts seek to enable Singapore to achieve the earlier articulated top-line goals.

For Singapore to achieve its first target of being the global leader in exploiting infocomm to add value to its economic sectors and society, deliberate and concerted efforts in transforming the economy must be undertaken. As mentioned, one strategic thrust puts in place the necessary sector-specific infocomm infrastructure, policies and programmes needed to make this transformation happen. This alone is however inadequate, if the underlying national infrastructure is unable to deliver the needed next-generation capabilities. Neither can it do so if the country's workforce is not trained with the right infocomm skills and if infocomm enterprises here are not equipped with the right capabilities to deliver what the sectors demand. This is why the other three strategic thrusts are equally critical for the country to successfully exploit infocomm for its economy and society.

For the infocomm industry to realise its second target of doubling its value-added to $26 billion and the third target of tripling its infocomm export revenue to $60 billion, the industry needs to deliver products which not just stand out, but ones which will also yield higher margins and greater volumes through exports.

This explains the Committee's emphasis on building enterprise depth to create more differentiated products, as well as on internationalisation to drive greater revenues.

But these targets will not be achievable without a pool of competent infocomm manpower. We expect to boost the number of infocomm jobs and supporting jobs in infocomm industry substantially by 80,000.

And finally, to ensure that every household is a part of this iN2015 vision, programmes to ensure digital inclusion will reach out to every household in society, with a target of 100 per cent computer ownership in households with school-going children and 90 per cent household broadband usage in the country.

The iN2015 vision paints a picture of what Singapore will look like in 2015, taking into account the Committee's knowledge of infocomm developments and the country's anticipated economic and social needs.

The Committee acknowledges that some of the assumptions may not hold over time, just as the needs of individuals and businesses here may change. In ten years' time, technology could be different from what has been anticipated today. How proactively Singapore manages this change will determine how much brighter this vision will be, and indeed, how much sooner the scenarios articulated in this vision will be achieved.

The Committee invites all readers – individuals, businesses and the international audience – to be part of this ongoing process of managing change. Each reader is invited to shape the iN2015 vision, in the same way each helped to shape the starting points contained in this report.

Only then, can Singapore realise its vision of being "An Intelligent Nation, a Global City, powered by Infocomm".

CHAPTER 1
VISION

An Intelligent Nation, a Global City, powered by Infocomm.

In this vision of 2015, the Committee believes that infocomm will play a critical role in enabling Singapore's growth, in both the economic and social spheres. The key initiatives and programmes recommended are organised along three themes: *innovation, integration and internationalisation*.

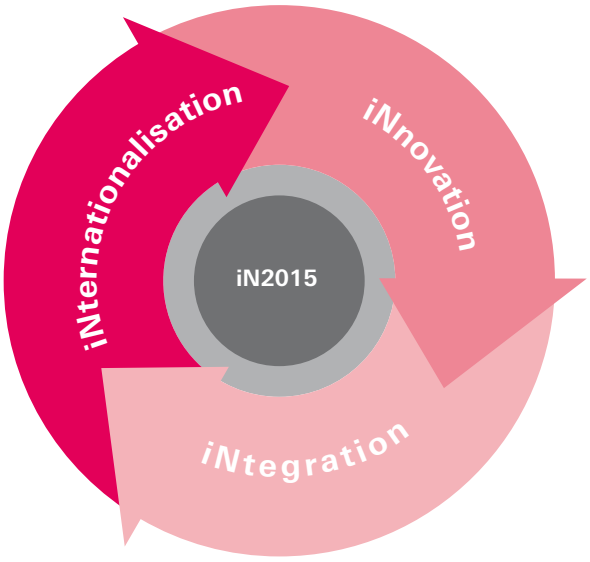


Figure 1-1: Key themes of iN2015

Innovation

By 2015, Singapore's capacity to innovate will be the key differentiator of the country's economy. A major factor behind that will be its use of infocomm. A first-class infocomm infrastructure, infocomm industry[3] and talent will be needed to support and enable innovation in the economic sectors and throughout society.

Infocomm will, for instance, enable new ways of learning anytime, anywhere, through personalised devices and wireless access. It will remove the boundaries that surround the delivery of healthcare now, allowing doctors to access holistic and updated records of each of their patients. At the same time, health information will be tailored to each individual based on his or her health situation.

Beyond innovative usage, creation of new intellectual property will also be a key focus for the country's infocomm enterprises and talent.

In this globalised economy, Singapore, with its limited talent and other resources, will not just concentrate on activities such as system integration or sales and marketing. Instead, its infocomm businesses and professionals will stride up the innovation curve, to provide new intellectual property and solutions.

3 Throughout this report, the term "infocomm industry" is used to refer to enterprises that engage in the following main categories of activities (a) wholesale of infocomm products such as telecommunication equipment; computer equipment, hardware and software; office equipment etc; (b) retail sale of infocomm products; (c) telecommunication services; (d) computer and IT services; and (e) content services. Activities pertaining to the manufacturing of infocomm products are not included.

Integration

Success in the future will depend on the ability to harness resources and capabilities across diverse organisations and geographies, speedily and efficiently. Infocomm will be the bridge within organisations and businesses, and between individuals, sectors, communities and geographies.

By integrating processes within the industry, businesses will become more efficient; new processes will also be made possible. For instance, the planned digital Health Information Exchange will integrate patient records that are currently fragmented among public and private health practitioners. With complete knowledge of patients' medical history, doctors will be able to provide better medical advice and care.

Infocomm will also link up different components of the production chain, whether in manufacturing or retail, so businesses are able to develop more effective supply chain processes, which can lead to cheaper products and shorter time-to-market for new products. Trade processes now available on various platforms, will also be brought together on a single platform, to smoothen trade flows and maintain Singapore's position as a leading global trade and logistics hub.

By integrating across industries, infocomm will allow the emergence of new services. For instance, the Digital Media and Entertainment as well as the Education sectors can then come together to develop interactive and immersive learning content. By combining a myriad of services and types of information across industries, from retail to hospitality to immigration, a personalised digital concierge service can provide visitors and residents with the data they want and the ability to transact using any device.

Apart from its obvious economic benefits, such integration will also spell convenience for individuals. By integrating information and processes at its back-end, for instance, the Government can deliver personalised, proactive e-services to citizens. Citizens will also be able to access these services through the most expedient ways for them – mobile phone, PC or some other next-generation device.

Internationalisation

As a small country, Singapore needs to be well plugged into this globalised economy. Infocomm will be vital in enabling this. In the process, it will facilitate the country's access to global resources, and open doors for the export of Singapore's best ideas, products, services, companies and talent.

While infocomm turns many services into virtual ones, trust, reliability as well as ready access to a supportive ecosystem, infrastructure and talent will continue to be as important as in physical services. And because Singapore can offer all these, the country can well aspire to be an important centre in this digitally-enabled globalised economy.

Infocomm can, for instance, help Singapore become a global hub for the trading of digital media content and services. It can also boost Singapore's standing as a supply chain nerve centre for logistics.

Infocomm exports by the country's enterprises will offer additional sources of revenue. Overseas networks will be strengthened to help local companies sell their products overseas, while the international marketing and branding of "Made-by-Singapore" infocomm solutions will create stronger recognition for these products.

Key sectoral expertise and solutions will be exported too. And there are many. They include education content and the Republic's highly-acclaimed e-Government solutions and experience.

iN2015 Key Goals

The intentions for iN2015 are threefold – to enrich lives, enhance economic competitiveness and increase the growth of the infocomm industry.

In aspiring to this, the Committee recommends that Singapore aim for these targets:

#1 in the world in harnessing infocomm to add value to the economy and society

2-fold increase in value-added of infocomm industry to S$26 billion

3-fold increase in infocomm export revenue to S$60 billion

80,000 additional jobs

90% of homes using broadband

100% computer ownership in homes with school-going children

Beyond these macro-economic targets, what will iN2015 mean for each of us, as an individual or business in Singapore?

"Half the time we're doing lessons outside the classroom. And we've got all these new classmates too. Do you know they're not even in Singapore? I'm working on a project now with girls from India, Finland and the US. It's easy! All we have to do is go to this learning portal and we can all touch base there. We leave messages for each other. Sometimes I pick up their messages in school, sometimes at home. Wherever I feel like it, because we can use broadband everywhere now. It's like you're not going to school.

The portal is pretty cool. It allows you to get information from all over. Once I got some stuff from the Smithsonian library in the US. And guess what, we don't have to carry books to school anymore. You just carry this thing called a Personalised Learning Device. Everything is there. Your Maths books, your English books, whatever. My teacher sends me notes and stuff on it also. And guess what – I can download music on it too, like those gadgets my big sis used to have. It's so cool!"

– **Renee**, 10, Primary School Student

Beyond broadband to the school, home and business, to broadband to the individual...

By 2015, gigabits broadband networks will be accessible by everyone in Singapore. Everyone here will have pervasive broadband connections through a combination of wireless and wired high-speed technologies. Singapore will tap on these networks to allow true global collaboration for individuals to work, live, play and learn.

...and from multiple devices to one gadget

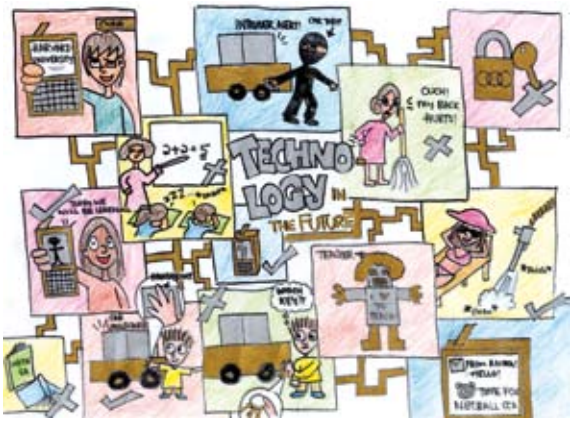
Already, a number of personal devices, such as personal music players, are equipped with memory capacities that exceed that of the old personal computers. Some new smart phones are multi-modal, capable of accessing different networks including cellular, Wi-Fi and short-range wireless. By 2015, devices with both multi-modal technologies and large amounts of data storage will become more pervasive and affordable. Singaporean students like Renee will only need one device for their communication, edu-tainment and computing needs.

IMAGINE A WORLD WHERE GOING FOR CLASSES DOES NOT MEAN GOING TO SCHOOL

LEARNING THAT IS TRULY GLOBAL…

"Sungei Buloh Nature Reserve and other nature reserves have always been popular excursion destinations for many schools. However, there is always a problem – students are not observant enough to spot the teeny insects or those agile and well-camouflaged animals. These inconveniences, in the near future, will be solved with the use of technology. A special scanner connected to a palm-sized computer will be able to find these animals and insects. The computer will process the information to determine the species of the animal."

– **Wang Liang Yau**, Tampines Junior College, 1st prize winner of Secondary/Pre-University category in the Express IT! iN2015 competition



– **Cassandra Sim**, 12, Parry Primary School

...to be done anytime, anywhere.

This drawing of how individuals are expected to benefit from infocomm in 2015, was one of thousands of entries submitted by individuals in Singapore to the Express IT! iN2015 competition on "How Technology can help me Work, Learn, Live and Play."

Among other things, Cassandra's effort depicts how students will move beyond learning in the classroom to accessing information from all over the world. Youngsters here will not only get material from abroad, students in other countries will also be able to access Made-by-Singapore content. And instead of lugging a stack of textbooks to school, students will tote just an all-in-one learning device, which will contain curriculum material.

"I used to forget my insulin injections now and then. I'd only realise I hadn't had one when I became dizzy. But I've got a small device now which I wear. It monitors my blood sugar levels. Some kind of sensor technology, they tell me.

If my insulin levels are too low, it remedies it. It transmits readings of my sugar levels daily to the Health Information Exchange. That's a sort of system where all our medical records can be accessed by authorised doctors. Amazing isn't it?

Anyway, if there're any abnormalities, my GP is buzzed. If necessary, he adjusts my medication.

I hardly need to see him with all this. Saves me so much time and taxi fare!"

– **Khatijah binte Abdullah**, 50, Diabetic

Beyond provider-centred services to user-centred services...

By 2015, many services will be centred around the user and personalised. In healthcare for example, authorised public and private healthcare providers in Singapore will be able to gain access to one consistent view of a patient's medical record. An individual will have access to his own records, as well as obtain information relevant to his or her health. For example, a diabetic patient will be presented with information relevant to diet, medication and exercise for diabetic patients on his or her "health portal".

IMAGINE YOUR LIFE WHEN VISITING THE DOCTOR MEANS STAYING AT HOME

IMAGINE A WORLD WHERE PERSONAL SECRETARIES ARE NO LONGER JUST FOR OUR BOSSES

"This is my fourth visit to Singapore for my check-up.

Like before, this visit has been excellent so far. My Digital Concierge obtained our visas, made my medical appointments at the hospital and, when we wanted to attend a concert at the Esplanade, guided us there. This is the only place where public and private sector services are truly integrated!

Each individual in Singapore also has a Digital Concierge, which can offer him all the personalised information he needs."

– **Ron Brown**, 59, Tourist

Beyond user-friendly to intelligent infocomm

By 2015, augmented reality and human interface tourist applications will be made possible with improvements in human-computer interaction technologies, such as multi-lingual text-to-speech and speech-to-text. Human Computer Interaction is one of the areas of research being focused on by the Interactive and Digital Media sector.

Using the payment, identification and location-enabling services made possible by the National Infocomm Infrastructure, health tourists such as Ron Brown, as well as Singaporeans, can obtain what they want to know through a personal Digital Concierge. This service, offering information on everything a Singaporean or visitor needs, will be accessible anytime, anywhere and on any device.

"What everyone in Singapore needs is a Personal Secretary… Appointments and bookings are done in the background, reminders are timely and useful, and everything runs like clockwork. Also, the secretary fits in the boss' needs and requirements so the boss has his existing lifestyle enhanced. Now this Personal Secretary will be embedded on a mobile device, similar to our handphones today. It can also be embedded in items like watches and possibly even spectacles… Beyond the basic task of booking lunch at the owner's favourite restaurant, the Personal Secretary should have enough intelligence to suggest alternatives that suit the owner's requirements, as well as personal preferences."

– **Chia Siak Yan, Vincent**, 2nd prize winner of Open category in the Express IT! iN2015 competition

A PERSONAL DIGITAL SECRETARY FOR EVERY SINGAPOREAN

IMAGINE YOUR WORLD WHERE WORKING OVERTIME DOES NOT MEAN WORKING TILL LATE

"Infocomm has redefined the meaning of work. My Digital Concierge does half the work for me. Well… almost! It takes over my routine office chores, so I can do much more! It arranges my appointments, makes the room bookings, records everything that takes place at work and reminds me of what I need to follow-up on. Instead of spending time setting up meetings or scribbling notes at the meeting, I can focus on coming up with new ideas and actually implementing them."

– **Dawn Tan**, 29, Assistant Vice-President, Bank

Beyond 'user-inputs' to 'intelligent data collection and mining'

By 2015, the cost of computing and storage will be extremely affordable. When this happens, business users can free themselves from the routine tasks of note-taking, meeting-scheduling and even task-scheduling. In the same way that we use personal devices as a "memory" tool for marking our appointments today, by 2015, it is foreseeable that our entire day can be recorded if we so choose to. An intelligent agent will sift through the "transcript" of the day, to process relevant information such as tasks at hand, appointments to be made and perhaps even new faces that we meet. Any action-items, such as arranging for follow-up meetings of our choosing, will then be dealt with by the same agent.

"From product conceptualisation to sales, the time to market for our Made-by-Singapore products is shorter than that of our other development hubs elsewhere. We take this for granted in Singapore. This is primarily due to a more efficient product development cycle. On the one hand, we are now doing collaborative product design over a manufacturing grid instead of needing to fly back to corporate headquarters. On the other, we have complete visibility over all our suppliers' shipments into Singapore, so we know how to manage our bottlenecks and adjust our production lines accordingly."

– **Alex Lim**, 34, Supply Chain Specialist, Manufacturing Company

Beyond a physical hub to an international supply chain nerve centre

By 2015, developments in grid computing – the integration of computing resources of many separate computers – will result in more cost-efficient, flexible and dynamic intra- and inter-organisational collaborative applications. Radio Frequency Identification (RFID) and other sensor technologies are also expected to become more widely deployed to assist in the tracking of logistics flows globally.

These, together with Singapore's existing world-class IT logistics infrastructure and the planned next-generation National Infocomm Infrastructure, will help realise a more seamless integration of logistics processes. This will in turn help Singapore realise its vision of an integrated supply-chain nerve centre. New services, such as trade financing, will also be introduced to make finance, information and trade flow even more seamless.

IMAGINE A BUSINESS ENVIRONMENT WHERE SPEED IS A GIVEN

IMAGINE A WORLD WHERE BUSINESS SUCCESS COMES FROM MORE THAN JUST LISTENING TO YOUR CUSTOMERS

"We used to do a great job of giving our local customers what they asked for. We were great system integrators. But that's all we were then. We now offer solutions to the underlying problems that organisations face, not just the ones they want us to sort out. It was a terrific decision to change. It has extended our customer base from the 4 million in Singapore to the 6.5 billion globally. Our company has been recognised as one of the leading innovators in the world. Our brand is now the top one in sectoral business applications."

– **John Tan**, 39, (PhD. in Computer Science and Biomedical Sciences), Infocomm Solutions Specialist, Singapore Infocomm Company

Beyond domestically-focused infocomm enterprises to global infocomm leaders...

The Committee proposes a focus on developing an infocomm industry with *depth* and *diversity*. This means encouraging infocomm enterprises to create and acquire intellectual property (depth) and having them engage in a spread of infocomm activities that go beyond the current activities of systems integration, sales, marketing and support (diversity). To illustrate, Singapore's award-winning e-Government applications can help open doors for exportable new products and solutions from Singapore companies. There will also be a national branding and marketing programme to advertise these "Made-by-Singapore" infocomm products and services.

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...and beyond technical specialists to "techno-strategists" and technopreneurs

To support those goals, enterprises will need a special breed of infocomm professionals – "techno-strategists" who have a strong grasp and understanding of infocomm technologies as well as business knowledge of various industries. Singapore will work to develop such expertise, continue to attract them, as well as build an environment that facilitates the country's access to global infocomm talent. Singapore will also attract aspiring foreign technopreneurs to use the island as a development and engineering centre for their business ventures, and as an operations hub for penetrating international markets.

CHAPTER 2
SETTING THE CONTEXT

Building Success from Success

Infocomm is relevant only if it addresses a need. Singapore's success in the area of infocomm over the past 25 years has come about due to a close alignment of infocomm capabilities with the needs of the economy and society.

Since the 1980s, Singapore has formulated and implemented national infocomm masterplans that have resulted in infocomm manpower development, increased infocomm awareness and literacy of the populace and businesses. Coordinated efforts arising from the masterplans, have also resulted in improved domestic and international infocomm infrastructure and connectivity, marked efficiencies in government agencies, as well as dramatic business transformation.

National Plans	Strategic Objectives	Outcomes
The National Computerisation Plan (1980 – 1985)	Computerise the Civil Service, facilitate the development and growth of a local IT industry and develop a pool of IT manpower to meet the needs of the industry	• Government computerised • Computer software and services industry grew 10-fold in revenue • IT manpower pool grew from 850 to 5,500
The National IT Plan (1986 – 1991)	Extend government systems to private sector through electronic data interchange networks	• TradeNet, MediNet, LawNet successfully deployed. TradeNet was a network for the trading, shipping and freight forwarding community, LawNet for the legal community and MediNet for the healthcare community
IT2000 (1992 – 1999)	Transform Singapore into an "Intelligent island"	• Nationwide deployment of Singapore ONE • Policy framework for e-commerce (Electronic Transactions Act) put in place • CORENET (for construction industry), common digital library catalogue (for public libraries), among other sectoral applications implemented
Infocomm 21 (2000 – 2003)	Establish infocomm as a key sector of growth, boost competitiveness of businesses and enhance quality of life through infocomm	• Telecommunications market fully liberalised • Domestic and international infocomm connectivity increased • First e-Government Action Plan launched

National Plans	Strategic Objectives	Outcomes
Connected Singapore (2003 – 2006)	Enable individuals, organisations and businesses to become more efficient and productive, through infocomm; create and realise new possibilities by bringing together the power of computing, communications and content	• Information harnessed in key sectors like logistics, manufacturing, retail and education for further development of the sectors • e-Government Action Plan II launched

Figure 2-1: Singapore's Infocomm Journey over 25 years
Source: National Computer Board, IDA

In all the previous infocomm masterplans, the concept of "Infocomm Unlimited" – infocomm as a tool to drive limitless possibilities in our economy and society – has remained an ever-green and underpinning goal.

As the next national initiative to transform Singapore's businesses and lives using infocomm, iN2015 is also closely linked to numerous developments happening today at the national and sectoral levels.

At the national level, Singapore aspires to be a vibrant, global city that is a centre for knowledge, talent, and business. A country which is full of life, energy and excitement. A city where people want to live, work, learn and play. An innovative and trusted hub for the international community.

Infocomm can play a pivotal role in making this national vision a reality.

Today, it is very much part our lives. Many of us use it without consciously paying attention to it. But more can be done to use technology to help us become more creative and to enjoy life. By removing the tedium of routine work, for example, people will have more time to dream up the new and the different.

Besides making a difference to the individual, infocomm can also be a key asset in remaking Singapore into the global city envisioned. It has the ability to fashion the economy into something more resilient and dynamic. By helping the Republic build up its human capital. By retooling Singaporeans and businesses to help them compete in the global marketplace. By fostering innovation and enterprise, as well as research and development.

Creating a Vibrant, Global City

"In Singapore, we have embarked on a challenging enterprise – to build a vibrant global city that is a centre for knowledge, talent, and business. We have every prospect of succeeding. We have the drive and talent, the ability to adapt to change, and the resolve to meet and overcome challenges. Our workers, employers and the Government have forged a strong tripartite partnership. Internationally we have a trusted brand name, and a reputation for integrity, quality and reliability."

- Prime Minister and Finance Minister, Lee Hsien Loong, in his 2006 Budget speech

Infocomm as a Critical Enabler in a Knowledge-based Economy

Infocomm is an important element in the nation's overall innovation and Research and Development (R&D) agenda. To underline the importance of R&D to Singapore, the Government recently announced a $13.5 billion programme, the Science and Technology 2010 Plan (S&T 2010)[4] which lays out the R&D directions for Singapore over the next five years. iN2015 will draw on the S&T 2010 Plan to generate industry-relevant research findings as inputs to the masterplan.

The S&T 2010 plan outlines the national R&D framework to implement the strategic thrusts to drive the economic transformation of Singapore into a research-driven knowledge-intensive economy. The framework is organised along three tracks: $7.5 billion is allocated to the Ministry of Trade and Industry (MTI) to drive the mission-oriented research, $5 billion is allocated to the newly established National Research Foundation (NRF) to fund longer term strategic programmes and $1.05 billion is allocated to the Ministry of Education (MOE) for academic and investigator-led research.

MTI in turn, funds the Economic Development Board (EDB) and the Agency for Science, Technology and Research (A*STAR). EDB's mission is to create sustainable economic growth and business opportunities in Singapore. As part of this role, EDB promotes private sector R&D by attracting multinationals to locate R&D centres and corporate R&D activities in Singapore. A*STAR supports about 12 Research Institutes (RI) of which five are directly or indirectly related to infocomm. Their R&D projects are mapped to Singapore's main science-driven industry clusters to ensure that the technology, expertise and infrastructure developed are relevant to the industry.

The NRF was set up on 1 January 2006 as a new department under the Prime Minister's Office, to implement the main strategic R&D thrusts, provide a coherent strategic overview and direction of R&D at the national level, and allocate funding to longer term strategic R&D programmes.

Part of MOE's funding goes to two of the local universities, the National University of Singapore (NUS) and the Nanyang Technological University (NTU). They are transforming themselves from merely being primarily "teaching" institutions to "research intensive" institutions and will play a key role in building up the R&D manpower base for Singapore. Their focus is on longer-term research aligned with Singapore's strategic directions.

Besides public sector investments in R&D, there is also increasing R&D investments in the private sector. More than 7,000 multinationals have a presence in Singapore, and many of them have started to go beyond manufacturing to also set up R&D centres here. Their investments into research, together with that of the public sector amounts to a gross expenditure in R&D (GERD) that puts Singapore in a comparable position with other developed nations today. The same can be said of the number of research scientists and engineers (RSE) per 10,000 people here.

Country	GERD/GDP (%)	Year
Sweden	3.98	2003
Finland	3.49	2003
Japan	3.15	2003
South Korea	2.64	2003
US	2.60	2003
Denmark	2.53	2002
Singapore	**2.25**	**2004**
Netherlands	1.80	2002

Figure 2-2: GERD as a % of GDP
Information source: OECD Main Science and Technology Indicators, 2005

Country	FTE per 10,000 labour force	Year
Finland	159	2003
Sweden	106	2003
Japan	101	2003
Singapore	**98**[5]	**2004**
US	91	2002
Denmark	90	2003
South Korea	66	2003
Netherlands	45	2003

Figure 2-3: Number of researchers (Full Time Equivalent) per 10,000 labour force
Information source: OECD Main Science and Technology Indicators, 2005

4 Science & Technology 2010 Plan, www.mti.gov.sg
5 In 2004, there were 87 RSEs per 10k labour force. To allow for international comparison, "researchers" (FTE) is used instead of "RSEs". "Researchers" includes degree and non-degree R&D personnel, and post-graduate students, while "RSEs" includes only degree R&D personnel.

Infocomm Propels Innovation and R&D in Singapore

As the result of growing R&D efforts in the infocomm space, Singapore enjoys the highest ratio of infocomm-related patents to total patents, compared to any other economy in the world.

In February 2006, the Organisation for Economic Co-operation and Development (OECD) attributed this high ratio, which it also found in South Korea, Finland and the Netherlands, to the presence of several electronics and telecommunication giants here.

In conjunction with initiatives under the national Science and Technology 2010 (S&T 2010) masterplan, iN2015 will work to further infocomm innovations in Singapore. This includes deepening the technical expertise of private infocomm companies based here.

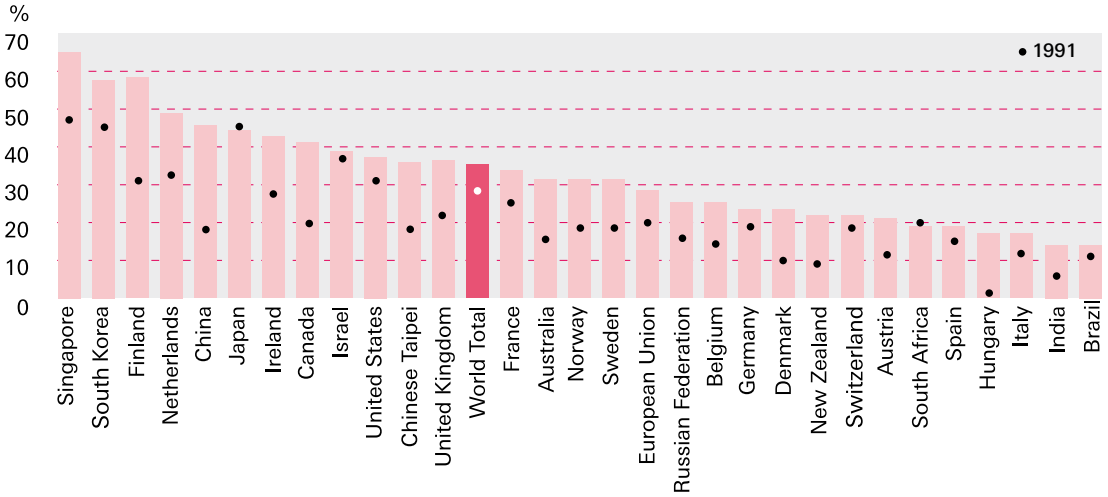

Figure 2-4: ICT-related patents as a percentage of the national total (European Patent Office): selected economies, 2002
Source: OECD, Patent Database, December 2005.

World-class R&D activities and capabilities are being further developed in both the public and private sectors in Singapore.

For instance, the Institute for Infocomm Research (I^2R), one of A*STAR's research institutes, is globally recognized for its high standard of research. In one of its projects on wireless personal area networks (WPANs) the team outperformed the Institute of Electrical and Electronics Engineers (IEEE) existing standard (802.15.4) by a factor of six. After undergoing a vigorous scrutiny process by the IEEE standards body, the design has been adopted by IEEE as a new wireless standard (802.15.4b).

Another example is the graduate education and research collaboration between NUS, NTU and the Massachusetts Institute of Technology (MIT) which aims to lift the knowledge and experience of Singapore graduates, researchers and the Singapore R&D community closer to the US standard, which ranks amongst the top in the world's R&D rankings.

Similar collaborations have been established with major research laboratories in Europe such as the Centre National de la Recherche Scientifique of France. On top of that, the universities here are attracting top academics and researchers from US, Europe and China to come and work here.

The private sector has been as active in research. Hewlett-Packard (HP) for instance, is researching and developing its next-generation Itanium processor-based Integrity servers in Singapore. The Asia Pacific Integrity Server Research & Development Center is part of HP's global strategy to build up a leadership position in a $32 billion global market currently served by RISC processors.

Motorola also has an R&D contingent of about 350 engineers stationed at its Singapore Design Centre (Mobile Devices), their Global Software Group-Singapore and the IC Design Center.

This keen interest in R&D will enable Singapore to do more than just exploit new technology trends – the Republic will also be among the parties that shape and create the technological breakthroughs.

Infocomm in Remaking the Economy

Besides taking into account the role of infocomm in Singapore's innovation and R&D agenda, iN2015 also sets out to ensure that infocomm is fully used to help remake the economy. In this respect, iN2015 has been drawn up in close alignment with a number of existing sectoral plans. Each of these plans paints a vision and objectives for a particular sector. Building on these, iN2015 outlines how infocomm can help these sectors achieve their long-term objectives.

Other Singapore National Plans	Area of Focus	Strategic Objectives
Media 21	Media & Entertainment	To develop Singapore as Asia's leading media marketplace and financing hub, producing high-quality content and building digital media capabilities.
IT in Education Masterplan	Education & Learning	To use IT pervasively and effectively to enhance educational process and structures.
Library 2010	Education & Learning	To bring the world's knowledge to Singapore and to create a positive social and economic impact.
Tourism 2015	Tourism	To strengthen Singapore's position as a leading convention and exhibition city in Asia, with a strong and dynamic business environment. To develop the country as a leading Asian destination for leisure by providing an enriching experience that is Uniquely Singapore. To establish the Republic as the place in Asia where visitors come to enjoy high-end quality services, such as healthcare and education.
Retail 21	Retail	To grow and expand the retail sector in Singapore. Under Retail 21, four strategic thrusts have been formulated to upgrade the retail sector as follows: to re-invent the retail sector, raise retail standards, enhance retail efficiency and manage the restructuring of the HDB retail sub-sector.
Manufacturing 2018	Manufacturing	To widen Singapore's lead in supply-chain management, strengthen the manufacturing ecosystem, deepen the manufacturing culture and skills, expand Singapore's reach as a hub in this area, grow emerging areas and intensify technology and innovation development.

Figure 2-5: National masterplans covering other sectors

Infocomm in Singapore Today

Infocomm Usage in the Economy and Society

The promise of infocomm in remaking the Singapore economy and in enhancing the lives of Singaporeans, is premised on the fact that infocomm matters today and will matter tomorrow.

In Singapore, infocomm certainly does matter. It has been used not only to enrich people's lives but also as a strategic enabler for businesses. For four years running, Singapore has maintained its position in the top three ranked economies in the World Economic Forum's Global Information Technology Report. Singapore's standing points to its ability to harness infocomm to effectively enhance the efficiency of businesses and to boost living standards.

Rank	2002 – 2003	2003 – 2004	2004 – 2005	2005 – 2006
1	Finland	US	**Singapore**	US
2	US	**Singapore**	Iceland	**Singapore**
3	**Singapore**	Finland	Finland	Denmark
4	Sweden	Sweden	Denmark	Iceland
5	Iceland	Denmark	US	Finland
6	Canada	Canada	Sweden	Canada
7	UK	Switzerland	Hong Kong	Taiwan
8	Denmark	Norway	Japan	Sweden

Figure 2-6: Rankings in Global Information Technology Report
Information source: World Economic Forum Global Information Technology Reports

In 2005, Singapore's fifth ranking in the World Economic Forum's Global Competitiveness Index was also strongly bolstered by its number one position in the Index's Technology Readiness component. Other international accolades received in the infocomm arena include:

- Ranked top two in Asia in the EIU e-Readiness Rankings 2001-2006[6]
- Ranked top three in the Accenture Annual e-Government Rankings 2000 -2005[7]

Singapore's infocomm achievements are a result of conscientious planning and the successful implementation of national infocomm policies and initiatives over 25 years.

Throughout these years, the availability of a world-class infocomm infrastructure, infocomm enterprises and infocomm manpower has been critical to Singapore's ability to harness the benefits of infocomm.

6 Economic Intelligence Unit
7 Accenture e-Government Overall Maturity Scores

Infocomm Infrastructure

Since 2000, the Singapore ONE initiative has provided nation-wide broadband access over Asymmetric Digital Subscriber Line (ADSL) and cable to households in Singapore.

Over the years, with full liberalisation of the telecommunications market resulting in greater competition, consumers and business have been enjoying higher-speed broadband and even more competitively-priced broadband services. For example, the percentage of households with broadband has risen steadily from 7 per cent in December 2000 to 54 per cent in March 2006. Figure 2-7 shows the growth of household broadband penetration between 2000 and 2005.

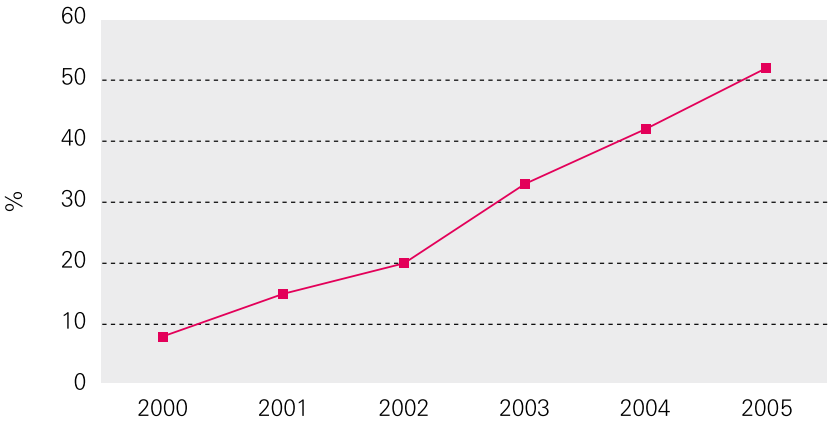

Figure 2-7: Singapore's household broadband penetration rate (as at December of respective years)
Source: IDA

Singapore's broadband penetration is one of the highest in the world, behind only a small number of economies such as South Korea and Hong Kong.

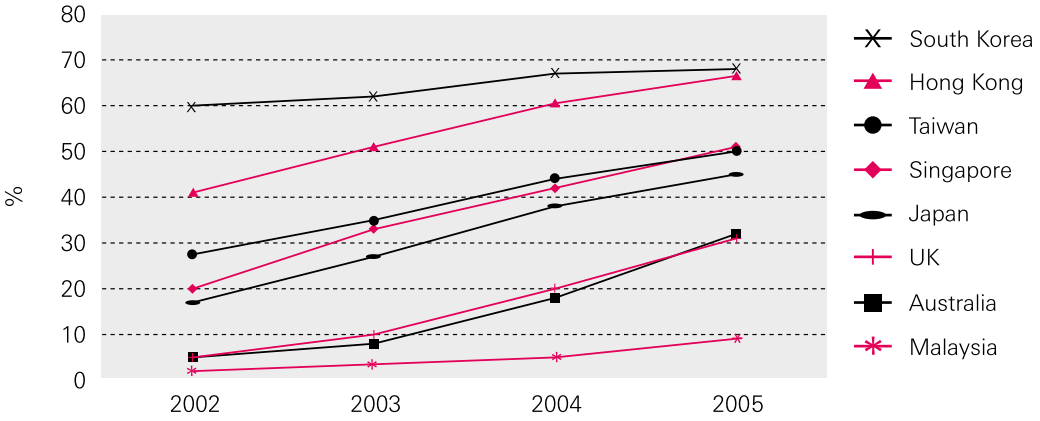

Figure 2-8: Household broadband penetration in selected economies from 2002 to 2005 (as at December of respective years)
Information source: IDC

Complementing this wired broadband market is a fast-growing mobile communications market. The segment has always been a vibrant one with almost every individual having a mobile phone subscription. In the month of March 2006 alone, mobile phone users here sent 866 million Short Message Service (SMS) messages or an average of seven messages per subscriber per day[8].

Since 2005, commercial 3G services have been offered by all three mobile service providers in Singapore. As of March 2006, there were 317,600 3G subscribers[9]. They make up 7 per cent of the population. IT research agency Frost & Sullivan forecasts that the number of 3G subscribers here would cross the one million mark by 2008[10].

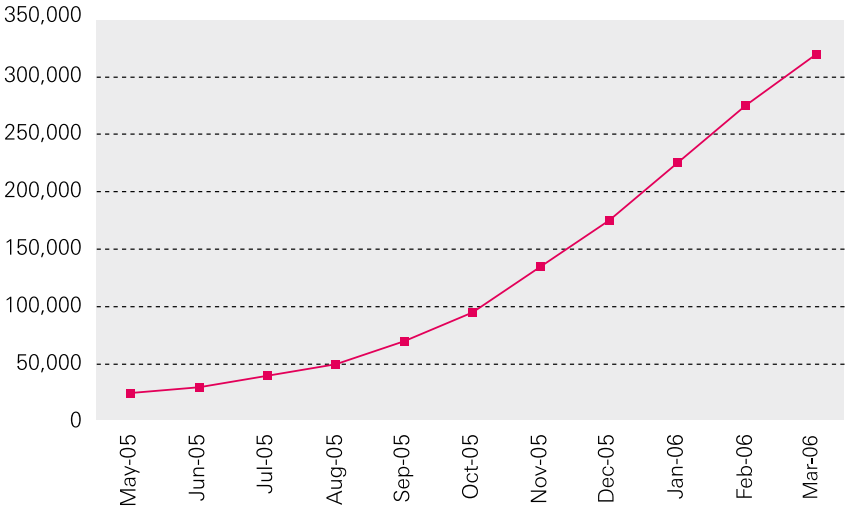

Figure 2-9: 3G Subscriptions growth in Singapore
Source: IDA

In the area of broadband wireless, Singapore had about 830 public wireless local area network (WLAN) locations at the end of 2005, or about 1 hotspot per square kilometre[11]. This makes it the Asian economy with the highest concentration of public hotspots on a per square kilometre basis.

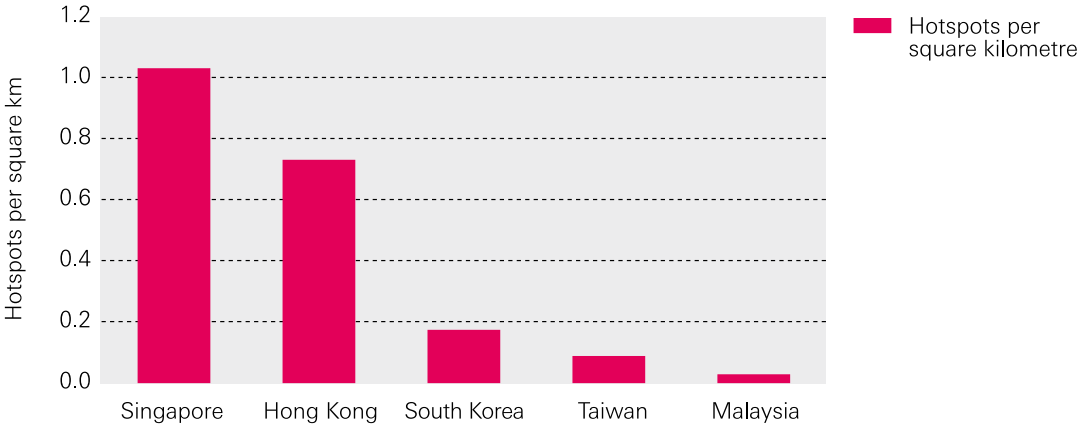

Figure 2-10: Hotspots density (at end 2005)
Information source: IDC, Asian Development Bank

Beyond wireless local-area network technologies, Singapore has already started exploring alternative forms of wireless broadband technologies that can provide further broadband coverage.

In 2005, the IDA auctioned spectrum in the 2.3GHz and 2.5GHz bands for the specific purpose of promoting the deployment of wireless broadband access (WBA) networks. Six successful bidders – Inter-touch Holdings, MobileOne, Pacific Internet Corporation, QALA Singapore, SingTel and StarHub – acquired spectrum for the purpose of WBA.

A few bidders have already begun trials or commercial offerings. For instance, in January 2006, MobileOne started a technical trial to test a mixed configuration of the pervasive Wi-Fi technology (based on 802.11) in the front-end. This was in turn supported by pre-Worldwide Inter-operability for Microwave Access (WiMAX) in the backhaul.

9 IDA
10 "3G Subscriber base seen doubling". Straits Times, 16 January 2006.
11 "Asia/Pacific (Excluding Japan) Hotspot LAN Equipment 2006-2010 Forecast and Analysis", IDC, March 2006

In February 2006, QMax – a joint venture between QALA Singapore and Creative Technology, became the first company to launch a pre-WiMAX commercial service here.

Singapore's infocomm infrastructure serves more than the domestic needs of individuals and businesses. Its quality has been an increasingly important factor for multi-nationals choosing to set up in the country.

Today, more than 7,000 multi-nationals have operations in Singapore, of which, over 60 per cent of them leverage on Singapore's international infocomm connectivity to conduct some form of regional or global operations from here. With a total submarine cable capacity of 28 Terabits per second (Tbps) connecting Singapore to the rest of the world, the Republic is today one of the most connected cities in Asia.

Country	Lit (Gbps)	Max (Gpbs)
Japan	2,280	29,750
Singapore	**1,161**	**27,971**
South Korea	1,020	20,450
Taiwan	960	16,770
Hong Kong	890	17,490

Figure 2-11: Submarine cable capacity (lit and maximum) of selected Asia Pacific economies, May 2006
Source: TeleGeography Research, © PriMetrica, Inc. 2006

Infocomm Enterprises

Apart from being an enabler for the rest of the economy, infocomm as an industry has also grown to be an important contributor to Singapore's GDP.

Latest estimates from the Department of Statistics show that the industry value-added was $12.6 billion, accounting for 6.5 per cent of Singapore's GDP in 2005. Between 2000 and 2005, the Compound Annual Growth Rate (CAGR) of the infocomm industry value-added (7.8 per cent) was almost double the CAGR of Singapore's GDP (4.0 per cent).

The total revenue of Singapore's infocomm industry reached $37.89 billion[12] in 2005. This was a nine per cent rise over 2004's infocomm revenue of $34.77 billion.

Consistent with the trend of previous years, the export market (58 per cent) in 2005 continued to contribute a bigger share of the total infocomm industry revenue than the domestic market (42 per cent). The export market registered a healthy growth of about 11 per cent in 2005, compared to 6 per cent growth in the domestic market.

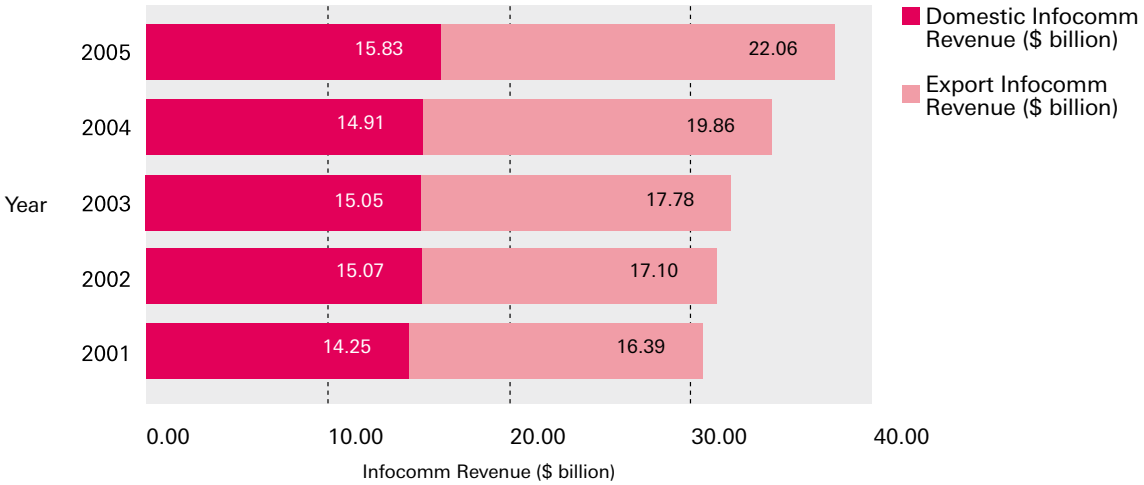

Figure 2-12: Domestic and export infocomm revenues 2001 – 2005
Source: IDA

12 "Annual Survey on Infocomm Industry for 2005", IDA.

Infocomm Manpower

Infocomm manpower, comprising persons engaged primarily in infocomm-related work in infocomm organisations as well as in end-user organisations, is also contributing significantly to the economy. To illustrate, the value-added per worker in the infocomm industry is almost one and a half times that of the services sector[13].

Between 2001 and 2005, the number of infocomm jobs went up by ten per cent, from 106,700 to 117,100. This was despite strong competition from the rising infocomm powerhouses of China and India.

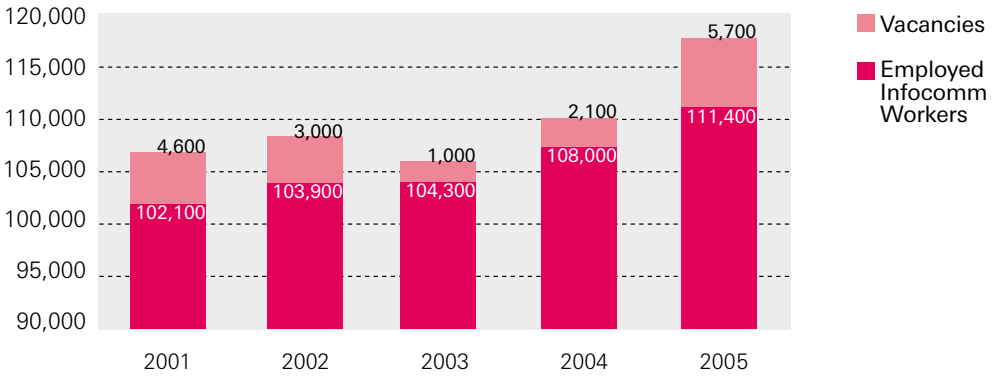

Figure 2-13: Total infocomm jobs
Source: Annual Survey on Infocomm Manpower for 2005, IDA

The resilience of Singapore's infocomm workforce is further underscored by its strengths: the workers are young but experienced, well-qualified, and have exposure to business domains and the global market. In 2005, more than 80 per cent were tertiary educated[14] and more than 70 per cent were below 40 years of age[15].

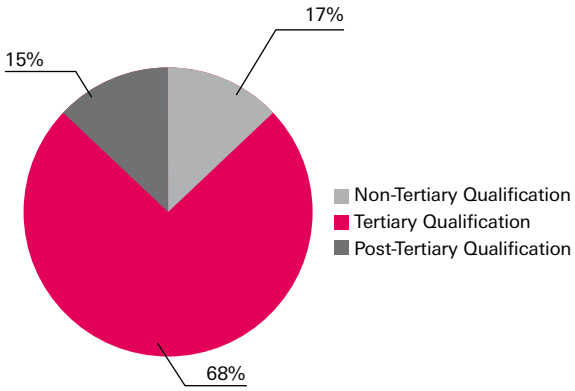

Figure 2-14: Education profile of infocomm manpower (2005)
Source: Annual Survey on Infocomm Manpower for 2005, IDA

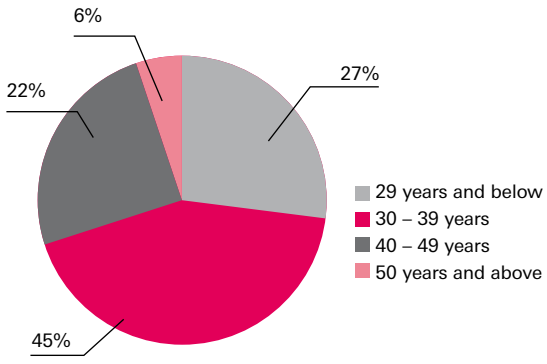

Figure 2-15: Age profile of infocomm manpower (2005)
Source: Annual Survey on Infocomm Manpower for 2005, IDA

13 In 2003, the value-added per infocomm worker was $116,000 compared with the average of $80,882 for the Services sector. (Source: Department of Statistics)
14 Tertiary educated persons include diploma and degree holders.
15 In comparison, about 30 per cent of the employed labour force in Singapore is tertiary-educated, and about 50 per cent is below 40 years of age.

About 50 per cent of the infocomm workforce work in companies that are users of infocomm. A significant proportion is in wholesale and retail, and financial services, a reflection of infocomm's contribution to Singapore's hub status in trade and finance.

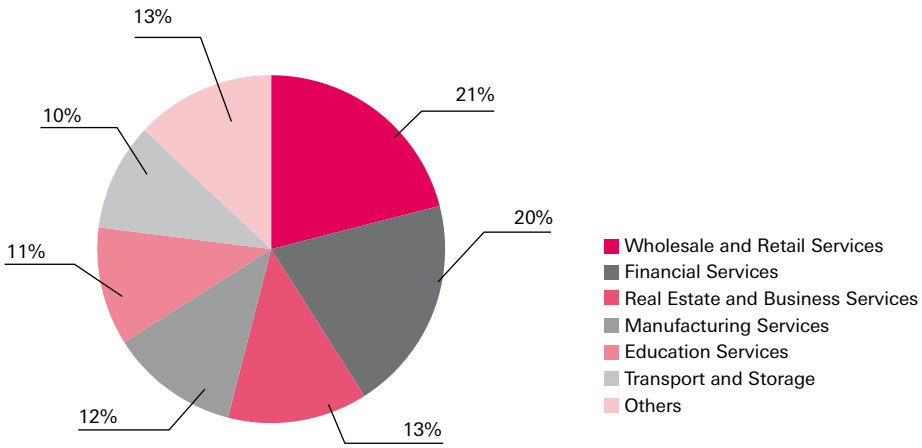

Figure 2-16: Distribution of infocomm manpower in end-user organisations (2005)
Source: Annual Survey on Infocomm Manpower for 2005, IDA

Technology Trends towards 2015

Singapore's willingness to invest in infocomm infrastructure and its ability to leverage on technology has helped power the country into becoming one of the world's most competitive nations. While this is a cause for celebration, it also underlines the need to keep up the momentum. iN2015, which outlines how Singapore can maintain its edge, is therefore timely and critical.

As in the drawing up of previous masterplans, the Committee made a number of assumptions about technology developments so that the iN2015 vision could be truly forward-looking.

Traditionally, developments have been forecast based on a handful of infocomm technology "laws":

- Moore's Law – where computing power doubles every 18 to 24 months
- Disk Law – where storage doubles every 12 months
- Fibre Law – where communications doubles every nine months
- Metcalfe's Law – where the value of a network increases by the square of the number of devices connected to it
- Community Law – where content increases by 2^x, with x being the number of people

Based on these laws, the Committee foresees three infocomm revolutions – the communications, computing and sentient waves. Each is expected to play a critical role in the realisation of the iN2015 vision.

Communications Wave

Over the years, society has embraced communication technologies such as the telephone, mobile phone and the Internet, with each new technology being adopted faster than the one before.

Communications systems in Singapore today, such as the Public Switch Telephone Network (PSTN), GSM cellular networks, public Wi-Fi hotspots and broadband DSL have served the Republic well. However, as each was independently developed to serve a specific need, seamless inter-working across these networks is difficult. This means that a user currently has to carry many devices and maintain different log-in identities as he traverses across various networks.

This situation is expected to change over the next ten years. Instead of a specific end-user device for each access network, future devices and networks will become more versatile. They will be able to negotiate the most appropriate protocols and access the most suitable system available, without any user intervention. So instead of toting multiple devices for communications, entertainment and business, and juggling multiple user identities and passwords, the user will need just one converged device.

The communications infrastructure itself will undergo a major transformation. Today's disparate communications systems will be unified by a common fibre-based backbone infrastructure. Each fibre will be capable of supporting multiple wavelength channels for virtually unlimited bandwidth. Combined with the Internet Protocol (IP), this advanced infrastructure will link Singapore to all major population centres of the world to make it a truly globally-connected city.

Computing Wave

Developments in computing have transformed room-sized mainframe computers to the present-day personal computer (PC). As the size of computers shrank, so did their cost, making computers affordable to the general public.

Other computing innovations are expected to make the same quantum leap in the next ten years. One such example is Google Earth, a virtual globe programme that can be downloaded free-of-charge. This highly popular application maps the entire earth by pasting images obtained from satellite imagery, aerial photography and Geographical Information System (GIS). It is one of the first next-generation Internet applications to be based on Web 2.0 technologies. This technology, which allows for fast and easy development of new applications, is expected to fuel an explosion of new, innovative applications over the next few years.

Other emerging technologies being developed in universities and research laboratories include grid computing and intelligent software agents. By aggregating resources over many separate computers connected by a network (usually the Internet), grid computing will make it easier to solve large-scale computation problems. Intelligent software agents will also simplify lives by acting with some degree of autonomy to accomplish tasks on a user's behalf.

Computing Grids and Utility IT infrastructures are also expected to become a reality by 2015. These will enable computing and software to be delivered as a utility or service, much like water and electricity today. This is expected to bring down software and services prices, and make pay-per-use business models more widespread. SalesForce.com, a leading web-based customer management service, is an early example of this. By providing sales force and marketing automation, as well as customer service applications on-demand, this service improves companies' productivity and increases their revenue. Its on-demand nature means that companies need not invest in heavy IT infrastructure and manpower to build and maintain these solutions in-house.

On the user device front, computing hardware has faithfully followed Moore's law over the last 20 years. Boosted by nanotechnology, computing power is likely to continue advancing at impressive rates. This is likely to shrink the physical size of computer platforms significantly by 2015. So much so that what is now available on a desktop will be available on a device small enough to be worn by a person.

Indeed, the transformation is expected to be so dramatic that FISTERA[16], a European thematic think tank that explores the key factors driving the Information Society Technology (IST), predicts that the PC as we know it will "disappear" by the end of the decade. Instead, it will be embedded in everyday objects such as cars and watches.

This means that we will have at our fingertips a walking office, databank, software and entertainment centre – anywhere and anytime.

Sentient Wave

While the computing wave makes computers more affordable for the masses and the communications wave brings greater network connectivity, the sentient wave promises more intelligent systems and devices. These applications will be able to collect information about their surroundings and context, and make judgments accordingly.

Used together with the Internet, for example, they would be able to analyse the growing amount of information online, and synthesise and present it such that the user gets only what he wants.

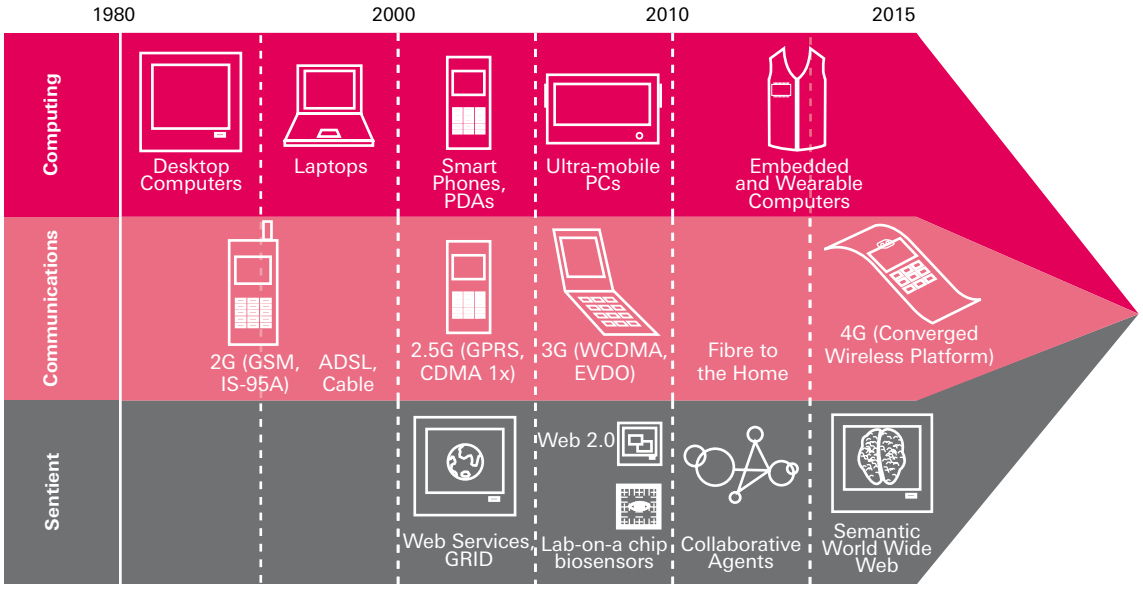

Figure 2-17: The Three Waves of Evolution – Communications, Computing and Sentient
Source: Infocomm Technology Roadmap 5, IDA, 2005

16 FISTERA (Foresight on Information Society Technologies in the European Research Area)

In addition to these three waves of technology change, the confluence of info-, nano-, and bio-technologies will dramatically hasten the pace of change.

The three waves will have a profound effect on our daily life. They will transform how we live our lives and how we do business. Here are some possibilities:

- **From broadband to the home to broadband to the person**. In the next decade, the race is not just broadband penetration but how pervasively one has access to broadband. It will be technologically possible for an individual to experience true broadband connectivity in parks and even on public transport.

- **From entry-level broadband, which is at or above 256 kbps, to real broadband, which is 10 Mbps or more**. As applications get more sophisticated and consumers' expectations grow, 256 kbps will no longer be sufficient. Applications such as peer-to-peer-based services like BitTorrent, and multi-party video conferencing can easily consume much more than 256 kbps. Real broadband will see the quality of visuals on TV improve beyond high definition TV, to even experiencing immersive 3D holographic TV.

- **From a collection of static content on a web page to a world of rich and immersive media**. Computer games have already morphed from single player, standalone console games to multi-media online versions involving thousands of players. Next-generation game consoles are all designed to be connected to the Internet. By 2015, expect a proliferation of interactive digital TV shows, where consumers can purchase items they see in a movie, bet and determine the outcome of a drama.

- **From information pull to information push**. The Internet has transformed the world from being a place where information was scarce to one where there is an onslaught of information. But, towards 2015, powerful search engines such as Google, coupled with personalisation technologies such as Amazon's shopping agent will usher in the sentient era. These personalisation technologies help keep track of an individual's shopping preferences and use this information to assist in future purchases, for instance, by offering relevant alternatives. In this world, software agents will have the potential to offer concierge services – cocooning the individual from the masses of information in cyberspace and delivering only that which is pertinent to the query at hand. They will also have the capability to take over mundane routine tasks, freeing you to concentrate on matters worth your attention.

- **From an Internet where identity theft, phishing and e-mail spam lurk to one that can be trusted and is secure**. One of the barriers holding back widespread adoption of the Internet for commercial transactions is concern about security on the worldwide web. The emergence of a secure Internet can result in booming e-business.

CHAPTER 3
REALISING THE VISION

Taking into account the state of infocomm today, as well as technology trends, the Committee has proposed four strategic thrusts to drive Singapore's ability to innovate, integrate and internationalise with the help of infocomm. As shown in Figure 3-1 below, these proposed thrusts are intended to help Singapore realise the iN2015 vision of "An Intelligent Nation, a Global City, powered by Infocomm".

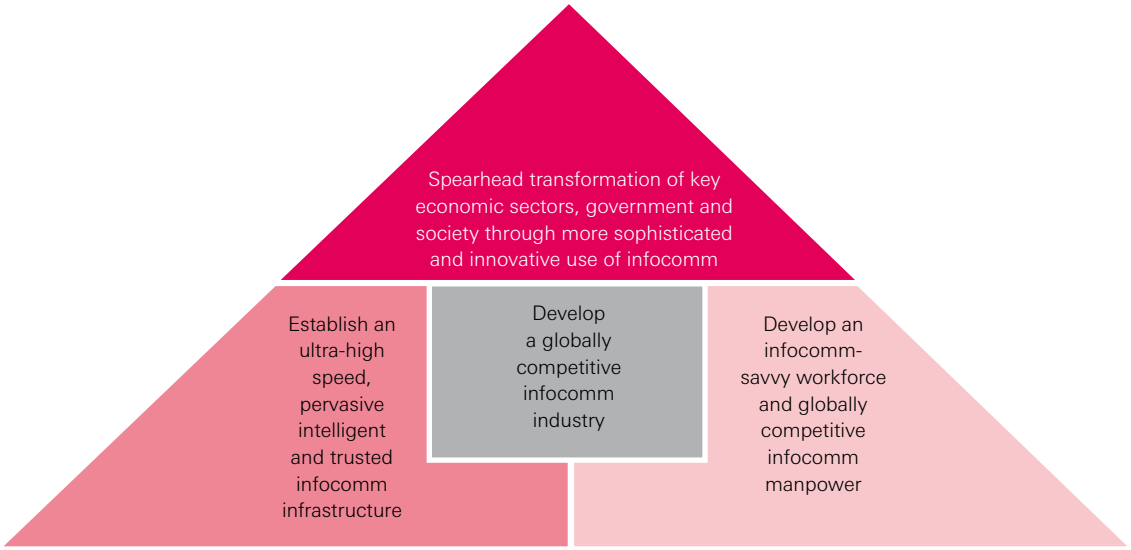

Figure 3-1: iN2015 Strategic Thrusts

At the very heart of iN2015 is the use of infocomm to *transform Singapore's key economic sectors, government and society*. By 2015, Singapore's competitive advantage from infocomm will no longer be derived solely from the country's ability to use it as a productivity tool. In an increasingly global economy with diverse specialisations, infocomm will be instrumental in enabling cross-sector and cross-border collaborations.

Infocomm will also play a critical role in Singapore's national innovation agenda. Beyond today's proven infocomm-enabled innovations such as self check-ins, e-ticketing and e-commerce, we are only constrained by our own imaginations of what we can do with falling costs of computing, storage and communications.

In addition, infocomm can help to bring customer-centricity to a new level, by enabling delivery of truly personalised services to every individual and business.

Apart from boosting the country's economic competitiveness, infocomm will also be used as a key enabler to enrich the life of every individual in Singapore.

These efforts will in turn, be supported by national-level initiatives identified by the Committee in the three areas of *infocomm infrastructure*, *enterprises and manpower*.

An easily-accessible and reliable national infocomm infrastructure has become as essential as highways, seaports and airports to economies. With more services delivered online, key economic sectors will increasingly rely on this infrastructure for the functioning of their businesses.

The second enabler, a globally competitive *infocomm industry* is essential to raise the diffusion and level of investment in infocomm here significantly. Several factors account for this: Firstly, the infocomm industry is by itself a heavy investor and user of infocomm technologies. Secondly, a competitive infocomm industry will boost the adoption and exploitation of infocomm by the economy, by providing the necessary expertise to co-create solutions that meet business requirements. Finally, having a competitive infocomm industry also helps generate the skills and competencies needed to drive sophisticated infocomm usage in the rest of the economy.

The third and final enabler is related to *infocomm manpower*. The need for infocomm-savvy workers is increasing in every sector, be it healthcare, retail, manufacturing, education or the biomedical sciences. Already a large proportion of jobs require the ability to handle large amounts of data and a basic familiarity with infocomm technology. But soon, today's level of infocomm knowledge will not be sufficient as Singapore and the rest of the world become increasingly reliant on technology.

At the same time, the infocomm industry itself in Singapore, and indeed, elsewhere around the world, is increasingly reliant on a broader spectrum of competencies. From research, architecting, providing solutions, software coding and development, to marketing and sales, infocomm companies are tapping expertise, sometimes from different parts of the world, to bring an infocomm solution to market. Singapore's infocomm manpower thus needs to ensure its relevance in the context of this global reality.

The four iN2015 strategic thrusts are elaborated in the following sections.

Strategic Thrust 1

Establish an Ultra-high Speed, Pervasive, Intelligent and Trusted Infocomm Infrastructure

An ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure. This is the Infocomm Infrastructure, Services and Technology Development Sub-Committee's vision for 2015.

This infrastructure will provide individuals with access at gigabits speed which are far beyond the megabits speed we are accustomed to in our homes and offices today.

It will deliver broadband to *anyone*, *anywhere*, and *anytime*. In the Education and Learning sector, for instance, learners – both adults and students – will be able to access multimedia information, video-conferencing and new learning resources anywhere, beyond classrooms and lecture halls. Using their personalised devices, students will be able to customise their learning, at their own pace, over broadband networks.

This new infrastructure will deliver real-time sensor-based information, *integrated from multiple sources*, beyond the data that we receive from *individual sources* today. Ever wondered if you would have been better off taking an alternative route when you find yourself in a traffic jam? Imagine what you could do with live traffic and road situation information, petrol-pricing, weather and Electronic Road Pricing information updated real-time to your car. You will literally be able to ask for the best dynamic route as you drive, based on pricing and/or time. Or have you ever wondered which nearby carpark would have the most available lots and offer you the cheapest rates based on your anticipated parking duration? Imagine what an intelligent infrastructure can do for you.

Beyond being intelligent, Singapore's new infocomm infrastructure will continue to be *trusted*. This will be one of Singapore's key differentiators because Singapore has built an important position as a trusted hub over the years, which others will find hard to emulate overnight. And trust is increasingly important for businesses to offer services online, both locally and internationally, and for consumers to want to carry out transactions in this new digitally-enabled economy.

A trusted infrastructure, for example, is necessary for the personalised healthcare delivery system envisioned by the iN2015 Healthcare and Biomedical Sciences Sub-Committee. It will make individuals more receptive to having their authorised healthcare providers update as well as access their personal health records online. By having an updated and holistic view of each patient's medical history, healthcare providers can in turn tailor care paths specific to each patient's conditions, needs and preferences.

This trusted next-generation network will also allow sectors in the economy, digital media companies, for instance, to collaborate on and share content more effortlessly with other companies in and outside Singapore.

	Today	Imagine your world in 2015 with...
Speed	High-speed (megabits per second)	Ultra-high speed (gigabits per second[17])
Reach	Broadband to premises (such as homes, schools and offices)	Seamless broadband to anyone, anywhere, anytime
Intelligence	Stand-alone data from individual sources	Real-time, sensor-based, integrated information from multiple sources
Trust frameworks	Organisation-centric	National and global

Figure 3-2: Vision of Infocomm Infrastructure in 2015

What will Singapore in 2015 be like with this next-generation infocomm infrastructure?

The Sub-Committee envisions that over 90 per cent of the country's households and business with over 10 employees will be using broadband. To these households and businesses, the new infrastructure will enable them to do tasks better and faster. As importantly, it will enable new applications and services.

Innovating with Higher Speeds

"Beyond just giving a huge boost to net access speeds, a high speed network means consumers can expect new services, such as Internet-Protocol (IP) based high-definition television. A wider array of tiered broadband access packages to cater to different consumers and business segments, high-quality video conferencing and Internet-based calls are amongst other (new possibilities) that the new network would bring... (From a business perspective) the availability of a high-speed network to power activities such as biomedical research, video rendering and transmission, as well as data storage and backup will undoubtedly boost Singapore's status as a regional hub."

– excerpt from "Boost for business, boon for consumers", The Business Times, 2 March 2006

Besides learning beyond classrooms, collaboration in digital media production and personalised healthcare services, Singapore's infocomm infrastructure of 2015 will also enable more trusted shared services in the financial sector, computing-intensive applications for design and modelling in the manufacturing sector, or simply, downloads and sharing of bandwidth intensive music videos and online games for the joy of entertainment on-the-go. So while infocomm infrastructure will not be the only driving force for sectoral transformation in the economy, it will certainly form the basis for some of these transformations to take place by 2015.

17 1 Gigabit = 1,000 megabits

While the primary beneficiaries of this infrastructure will be Singapore-based individuals and businesses, the opportunities created will not be solely domestic.

It will be in Singapore's best interests to adopt international standards where available, and to harmonise Singapore's policies and accreditation standards with best practices around the world.

International alignment will ensure that new services developed on this infrastructure are of world-class standards. After all, for Singapore to be a global trusted hub, its security standards, policies and manpower accreditation standards will have to be on par with the best in the world. This level of assurance will be necessary for the Republic to attract the high-value activities of international banks, digital media companies and other enterprises.

At the same time, international alignment will help ensure that new services developed on this next-generation infrastructure are easily exportable. To this end, programmes will be put in place to assist Singapore-based as well as foreign companies to use Singapore as a test-bed and subsequently, a global launch-pad for new value-added services. Be it services in education, entertainment, healthcare, finance, or infocomm services such as cyber-threat monitoring services, Singapore can become the location of choice for the export of next-generation *infocomm-enabled* as well as *infocomm* services.

To realise this next-generation infrastructure over the next decade, the Sub-Committee has proposed two strategies. One is related to the development of the next-generation *infrastructure*, while the other aims to encourage the creation of new *applications and services*. Both are critical. With today's infrastructure, Singapore is constrained by the realities of what can be done to enhance our lives and improve the country's competitiveness. Without an environment that encourages new and innovative applications, the next-generation infrastructure will merely deliver incremental improvements in current services and applications.

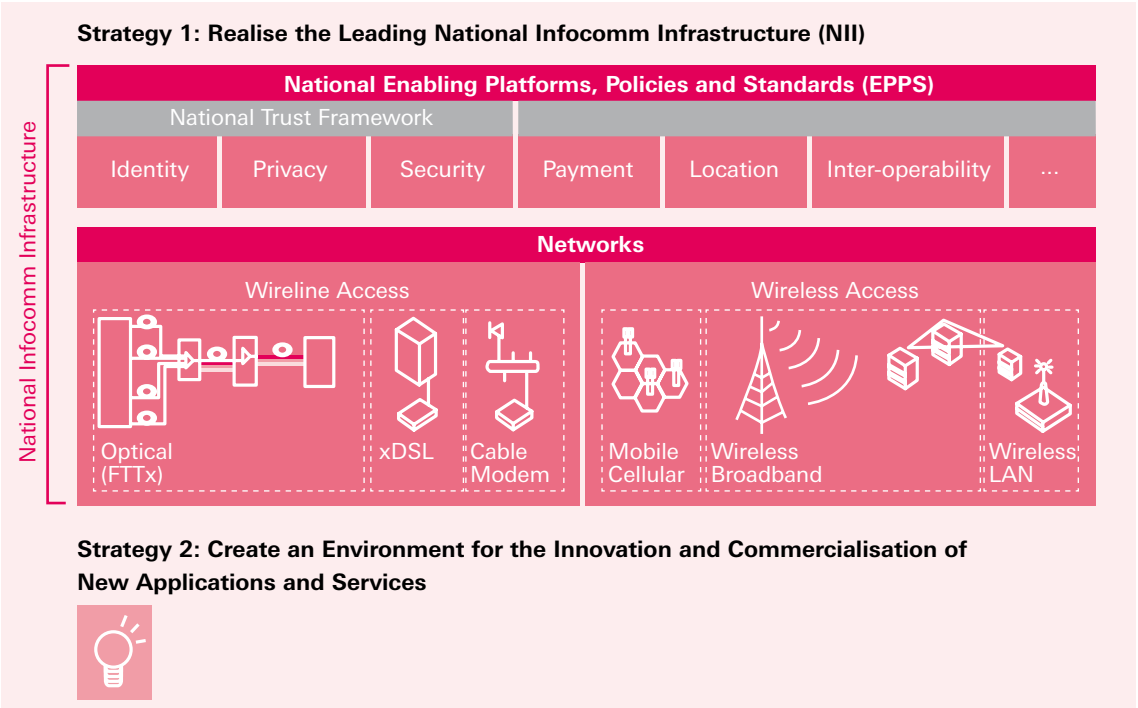

Figure 3-3: Strategies for Infocomm Infrastructure

Realising the Leading National Infocomm Infrastructure

In relation to the first focus area of infrastructure, the Sub-Committee recommends the realisation of Singapore's new National Infocomm Infrastructure (NII), which comprises two fundamental 'building blocks' – networks as well as National Enabling Platforms Policies and Standards (EPPS).

Networks

The network layer provides the pre-requisite underlying physical infrastructure to support all enabling platforms, and applications and services. The network layer will comprise the following:

- Wired access networks: An ultra-high speed fibre network – the **National Fibre Network (NFN)** – that supports new high-bandwidth applications and services; and

- Wireless access networks: A pervasive **Wireless Broadband Network (WBN)** that supports new mobile and location-aware services.

Wired

Singapore's existing broadband infrastructure has largely met the current needs of individuals and businesses. However, increasing demand for data and connectivity implies that the network is likely to be inadequate to meet future needs in the next five to ten years.

To address this, the Sub-Committee proposes the development of a NFN that will offer high-speed access speeds of more than 1Gbps – compared to the Mbps speeds that individuals are enjoying today. This fibre-based network will connect all homes, schools and businesses in Singapore.

The network will also be IPv6-ready, a standard which is expected to be widely deployed in the networks of countries such as Japan and South Korea.

The NFN should also be an open-access carrier-neutral fibre network, leveraging on existing infrastructure where possible. This will allow other service providers to use the network to deliver their services to their customers, creating service-based competition.

Wireless

While the NFN fulfils the promise of ultra-high speeds, the Sub-Committee recognises that a wired network alone will not deliver the broadband pervasiveness needed to fulfill the mobility needs of individuals.

Beyond high-speeds, Singapore's new NII needs to be accessible anywhere on the island: beyond homes, schools, and hospitals, to even business parks, places of interests for tourists, major shopping malls, MRT stations, bus interchanges and even the lobbies of commercial buildings and hotels.

It is likely that a multitude of wireless technologies will be required to meet the mobility needs of all users. For example, wide area wireless technologies such as 3G and High Speeds Packet Data Access (HSPDA) will provide more pervasive coverage nation-wide. However, they cannot match the bandwidth that is offered by local area or metropolitian area wireless networks such as Wi-Fi or WiMAX. Wi-Fi today also has the advantage that many computer notebooks and PDAs have in-built capabilities to connect to the network. However, public Wi-Fi networks are not pervasive today.

So the Sub-Committee recommends making all of Singapore a wireless hot zone. This means the co-existence of relevant wireless technologies to cater to the needs of individuals while they are on the go. While new applications will continue to be promoted on existing mobile networks such as 3G, more can be done to make high-speed wireless broadband networks, such as Wi-Fi, more pervasively available in major public areas.

As a start, Wi-Fi can be used to provide coverage for selected "catchment" areas. These catchment areas could include places which are accessible to the general public, have a high volume of human traffic and where there is a high concentration of commercial activities. Given the pervasiveness of Wi-Fi-enabled notebooks and PDAs today, this will help catalyse the use of wireless broadband as users become familiar with using broadband on the go. By helping to develop a base of users and subscribers, service providers will then have more incentive to roll out the wireless broadband infrastructure quickly.

As other wireless broadband technologies such as WiMax become more mature, these alternatives should also be explored for either last-mile access or for backhaul use.

National Enabling Platforms, Policies and Standards

The National Enabling Platforms, Policies and Standards (EPPS) provide a trusted, seamless and cost-effective environment for the development of new applications and services on Singapore's National Infocomm Infrastructure. The Sub-Committee recommends that the Government, in particular the IDA, play a key role in putting these in place.

As a start, six areas of focus – *identity, security, privacy, location, payment* and *inter-operability* – have been identified.

National Trust Framework

Issues relating to identity, security and privacy will be addressed under the National Trust Framework (NTF).

Online services such as banking, healthcare, and commerce can only be pervasively adopted in an environment that does not put valuable and personal data at risk. Today, the lack of trust is increasingly a major impediment to the development of the global information economy. To continue successfully leveraging on infocomm and for Singapore to continue maintaining its trusted hub reputation, the country must tackle these infocomm security and privacy challenges in tandem with the development of its next-generation infrastructure.

Three issues that stand in the way of trust need to be addressed in order to fully realise the potential of a ubiquitous networked environment. They are:

- Security – Cyber attacks compromise the security, reliability and integrity of systems and data;
- Privacy – Data privacy infringements undermine consumer confidence and trust in online services; and
- Identity – Identity thefts lead to unauthorised access of online assets and resources.

Building on the existing national infocomm security incentives, policies, legislation and standards in the area of security, privacy and identity, the National Trust Framework will focus on the development of 'hard' and 'soft' trusted infrastructure in four key areas: infrastructure development, policy and regulation, education and adoption and manpower development. To illustrate, a *National Cyberthreat Monitoring Centre (NCMC)* will be developed to provide the Government, and eventually the nation, with the capability to respond to infocomm security events.

Electronic Payments

The increasing demand for online and real-time payments has spurred the development of new and innovative products for electronic payments. Innovations in payment systems have the potential to reduce the costs of handling cash and reconciling payments, increase efficiency by streamlining processes, and increase convenience by enabling remote payments.

Initiatives in this area will aim to support the development of a next-generation nation-wide electronic and mobile payment infrastructure. As part of the programme, the Sub-Committee recommends that Singapore:

- Ensure that the right standards and policies are put in place through co-ordinating payment standards and reviewing government policies;
- Support the development and pilot projects of innovative payment solutions; and
- Encourage collaboration among electronic-payment players to implement a next-generation National Electronic Payments Infrastructure.

Inter-operability

To meet the vision of a seamless infocomm infrastructure in an increasingly converged wired and wireless technology world, inter-operability will become a basic expectation and requirement.

The Sub-Committee recommends exploring the feasibility of inter-operability in the following areas:

- Seamless access to networks;
- Strategic telecommunication services such as in the area of mobile number portability. Such an infrastructure may subsequently be expanded to include fixed-mobile number portability; and
- Computing resources and storage systems. Grid computing technology may, for example, enable businesses to aggregate huge computing resources from commonly-available computing resources, providing new capabilities and new business models.

Location

To enable context-driven information services to meet consumers and business needs anytime and anywhere, the Sub-Committee recommends the development of an infrastructure to enable location information to be made available to service providers in a cost-effective manner. This location service should comply with national and international security and privacy best practices.

Creating an Environment for the Innovation and Commercialisation of New Applications and Services

To promote the development of new applications and services, the Sub-Committee suggests the creation of showcases of innovative applications and services, in a live, commercial environment.

Under the Stage Alpha programme, the development of infocomm infrastructure could be carried out in phases to take into account the creation of these showcases. These showcases could be in various localities such as Downtown Singapore and Fusionopolis at Buona Vista. Successful applications and services from these showcases could then be introduced in other parts of the island, or be exported overseas.

The Sub-Committee also recommends the engagement of key anchor users to ensure that the National Infocomm Infrastructure meets the needs of the market. This could include working with the media industry on the secure delivery of bandwidth-intensive content, homeland security agencies on security and location-based related information, transport companies on traffic-related sensors information, schools on pervasive broadband access and hospitals on privacy-related infrastructure.

Innovation can also be derived from business models. For instance, many major infocomm companies, expect basic computing and storage resources to be available "on tap", in the same way that electrical energy is available from a power outlet. This can be a new business delivery model for delivery of infocomm services. Such new business delivery models can be realised on a larger scale, with several companies sharing the resources. One initiative in this area could involve the development of an Infocomm Resource Marketplace – a vibrant regional marketplace for infocomm resources and services.

Strategic Thrust 2

Develop a Globally Competitive Infocomm Industry

To ensure the sustainability of Singapore's infocomm industry, and to launch the industry on the world stage, the iN2015 Enterprise Development for Singapore-based Infocomm Companies Sub-Committee recommends the industry's competitive capabilities be developed through creating *depth* in Singapore's enterprises as well as *diversity* in the industry.

While Singapore's infocomm industry has performed well to date, it currently relies on a few major players. Based on a sample of 2,000 companies, 21 per cent of the infocomm local enterprises[18] contribute to 73 per cent of the total operating receipts for the Singapore's infocomm industry. Around 96.5 per cent of the local enterprises have total operating receipts of less than $50 million. Besides being small in size, they also generally lack the expertise and business connections to market their products and services outside the country. While they may be strong in technology capabilities, many have limited marketing and finance skills. Hence, very few have successfully penetrated into overseas markets.

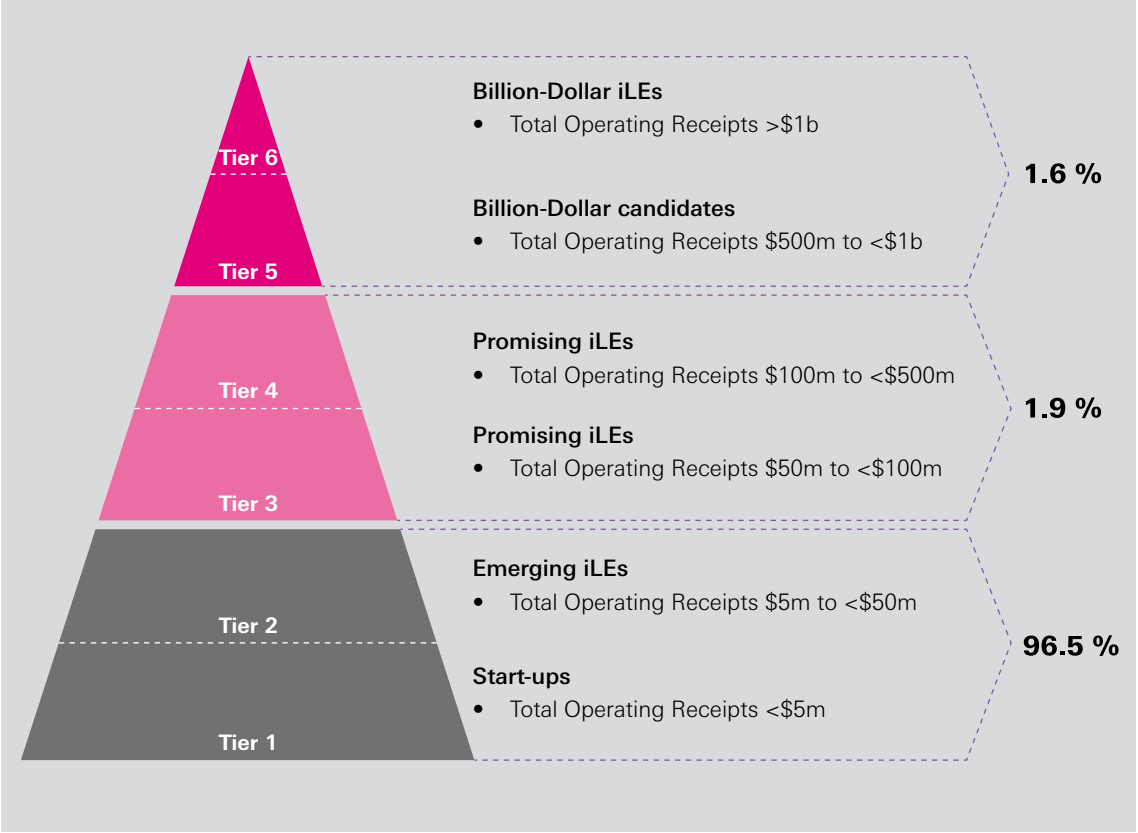

Figure 3-4: Infocomm Local Enterprises Total Operating Receipts Tier Pyramid[19]
Source: IDA, 2005

Besides the reliance on a few major players, there is also a heavy concentration of activities in one part of the infocomm value chain. Most activities of Singapore-based infocomm enterprises are skewed towards systems integration, marketing, distribution and support. Value-added from these activities are typically lower than that from activities such as R&D and solutioning.

18 Infocomm local enterprises refer to companies with equal to or more than 30 per cent local equity.
19 Data is based on a sample of 2,000 infocomm local enterprises (with equal or more than 30 per cent local equity) in Singapore

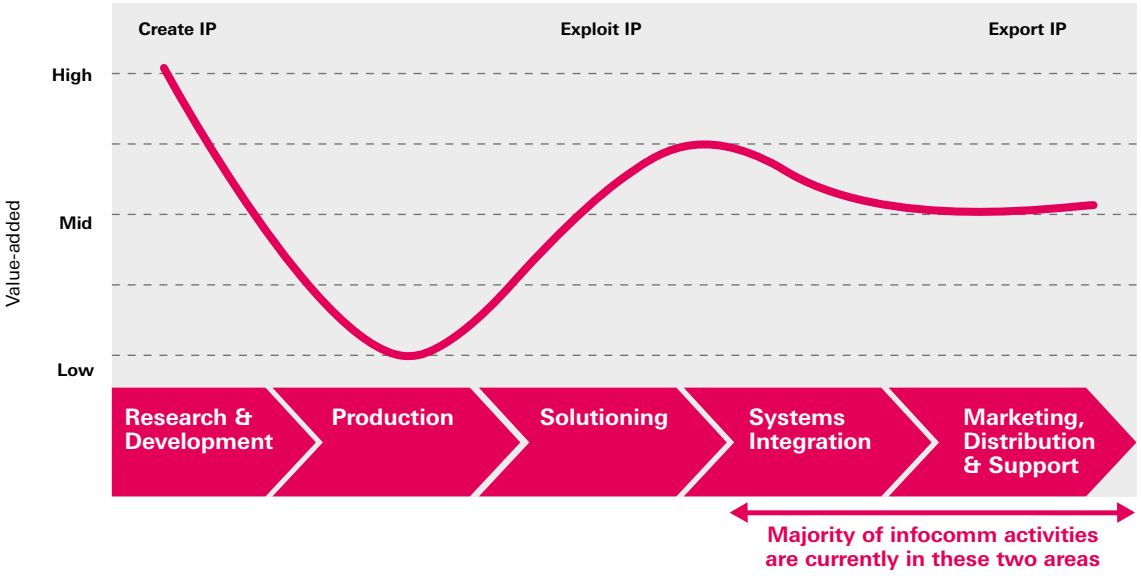

Figure 3-5: Activities of Singapore-based Infocomm Enterprises
Source: IDA

Infocomm local enterprises (iLEs) tend to be marketers and distributors of multinationals' solutions, or providers of system integration services. Although some software vendors have generated "Made-by-Singapore" applications, these are mostly standalone solutions that need to be customised for different markets.

This, coupled with Singapore companies' focus on importing technologies from foreign companies, means that attractive start-ups and technological innovations in infocomm are few. This is evident from the low levels of infocomm investment from venture capitalists here. Another sign is that only a few local players have made a significant impact in overseas markets.

In addition, about half of the industry's revenue is derived from selling hardware, as shown in the figure below. This segment provides lower profit margins compared to higher value-added areas like custom-made software, IT services and content development. Hence, there is a need for the industry to move towards higher value-added activities so as to create, exploit and export intellectual property (IP). There is also an impending need to develop strong local enterprises to ensure sustainability of the infocomm industry in Singapore.

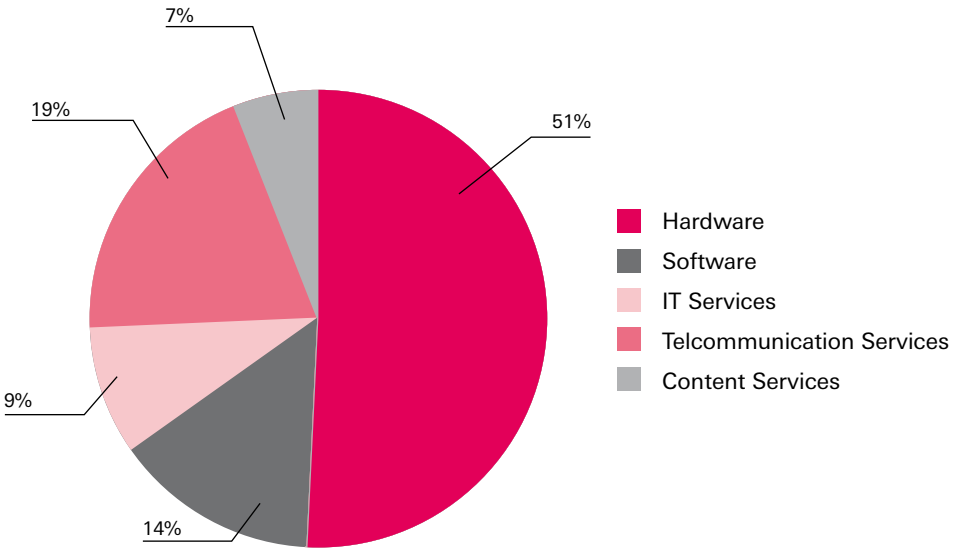

Figure 3-6: Breakdown of Singapore's Infocomm Revenue by Market Segments in 2005
Source: Annual Survey on Infocomm Industry for 2005, IDA

In addition, Singapore's infocomm local enterprises today do not have a strong distinct brand, With each enterprise making its own marketing pitch, the fact that the country as a whole has several worthwhile products to offer often goes unnoticed.

So Singapore does not appear to have global mindshare, which leads to poorer reception in overseas markets for its companies' offerings.

In contrast, many Asian countries have carved an infocomm image for themselves.

To develop the industry as a global force over the next decade, the Sub-Committee proposes the following targets for the industry:

- 2-fold increase in value-added of the infocomm industry to S$26 billion
- 3-fold increase in total infocomm export revenue to S$60 billion, with a proportionate increase in the export revenue of infocomm local enterprises
- 4-fold increase in Software and IT services revenue to S$36 billion, contributing 40 per cent of total infocomm revenue

To achieve these goals, the Sub-Committee recommends a holistic set of strategies. Collectively, they spell **DoT.BEST**.

- **Do**main and **T**echnology capabilities development
- **B**randing and marketing
- **E**xpansion and growth of infocomm local enterprises
- **S**ectoral solutions for export
- **T**echnopreneurs and start-ups attraction

Strengthen the Development of the Industry's Domain and Technology Capabilities

Domain Capabilities Development

Instead of competing head-on with lower cost infocomm-producing countries, Singapore's industry needs to compete on value, premium services and niche solutions, which customers are willing to pay more for. To prepare the industry to play in these areas, its domain-specific capabilities need to be strengthened, especially where Singapore has been successful in implementing infocomm, such as in Government, Digital Media and Entertainment, and Education and Learning.

Indeed, Singapore is noted for being one of the first countries in the world to have successfully deployed integrated end-to-end solutions in government, trade and logistics, and transportation. With such expertise, local enterprises, though lacking in size, can look to taking on multinationals as partners, to develop sectoral end-to-end solutions that are scaleable and replicable in other markets.

To capitalise on this, Singapore needs to develop a pool of "techno-strategists" – people who are well-versed in the technical aspects of infocomm as well as in their respective business domains.

Technology Capability Development
Infocomm enterprises need to strengthen their technology depth in niche areas where Singapore can excel. One way they can do this is by collaborating with each other, as well as with research institutes and institutes of higher learning. This includes strengthening links between the industry and the Agency of Science and Technology and Research's research institutes, a development A*STAR is pushing for under its Science & Technology 2010 plan.

These efforts will help identify and develop infocomm technologies that meet the industry's needs. They will also lead to better transfer of intellectual property rights from the research institutes to the industry for the commercialisation of new applications and services. Both are the aim of the talent exchanges and partnership initiative under the iN2015 Infocomm Manpower Development Plan.

Besides developing intellectual property on its own, the industry can also source and acquire relevant intellectual property from around the world to shorten the development process.

To this end, the Sub-Committee recommends establishing an **Enterprise Capability Development Programme** to assist local firms to develop business strategies, build management capability and human capital, improve processes and acquire technologies to compete in the global marketplace.

There will also be initiatives to help local companies pursue business development goals. These will be available to see them through start-up, product development, and beyond. Specialised external advisors and experts will be engaged to identify projects that will benefit and nurture local enterprises. On top of that, the IDA will look into setting up an international network of experts to mentor local companies.

An Industry Experience Sharing Platform will be set up to provide a neutral platform for like-minded enterprises to learn from one another and jointly explore opportunities to go international. With the creation of a CXO Programme for users, which has been proposed by the Infocomm Competency Council, there would be regular interchanges between senior company executives during which they can share their organisations' experiences in infocomm adoption.

The Sub-Committee also recommends establishing an Idea Generation Centre. This would be a neutral facility to help various economic sectors understand how infocomm can be exploited.

Embark on a Concerted International Branding and Marketing of "Made-by-Singapore" Infocomm Products and Services

Infocomm local enterprises and their offerings currently lack strong recognition in both local and overseas markets, because of their size, and lack of know-how and financial resources to market themselves internationally. Marketing efforts in overseas promotions have also been disparate. In view of this shortcoming, the Sub-Committee recommends that a concerted national effort be undertaken to develop a single brand for all Singapore's infocomm enterprises and offerings, and to market this brand widely and aggressively.

This **"Made-by-Singapore" Infocomm Branding Programme** will benefit the companies by:

- Raising the perceived value of Singapore's infocomm products and services both within the Republic and in external markets; and
- Generating stronger recognition of the quality and reliability of Singapore's infocomm products and services.

This will involve:

- Establishing and marketing the "Made-by-Singapore" brand at local and international industry-wide events.
- Conducting a feasibility study into having an endorsement mark for Singapore's infocomm industry.
- Profiling infocomm enterprises in the media, and through advertisements in regional publications and other collaterals.
- Developing an industry portal for "Made-by-Singapore" infocomm products and services. Such a portal will be a virtual storefront for local enterprises to promote and market their products and services in Singapore and, more importantly, to the larger overseas markets. It will also serve as an additional channel for match-making complementary companies to create partnership opportunities.

Nurture the Expansion and Growth of Local Infocomm Enterprises

Strong local enterprises will help ensure the industry's resilience and growth. However, before they can take off internationally, they must first have the resources to do so. Under this strategy, the Sub-Committee recommends having an **iLE Internationalisation Programme** to help infocomm local enterprise expand overseas.

One key initiative under this is to provide support services in markets that do not yet have an IDA overseas office. These services include:

- Provision of market intelligence. Agencies such as the IDA can use its overseas offices and contacts with foreign governments and businesses to help gather market intelligence on potential business opportunities.

- Assistance in establishing overseas networks that can provide entry to markets abroad. These networks will offer marketing channels and partners, to help Singapore enterprises find customers. They will also help to identify partnership opportunities among local enterprises and foreign companies.

The IDA can capitalise on Singapore's well-known success in e-Government to help local firms make their mark abroad, by having them export e-Government solutions and secure such projects overseas.

To support this, the Sub-committee recommends the IDA establish an **e-Government Solutions Export Programme**. It would involve:

- Setting up a Singapore e-Government Leadership Centre to provide training to foreign government officials on the Republic's e-Government experience. The Centre can also serve as a vehicle to brand and market these software and IT solutions and local companies' capabilities internationally.

- Making government-held intellectual property available to local enterprises to commercialise and export to foreign governments. This too is a part of the iGov2010 plan which, among other things, seeks to encourage government collaboration with the infocomm industry.

Besides this, having an **Enterprise Growth Programme** can provide access to capital to promising local enterprises looking for post-startup funding. Companies can use the fund to develop the necessary scale to expand and compete in the global market.

Develop Sectoral Solutions for Export

To complement the IDA's current efforts in industry collaboration, the Sub-Committee recommends establishing a **Sectoral Projects Partnership Programme** to expedite the creation of intellectual property for enterprises in Singapore and strengthen their branding in the international market. This programme aims to support efforts by infocomm enterprises to create larger-scale and iconic "reference sites". Specifically, the IDA can help facilitate partnerships between local firms and multinationals, so that they can work together on sectoral solutions for overseas markets.

The Sectoral Projects Partnership Programme will:

- Offer incentives for the creation of intellectual property and the formation of consortiums and partnerships amongst enterprises to develop sectoral infocomm solutions;

- Facilitate the development of "Made-by-Singapore" exportable software and IT solutions, and leverage on Singapore's strengths in rolling out infocomm solutions for various economic sectors; and

- Create reference sites for the country's infocomm enterprises in their internationalisation efforts.

Attract and Nurture a Vibrant Pool of Infocomm Technopreneurs and Start-ups

For Singapore's infocomm industry to be vibrant and thriving, it needs a continual influx of infocomm technopreneurs and start-ups that engage in high-end activities. These will help to rejuvenate the industry. The broader mix of enterprises and activities across the value chain will also create diversity in the industry.

Fortunately, the factors to support this development, such as infrastructure, strong laws protecting intellectual property and a pro-business environment, are already in place here. However, these strengths have to be monitored and enhanced to ensure that Singapore continues to be attractive to technopreneurs and start-ups in the face of intense regional competition for infocomm talent and investments.

The Sub-Committee recommends setting up an **Infocomm Start-Up Attraction Programme** to attract aspiring foreign technopreneurs to use Singapore as a development and engineering centre for their business ventures and as an operations hub for penetrating international markets. This programme can leverage on existing initiatives to promote entrepreneurship, as well as IDA's overseas offices and the relationships that Singapore companies have built with multinationals and major infocomm local firms, to attract technopreneurs and start-ups here.

A larger pool of start-ups is expected to drive the development of new products and services, and accelerate the creation of intellectual property. This should in turn attract more investments and venture capital to Singapore. At the same time, cross-pollination of knowledge and ideas between local and foreign technopreneurs will promote diversity in technology capabilities and spur innovation by the local industry.

Strategic Thrust 3

Develop an Infocomm-savvy Workforce and Globally Competitive Infocomm Manpower

The journey towards the iN2015 vision does not stop at having the hardware and software. It also requires having people with the expertise to put in place the infrastructure and applications, as well as manpower with the skills to make full use of available technologies.

In this respect, the Infocomm Competency Council's vision is to have an infocomm-savvy workforce and globally competitive infocomm manpower.

Why is such manpower needed? On one hand, companies, regardless of the sectors they are in, are beginning to adopt infocomm-enabled innovation to meet business goals and create opportunities for growth, as reaping cost and efficiency benefits from infocomm has become fairly widespread. In fact, the twinning of infocomm and business success looks set to deepen.

While Singapore has long recognised the importance of harnessing infocomm to gain strategic advantage, the increasingly strategic role of infocomm in businesses implies a need for Singapore to continue raising the people's capacity and capability to use infocomm.

When people are empowered through infocomm to make task-specific improvements, their organisations benefit from continual innovations that contribute to greater market differentiation and long term sustainability. This means that there is a need to upgrade the infocomm skills of the general workforce, right from the shop floor worker to the head of the company, and help them be attuned to constantly seek innovative ways to deliver better results using infocomm.

On the other hand, the infocomm industry itself is undergoing a sea change, as a result of stiffer competition from countries that offer lower cost infocomm services. Among these places are China, India, the Philippines and Vietnam. The dominance of China and India, in particular, will continue to rise as more and more companies offshore their software development, call-centre operations and other infocomm technology functions to these countries.

With so much competition at that level, there is a need for Singapore's infocomm industry to shift its focus to higher value-added activities in intellectual property creation and exploitation.

Currently, the majority of Singapore's infocomm activities are in marketing, distribution and support. As the industry matures, it needs to put down roots in areas such as providing solutions and R&D, which can better differentiate Singapore from its global competitors and strengthen the country's position as a key node in the global network.

Overseas capabilities in software development and hardware manufacturing would then become a valuable resource that Singapore can leverage on, while focusing its efforts on creating and commercialising intellectual property.

Hence, there is a need to develop more of two types of infocomm professionals: the techno-strategists, who have the ability to combine technical know-how with domain experience to develop innovative solutions; and technologists, who need to be equipped with deep technical expertise to engage in R&D. This in turn involves raising the education level, industry exposure and innovative capacity of Singapore's infocomm manpower.

To grow the country's existing talent pool in infocomm, as well as to draw in more infocomm talent, the Council has identified these strategies:

- Develop infocomm competencies in key economic sectors
- Develop globally competitive infocomm professionals
- Develop, attract and retain infocomm talent

In line with this, the Council has targeted to:

- Boost the number of infocomm jobs by 55,000 to about 170,000 in 2015

This is expected to generate another 25,000 non-infocomm jobs in the infocomm industry, to bring the number of such jobs to about 70,000. In total, the number of new jobs created would be about 80,000.

Develop Infocomm Competencies in Key Economic Sectors

Singapore needs to invest in its national capacity to effectively harness infocomm technology in the key economic sectors. To achieve this, decision-makers need to appreciate the strategic advantages of integrating infocomm with their business operations.

On top of that, the general workforce should also be empowered with more sophisticated skills to use job-specific infocomm applications, and imbued with the mindset to constantly seek innovative ways to deliver better results using infocomm.

To achieve this, the Council suggests establishing:

- **CXO Programme** – There should be opportunities for decision-makers such as chief executive officers and chief information officers, people at the "C-level" in user organisations, to share views on how infocomm can be used as a strategic tool to sharpen their competitive edge. Overseas business experts and technology gurus could be engaged to share their experiences at such business roundtables. Further help could be extended to businesses that lack experience finding the right infocomm solutions for their businesses. For the longer term, steps should be taken to start tuning the "technology receptive" mindsets of the young.
- **Infocomm Competency Development Initiative** – Efforts should be made to develop the necessary competencies for key sectors or occupations for maximum national impact. This plan should provide training and certification opportunities for non-infocomm workers to develop more sophisticated infocomm skills that are relevant to what they do. This programme should also empower the general workforce to put into action their own ideas on improving job tasks using infocomm.

Develop Globally Competitive Infocomm Professionals

Here, the Council proposes to build a pool of highly valued techno-strategists who are able to develop innovative infocomm solutions, and another of technologists who are capable of engaging in R&D. To do so, the Council suggests establishing:

- **A National Infocomm Competency Framework** – Skill requirements and the corresponding training available for the various infocomm occupations should be clearly set out at the national level. Individuals can use this Framework to assess their level of competency, and map out their training and career paths. Employers can use it to better articulate their job requirements, as well as understand the

competency and skill gaps of their workers. To encourage companies and individuals to make use of the Framework, agencies like the IDA should continue to provide incentives for them to take up the training courses suggested through its existing Critical Infocomm Technology Resource Programme (CITREP), which defrays a portion of the course fees.

- **Work-study Opportunities** – More often than not, companies require people with industry experience and more advanced infocomm skills for higher value jobs. But fresh infocomm graduates will not have all this. Thus, besides equipping them with the relevant technical skills, there is a need to also help them get some experience under their belt before they enter the workforce. To do this, training and work study attachment programmes to companies could be included to help fresh infocomm graduates to acquire advanced skills and gain experience.

- **Talent Exchanges and Partnerships** – The Council encourages the sharing of talent and ideas between local and overseas infocomm enterprises, research institutes and tertiary institutions. It believes that foreign talent should be persuaded to study, work and live here, to help foster a culture of innovation and entrepreneurship.

Develop, Attract and Retain Infocomm Talent

This strategy encompasses attracting a fair share of talent to drive the growth of the industry, as well as ensuring that young people, who will form the leaders and workforce of the future, are excited about trying new technology and experimenting with various ways of using infocomm to make their lives more fulfilling.

The initiatives proposed are to have:

- **Scholarships** – Top students, whether local or foreign, should be drawn to pursue infocomm as a field of study. The IDA's extension of its National Infocomm Scholarship to support overseas studies and foreign students who have the intention to stay and pursue an infocomm career here, are steps in this direction.

- **Flagship Infocomm Courses** – In addition, agencies like the IDA can facilitate the launch of more flagship infocomm courses offered jointly by local and top overseas universities, including "fast-track" bachelors and masters programmes that attract more students to pursue post-graduate degrees. Local universities should also be encouraged to develop their infocomm schools so these rank among the best in the region.

- **National Campaign** – To raise the interest in infocomm among the young, the first step is to launch a national campaign to start people talking about a career in infocomm. The campaign can include competitions to generate excitement and recognise students skilled in infocomm, as well as create opportunities for dialogue sessions to inspire students, where the speakers – who would be infocomm leaders – talk about their trials and successes.

- **Infocomm Co-curricular Activities** – Learning about infocomm can be made more engaging through co-curricular activities offered in schools. In such settings, students can acquire competencies that will serve as a life skill by being involved in interesting projects and competitions. Regardless of what career they embark on, infocomm will be essential to them at work and at play.

Strategic Thrust 4

Spearhead the Transformation of Key Economic Sectors, Government and Society through more Sophisticated and Innovative Use of Infocomm

The transformation of the country's main economic sectors, government and society is critical to the iN2015 vision. At the heart of this will be the development of the country's infocomm infrastructure, enterprises and manpower, the foundation pillars for other sectors. But doing this will not be sufficient. iN2015 must also ensure that Singapore's key economic sectors and individuals are well-served with the right environment to truly enhance the economy and enrich lives using infocomm.

Already, infocomm has had significant economic impact here. Today, Singapore's infocomm spending of 6.2 per cent of Gross Domestic Product (GDP) makes the country one of the highest investors in infocomm globally[20]. And Singapore has put its infocomm investments to good use. For four years running, it has maintained its position in the top three ranked economies in the World Economic Forum's Global Information Technology Report.

Today, almost every individual and business in Singapore makes use of infocomm. Most people own an infocomm device such as a mobile phone, portable music player or personal computer, while just about every business relies on e-mail and other Intranet or Internet-enabled applications.

Infocomm Usage in Singapore	%
Household broadband penetration (March 2006)	54
Business broadband penetration* (2005)	77
Business usage of infocomm appliances (2005)	93

* Business with 10 and above employees

Figure 3-7: Infocomm usage in Singapore
Source: IDA 2005

Because technology will not stand still, the possibilities for infocomm usage will also change dramatically over the next decade. New possibilities will present themselves in innovation, integration and internationalisation.

To this end, the Committee has put forth proposals on how these possibilities will be realised in the following eight areas:

- Digital Media and Entertainment
- Education and Learning
- Financial Services
- Healthcare and Biomedical Sciences
- Manufacturing and Logistics
- Tourism, Hospitality and Retail
- Government
- Society

These eight areas serve only as a start and by no means represent the only areas where infocomm can make an impact. Because iN2015 is a living plan, the Committee has proposed that IDA continue to work with partners and stakeholders of other sectors to similarly identify areas where infocomm can be better harnessed.

20 "Worldwide Telecom Spending, 2002-2007", IDC and "Worldwide IT spending: 2002-2007", IDC. IDC defines ICT spending as consisting of IT spending and telecom spending. IT spending consists of IT services, packaged software and hardware. Telecom spending consists of telecom services and telecom equipment.

Digital Media and Entertainment

Setting the Context

The media and entertainment industry is at the brink of a revolution as a result of infocomm technologies. This is transforming the production, processing and distribution of content and services.

In the process, it is opening up an era of new possibilities for interactive and immersive experiences, and business opportunities that will radically change the world by 2015 when applied to key economic sectors like education, healthcare and manufacturing.

The Government is aware of the phenomenal impact interactive and digital media will have in the next 10 years. In January 2006, the sector was selected as one of the three[21] key potential growth areas here. The plan is to build Singapore into a global capital in interactive and digital media, to propel the economy forward and enhance the quality of life.

The iN2015 Digital Media & Entertainment (DME) Sub-Committee has identified three significant developments that will shape the media and entertainment sectors over the next 10 years:

- **Availability of Infocomm Infrastructure and Platforms**
  Investments in infocomm infrastructures and platforms during the dotcom era have made infocomm products and services much more affordable to businesses and consumers today.

  The cost of bandwidth has come down tremendously due to over-investments in submarine cable capacity creating a surplus in bandwidth supply today. More advanced technologies invented during that period have also brought down the cost of software and hardware, including screens and storage devices. This has increased the availability and affordability of sophisticated infrastructure and platforms to businesses and consumers alike.

  As a result, the way we work, live, play and learn will continue to evolve with the increasing bandwidth, smarter software applications and multi-functional devices as they become more available and affordable.

- **Adoption of Infocomm Technologies across the Value Chain**
  The adoption of infocomm technologies across the DME content value chain has fundamentally changed the cost equation, and has opened new opportunities for innovation in DME content production, processing and distribution.

  With lower production costs, niche content producers are now able to publish their material without relying on traditional media publishers. Adoption of infocomm technologies has also enabled content production to be done concurrently around the world, as it taps on the best skills offered by different production locations.

  In content processing, the adoption of infocomm technologies has opened up new opportunities for cross-platform media. It has also created greater demand for secured digital-key management and media storage for digital content as chemical-based processes have become increasingly centred around high-end computers, fast networks and large databases.

  In distribution, the accessibility and affordability of telecommunication networks are changing the way entertainment is being delivered by reducing the roles of middlemen, physical spaces and channels. Greater opportunities to offer complementary content through cross-platform selling and integration are emerging. Infocomm technologies also make it more affordable to distribute content, and this opens up new avenues of distribution as well.

21 The other two are life sciences and environment technologies

The figure below summarises these key shifts and the new opportunities from the adoption of infocomm technologies.

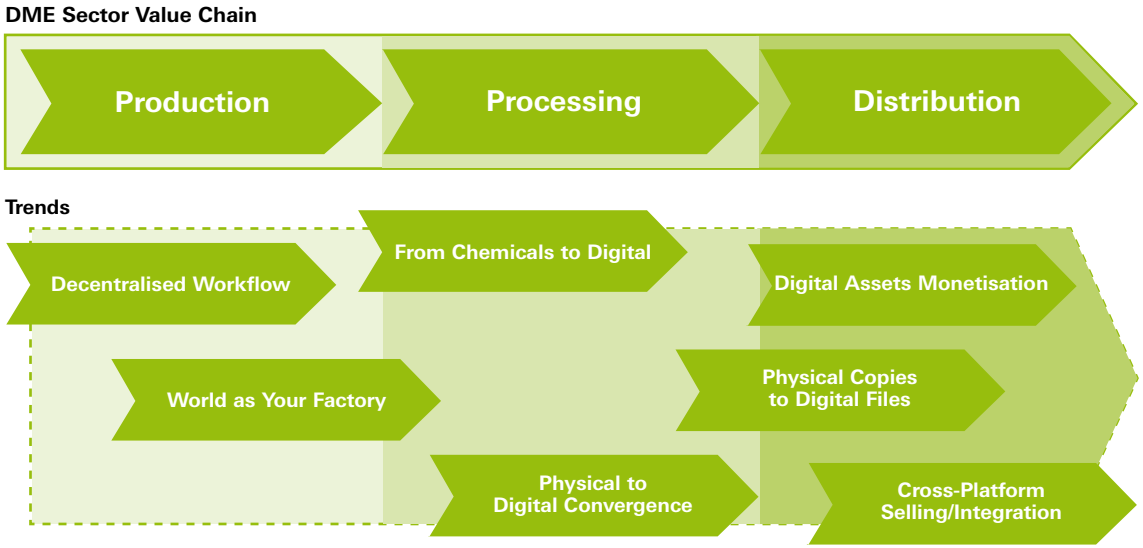

Figure 3-8: DME Sector Value Chain and Trends

- **Advent of Consumer as Creator**
  Where there used to be a clear delineation between those who produced content like TV shows, music and video games, and those who consumed these creations, the lines are blurring. This is because now the consumer himself can also generate content. The situation arises as the barriers for indulging in content creation have been lowered, together with the cost of digital equipment and recording/storage mediums. As such, it is now easier for consumers to create and publish their content without relying on traditional publishers. They may even make money out of such efforts.

  The awareness that anyone can be a creator is resulting in the emergence of new content, new business models and new players. This is especially evident in the online games space, where consumers are increasingly becoming co-creators of the online experience as part of the game design offering. It is also pushing media content companies to innovate faster.

Desired Outcomes by 2015

To join in this revolution and embrace its promises, the DME Sub-Committee recommends that **Singapore be established as a DME capital offering innovative content, services and technologies to the world**.

This supports Media 21, the Media Development Authority's blueprint for the sector, to establish Singapore as a global media city. The objectives are also well-aligned with other national level initiatives, such as the Interactive and Digital Media plan by the National Research Foundation.

To realise its vision, the Sub-Committee recommends the following two broad strategies and programmes:

- Develop Singapore as a centre of creation and commercialisation through a DME Technology Research and Development Programme

- Develop Singapore as a global node to provide core services and infrastructure for the sector through a Global Digital Assets Marketplace programme

The figure below illustrates the two key programmes for developing Singapore into a global digital media and entertainment capital.

iN2015 Digital Media and Entertainment Goal:
Establish Singapore as a digital media and entertainment capital offering innovative content, services and technologies to the world

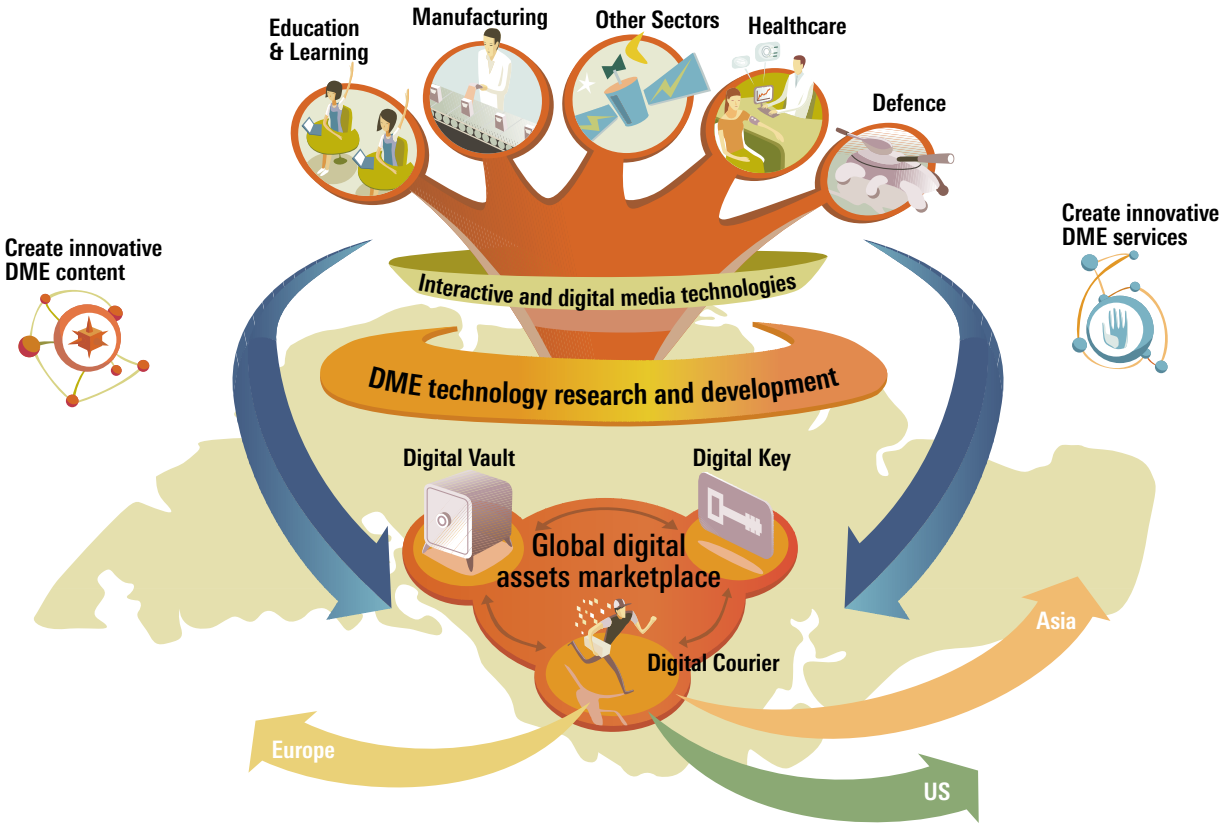

Figure 3-9: iN2015 DME's Key Programmes

Realising the Goals

Strategy 1: Develop Singapore as a Centre of Creation and Commercialisation
With Singapore's focus on R&D in the interactive and digital media sector, the Sub-Committee envisages that a variety of new technologies, platforms and toolkits will emerge. The group believes that the Republic should encourage DME companies here and in the region to jointly use these to create new content and services for this and other economic sectors.

The next-generation National Infocomm Infrastructure, an enabler for many of the other iN2015 initiatives, will provide the necessary connectivity and soft infrastructure to support the creation of new DME technologies, content and services.

Collectively, they provide an excellent opportunity for Singapore to be developed as a centre of creation and commercialisation of DME technologies, content and services.

Technology Research and Development Programme

The aim here is to create new DME technologies, content and services.

The programme adopts a 2-prong approach:

- *Technology and Resource Centres* will be set up to provide DME firms with technology tools, resources and training so they can create new content and services.

  Cutting-edge software, applications and toolkits required to produce world class digital content and services are usually out of the reach of individual DME companies because of their high costs. To develop Singapore as a centre of creation and commercialisation, technology and resource centres will be set up to aggregate the demand of DME companies and provide them with access to these technologies, the latest hardware, software and platforms, so as to create next-generation content and services. In addition, they will provide a digital media library and editing suites, training in technology and master classes.

  In the near-term, the group expects the centre to play the role of a "Technology Well", to which local and regional DME companies will come to draw technology and resources. In the medium term, the Sub-Committee anticipates that these centres will become places where a confluence of interests and talents across the spectrum of digital and interactive formats converge to explore, collaborate and innovate.

  By 2015, these centres should be locations where people throughout the region come to explore ideas, collaborate on them and come up with new products, services and technologies.

- *DME technology creation & commercialisation* initiative to develop new DME technologies to create the industry's next generation of content and services.

  This initiative will depend on Singapore's R&D community to create new technologies for the industry and help bring them to the market. Here, collaboration between the R&D community and media companies is essential in order for the new products to be tried out and eventually used widely.

  Areas for the creation of new "Made-by-Singapore" technologies will be identified for research and development. Funds will be provided to help market them. The Sub-Committee recommends that the IDA works with A*STAR and other research institutions on this.

  High on the list of technologies for research and development are: human-computer interaction, sensor technologies, ubiquitous network connectivity, and media management.

Strategy 2: Develop Singapore as a Global Node to Provide Core Services and Infrastructure for the DME Sector

Singapore can become a major node of the global distribution network for high-value DME content and services. To achieve this, Singapore needs to be an attractive location for DME companies to base their processing and distribution businesses here. This can be done by creating a trusted marketplace environment, with players able to provide core services and infrastructure.

Digital Assets Marketplace Programme

Today, there are few places where digital content trading can take place seamlessly. Generally, sellers and buyers strike deals at face-to-face meetings and during trade shows for such business. With the increasing adoption of digital technology and efficiency in cross-border trade, Singapore can take the opportunity to establish a Digital Assets Marketplace here.

Analogous to a financial stock exchange, this will be a one-stop trusted trading centre for businesses and consumers to buy and sell digital assets. Together with this will be the offering of related services such as aggregation, rights management, storing and distribution of assets.

There is currently no such proven marketplace in the world though several Asian countries and cities have made bids to be the "Digital Content Capital" or "Digital Media City".

Singapore has many factors to its advantage to be such a marketplace. It has the trust factor, strategic geographic location, established financial trading status and a strong IP rights protection regime.

In addition, it has a sophisticated technology infrastructure, extensive connections to the region, and people with strong project management and systems integration skills.

To establish the marketplace, the Sub-Committee recommends that Singapore focus on transforming the processing and distribution of content. This programme will comprise the following components:

- ***Digital Vault***
  The central piece of the marketplace ecosystem is the Digital Vault – a leading Asian digital content bank for all major content owners: a place where they can store, trade and account for their digital assets and resources.

  As the switch to digital is in its early stages, there exists an immediate window of opportunity to provide the processing services to convert and encode existing content into the digital format. To seize this chance, the Sub-Committee proposes that the Government and industry work together to identify and plug the current gaps in the local processing industry in terms of equipment, infrastructure and skills. One possibility is for the firms to add on the capability to encode the content master for the different digital platforms to what they do. Investments in capital equipment, such as telecine machines and encoders, infrastructure in the form of a dedicated high-speed network linking processing facilities and content owners, and manpower training can be made.

  The capacity for storage is a must for the marketplace to function. What would make Singapore even more attractive in this area would be the provision of scaleable, customised storage services and a compliance with strict security criteria. The Sub-Committee recommends that the Government work with leading service providers, including data centres and teleports to create storage capacity here that can meet the current and future needs of content owners. The IDA and service providers can also work together to engage content owners on a regular basis so as to understand their needs better. This will help the providers develop more sophisticated storage services, business and operation models.

- ***Digital Key***
  The second component of the programme is Digital Key. This is to address the content owners' needs for safeguarding and trading their content, as well as managing licensing and rights.

  To content owners, an ideal marketplace must be able to represent and protect their rights before they can trade their content. As such, there must be companies to provide these services. They would include security key management, a clearing house for digital assets, licensing, intellectual property and rights management, and trading management. Such depth in the marketplace can be built by working with key players and research bodies. Certification capabilities will also be useful to establish Singapore as an authority in the various areas of the sector such as digital cinema and Internet Protocol TV. The Sub-Committee proposes that the Government work jointly with the industry to develop these capabilities.

- ***Digital Courier***
  The programme's third component is the Digital Courier for end-to-end delivery, payment management and sales fulfilment of digital assets.

Through Singapore companies' business networks, distribution points for content and services can be established in regional markets. Government agencies like IDA can help Singapore-based companies establish a network of distribution points in regional markets through the creation of business alliances, such as the 25-member Games Exchange Alliance[22] set up to help game companies cross last-mile hurdles to get titles to Asian gamers.

The Sub-Committee proposes that agencies such as the IDA can work together with service providers on the provision of integrated services. This could entail increased collaboration among service providers and content owners. For example, telecommunication operators, electronic-payment service providers and end-device providers can work closely with media companies to realise a secure, seamless and immediate system for consumers to access and pay for content and services across different devices. Service providers can also work on providing local and international bandwidth to meet the sporadic and ultra-high speed bandwidth needs of the industry.

Continuation of Digital Exchange's efforts

Through the IDA's Digital Exchange, Singapore has taken initial steps to expand its international trading role from being a hub for physical goods to an international exchange for digital assets.

The Sub-Committee recommends that IDA build on successes it has seen in the last three years, and continue to develop Singapore as a games exchange and trusted digital cinema hub. These important sectors serve to rally key players in the industry, as well as to focus on mindshare, policy and development needs. Developing these areas well will serve to demonstrate DME companies' ability to manage a wider spectrum of activities and services.

Building on existing capabilities and continually innovating, Singapore can become a digital marketplace for the global media and entertainment industry where businesses can congregate, create and trade digital assets.

22 Games Exchange Alliance (GXA) – An initiative of IDA, the GXA is a business alliance of 25 member companies that help game companies cross last-mile commercialisation hurdles to place titles into the hands of Asian gamers. Each member provides their respective strengths in distribution, hosting, localisation, billing, and marketing to shorten the time-to-market for game companies.

Education and Learning

Setting the Context

Powerful trends in globalisation, technology and economic liberalisation are accelerating the pace of competition across the world. Human capital is Singapore's key competitive differentiator in the evolving economic landscape.

To thrive in the world in 2015, Singaporeans need strong analytical, communication and interpersonal skills. They have to be more risk-taking, entrepreneurial and be able to tolerate greater ambiguity. Most importantly, it is essential that people have the attitudes and skills to learn, re-learn and unlearn, in order to thrive in the face of an unpredictable future.

Infocomm is a key enabler that can help us enrich the learning experience for the individual and to expand the nation's capacity. It does so by enabling access to the latest knowledge and new learning resources; making learning come to life with multimedia and interactive elements; facilitating collaboration within and across learning communities; supporting educators' efforts in customising teaching for different learners; and creating an environment in which independent and life-long learning can take place.

Desired Outcomes by 2015

To this end, the iN2015 Education and Learning Sub-Committee has painted a possible scenario of what learning can be like with infocomm in 2015:

iN2015 Education and Learning:
Empowering Learners and Engaging Minds, through Infocomm

Figure 3-10. Possible learner's world in 2015

Learning in 2015 will be different from what we experience today. Learners will access the latest learning resources using personalised learning devices. Content will be delivered via ultra-high speed broadband networks. Learners can choose to learn anytime and at any place, leveraging on pervasive wireless access. Learners will be able to collaborate with one another over the network, using tools for this purpose. Educators will in turn guide learners, by customising learning plans and resources, and using new assessment tools to monitor their progress. The habits of independent search, integration and construction of knowledge and the skills acquired from working with others will equip our people to continue to adapt and learn. Even after they complete formal education, they will continue to access resources in the community, including the public libraries, for work and leisure.

The Sub-Committee proposes the following goal and outcomes for the Education and Learning sector in 2015.

Goal	To foster an engaging learning experience to meet the diverse needs of learners in Singapore, through the innovative use of infocomm		
Outcomes	Our people experience engaged learning and enriched lives, and Singapore benefits from enhanced national capacity	Our educational institutions, with their pervasive and innovative use of infocomm, are magnets for global talent	Our infocomm industry is recognised for its innovative Education and Learning products and services

Figure 3-11: Goal and desired outcomes for Education and Learning by 2015

To achieve all these, the Sub-Committee proposes these strategies and areas of focus:

Strategic Thrust 1	Strategic Thrust 2	Strategic Thrust 3
Creating an enriching and personalised learner-centric environment in our educational institutions	Building a nation-wide Education and Learning infrastructure	Positioning Singapore as a centre for innovation in the use of infocomm technologies for the Education and Learning sector
• Use infocomm to support changes in pedagogies in our educational institutions • Develop new learning resources and new infocomm-enabled assessment modes • Build capabilities of teachers, school leaders and curriculum planners • Develop incubator educational institutions that will generate innovation in the use of infocomm to support engaged learning	• Make broadband infrastructure affordable and accessible to educational institutions • Build a network of knowledge assets for lifelong learning	• Forge strategic partnerships with key companies and research institutions in this field, and locate test-bedding, prototyping and R&D centres in Singapore • Develop a R&D agenda on new technologies and models for harnessing infocomm in Education and Learning • Develop capability in industry to harness infocomm for Education and Learning

Figure 3-12: Strategies to realising the Education and Learning Goal by 2015

The Sub-Committee proposes that, efforts be focused on Singapore's public schools and tertiary institutions, as they educate the vast majority of young Singaporeans and help them acquire the habit of independent learning and infocomm usage. At the same time, the public educational institutions will also provide the critical mass and market size to catalyse developments across the entire sector.

Through these efforts, demand for infocomm products and services will be created. This will in turn spur innovation by infocomm companies and research institutions.

Realising the Goal

The **EdVantage** programme is the proposed implementation roadmap. The programme aims to use infocomm in Education to provide a learner-centric, collaborative environment that extends beyond the classrooms, thereby enabling a diverse and vibrant landscape in the use of infocomm in schools. The Sub-Committee proposes adopting an approach of building a strong and broad base of infocomm usage in public educational institutions, while encouraging peaks of excellence.

EdVantage comprises three components: **iACCESS**, **iLEARN** and **iEXPERIENCE**

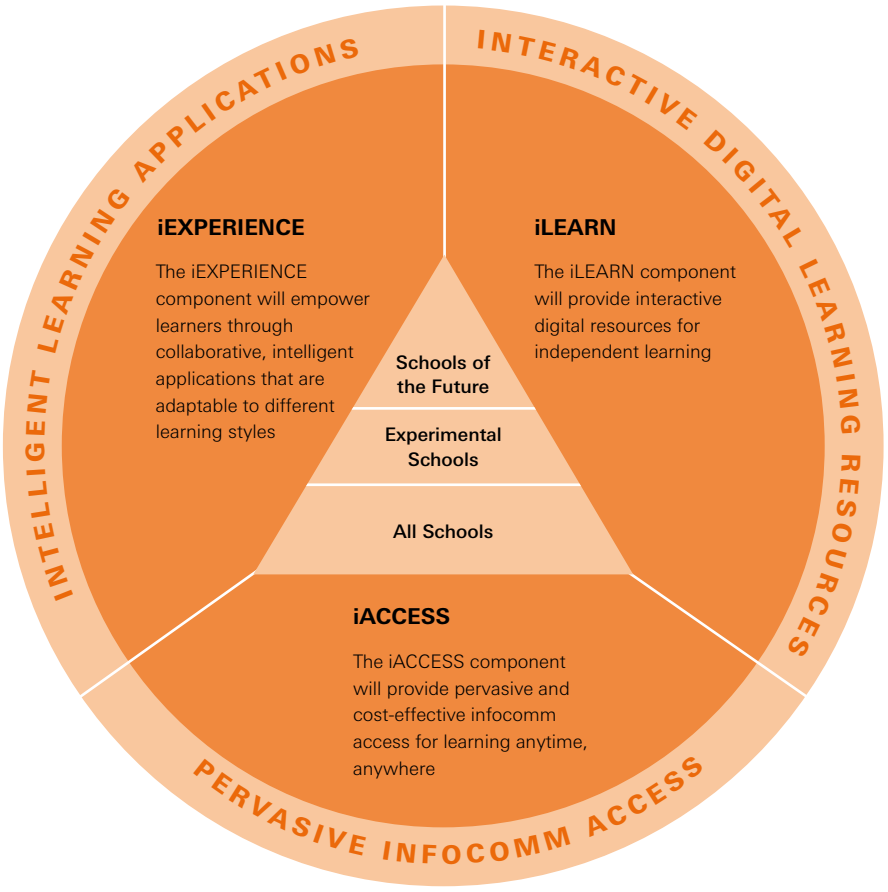

Figure 3-13: EdVantage Programme

In other words, **iACCESS** provides the infrastructure, **iLEARN** makes available interactive digital learning resources, while **iEXPERIENCE** integrates these through the development of applications for learners to enjoy a wonderful learning experience.

Through EdVantage, all schools will be competent users of infocomm. Among them 15-20 per cent (Experimental Schools) will be test-beds for the innovative use of infocomm in teaching and learning. Another five per cent of schools will serve as beacons of innovative infocomm usage in the education setting, for Singapore and beyond. These will be the Schools of the Future and will be exemplary in their integration of infocomm into learning, while experimenting with emerging technologies that will become more widely used in the future.

Through this, Singapore's reputation as an education and infocomm hub will be further enhanced. Our infocomm enterprises will also be well-positioned to export their products.

Components of EdVantage

Possible projects under each of the EdVantage components have also been identified. These proposed projects are not meant to be comprehensive but will be revised from time-to-time to account for advances in educational practices and technology.

- ***iACCESS***

  One-To-One Computing

  To fully realise the benefits of an infocomm-enriched learning experience, the learner will need to be equipped with a personal computing device. Under the One-To-One Computing project, suitable devices and appropriate financial and deployment models will be developed.

  Wireless Campus

  In this project, entire school compounds will be transformed into a giant wireless hotspot for learners and teachers to roam and enjoy seamless Internet connectivity. This will be part of Singapore's plans to develop a next-generation, pervasive National Infocomm Infrastructure. It will give learners greater ability to exercise their independence as they manage their own learning, taking learning beyond the boundaries of the traditional classroom.

  Learner on the Move

  As part of efforts under Singapore's next-generation National Infocomm Infrastructure, the Learner on the Move project will allow learners and teachers to stay connected to the Internet beyond school compounds, making collaboration easier for cooperative learning. For example, learners will be able to access content and hold discussions with others in other locations when they are on a field trip. The project also aims to provide connectivity in more areas to ensure learning hotspots, such as nature reserves, are covered and that education subscription plans are also available.

  Learning@Home

  The Learning@Home project will enable learners at home to enjoy ultra-high speed and symmetric broadband access at affordable prices. This opens up new, exciting possibilities for teaching and learning, as greater collaboration and improved speed of interaction between local and global learning communities can be achieved.

- ***iLEARN***

  Interactive Textbooks

  The Interactive Textbooks project builds on past efforts to produce digital textbooks to provide learning resources with greater interactivity. Such resources will better support flexibility in pedagogies by teachers, and provide a more immersive and engaging learning experience for learners.

  Learning Digital Exchange

  The demand for supplementary digital learning resources has been growing. This project aims to enhance learners' and teachers' access and to enable the sharing of digital resources online, not only amongst themselves, but with different commercial providers.

  Digital Games for Learning

  Young learners who are growing up with the Internet, mobile phones and digital entertainment, are likely to be less engaged with traditional classroom teaching. Under this project, specially designed digital games will be used as tools to adapt to different learning styles. This is an area where there is export potential for Singapore's infocomm companies.

- ***iEXPERIENCE***

  Learner Portfolio

  The Learner Portfolio project, which comprises the learner profile and e-portfolio, will be developed. The learner profile helps to define the characteristic behaviour and performance displayed by learners. The e-portfolio is an electronic record of the learner's skills, knowledge and achievements. The Learner Portfolio will help educators to develop lessons based on the individual's learning style.

  Infocomm in Assessment

  This is an increasing emphasis on the learning process and not just final outcomes. New modes of assessments will therefore be needed to provide more holistic evaluation of the learner, beyond just measuring his academic achievements. The project will look into identifying and prototyping infocomm enabled assessments.

  Learning through Collaboration

  Collaboration through online and mobile interactive activities is a key feature of the engaged learning environment. In this project, 'peering' schools will be identified to form virtual learning communities of practices, online tutors and digital mentors. For example, learners could seek opinions from and discuss viewpoints with experts in other locations during an outdoor lesson.

Financial Services

Setting the Context

The financial services industry constitutes a significant component of Singapore's economy. With a diversified group of more than 500 local and foreign financial institutions in Singapore offering a wide range of financial products and services, the country is today recognised as a key financial services centre in the world. Singapore has been consistently ranked as the fourth most active foreign exchange trading centre in the world[23], after London, New York and Tokyo, and the sixth most important offshore private banking centre[24] in the world. At end-2004, the total funds managed out of Singapore amounted to more than $570 billion.

In the next 10 years, a confluence of developments will drive the transformation of the global financial services industry, creating both new opportunities and challenges for Singapore. Asia, powered by the growth of China and India, will alter global patterns of trade and investment and open new opportunities for the financial services industry. As the companies set up their local presence in Asia, they will continue to rebalance their sourcing strategies and streamline business processes to achieve greater competitive edge. Globally, financial markets are also going through intense competition and rapid market evolution. The continued demand for cross-border investments and the pursuit of greater liquidity will lead to further consolidation of global financial markets.

As financial services are information and technology-intensive in nature, infocomm will play a major role in shaping the way the financial institutions transform their businesses and infuse their legacy operating models with unprecedented functionality. Leadership will be claimed by those adept at harnessing product, service and process innovation. Singapore's strengths in infocomm and market infrastructure will provide a competitive advantage that will allow the sector to capture the emerging opportunities in Asia.

Desired Outcomes by 2015

Against this backdrop, the iN2015 Financial Services Sub-Committee envisions Singapore as a **Trusted Gateway to emerging Asia** and an **Innovative Hub for Financial Services** through the use of infocomm to capture those emerging opportunities.

As a trusted gateway to emerging Asia, Singapore will be the place global financial services companies rebalance their sourcing strategy to serve their customers. In 2015, Singapore will be one of the top three knowledge process outsourcing/offshoring hubs in the Asia Pacific region for the development and processing of high-end financial services. This means that even if the front-end execution takes place outside Singapore, the delivery of financial services can be orchestrated here. This can be done by leveraging on the country's international connectivity, trusted infrastructure and expertise in providing higher value-added services to create new products and managing high volume and time-sensitive activities.

As an innovation hub, Singapore with its advanced infocomm infrastructure, high quality workforce and infocomm-savvy finance sector, will be the ideal location for companies to leverage on infocomm to develop and deploy innovative financial products. On top of these pluses, financial services institutions will have access to a new breed of professionals – techno-strategists with cross-disciplinary skills in infocomm and finance, as well as a ready pool of financial technology suppliers to help them test new technologies, such as grid technologies, to put together innovative services to meet increasingly complex demands.

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23 Based on the last three triennial surveys conducted by the Bank for International Settlements. The three surveys are: "Central Bank Survey of Foreign Exchange and Derivative market Activity 1998", Bank for International Settlements, 1999; "Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity 2001", Bank for International Settlements, March 2002; "Triennial Central Bank Survey of Foreign Exchange and Derivatives Market Activity 2005'', Bank for International Settlements, March 2006. The full publication is available for free at the following website: http://www.bis.org

24 "Singapore: The New Switzerland", www.wealthbriefing.com, March 2006.

In particular, there will be next-generation electronic payment solutions across different channels for all users and businesses by 2015. Users will be able to transact with anyone, anytime, anywhere. As a result, commerce activities will not be confined to only brick-and-mortar shops or even websites. For example, an advertisement at a bus-stop will be able to interact with commuters via wireless technologies. So a user interested in watching a movie advertised will be able to buy tickets for it by, say flashing his mobile phone over the flat wireless terminal at the advertisement panel. The terminal is able to select the best seats based on his profile, confirm his booking and transmit his electronic movie ticket to him. The availability of new payment solutions will catalyse transactions across all sectors of the economy and create new markets and channels to engage customers.

Realising the Goals

To realise this, the Sub-Committee has proposed these strategies:

iN2015 Financial Services Goal:
A trusted gateway to emerging Asia, an innovative hub for financial services, powered by infocomm

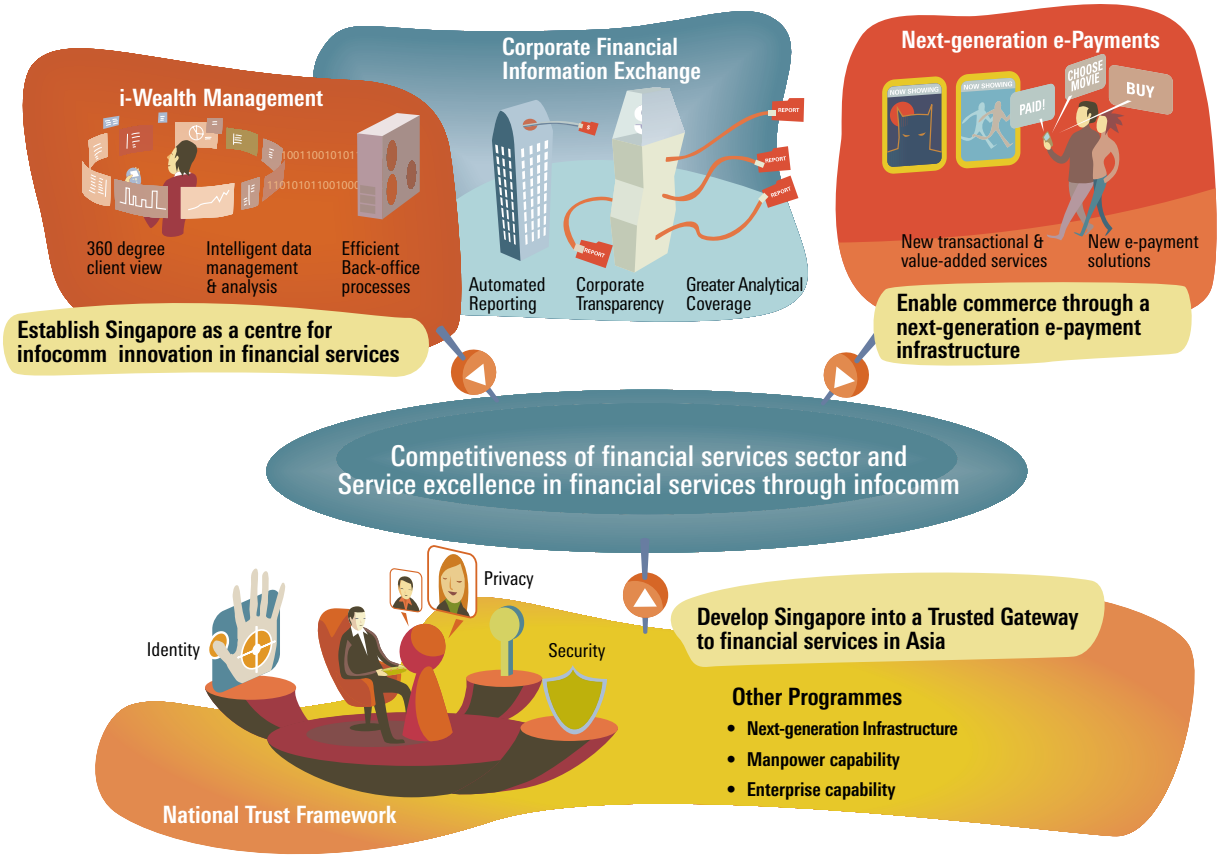

Figure 3-14: Strategies proposed by the iN2015 Financial Services Sub-Committee

Strategy 1: Develop Singapore into a Trusted Gateway to Financial Services in Asia
More than any other industry, the financial services industry depends on trust. With the rising incidence of cyber-threats and increasing pressures for regulatory corporate governance compliance, the importance of trust as a competitive factor of a financial services hub cannot be understated. Today Singapore is already well-reputed as a trusted business hub.

The Sub-Committee recommends that Singapore further entrench its reputation as a trusted hub. This can be done by leveraging on the **National Trust Framework**, which will include both hard infrastructures as well as conducive pro-business policies, to further secure our electronic channels here and set standards to ensure the resiliency of Singapore's financial infocomm infrastructure. This framework will be a key factor in securing, protecting and managing users' online assets, activities and identities, and entrenching Singapore's reputation as a trusted business hub.

As part of the plan to strengthen Singapore's attractiveness as both a choice location for financial services and an access point to other markets, it will be necessary to:

- Ensure a quality and cost-competitive telecommunication infrastructure and connectivity;
- Build a high quality innovative workforce with cross-disciplinary skills in infocomm and finance;
- Work with relevant agencies to attract high-end shared services into Singapore; and
- Support the creation of new marketplaces for financial products through promoting the harmonisation of technology standards.

Strategy 2: Establish Singapore as a Centre for Infocomm Innovation in Financial Services
The ability to innovate and create new products, processes and services that anticipate and meet customers' increasing demands is critical to being a sustainable premier financial services centre. Here, the Sub-Committee recommends that Singapore:

- Drive its innovation agenda across the financial services industry through a concerted effort to create iconic projects. iN2015 will identify flagship infocomm projects that can deliver significant sector-wide benefits. These projects will help Singapore rally resources from solution providers and research institutes to develop and test new products and ideas in financial services. These products and ideas can then be exported, generating additional revenues to the infocomm industry.
- Develop capabilities within the infocomm industry to support innovation within the sector. As competitive forces intensify within the financial services industry, the ability to partner best in class specialists and solutions providers is critical to the growth of a financial institution. Here, iN2015 will foster stronger collaboration amongst financial service providers, research institutes and infocomm solution providers to jointly develop leading capabilities in the effective application of infocomm.

To capture a share of the growing wealth management market, the Sub-Committee recommends driving infocomm innovation to meet the complex needs of wealth management customers, through the implementation of an **i-Wealth Management** programme.

i-Wealth Management

This programme will use infocomm to capture new opportunities in wealth management and strengthen Singapore's position as a premier wealth management centre. In addition, through use of technology, basic wealth management services can be extended to the mass affluent to empower them to better manage their wealth. Premium financial advice can also be provided more cost effectively, enabling wealth managers to service more clients locally and across Asia.

The implementation of the programmes will extend the industry's capabilities in the areas of:

- Client service and advisory – to provide clients with multi-channel access and a 360-degree view of personalised information across different asset classes;
- Investment management – to enable better risk management as well as quicker time-to-market of innovative financial products and services; and
- Back-office processing – to improve process efficiency and cut costs.

As part of the programme, the Sub-Committee recommends that the IDA do the following:

- Work with relevant agencies to review policies where necessary to facilitate data-sharing and enable straight-through processing;
- Spur infocomm innovations in wealth management through supporting innovative pilot projects; and
- Encourage value-chain players to collaborate on implementing iconic projects in key areas of financial services.

Three projects under consideration include:

- ***360° Service Delivery***
  This involves supporting the innovative use of knowledge management and customer support technologies to provide end-users with a holistic view of their assets and personalised information. If possible, this will be made available across multiple channels. To this end, innovative pilot projects will be supported and conducive policies put in place to allow sharing of information while protecting users' needs for privacy.
- ***Paperless Fund Management***
  The aim here is to streamline fund management processing in Singapore by promoting the adoption of common international standards for financial messaging. This will help the industry save costs, cut down the time required for clearing and settlement and enable paperless front-end customer servicing.
- ***Paperless Insurance***
  This involves supporting business-to-consumer and business-to-business integration between consumers, financial advisors, insurers, brokers, re-insurers and other players through the adoption of a common platform and standards. This project will provide the industry with the new capabilities in financial advisory, real time underwriting and claims processing.

In addition to the i-Wealth Management programme, infocomm and new electronic standards could be leveraged in corporate reporting to streamline the corporate financial reporting process. This is necessary in the face of increased economic, market and regulatory pressures requiring companies to publish information to a myriad of internal and external stakeholders with greater frequency and in a variety of formats.

Streamlining the financial reporting process would facilitate financial analysis and provide consumers with greater and faster access to financial information. It will also mean greater transparency and a more efficient capital market.

This will be done through the **Corporate Financial Information Exchange** Programme.

To implement the programme, these actions will need to be taken:

- Co-ordinate efforts in taxonomy development of the standards for electronic reporting of financial information
- Engage government agencies to roll out regulatory reports using these standards
- Promote the adoption of these standards among businesses
- Engage the industry to provide value-added services for the corporate community and individual investors through supporting innovative pilot projects
- Align academic institutions to fine-tune curriculum to incorporate the necessary skills development for implementation of financial reporting

Strategy 3: Enable Commerce through a Next-generation e-Payment Infrastructure

To catalyse transactions across all sectors of the economy and create new markets such as interactive advertising, next-generation electronic payment solutions for users and businesses need to be created.

Building on its relatively mature payment market and sophisticated pool of users, Singapore can become a leader in innovative payment solutions through:

- Working closely with all parties to concertedly drive the deployment of innovative payment solutions to minimise fragmentation;
- Promoting the adoption of open standards to extend the potential for the export and growth of cross-border transactions; and
- Driving the creation of value-added services to spur online transactions and bring greater convenience to end-users.

Next-generation Electronic Payments

To realise this, the Sub-Committee recommends these initiatives to develop next-generation electronic payments solutions:

- Standards and policies should be put in place to allow innovation development and future rollout of payment solutions. Payment is a complex process which involves different parties, different payment modes and different channels. Hence payment standards will be promoted to allow inter-operability of solutions and minimise fragmentation along the payment value chain. In addition, there will be a review of policies with a view of driving greater adoption of electronic payment solutions while ensuring the security of online transactions;
- Singapore should continue to stay at the forefront of technology innovation in payments and be ready for the future implementation of new payment solutions. To this end, the development of innovative payment technologies and solutions, such as biometrics, will be supported; and
- Collaboration among electronic payment value chain players to implement nation-wide next-generation electronic payment solutions will be encouraged. The Sub-Committee recommends getting the industry involved in rolling out new mobile as well as contactless payment solutions.

To achieve the outcomes in the above strategies and programmes, the Sub-Committee recommends that IDA work closely with the Monetary Authority of Singapore, the lead agency promoting Singapore as an international financial services centre, to collaboratively engage the private sector to strategically exploit infocomm for greater competitiveness. New programmes should also be introduced as the industry evolves and new opportunities arise.

Healthcare and Biomedical Sciences

Setting the Context

Infocomm is opening up exciting new possibilities for the healthcare sector, a sector that is heavily reliant on data. The possibilities are wide-ranging – more effective patient-care; better communication between patients, doctors and other care givers; more proactive management by patients of their health with the help of monitoring systems; better medical decisions with the assistance of intelligent applications; and faster research discoveries, to name a few.

At the same time, socio-demographic trends, changing disease patterns, the explosion in biomedical knowledge and rapid advances in medical technology provide a strong impetus for changes in the healthcare system. Many of these changes will benefit from the innovative use of infocomm.

Infocomm alone, however, cannot effect these changes. The healthcare sector is a multi-faceted and complex one and infocomm can only provide the means. Strong support for change and leadership from key stakeholders in the healthcare sector is required to transform the delivery of healthcare. Also needed are concurrent changes in policies, legislation, business models and work processes.

It is in this context that the iN2015 Healthcare and Biomedical Sciences Sub-Committee deliberated on the role of infocomm in the sector towards 2015. While the primary focus was on the healthcare sector, the Sub-Committee also considered two major interfaces of biomedical sciences with healthcare – namely how infocomm can facilitate the application of new scientific discoveries to clinical medicine; and how healthcare data can support Singapore's biomedical science research thrust.

A number of developments will be likely drivers for change in the healthcare sector here towards 2015:

- **Singapore's Rapidly Greying Population**
  Singapore's population is ageing rapidly. About nine per cent is made up of senior citizens. Eighty-five per cent of this group is likely to have one or more chronic diseases that will require lifelong treatment[25].

- **Higher Demands for Relevant and Accurate Health Information**
  Today, the public and patients have access to large amounts of "information" about health, wellness and disease. However, information overload will be a growing challenge particularly where there is divergent or even wrong or misleading "health information" being provided by different sources. To facilitate and encourage the public to more proactively manage their health, it is important to provide each individual with easy access to his or her medical history and other relevant health information which can be tailored to specific needs.

- **More Fragmented Healthcare**
  Rapid advances in medical knowledge and technologies have resulted in greater specialisation and sub-specialisation of healthcare professionals. Patients with chronic diseases typically suffer from multiple medical conditions and have to consult several doctors from different disciplines. They will also be prescribed several medications to deal with all these conditions.

25 "Ministry of Health Budget Speech (Part 3) – The Elderly Chronic Sick", Dr. Balaji Sadasivan, Senior Minister of State for Information, Communication and the Arts and Health, March 2006.

- **Advances in Medical Technology and Infocomm**
  Advances in medical technology and biomedical knowledge hold the promise for more personalised treatments based on a person's medical conditions and genetic profile. Similarly, advances in infocomm can enable new healthcare delivery models. For instance, home diagnostics and remote monitoring applications can make it safe and feasible for many patients with chronic illnesses and/or physical disabilities, to be cared for at home.

In view of these developments, it is likely that several changes will occur in the healthcare system. They are:

- **Greater Responsibility by the Individual to Proactively Manage his Health**
  Many of the major chronic medical conditions are largely preventable. To achieve this, however, the individual will have to play his part with proper diet, exercise, and regular health monitoring. To help encourage him to proactively monitor his health, he should have easy access to his personal health records and other relevant health information. Such an information system can even alert the individual to the need for timely interventions based on his health screening results and medical history.

- **Shift from Treatment of Diseases to Prevention, Health Promotion and Wellness Care**
  More emphasis is expected to be placed on preventive care and health promotion. For patients with chronic non-communicable diseases, infocomm can be used to support a well-coordinated process of care which includes better long-term monitoring of test results and timely follow-up action. This will help prevent the development of serious complications which require costly and complex medical interventions and hospital admissions. Some of these patients could also be monitored from home using remote monitoring technologies.

- **Shift from Provider-centric, Fragmented Care Delivery to a More Integrated and Patient-centred System of Delivery**
  A healthcare delivery model will be developed where services are coordinated around patients' specific needs and problems. For patients requiring the care of multiple specialists and healthcare teams, infocomm, by integrating different sources of patients' information across the healthcare system, can provide doctors with a complete overview of patients' medical information, reducing the need for duplicate tests and the risks of medical errors and unintended adverse drug interactions. It can also enable the doctors to manage the patients at the right level of care delivery (right-siting). Infocomm can therefore enable cost-effective and efficient healthcare delivery.

- **Stronger Shift towards Widespread Use and Consistent Delivery of Evidence-based Medicine**
  At present, there are significant variations among doctors in care delivery for the same disease and in the management of patients, particularly those with long-term medical conditions. Infocomm systems will be critical to support the consistent delivery of evidence-based medical care for each patient on a long-term basis.

- **Greater Integration of Information between Healthcare and Biomedical Sciences**
  Spectacular advances in research technologies have led to rapid growth of medical knowledge. A major challenge however, is to gain a clearer understanding of how these may be related to human health and disease, either directly or through complex interactions with environmental factors. In turn, this could lead to fundamental insights into the genesis and development of diseases, the identification of new diagnostic or prognostic markers, and new treatment approaches.

Desired Outcomes by 2015

Taking into consideration the above drivers and their implications, the Sub-Committee has put forth the following goal for the use of infocomm in the Healthcare and Biomedical Sciences sectors: **'To accelerate sectoral transformation through an infocomm-enabled personalised healthcare delivery system to achieve high quality clinical care, service excellence, cost-effectiveness and strong clinical research'.**

This goal will help achieve the following outcomes by 2015:

- **Well-integrated Quality Healthcare**
  Infocomm systems that allow access to, and sharing of, patients' clinical and treatment data will enable different healthcare providers to work together in an integrated and coordinated manner.

  With access to patients' complete medical records, doctors can better judge the most appropriate point of care to treat the patients. This will help patients save costs in the long run.

  For a selected group of chronic diseases, remote monitoring services would be available. Patients can continue to receive the necessary medical supervision from home while saving unnecessary hospital bills.

- **Cost-effective Healthcare Services**
  Clinical decision support systems that provide point-of-care clinical practice information can assist doctors and healthcare workers with clinical decision-making. Through these systems, hospitals and clinics will be better able to deliver consistent and evidence-based care. This will help to reduce prescription and medical errors and improve clinical outcomes.

- **Greater Ability of Public to Manage their Health**
  This will be made possible through simple home infocomm systems that will proactively facilitate health promotion activities and wellness. These systems will allow individuals to search and access healthcare information from healthcare providers' portals and make a significant proportion of interactions with providers more patient-centric and convenient.

  All individuals will have a personal electronic health record which will capture and store a pre-defined set of common longitudinal medical data for each person. This would be made accessible to all healthcare providers treating the individual.

  These health records will also be integrated with the home infocomm systems, thus allowing the systems to alert the individual when there is a need for appropriate medical interventions.

- **Strong Clinical and Health Services Research**
  A conducive regulatory framework should be established to govern the collection and sharing of health data. This would facilitate both biomedical and health services research, while protecting patients' confidentiality.

  Infocomm linkages between biomedical and healthcare databases can then facilitate research and conversion of new biomedical discoveries into more effective treatments. Pharmaceutical companies can also leverage on these databases to develop more effective drugs.

Realising the Goals

Goal	To accelerate sectoral transformation through an infocomm-enabled personalised healthcare delivery system to achieve high quality clinical care, service excellence, cost-effectiveness and strong clinical research			
Outcomes	Well-integrated quality healthcare	Cost-effective healthcare services	Greater ability of public to manage their health	Strong clinical and health services research
Strategic Thrusts	Enable integrated healthcare services		Enable integration between healthcare and advances in biomedical sciences	
Strategies	Health Information Exchange – e-Enable seamless and secured information exchange in the healthcare value chain	Integrated Healthcare Continuum – e-Enable processes and linkages across the healthcare value chain	Translating Biomedical Research to Healthcare Delivery – Integrate clinical and biomedical research data	

Figure 3-15: Goal, desired outcomes and strategies for Healthcare and Biomedical Sciences sectors by 2015

As summarised by the table above, the goal and its corresponding set of outcomes can be realised through the following two strategies:

Strategy 1: Enable Integrated Healthcare Services
This strategy aims to facilitate the integration of care across different segments of the healthcare value chain from health promotion, disease prevention to primary, secondary care and step-down care.

- ***Health Information Exchange: e-Enable Seamless and Secured Information Exchange in the Healthcare Value Chain***
  Since April 2004, the Ministry of Health has implemented an Electronic Medical Records Exchange (EMRX) which has facilitated information sharing among the public hospitals. The Sub-Committee recommends that a Health Information Exchange be built on the EMRX to extend information sharing to all healthcare providers. A personal health record system can also be built within the Exchange based on a defined set of health information. In addition, the Exchange can centrally host patients' critical medical information such as medical alerts and allergies.

To achieve the above, initiatives under the Health Information Exchange include:

- ***Develop Standards and Enable Inter-operability***
  To enable inter-operability, the first step would be to put in place the necessary standards and mechanisms for exchange of information.

  A Health Information Exchange will need to be established to enable secure flow of information throughout the healthcare ecosystem.

  Besides acting as the conduit for information flow, the Exchange will need to have a 'Master Index' that will locate information from different data sources and present relevant information to doctors.

  The Exchange will also contain the Health Data Dictionary, which maintains the data standards and seamlessly updates new codes into infocomm systems.

  In addition, as part of the drive to be a global medical hub and strategic leader in healthcare, Singapore should actively participate and shape the development of international healthcare standards.

- ***Deploy Personal Health Records***
  To develop a personal health record for each individual, the minimum data set, security framework and business models will have to be defined. This record must be accessible by each individual. Information in the personal health records could include, but not be limited to medical alerts, allergies, immunisation records, disease histories (for important diseases), medication (for a defined period), hospital discharge summaries (for a defined period), results of health screening (for a defined period) and even the status of Medisave claims.

- ***Develop Necessary Medico-legal Framework***
  Concurrent to defining inter-operability standards, policies are needed to address medico-legal issues which currently impede the sharing of medical information and use of genetic information. These would include data privacy, protection and confidentiality.

- ***Integrated Healthcare Continuum: e-Enable Processes and Linkages across Healthcare Value Chain***
  Leveraging on the Health Information Exchange, an Integrated Healthcare Continuum initiative should be put in place to facilitate the transformation of care processes across the healthcare value chain. To this end, it is critical to have infocomm systems that link up the respective entities within the healthcare value chain into an integrated ecosystem. For example, to enable family physicians to be primary coordinators of care within the healthcare ecosystem for major chronic diseases by 2015, infocomm links between them and the rest of the healthcare system would be critical.

  Four initiatives have been proposed by the Sub-Committee under the Integrated Healthcare Continuum:

  - *Enable Right-siting of Care and Chronic Disease Management*
    Develop infocomm linkages that facilitate different players in the healthcare value chain – hospitals, community hospitals, family physicians, step-down care providers and patients – to work together in an integrated and coordinated manner to provide holistic care and manage chronic diseases. This will be necessary to enable delivery of healthcare services at the most appropriate level, for example, primary care for simple conditions rather than tertiary hospital care.

  - *Increase Infocomm Adoption by Family Physicians and Step-down Care Institutions*
    In order for family physicians and step-down care institutions to actively participate in the care of patients within the healthcare ecosystem, active measures would be necessary to encourage a much higher level of infocomm adoption in these facilities. In addition, processes should be streamlined to enable seamless patient referral and handing over between hospitals and these facilities.

  - *Empower the Public to Manage their Health*
    Leveraging on individuals' personal health records, remote home monitoring, sensory and tele-consulting systems can be developed to empower the public to manage their health outside of hospitals and other healthcare institutions.

    Patients with chronic, non-communicable diseases will be able to manage and monitor themselves largely at home, assisted by appropriate infocomm and monitoring technologies linked remotely to a healthcare provider and family members. Relevant health and educational information can also be pushed out to patients, tailored to their specific needs.

- *Enable Patient-centric Healthcare Services*
  Infocomm systems that enable information about patients to be available at all points of care can be developed. This will enable healthcare professionals to deliver care based on patients' specific needs and requirements.

  Integrating these patient information systems with clinical decision support systems will facilitate consistent delivery of evidence-based care and monitoring of key clinical and service outcomes.

Strategy 2: Enable Integration between Healthcare and Advances in Biomedical Sciences

The spectacular advances in basic medical sciences hold out the promise for fundamental improvements in the diagnosis, treatment and monitoring of patients. To help realise this potential, however, it is critical to greatly strengthen the links between clinical medicine and biomedical research.

- ***Translating Biomedical Research to Healthcare Delivery: Integrating Clinical with Biomedical Research Data***
  The core of this second strategy aims to facilitate the translation of new discoveries in biomedical research into clinical applications and conversely, to enable clinical data to support and drive biomedical research.

  An important factor towards achieving this is the flow of health and clinical information between the healthcare and biomedical sciences research communities.

  To this end, two initiatives have been proposed by the Sub-Committee:

  – *Develop Excellent Clinical Databases*
    Excellent clinical databases and Disease Registries can be developed to serve as a major resource for clinical, biomedical and health services research. They should be made accessible to researchers and doctors with proper systems to safeguard individuals' confidentiality and privacy.

  – *Establish Intelligent Systems to Analyse Healthcare and Genetic Data*
    Intelligent systems can be built to mine and analyse the databases and Disease Registries mentioned above. These applications would help to accelerate clinical and biomedical research. They would also greatly facilitate the regular conduct of data analyses for the purposes of clinical care quality audit and monitoring of outcomes. This would in turn facilitate the translation of biomedical discoveries into new medical treatments.

Critical Challenges

Given the scale and complexity of making transformative changes in the healthcare sector, the Sub-Committee has identified a spectrum of critical challenges which would need to be addressed for the successful implementation of the earlier stated goal and strategies – some of which will be addressed under the adjacent iN2015 initiatives. Taking into consideration the current state of infocomm adoption in the sector, these challenges include:

- Developing appropriate funding models through which the government, private sector and the public can jointly develop and sustain the national healthcare infocomm infrastructure. Appropriate funding models are critical since a major challenge of developing this infrastructure is that a few entities such as public hospitals are likely to have to bear the bulk of the costs even though the benefits will accrue to many.

- Ensuring sufficient availability of proficient healthcare infocomm manpower. As healthcare processes are very complex, re-engineering these processes will require infocomm professionals with deep healthcare domain knowledge. Such infocomm manpower is currently lacking in Singapore. This hinders the development of products and services for the healthcare sector as well as the generation of new intellectual property for the infocomm companies.

  To address this, the infocomm manpower thrust under iN2015 will put in place programmes to raise the infocomm competencies in the healthcare sector, just as will be done for the other economic sectors.

- Achieving buy-in and leadership by doctors and healthcare providers for process changes. Improving the quality and consistency of healthcare services will require healthcare providers to re-engineer many of their care processes and to work more closely together as teams. The buy-in and active leadership of physicians will be critical in order to overcome established healthcare/medical practices and resistance to change. A process of engaging and securing the support and buy-in of doctors, health professionals and medical students will be necessary. Part of this may require pilot projects to demonstrate the benefits of process changes. Appropriate incentives and policies will also be needed to facilitate change management.

- Improving public willingness to adopt infocomm for accessing healthcare services. The proposed goal and strategies will require a higher level of infocomm adoption for infocomm-enabled healthcare services. Success of the programmes will therefore hinge on the level of public infocomm acceptance and savviness, part of which are addressed under adjacent iN2015 programmes to raise infocomm literacy in the population.

  Further to these efforts, the Sub-Committee views that specific efforts will be needed to improve the public's awareness of and proficiency with new healthcare services and applications. At the same time, particular emphasis has been proposed on making infocomm interfaces as simple and intuitive as possible. Realistically, however, the process will take a long time as a significant proportion of the population is not adept in and probably uncomfortable with using infocomm. However, generational change will help address this, as the proportion of younger members of family units, to whom infocomm is a way of life, grows.

Manufacturing and Logistics

Setting the Context

The manufacturing and logistics sectors are important engines of Singapore's economy. Collectively, their contribution made up more than 30 per cent of Singapore's GDP in 2005[26]. These are also sectors that have experienced significant changes over the past decade. Forces such as globalisation, increased outsourcing and intense competition among manufacturers have compelled companies in these sectors to find ways to enhance their competitive advantage. These include shifting work to where it is best done, process optimisation and increased automation.

Such forces will continue to exist and will intensify in the next 10 years. Supply chains will become even more complex as companies source for components from more locations. Collaborative partnerships will multiply and intensify as companies need to work more closely with their partners, to react faster to customer demands and deliver products in a shorter time.

Companies will also need to cope with changes amidst a number of trends and drivers. One is greater demand from consumers for personalisation. Consumers will no longer be satisfied with mass-market products and will want to buy products that are more customised to their needs. Another is the increased security requirements of supply chains and environmental sustainability of products and manufacturing processes. Related to this, the growing threat of terrorism is also pushing governments and industry to work together to secure global supply chains.

Desired Outcomes by 2015

Singapore's manufacturing and logistics sectors need to find new sources of competitive advantage to remain relevant in the midst of all these developments. The iN2015 Manufacturing and Logistics Sub-Committee believes that the best way to do this is for Singapore to position its manufacturing and logistics sectors to strengthen its supply chain capabilities and to capture high value-added areas. It proposes that Singapore be developed into "**a supply chain nerve centre and high value manufacturing hub, powered by infocomm**".

In the Sub-Committee's vision of Singapore as a **Supply Chain Nerve Centre**, Singapore will have a world-class logistics infrastructure and be the location of choice for manufacturers to design, monitor and control their regional and global supply chains. It will be the place from which logistics companies offer services to support these activities. Supply chain activities here will become more global and strategic rather than regional and operational in nature. The sea- and air-ports will continue to maintain their global leadership as a sea container transhipment hub and an air freight transhipment hub respectively.

As a **High Value Manufacturing Hub**, Singapore companies will excel in high value-added activities such as research and product development. The innovative deployment of infocomm, such as grid technology, will also help draw more R&D activities here. The aim is to build Singapore into a location where new products can be developed and brought to market in the shortest time; the place manufacturing companies pick to deliver new business models.

Infocomm will play a key role in turning Singapore into a Supply Chain Nerve Centre. It will help provide *visibility*, *intelligence* and *flexibility* to manufacturers, logistics companies and infrastructure operators in the following manner:

- **Visibility**, through the use of sensor technologies such as RFID, enables information and physical flows to be integrated, and provides the data points for supply chain orchestration and security enhancements to be carried out;

26 "Economic Survey of Singapore First Quarter 2006", Singapore Department of Statistics, 2006; "Logistics Skills Report 2005/2006", Singapore Workforce Development Agency, 2006

- **Intelligence**, provided by optimisation algorithms, means better coordination and planning between partners, resulting in supply chain efficiencies. Technologies like grid computing coupled with powerful software will allow companies to undertake more complex manufacturing activities and move up the value chain; and
- **Flexibility**. International standards like Web Services and RosettaNet allow disparate systems to identify and connect with one another for end-to-end integration. This will also enable closer collaboration among manufacturing and logistic players, resulting in an enhanced ability to innovate and manage collaborative design and production, as well as develop new manufacturing business models.

Realising the Goal

To achieve the iN2015 Manufacturing and Logistics goal and outcomes, a number of programmes have been formulated:

Goal	A supply chain nerve centre and high value manufacturing hub, powered by infocomm	
Outcomes	Enhanced competitiveness of manufacturing and logistics sectors	
Strategies	Establish Singapore as a supply chain nerve centre	Establish Singapore as a high value manufacturing hub
Programmes/ Initiatives	• Build adaptive supply chains • Develop a national integrated infocomm platform for supply chain management • Entrench world-class status of key supply chain infrastructure	• Enable complex manufacturing capabilities

Figure 3-16: Goal, desired outcomes and strategies for Manufacturing and Logistics by 2015

Strategy 1: Establish Singapore as a Supply Chain Nerve Centre

- ***Build Adaptive Supply Chains***

  In Singapore's efforts to entrench itself as a supply chain nerve centre, the Sub-Committee recommends that assistance be provided to companies to build adaptive supply chains and grow their local pool of supply chain expertise, in order to anchor their global and regional supply chain management organisations in Singapore.

  As product lifecycles shorten and business conditions become more volatile, supply chains will need to be more flexible and responsive. At the same time, companies will also need to redesign their supply chains in order to cope with surging complexity due to outsourcing and globalisation.

  Singapore is well-placed to be a location of choice for companies to architect, integrate and coordinate different parts of the supply chain out of Singapore. In this area, the Sub-Committee has recommended putting in place an **Adaptive Supply Chain** programme.

  This programme is to help companies build and manage adaptive supply chains out of Singapore. The immediate results of this initiative are increased efficiency in supply chains and lower operating costs. This also means companies can generate additional revenue due to enhanced competitiveness.

Over the longer term, by continuously encouraging companies to improve their supply chain capabilities, Singapore can anchor their supply chain management organisations here. Using Singapore as a base, these organisations will be able to help their companies architect and coordinate regional and global supply chain activities, some of which may not even touch Singapore.

The Adaptive Supply Chain programme will comprise the following components:

- ***Catalysing innovation by raising the level of supply chain innovation and technology development in Singapore***. Such a development will attract MNCs to set up their supply chain centre of excellence here to help drive innovation in supply chains. There will also be a focus on developing systems that have industry-wide impact, such as an e-logistics system with well-defined standards that provides seamless linkages between manufacturers and their logistics providers;

- ***Linking up end-to-end supply chains***. This entails efforts to link up complete supply chains of key economic sectors, from design to manufacturing to distribution, through the use of relevant infocomm standards. It also entails cross-industry linkages, such as those between the logistics, manufacturing and finance sectors, so that there is efficient flow of information, goods and finance across these sectors that are highly dependent on each other; and

- ***Levelling up capabilities***. This helps small and medium-sized businesses to adopt supply chain technologies so that they can stay connected and nimble in the global production network.

- ***Develop a National Integrated Infocomm Platform for Supply Chain Management***
  Apart from jumpstarting the development of adaptive supply chains, the Sub-Committee also recommends an initiative to integrate all the trade information systems, bringing about a quantum leap in efficiency and innovation in supply chain management. Currently, trade information systems, such as TradeNet, Portnet and the Cargo Community Network, enable Singapore to be one of the top transhipment hubs in the world where goods moving through the country's ports can be turned around in the shortest time.

  The Sub-Committee proposes that all these disparate information systems be integrated and a common platform created for the trade and logistics community.

  To this end, the group recommends the Government to expand on existing efforts in TradeXchange. New extensions could include value-added services on the platform and new international linkages to facilitate cross-border trade flows. An example of such an international linkage is a certified channel for advanced manifest reporting to the US. This would expedite the clearance of goods through the customs.

  In this environment, manufacturers, logistics service providers, traders, banks and other supply chain partners will be able to just plug into the system and be connected to the whole business community.

- ***Entrench World-class Status of Key Supply Chain Infrastructure***
  Singapore's ports and airport have been touted as being among the best in the world and are already considered leading users of infocomm. In order to maintain their leading positions, they will however, need to continuously improve their productivity and service quality. Infocomm will be critical in enabling this.

  The **Infocomm @ Airport/Seaport** programme will leverage on infocomm to improve the efficiency, security and connectivity of these entry and exit points. This will help to strengthen Singapore's competitiveness as a major air and sea hub and boost the flow of cargo through both gateways.

Strategy 2: Establish Singapore as a High Value Manufacturing Hub

- ***Enable Complex Manufacturing Capabilities***
  To compete against low-cost locations, Singapore has to excel in more sophisticated and high value-added manufacturing activities such as product development, complex manufacturing and engineering processes. At the same time, the demand for speed by companies presents an opportunity to position Singapore as the manufacturing hub that can turn innovative ideas into quality products faster than anywhere else in the world.

  All this requires vastly improved manufacturing process capabilities. Infocomm will likely play a critical role in enabling many of these capabilities. Here, the Sub-Committee proposes driving greater adoption of new infocomm tools by companies, for instance, grid computing for computationally intensive tasks and software agents for process automation. The Sub-Committee also recommends the use of infocomm such as RFID, sensor networks and intelligent software agents to bring about more innovative and profitable business models.

  For this, the **Digital Manufacturing** programme has been proposed to drive efforts to entrench Singapore as a high-value manufacturing hub.

  This programme requires:

  – Encouraging the use of Product Lifecycle Management applications to effectively and efficiently innovate and manage products and related services throughout their entire lifecycles. Such applications can help companies significantly reduce the time and costs needed to develop a product. Quality will also be improved as they help reduce design errors. This part of the programme will focus on selected manufacturing sectors with high levels of design activities, such as offshore and marine, aerospace and high-tech manufacturing;

  – Leveraging on grid computing to allow companies to tap into powerful computing resources. Companies can have access to more powerful software for collaborative design, modelling, simulation and analysis in product development; and

  – Encouraging new manufacturing business models using infocomm. The Sub-Committee proposes that the Government work with industry organisations like the Singapore Manufacturers' Federation, thought leaders and research institutes to improve industry's awareness and to stimulate discussions of technology applications and their business possibilities. Relevant agencies and venture capitalists may also be roped in to provide necessary seed funding to realise innovative business models. Government agencies such as the IDA can also support the development of enabling platforms for new business models.

Tourism, Hospitality and Retail

Setting the Context

When service matters, technology, which is often viewed as being impersonal, is frequently relegated to the backseat. This has been the case in Singapore's tourism, hospitality and retail (THR) sector, where the emphasis is on high-touch services, and the adoption of technology is low. The companies in the sector also may not understand how technology can benefit them, or may consider its use unaffordable.

However, more people are turning to technology to turn their travel into once-in-a-lifetime experiences. They check out a destination on the Internet, make their bookings online and, where possible, use it to guide them around during a visit.

Infocomm has also been shown to help companies become more competitive by providing new ways of reaching their customers or running their operations. For instance, using the Internet, tourism service providers like small hotels and budget airlines can reach customers in a more efficient and effective way, enabling them to save cost and increase the number of customers. Retailers also use technology to link up their supply chains and enhance productivity.

Over the next 10 years, driven by increasing affluence and globalisation, the tourism industry is set to grow. Experts predict that tourism will see 1 billion visitor arrivals by 2010[27] and generate US$12 trillion of economic activity worldwide by 2016[28]. It will become increasingly necessary for destinations to enhance their attractiveness in this highly-competitive industry. Consumers are also becoming more sophisticated and discerning, and will come to expect, and demand, differentiated experiences, and faster and better service.

Although THR is ultimately a service industry, with technology becoming more ubiquitous, Singapore can leverage on infocomm to differentiate itself in several ways. These include providing more personalised services, making information more accessible and targeted, helping companies deliver improved service to their customers and enhancing their operating efficiency. Through innovative use of infocomm, Singapore can increase visitor arrivals, revenue from tourism and improve the overall productivity of the sector.

Desired Outcomes by 2015

The iN2015 goal for this sector is:

Using Infocomm to transform the Tourism, Hospitaity and Retail Sector, Differentiating Singapore as a Leading Travel Destination

Through the use of technology, Singapore can offer the visitor a more personal experience so each visitor will feel like he is enjoying premium service in the country, as his unique needs and likes are catered to in detail.

Singapore can thus differentiate itself from other destinations, especially when it comes to visitors from the BTMICE[29], leisure, healthcare and education segments.

Support will come from an integrated, efficient and competitive industry, where information and data are shared seamlessly among companies. This allows the industry's players to focus on providing the best value, service and experience to their customers.

The outcomes that will be realised through this goal are:

- A superior experience for visitors to Singapore
- Enhanced growth and competitiveness of the sector

27 "Tourism 2020 Vision", UN World Tourism Organization, 2001
28 "World Report, Travel & Tourism Climbing To New Heights, The 2006 Travel & Tourism Research", World Travel & Tourism Council, 2006
29 BTMICE: Business Travel, Meetings, Incentive Travel, Conventions & Exhibitions

Realising the Goals

Three strategies have been proposed to help the sector achieve the goal. They are outlined in the figure below.

iN2015 Tourism, Hospitality and Retail Goal:
Using infocomm to transform the tourism and retail sector, differentiating Singapore as a leading travel destination

Figure 3-17: Goal, Desired Outcomes, Strategies and Programmes for the Tourism, Hospitality and Retail Sector

Strategy 1: Create Seamless and Personalised Services for the Visitor

It is important to devise ways to attract visitors to Singapore and make their stay here a delightful and unique one. A superior experience can be accomplished by offering them intelligent and personalised services – to understand and anticipate their needs, giving them what they want, and when they want it – and by streamlining and consolidating their various interactions with service providers.

Two programmes are proposed – the Digital Concierge to provide easy access to personalised information and services, and EASE (EnAbling Speedy rEgistration) for Visitors to enable a seamless and hassle-free experience for the visitor.

Digital Concierge for Visitors

Through this personalised information service, a visitor will have access to tourism-related content and services at his finger-tips, anywhere and anytime – through his mobile device and other channels, like the Internet, a tourist kiosk and interactive television.

The Digital Concierge will integrate content from different sources – relevant government agencies, companies in the private sector and content aggregators – and deliver them in a seamless manner. Using knowledge of the visitor's needs and preferences, information and services can also be more targeted. Because of a wireless broadband network across Singapore, visitors will have nation-wide ubiquitous access to a rich variety of information and services, including location-based content.

The service will cater to all points of a trip:

Figure 3-18: Using the Digital Concierge Before, During, and After the Trip

Before a visitor arrives in Singapore, it will help to improve his experience when he is planning his trip here, capturing the growing number of travellers who do their travel research online.

While in Singapore, with hassle-free mobility and knowledge of a broad range of customised activity choices, the visitor may be stimulated to spend more or to extend his stay here.

After he has left Singapore, his experience can be extended by allowing him to relive and share his trip with his friends and family. This can help bring him back again or draw new visitors.

Using the Digital Concierge before, during and after a visitor's trip

The service can also be made available to those living here as some features will be useful for them, such as information about museums, Singapore's heritage, times of events and booking of tickets. Eventually, it can be expanded to include the other services relevant to residents, such as government services. This will further enrich the range of content and services, and help increase the overall customer base and usage.

EnAbling Speedy rEgistration (EASE) for Visitors

BTMICE is an important visitor segment for Singapore. These visitors place a high premium on convenience and speed, and they do not want to waste time waiting in queues and going through different registrations.

The objective of this programme is to streamline the interactions that BTMICE visitors have with multiple service providers, getting them from airport gate to the hotel room in 30 minutes. It provides a hassle-free experience by requiring only one point of registration and integrating service providers along the value chain, thereby enabling speedy entry into Singapore, check-in at hotels and registration at conference venues for visitors. A better experience here will encourage organisations and travellers to continue choosing Singapore for BTMICE events and activities.

The programme can start with BTMICE visitors and link up the operators catering to this market, e.g. hotels and MICE organisers. It could later be extended to other groups of visitors, such as those coming here for medical treatment.

Strategy 2: Improve Industry Efficiency

The aim of this strategy is to raise the competitiveness of the THR sector by leveraging on infocomm to boost efficiency. Technology will also help companies deliver service with greater consistency.

Technology Adoption Programme (TAP)

While technology has the potential to help companies save cost, improve productivity, provide better service and increase revenue, the extent of its investment in infocomm is ultimately a company's decision. Thus, the Government's role is not in dictating the pace and manner in which companies adopt technology, but in developing policies and mechanisms to support and promote their adoption.

A 2005 survey[30] by the Singapore Tourism Board and the IDA of 2,200 companies in the tourism industry has shown that the main factors affecting decisions to adopt infocomm are affordability and technology fit.

This programme aims to increase infocomm adoption in the THR sector through these measures:

- **Raising awareness**: This is to raise the level of knowledge among companies on how technology can help them be more competitive, to change their mindsets from "not investing in infocomm to save cost" to "investing in infocomm to stay competitive". A range of initiatives can be targeted at companies at different stages of infocomm adoption, such as providing them with information on infocomm opportunities, benefits, relevant solutions and best practices.

- **Developing infocomm skills**: This is two-pronged – to enhance the level of infocomm competency amongst users in the THR sector, and to deepen domain knowledge amongst the infocomm professionals working in this sector.

- **Encouraging infocomm use through incentives**: Some form of incentives can be formulated for companies that have a fairly low level of technology adoption, to help them get started. For instance, the Government can work with service providers on the provision of infocomm services on a utility model for common functions, such as IT facilities management, human resource processes and procurement, to help companies avoid the high initial capital outlay and buy services on a need to basis. Companies that are ready to make more sophisticated use of infocomm will be encouraged to work with infocomm companies to develop innovative solutions.

30 A total of about 2200 companies from these segments responded to the survey: Gazetted Hotels, Travel Agents, Tourist Attractions, Food & Beverage outlets, Wellness Centres/Spas, Retailers, MICE, Tourists Guides

Supply Chain Integration

Supply chain integration can boost efficiency and productivity and there have been several such efforts done in the past, particularly in the retail sector. This programme seeks to maximise the potential of supply chain integration by widening the scope of integration within the retail sector (such as pursuing different retail segments), and extending it to the tourism and hospitality sector.

In the retail industry, the Sub-Committee recommends further supply chain integration initiatives, which include:

- **Cross-consortium supply chain integration**, to further enhance efficiency among the suppliers, implementing greater standards conformance and inter-operability. It will also minimise the duplication of systems for different supply chains.

- **Extension to other retail segments**, from fast moving consumer goods in the supermarket segment to other retail segments, such as those engaged in general merchandise, fashion and consumer electronics.

- **Cross-border supply chain integration**. For retailers making forays into markets outside Singapore, this can involve the replication of local infocomm systems and applications to the retailers' overseas networks, such as using one integrated, but globally dispersed supply chain that serves their domestic and regional business needs.

Strategy 3: Extend to New Areas

The strategy is to grow the THR sector by creating new products to attract new customers. One way is through the use of infocomm to create innovative infocomm-themed entertainment and experiences, resulting in more attractions to support Singapore as a compelling travel destination.

New attractions will also help to create buzz and generate continued interest in the local tourism industry, making it more dynamic and vibrant. It can also leverage on the IDA's efforts to build up the digital media sector in Singapore, with new attractions being formed through the convergence of infocomm technologies, digital media and local culture in a real physical setting.

Implementation Approach

The programmes outlined in this chapter will leverage on the recommendations proposed by the other Sub-Committees, and will need to integrate with the efforts in other sectors. For instance, the deployment of an affordable nation-wide infrastructure like a wireless network and location-based services in areas frequented by visitors will enable the Digital Concierge service to be more accessible to its users. Implementation of a mobile payment system will allow easy transactions of services via mobile devices. The development of infocomm-themed attractions and content for the Digital Concierge will leverage on efforts to develop Singapore's Digital Media and Entertainment sector.

The Sub-Committee recommends that the Government and private sector work in close partnership, not only in the implementation of these programmes but also to continually seek opportunities and exploit the latest technology, to transform the sector and differentiate Singapore as a leading destination.

Government

Setting the Context

The Singapore Government's infocomm journey began in the early 1980s with the Civil Service Computerisation Programme. This focused on raising the efficiency of internal operations through the automation of traditional work functions.

The late 1990s saw the convergence of information technology and telecommunications which transformed the concept of service delivery. This paved the way for the launch of the two e-Government Action Plans (eGAP) in the year 2000 and 2003 respectively. Under eGAP, a total of 1,600 public services were made available online. Today, Singapore leads in e-Government globally, and infocomm continues to bring about exciting changes to the way the Government serves and interacts with its constituents.

Key Drivers and their Implications

In formulating the strategies for its latest five-year plan, the iGov2010 Project Steering Committee examined both internal and external drivers that have an impact on Government services and operations:

- More infocomm-savvy customers and citizens are benchmarking Government e-services against world-class electronic service providers;
- Infocomm is becoming an integral part of peoples' lives, and the online medium has become the medium of choice for communication;
- Singapore is facing increasing competition worldwide for resources and investments, from regional giants like China, South Korea and Japan; and
- There is a renewed focus world-wide on re-engineering internal processes and systems to improve the efficiency and effectiveness of Government operations.

Desired Outcomes by 2010

The Committee's vision for iGov2010 is to be **an Integrated Government (iGov) that delights customers and connects citizens through infocomm**.

The Committee aims to achieve the following by 2010:

- 8 out of 10 users being very satisfied with the quality of its electronic services;
- 8 out of 10 users being very satisfied with the level of clarity and usefulness of online information on government policies, programmes and initiatives; and
- 9 out of 10 users recommending others to transact with the Government electronically.

Realising the Goals

The strategies over the next five years map out how the Government would use infocomm to enable it to better serve its citizens and customers.

iGov2010 Goal:
To be an Integrated Government that delights customers and connects citizens through infocomm

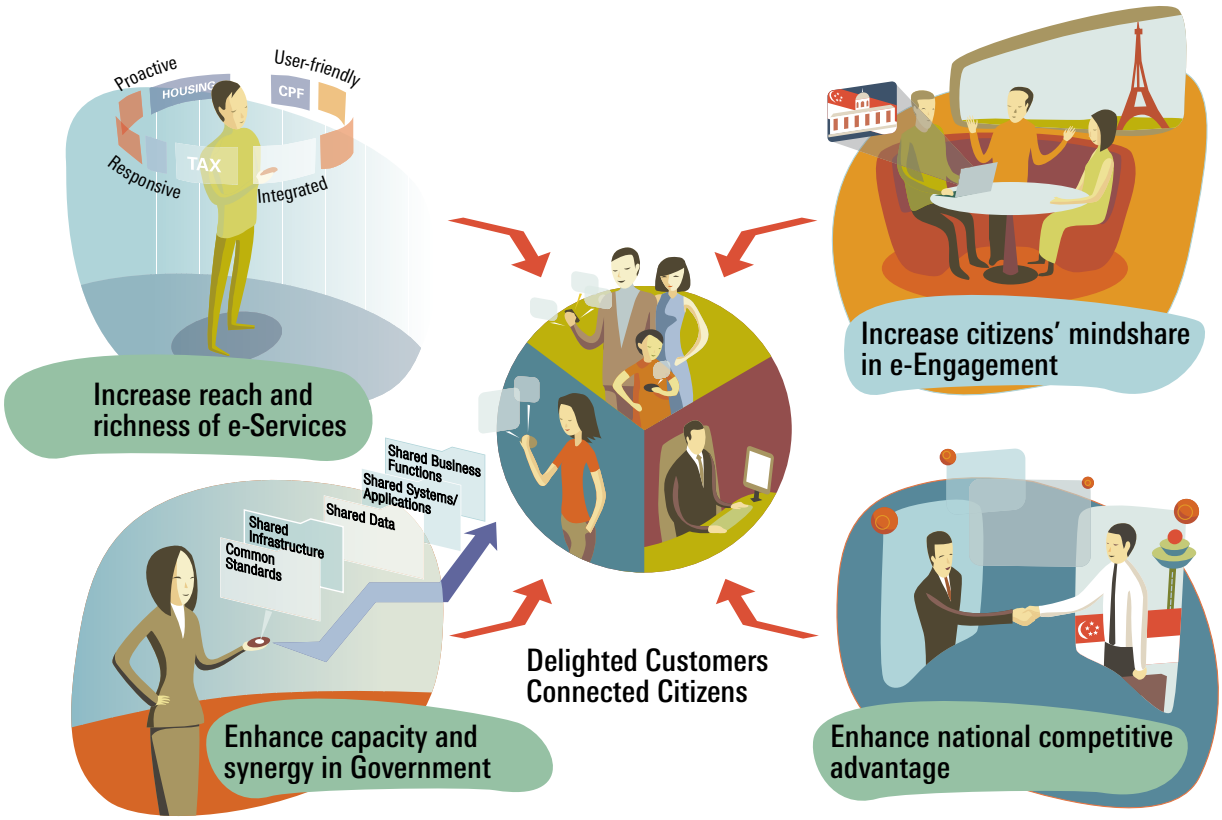

Figure 3-19: Goal, Desired Outcomes and Strategies for iGov2010

Strategy 1: Increasing Reach and Richness of e-Services
The Committee recommends that the Government focus on improving the quality of e-services and increasing the use of these e-services by:

- ***Developing Insights to Enhance e-Services to Customers***
  To bring about effective service transformation, the Government, under the **Know Our Customers Better** programme, will need to develop a good understanding of the needs and preferences of its customers, from a whole of government perspective.

  Today, each public agency on its own has a good knowledge of its customers. To be able to further leverage on this knowledge, the Committee suggests the implementation of integrated systems across public agencies to develop better insights into the needs of customers as a whole. These insights can then be studied and used to configure "smart" e-services targeted at specific groups, such as youths, senior citizens, overseas Singaporeans or businesses.

  For businesses, the Government will introduce a unique identification number for each establishment. This will allow the Government to further improve its coordination of the needs of each establishment that it registers or licenses. With such an identification, establishments will enjoy simpler, faster and easier interactions with different public agencies.

- ***Delivering Proactive, Responsive, User-friendly and Integrated e-Services***
  The Committee also envisions enhancing and simplifying Government e-services to make it easier for customers to use them. To do this, it proposes the revamp of the My.eCitizen personalised portal to offer new features, such as a single log-in to access all e-services, and the option to view all recent and past interactions with the Government. A similar portal for businesses, My.eBusiness, should also be created to deliver personalised information and e-services to businesses.

  Under the **Transact on the Move** programme, the Government will implement new mobile services that will make transacting with the Government a breeze. Customers will need to only remember one SMS number and use only one SMS message format to carry out transactions with all public agencies.

- ***Extending the Reach of e-Services***
  To extend the reach of Government e-services, several initiatives are recommended under the **Access for All** programme. Firstly, the Committee recommends that the Government capitalises on Singapore's high mobile phone penetration rate by making its services available over the mobile channel. Secondly, the Government will set up infocomm facilities with dedicated service staff in the form of CitizenConnect centres in neighbourhood Community Clubs to reach those without Internet access from home or need help to transact electronically. Lastly, publicity programmes will be put in place to raise customers' awareness of available e-services so that they can easily recall which service to use when they need them.

Strategy 2: Increasing Citizens' Mindshare in e-Engagement

Connecting with citizens involves the strengthening of Government-citizen relations, and engaging them as an integral part of the process of formulating public policies.

The Committee recognises that in this area, infocomm is only an enabler and the focus should be on how it can support the Government's overall efforts in engaging citizens, particularly in the provision of public information, supporting public consultations and the gathering of feedback.

To raise citizens' awareness and bring to their attention government efforts in engaging them online, the Committee suggests that the Government, undertake a **Connect with Citizens** programme. This programme should focus on two areas:

- ***Deliver Clear and Useful Information Online in a Vibrant and Interesting Manner***
  The Singapore Government Online (www.gov.sg) portal will have an improved look-and-feel, better content search facilities, and most importantly, clearer presentation of information on Government policies, programmes and services. Illustrations and bite-size video snippets could be used to bring across messages in a more vivid manner.

- ***Attract Participation in Online Public Consultations and Feedback***
  To encourage more participation, efforts will be made to reach out to new groups of customers online. To do this, the Government Consultation Portal will be enhanced. A Government-to-Business Consultation space and an Overseas Singaporeans Portal will be introduced to better engage the business community and citizens overseas respectively. These efforts will complement non-electronic attempts to engage citizens, to move the Government-citizen relationship to the next level – to get people actively engaged in the policy-making process.

Strategy 3: Enhancing Capacity and Synergy in Government

To create an integrated and synergistic Government, three initiatives are proposed:

- ***Create Synergy through Shared Data, Processes and Systems***

  Under the **Create Value through Sharing** programme, the Committee encourages greater sharing of processes, data and systems across the Government, so as to realise synergies that will increase the capacity and capability of public agencies.

  Mapping the way to greater efficiencies will be the Singapore Government Enterprise Architecture (SGEA), a blueprint to identify potential business areas for inter-agency collaboration. It will also set data and application standards to facilitate sharing of information and systems across public agencies.

- ***Enrich Public Officers' Work Experience through Innovative Use of Infocomm***

  Another way of enhancing the Government's capacity is to leverage on infocomm to raise the capabilities of public officers. Infocomm will be exploited to transform the way public officers work, and to create solutions that address the common challenges they face.

  This **i-Powered Public Employee** programme will feature a technology showcase to help the public officers conceptualise and visualise how they can make use of new tools such as intuitive computer desktops and computing devices to improve the way they work. Another initiative to be explored here will be a virtual employee workspace with the necessary tools that facilitate collaboration and knowledge sharing across public agencies.

- ***Foster Innovative Ways of Using Infocomm in the Public Sector***

  The Singapore Government has built a reputation for being a leading adopter of innovative technologies. There is a need to foster an environment that continues to support the generation of new ideas and the innovative use of infocomm.

  To do this, a **Crucible for Innovation** programme will be launched to encourage and reward efforts to innovate, and allow public agencies to benchmark their efforts against others. Regular scans and updates of new infocomm initiatives in the public and private sectors will be conducted.

  At the same time, forums will be held where experiences and case studies can be shared. In addition, funds for technology trials of new technology or innovative ideas will be provided.

Strategy 4: Enhancing National Competitive Advantage

At the national level, iGov2010 will also contribute towards creating a strategic competitive advantage for Singapore. The Government can help boost the growth of the private sector, especially the infocomm industry, through partnerships in innovative projects.

Government efforts in iGov2010 can also be made to create a pro-business environment that attracts investors to Singapore and promotes Government-to-Government collaborations.

To strengthen Singapore's global position as one of the best environments for businesses and to anchor more businesses, the Committee proposes a focus on the following areas:

- ***Sectoral Transformation***

  Public agencies play an important role under iN2015 in supporting the transformation of key economic sectors like logistics, healthcare and education with infocomm. For example, in the logistics sector, the Government is a major player in the TradeXchange project in driving the transformation in that sector. This integrated infocomm platform will have a single web interface to all trade-related infocomm systems to facilitate the exchange of commercial and regulatory data throughout the entire trade and logistics value chain.

- ***Collaboration with the Infocomm Industry***
  Public agencies will be called upon to play a major role in boosting the development of infocomm enterprises. To deepen their collaboration with the infocomm industry in the co-creation, development and export of iGov solutions, a **Partnerships with Private Sector** programme will be conceived.

  Where feasible, public agencies will be encouraged to release the intellectual property rights of solutions and systems to the industry to market abroad, to help Singapore's infocomm enterprises expand overseas, and make their mark on the global stage.

  To aid the national effort to create, brand and market "Made-by-Singapore" products and services, they will provide domain expertise to help commercialise these products and help the industry work on new intellectual property.

- ***Showcasing and Promoting iGov Solutions***
  The Committee suggests that the Government build on Singapore's reputation as a centre of excellence by actively showcasing and promoting Singapore's iGov expertise and solutions to the world. Under the **iGov Global Showcase** programme, the Government can also explore ways for Singapore to lead in the development of cross-border infocomm initiatives with other like-minded countries.

Key Enablers

Three key enablers that cut across and support all the four thrusts of iGov2010 have also been identified. These are Infocomm Management and Governance, Public Sector Infocomm Competency Development and Infocomm Security and Infrastructure. Together with the strategies defined, these will help to realise the achievement of the iGov2010 vision.

Under **Infocomm Management and Governance**, there will be committees and strategy owners appointed to ensure smooth implementation of the overall plan and specific programmes. Best practices and methodologies will also be developed and promulgated to guide public agencies to better manage their infocomm investments.

To facilitate **Public Sector Infocomm Competency Development**, courses and seminars will be organised to equip public servants with the skills to appreciate, understand and implement iGov2010 initiatives. An iGov Competency Framework will also be developed to map out the competency needs.

In the area of **Infocomm Security and Infrastructure**, the Infocomm Security Masterplan and the National Authentication Framework are two programmes that will contribute towards addressing the security considerations. The Government is also working on implementing a Standardised Operating Environment that will provide public employees with the computer desktop, network and messaging services that they require for their work. It will also allow for central control of infocomm assets and the management of security policies, ensuring the nimbleness and security of the infocomm environment that supports the Government.

Society

Setting the Context

The iN2015 vision goes beyond enhancing the economic competitiveness of the nation and infocomm industry. It is also about enriching lives by delivering personalised services to make infocomm more relevant. And because it is important that everyone benefits from these new services, iN2015 strives to develop a digitally inclusive society – one which ensures infocomm access and competencies for all.

In the World Economic Forum Global Information Technology Report 2005-2006, Singapore was ranked 1st in individuals' readiness to use infocomm but ranked 14th in actual infocomm usage. This reflects a gap between individuals' capacity and actual usage of infocomm. A recent IDA survey also revealed that close to 26 per cent of households do not have a computer at home. Of these households, a third cited "lack of skills" as a reason[31].

Clearly, not everyone in society today is equipped to benefit fully from infocomm. A digital divide exists between the tech-savvy and those less comfortable with infocomm. Yet another gap exists between those who can afford a host of the latest gadgets and those without the financial means to afford a basic computer at home.

As infocomm becomes increasingly embedded within the workings and infrastructure of society, those who fall on the wrong side of this divide will become increasingly disadvantaged.

This could be the elderly patient who wastes time queuing at the hospital because he does not know how to operate a home monitoring device for chronic disease. It could also be the student who misses out on interactive learning experiences because his parents are too cash-strapped to buy a computer for the home.

To ensure that no one is left behind, the Committee has proposed initiatives to reach out to all facets of society, among them the elderly, the needy and persons with disabilities. With the right programmes and a targeted approach, infocomm can become a powerful leveller to build a digitally inclusive society and enrich all lives.

Desired Outcomes by 2015

As such, the Committee proposes the following goal and outcomes:

Goal	An All-inclusive Digital Society			
Outcomes	Society is equipped with the necessary infocomm competencies and is well-connected through infocomm	No student is denied a computer and Internet access because of lack of funds	People with disabilities are able to integrate with the mainstream workforce through the help of infocomm	Society uses infocomm pervasively to enrich lives

Figure 3-20: Goal and desired outcomes for Society by 2015

31 Annual Survey on Infocomm Usage in Households and by Individuals 2005, IDA

Realising the Goals

To realise all these, the Committee has proposed the strategies below:

Strategy 1: Bridging the Digital Divide

A concerted effort is required to create an all-inclusive society that can use infocomm proficiently to benefit all. To bridge the digital divide, the Committee recommends specific steps to engage society at different levels.

Engaging the Elderly

Singapore is a rapidly ageing society, where the proportion of elderly persons will continue to grow. With this comes mobility concerns, an increased prevalence of disease, a heavy burden on the young to care for their aged parents, and possible alienation of the elderly from the rest of society. To this end, infocomm can play an important role in helping the elderly lead more independent and fulfilling lives by facilitating home health monitoring, shopping from home, online learning or communication with friends and loved ones.

- The Government has set up Seniors@eCitizen, a new one-stop information portal to cater for the elderly and their caretakers. Seniors@eCitizen provides data from information on health-care services to grandparenting tips to selling their HDB flats. For caregivers, the portal contains useful tips on interacting with the elderly and a comprehensive guide to caregiver services, such as caring for people with dementia. This portal will be constantly updated to serve as a useful gateway to resources for the elderly and their caregivers.

- Training programmes will be customised to the needs, mobility and abilities of the elderly to make them feel more comfortable with using technology. This includes teaching them how to use devices like mobile phones, and applications such as Voice over Internet Protocol (VoIP) and instant messaging to communicate with their loved ones overseas. It will also introduce them to services that will simplify and enrich their lives, such as bill payments through booths or the Internet, pre-registrations to avoid queuing, e-purchases and home deliveries of groceries, Internet and phone taxi booking services, as well as e-learning to enable lifelong learning at their own pace. These courses could be conducted at community centres or senior citizen corners close to their homes and at a slower pace to suit their learning needs.

Equipping the Needy Students

Infocomm promises new and exciting possibilities to motivate and engage learners, and to enable learning outside their classrooms. Unfortunately, not every family can afford to purchase a computer for their children. The Committee aims to turn this around by setting a target to achieve 100 per cent computer ownership in homes with school-going children by year 2015. Since 1999, through the **NEU PC programme** the IDA has helped to provide computers to over 19,000 less privileged households, out of which about 75% are with school-going children.

- The NEU PC programme currently provides for a new computer and a free one-year dial-up access. The programme will be improved to meet the needs of students, in line with the growing sophistication of technology. For instance, NEU PC will look at providing broadband connection for faster Internet speeds.

- This programme will be expanded to cover more needy families. While it currently relies on such families to come forward, a more pro-active approach will be adopted in which all families with school-going children below a certain income level will automatically qualify.

- To make the computers more affordable for eligible students, the IDA will collaborate with the Ministry of Education and self-help groups to further offset costs. Students should also be allowed to "earn" their computers by rendering their services for community work. For starters, they could serve as e-ambassadors at community centres to help the elderly learn how to use instant messaging or e-services.

Empowering People with Disabilities

The disabled community forms another segment of our society that can benefit significantly from technology. Infocomm can widen the opportunities for this special group so that they too can enjoy what the able-bodied population often takes for granted. This ranges from taking care of their day-to-day problems like accessibility to helping them lead a more fulfilling life by enhancing their employability and connecting them with others. By doing so, infocomm will help to create a global and seamless world for people with disabilities and integrate them into society via meaningful employment.

- A major obstacle faced by people with disabilities is accessibility to places. Mobility for the wheelchair-bound can be enhanced, if they have access to location-based services and maps that detail all the accessibility points in Singapore fitted with ramps. The IDA could help fund the development of these services and maps, and involve students from the Infocomm Clubs or NEU PC programme in this project to create awareness and draw different segments of our population together.

- Relevant assistive technologies can improve the lives and employability of people with disabilities, such as Internet-to-Braille conversion hardware and voice recognition software for the blind. To this end, the IDA will work with the National Council of Social Service (NCSS) to identify new assistive technologies that could be brought to Singapore. Such efforts could potentially tap on the Government's Assistive Technology Fund, which provides financial assistance to the disabled community.

- Technology can thus be used to enable this community to take on existing jobs they otherwise could not, or to redesign jobs that they could then readily perform. For example, this community could be trained as an alternative workforce to perform data entry and other business process outsourcing functions.

- In addition, infocomm can be a direct creator of jobs. The IDA would work with BizLink, an organisation that reaches out to people with disabilities in Singapore[32], to look into setting up a Media Content Digitisation workshop where some in the disabled community can perform digital conversion. This would engage them in the national effort to promote Interactive and Digital Media, as well as our iN2015 vision of becoming a digital media and entertainment capital.

- To help people with disabilities integrate into the mainstream community and workforce, two types of training could be provided. The first will comprise general infocomm training courses to improve their quality of life. Like with other segments of the able-bodied population, technologies such as Voice over Internet Protocol (VoIP) could be introduced to empower this group and connect them with others. The second sort of infocomm training would be for specific jobs, such as in the field of digital content conversion. Some of them could attend courses conducted at the training schools together with the mainstream students. Alternatively, lecturers could be brought in to conduct on-site training at BizLink workshops. Training certifications could be issued to allow this segment of the population to use their new skills and qualifications to take on jobs in mainstream society.

- Infocomm can also be a powerful tool in building a community among people with disabilities and connecting them to the rest of the world. Taking a cue from the popularity of blogging and online communities today, a website could be established for them to exchange ideas, inspire one another and learn about the lifestyle of others around the world who are in the same boat. This website could serve too as a job matching site where they are able to post their resumes online. It could also include a marketing portal to promote their fund-raising handicrafts to companies for use as corporate gifts.

32 Bizlink also provides training, support services and help in setting up workshops for people with disabilities

Providing Access for All

- Currently administered by the Ministry of Finance and the People's Association (PA), iGov2010's CitizenConnect programme aims to provide convenience and accessibility for the public to transact with the Government through the Internet. This programme offers free Internet access and on-site support at community centres to help citizens and residents access the eCitizen portal and perform online transactions with Government agencies.

Strategy 2: Enriching Lives

Besides efforts to bridge the digital divide, iN2015 is also about enriching lives for society as a whole. Not only will iN2015 create the additional 80,000 jobs as described under the infocomm manpower thrust, the infocomm infrastructure developed will also be used to deploy new services that are more personalised and user-centred.

Personalised Information to Anyone, Anytime, Anywhere

- The **Digital Concierge** service will allow citizens and visitors to access personalised, location-based information and make transactions on-demand, anytime, and anywhere. It will integrate across the public and private sectors to offer content that is customised to each individual's needs and preferences.

- The Government could work with content providers to deliver relevant information, as well as ensure the availability of an electronic payment infrastructure and location-based services. With such infrastructure and services, citizens would be able to carry out transactions with the Government anywhere and anytime through new mobile government services. This will be especially useful when reporting incidents involving the environment and security.

User-centred Services

- **Healthcare** will become more personalised as a result of more integrated and patient-centred healthcare delivery. This involves integrating information from different sources on each person's health into one electronic file. With a complete overview of the patient's medical history, doctors can then provide treatment based on each patient's specific problems and needs. In addition, home monitoring systems will enable selected patients to manage chronic diseases like diabetes from home, saving them both time and money. Interacting with health providers will become more convenient through home infocomm systems, where individuals can access their electronic personal health records. The home infocomm system will also send electronic medical alerts and reminders of tests and health screenings so that individuals can proactively manage their own health.

- **Education and learning** experiences too will be customised to individual learning styles and aptitudes. The EdVantage programme aims to use infocomm to provide a learner-centred, collaborative environment that extends beyond the classroom. This includes equipping all students with a Personal Learning Device for learning anytime, anywhere. With engaging digital learning resources like interactive textbooks and online exchanges, students can also pick up knowledge more independently and in their preferred learning style.

CHAPTER 4
CONCLUSION

Conclusion

Barely a day goes by without new developments in infocomm. Whatever the advances in computing, communications or other fields of infocomm, one thing is certain – Singapore's world of 2015 will be one where there will be more infocomm choices. These choices will seem more bewildering than those we face today.

There are opportunities for the taking here though. If we are intimidated by these choices, then we will not be able to use infocomm to our advantage. On the other hand, if we understand and grasp the implications of infocomm, the choices we as a nation make in creating and capitalising on infocomm can greatly bolster our success over the next decade. This is why continuous dialogue on the impact of infocomm is necessary.

The iN2015 vision is a starting point for this discussion. It paints a picture of what Singapore could be in 2015 taking into account what is known of infocomm developments, and the country's anticipated economic and social needs.

It also lists goals which act as a broad guide for Singapore as it strives to be a leader in exploiting infocomm for the economy and society.

The Republic aims to double the value-added of its infocomm industry, triple the industry's export revenue and increase the number of infocomm positions and supporting jobs in the infocomm industry by 80,000.

One thing is sure: infocomm will enrich lives. This is because the Committee is targeting to put a computer in every home with school-going children. Singapore will achieve at least 90 per cent broadband usage in homes.

These recommendations are bold proposals to transform Singapore so it can achieve these aspirations.

The Committee acknowledges that some assumptions in this report will change over time. How proactively Singapore manages this change will determine how much brighter this vision will be, and indeed, how much sooner it can be realised.

The Committee invites all readers, whether in Singapore or elsewhere, to be part of this ongoing process of managing change. Each of you is invited to help determine the eventual result of the iN2015 vision, in the same way you helped shape the vision put forward in this report.

Only then, can Singapore realise its goal of being "An Intelligent Nation, a Global City, powered by Infocomm".

Annex A: Overview of iN2015 Programmes

No.	Programmes	Brief Description
Spearhead Transformation of Key Economic Sectors, Government and Society through More Sophisticated and Innovative Use of Infocomm		
Digital Media and Entertainment		
1	Digital Assets Marketplace	The Digital Assets Marketplace programme aims to put in place advanced technical, business, financial and service infrastructure, to enable hubbing, management, trading, brokering and distribution of digital assets to be conducted in and through Singapore.
2	DME Technology Research and Development (DME-TRD)	The DME Technology Research and Development programme aims to make Singapore a global centre of excellence for DME technology and research & development. The DME-TRD programme will commence with technology and resource development activities in Singapore, focusing initially on games and branching out subsequently to other digital media types such as animation and special effects.
Education and Learning		
3	EdVantage	EdVantage aims to strategically deploy infocomm in Education to provide a learner-centric, collaborative environment that extends beyond the classrooms, thereby enabling a diverse and vibrant schools landscape in the use of infocomm. The EdVantage programme will comprise three components – iACCESS, iLEARN and iEXPERIENCE. • iACCESS will enable a pervasive and cost-effective infocomm access for learning, anytime and anywhere; • iLEARN will provide interactive digital resources for independent learning; and • iEXPERIENCE will empower learners through collaborative, intelligent applications that are adaptable to different learning styles. All schools will be competent users of infocomm. Among them, 15-20 per cent (*Experimental Schools*) will be test-beds for the innovative use of infocomm in teaching and learning. Another five per cent (*Schools of the Future*) will be exemplary in their integration of infocomm into learning, while experimenting with emergent technologies that will become more widely used in the future.

No.	Programmes	Brief Description
Financial Services		
4	i-Wealth Management	The programme seeks to leverage infocomm to capture the growing wealth management market and strengthen Singapore's position as the premier wealth management centre. Plans include the use of infocomm to extend the industry's capabilities in: • Client service & advisory: to provide a 360° view of personalised information across different asset classes to users; • Investment management & product development: to enable better risk management as well as quicker time-to-market of innovative financial products and services; and • Back office operations: to enable Straight-Through-Processing Three projects under consideration include: • 360° Service Delivery: to allow innovative use of customer management and customer support technologies to provide end-users with a holistic view of their assets and personalised information; • Paperless fund management: to streamline fund management processing in Singapore through promoting the adoption of a common standard for financial messaging; and • Paperless insurance: to support B2C and B2B integration between consumer, financial advisors, insurers, brokers, re-insurers and other value chain players through adoption of common platform and standards.
5	Corporate Financial Information Exchange	The programme seeks to leverage infocomm to streamline financial reporting process and facilitate financial analysis. As part of implementation, the following will be undertaken: • Co-ordinate efforts in taxonomy development of the standards for electronic reporting of financial information; • Work with government agencies to rollout regulatory and tax reporting using XBRL; • Engage the industry to provide value-added services on top of the platform for the corporate community and individual investors through supporting innovative pilots; and • Align academic institutions to fine-tune curriculum to incorporate the necessary skill development for implementation of financial reporting.

No.	Programmes	Brief Description
6	Next-generation Electronic Payments Programme	The programme aims to support the development of a nation-wide electronic and mobile payment infrastructure. As part of the programme, relevant government agencies and industry will work together to: • Ensure that the right standards and policies are put in place through co-ordinating payment standards and reviewing government policies; • Support the development and piloting of innovative payment solutions; and • Encourage collaboration amongst electronic payment value chain players to implement new payment solutions.
Government		
7	Know our Customers Better	This programme seeks to gain insights into customers' needs, and strengthen customer-centricity in service delivery through greater proactiveness, responsiveness, as well as more personalisation and integration.
8	Transact on the Move	This programme will oversee the delivery of services through mobile technologies so as to make Government e-services more accessible to a larger population, and open possibilities for new innovative services that were not possible before with other channels such as the Internet or counters.
9	Access for All	This programme will extend the reach of e-services to customers who have no Internet access or have difficulties transacting electronically on their own.
10	Connect with Citizens	This programme will: • Increase the "attractiveness" of government websites with the intended outcome for government websites to be citizens' preferred source for government information; and • Raise citizens' awareness of government's consultation efforts, and make it more accessible and convenient for citizens to give their views and feedback through government e-channels
11	Create Value through Sharing	This programme seeks to reap synergies and efficiencies through the sharing of data, processes and systems.
12	i-Powered Public Employee	This programme will develop a high performance employee workspace with next-generation desktop applications. It will build upon the vision of a knowledge enterprise and implementation of knowledge management initiatives, so as to enhance public officers' capacities and productivity.
13	Crucible for Infocomm Innovation	This programme aims to foster an environment for innovative exploitation of infocomm in the public sector, such as through infocomm scans and trials for innovation ideas, setting up of incentives, and sharing of technology exploitation experiences.
14	Partnerships with Private Sector	This programme seeks to make Singapore a great place for businesses and enhance economic competitiveness. Public agencies will work and collaborate with the infocomm industry in the co-creation, development and export of iGov solutions.
15	iGov Global Showcase	This programme seeks to build up Singapore's reputation as a centre of excellence and test-bed for iGov solutions by showcasing and promoting the Singapore iGov brand name, expertise and solutions globally and position Singapore as a place of choice to live, work and do business.

No.	Programmes	Brief Description
Healthcare and Biomedical Sciences		
16	Health Information Exchange	The programme aims to build a seamless and secured information exchange by establishing standards on data and information exchange across healthcare providers, and standards and practices for data privacy and confidentiality. IDA will also work with the Ministry of Health on defining policies for resolving medico-legal issues which currently impede the sharing of medical information. With the standards in place, IDA will then build linkages among the different databanks through an information exchange which will also include a master index that provides references to all databanks. This programme will also define a clinical dataset accessible by healthcare providers and a minimum set of longitudinal medical records to be kept for each individual.
17	Integrated Healthcare Continuum	To integrate care across the healthcare value chain, this programme aims to link up systems in different parts of the healthcare value chain into an integrated whole. Such a network will enable right-siting of care where patients are cared for at the most appropriate point with the most appropriate treatment. It will entail re-engineering primary care, step-down care and hospital processes to enable easy patient referral and increasing the infocomm adoption of family physicians and step-down care facilities. Further out, the programme will also empower members of the public to proactively keep themselves healthy. Patients with chronic, non-communicable diseases will also be able to manage and monitor themselves largely at home, assisted by appropriate infocomm and monitoring technologies linked remotely to a healthcare provider and family members. This programme will also enable the delivery of patient-centric healthcare services by providing complete patient health information at all points of care and integrating patient information with clinical decision support systems to ensure consistent delivery of care.
18	Translating Biomedical Research to Healthcare Delivery	This programme aims to facilitate the translation of new discoveries in biomedical research into clinical applications and conversely, to enable clinical data to support and drive biomedical research. This programme will enable the healthcare and biomedical research communities to tap on each other's databases. Such access will enable doctors to tailor personalised treatments for patients by integrating clinical information for specific patients and their family history, and stratifying them into accepted risk profile and treatment groups. These will be supplemented by genetic and/or biomarker profiles from biomedical research that can further improve stratification and choice of therapies. Doctors can also analyse different care paths to identify the most effective treatment protocol. This will facilitate the translation of new scientific discoveries into useful clinical applications. From the researcher perspective, providing access to healthcare databases by biomedical researchers will help move Singapore towards a more vibrant research environment.

No.	Programmes	Brief Description
Manufacturing and Logistics		
19	Adaptive Supply Chain	This programme aims to help companies build and manage adaptive supply chains out of Singapore. It will encourage companies to develop more effective supply chain processes and technologies, link up major networks of companies using supply chain and infocomm standards, and assist smaller companies to boost their supply chain capabilities using infocomm. Companies can also tap on this programme to pilot new processes and technologies in Singapore, develop local expertise and leverage them to roll out to their regional network. They will also benefit from being better integrated to their suppliers, service providers, customers and partners here in Singapore.
20	TradeXchange and Value-added Services	This programme will integrate the existing national trade information systems into one single platform. It will also work with industry to develop value-added services on top of this platform. With this single, integrated platform for all transactions, businesses will find it easier to carry out international trade from Singapore. Such a platform will also enhance the reach of third-party service providers. Users of this platform can therefore enjoy a greater selection of such value-added services.
21	Infocomm @ Airport/Seaport	This programme plans to give Singapore's ports and airport, which are already world leaders, an even bigger edge over their competitors. The Infocomm @ Airport/Seaport programme will see the improvement of business processes and development of new services through infocomm. It could also include the mass deployment and trials of new technologies that would have industry-wide impact, e.g. piloting of RFID at seaports and airport. Given the threat of terrorism in recent years, some of these services could focus on improving the security of trade and transport linkages between Singapore and other countries. Over time, these efforts will strengthen our position as a preferred transhipment hub for both air and sea cargo because of our ability to use infocomm to address security concerns. Technology providers will also benefit from using this world-class infrastructure as reference sites to pilot new solutions.
22	Digital Manufacturing	To stay competitive against the low-cost manufacturing locations, this programme aims to help manufacturers build up complex manufacturing know-how through infocomm. Product development is one such area that we can focus on. This programme will help build Singapore's reputation as a fast innovation manufacturing hub, where companies' ideas can be rapidly turned into marketable products. The IDA will work with manufacturers to implement infocomm that will grow Singapore's capabilities in product development, e.g. Product Lifecycle Management applications. Powerful modelling and simulation software will be made accessible and affordable for most companies over the national grid. This will further spur companies' product design capability. Beyond product development, companies will also be encouraged to look into new business models that are made possible by advances in infocomm.

No.	Programmes	Brief Description
Tourism, Hospitality and Retail		
23	Digital Concierge for Visitors	This programme aims to offer every visitor his "own concierge", with access to information anywhere, anytime. It will anticipate the visitor's needs and preferences, providing personalised services to him. For example, he will receive location-based information of his favourite retail stores, get suggestions on the places to visit, and make bookings while on the move, helping him optimise time that he has in Singapore.
24	Enabling Speedy Registration (EASE) for Visitors	The objective of this programme is to streamline the interactions that BTMICE visitors have with multiple service providers. It provides a hassle-free experience by requiring only one point of registration and integrating service providers along the value chain. It is expected that a better experience here will encourage organisations and travellers to continue choosing Singapore for their BTMICE activities.
25	Technology Adoption	In collaboration with SPRING and STB, the aim of this programme is to increase infocomm adoption in the THR sector through (a) working with associations to raise awareness by holding seminars and sharing best practices; (b) developing infocomm skill competencies; and (c) incentivising infocomm use.
26	Supply Chain Integration	For the retail industry, this programme will build on existing efforts in Electronic Supply Chain Management (eSCM) implementation. In this aspect, the programme will target the large retailers to promote the adoption of technologies such as Collaborative Planning Forecasting and Replenishment (CPFR) for more accurate management of inventory levels, RFID for tracking of physical goods flow, and B2B data standards for interfaces among the operators. When the large retailers that are the supply chain masters adopt such technologies, its multiple suppliers will have to follow. For the tourism and hospitality industry, the aim is to link up the operators along the tourism value chain by establishing data standards and implementing inter-operability among the operators.
27	Infocomm-themed Attractions	The programme aims to grow the THR sectors by creating new products to attract new customers. Initiatives will be focused on using infocomm to reach new THR markets, i.e. create infocomm as a destination, and provide more attractions to help market Singapore as a compelling travel destination. This can leverage on our efforts to build up the digital media sector in Singapore. New attractions can be formed through the convergence of infocomm technologies, digital media and local culture in a real physical setting.
Society		
28	Infocomm Awareness in Community	This programme aims to make the less tech-savvy feel comfortable with using technology. It includes customised training programmes to help the elderly learn how to use e-services and technologies like instant messaging. It also includes infocomm training courses for people with disabilities on harnessing technologies like Voice over Internet Protocol (VoIP) to empower themselves and connect with others.
29	Infocomm Access for All	This programme aims to bridge the digital divide by providing infocomm tools and facilities to those who need it most. It includes the NEU PC initiative to provide for a new computer and free one-year dial-up access to needy families with school-going children. It also includes the Government's CitizenConnect programme, which offers free Internet access and on-site support at community centres to help citizens transact online with the Government.

No.	Programmes	Brief Description
Develop a Globally Competitive Infocomm Industry as a Key Engine of Singapore's Growth		
Strengthen the Development of the Industry's Domain and Technology Capabilities		
30	Enterprise Capability Development	This programme will assist local firms to develop business strategies, build management capability and human capital, improve processes and acquire technologies to compete in the global marketplace. The initiatives will be available to see them through start-up, product development management capability and more. Specialised external advisors and experts will be linked up to identify projects that will benefit and nurture local enterprises. This programme will also look at setting up an international network of experts to mentor local companies. An Industry Experience Sharing Platform will be set up to provide a neutral platform for like-minded enterprises to learn from one another and jointly explore opportunities to go international.
Embark on a Concerted International Branding and Marketing of "Made-by-Singapore" Infocomm Products and Services		
31	"Made-by-Singapore" Infocomm Branding	The programme aims to develop greater perceived value of Singapore's infocomm products and services both within Singapore and in external markets, and generate stronger recognition of the quality and reliability of the country's infocomm products and services. The branding campaign will include establishing and marketing the "Made-by-Singapore" brand at local and international industry-wide events, conducting a feasibility study for Singapore's infocomm industry endorsement mark, profiling infocomm enterprises in the media, and through advertisements in regional publications and other collaterals, and developing an industry portal for "Made-by-Singapore" infocomm products and services.
Nurture the Expansion and Growth of Local Infocomm Enterprises		
32	Infocomm local enterprises Internationalisation	The objective of this programme is to help local companies expand overseas. Initiatives include the provision of market intelligence and assistance in establishing overseas networks to help local companies gain entry into overseas markets.
33	e-Government Solutions Export	This programme leverages the Singapore government's capabilities and well-recognised brand in e-Government to help our iLEs export their e-Government Solutions and secure such projects overseas. It includes setting up a Singapore e-Government Leadership Centre to provide training to foreign government officials on Singapore's e-Government experience. It will also involve making government-held intellectual property available to the iLEs to commercialise and export to foreign governments. The programme will complement iGov2010's desired outcome of maximising economic spin-offs from e-Government. Under iGov2010, government agencies will provide support to companies by sharing their government domain expertise and by identifying a list of e-Government intellectual properties that can be commercialised.
34	Enterprises Growth	The objective of this programme is to to provide access to capital to promising local enterprises which are looking for post-startup funding for future growth and expansion. Companies can use the fund to develop the necessary scale to compete in the global market.

No.	Programmes	Brief Description
Develop Sectoral Solutions for Export		
35	Sectoral Projects Partnership	The objective of this programme is to expedite the creation of intellectual property by infocomm enterprises in Singapore and strengthen their branding in international markets. It aims to support the efforts of infocomm enterprises in Singapore to create larger-scale and iconic "reference sites". Partnerships between local firms and multinationals will be established, so that they can work together on sectoral solutions for overseas markets. This reinforces other efforts to help the local industry develop domain and technology capabilities.
Attract and Nurture a Vibrant Pool of Infocomm Technopreneurs and Start-ups		
36	Infocomm Start-ups Attraction	This programme aims to attract aspiring foreign technopreneurs to use Singapore as a development and engineering centre for their business ventures and as an operations hub to penetrate international markets. This programme will leverage on IDA's overseas offices and the relationships between multinational companies and major infocomm local firms to attract technopreneurs and start-ups. At the same time, cross-pollination of knowledge and ideas between local and foreign technopreneurs will promote diversity in technology capabilities and spur innovation by the local industry.
Establish an Ultra-high Speed, Pervasive, Intelligent and Trusted Infocomm Infrastructure		
Realise the Leading National Infocomm Infrastructure		
37	National Fibre Network	The National Infocomm Infrastructure will consist of two fundamental building blocks – networks and enablers. The National Fibre Network (NFN) will offer high-speed access of Gbps – compared to the Mbps speeds that individuals are enjoying today. This fibre-based network will connect all homes, schools and businesses in Singapore. The NFN be an open-access carrier-neutral fibre network, leveraging on existing infrastructure where possible. This will allow other service providers to use the network to deliver their services to their customers, creating service-based competition.
38	Wireless Broadband Network	While the NFN fulfils the promise of ultra-high speeds, a wired network alone will not deliver the broadband pervasiveness needed to fulfill the mobility needs of individuals. A Wireless Broadband Network will complement the NFN in delivering broadband access to areas beyond homes, schools, and hospitals, to even business parks, places of interests for tourists, major shopping malls, MRT stations, bus interchanges and even lobbies of commercial buildings and hotels.
39	National Enabling Platforms, Policies and Standards	The National Platforms Policies and Standards provide a trusted, seamless and cost-effective environment for the development of new services on Singapore's National Infocomm Infrasructure. As a start, six focus areas of identity, security, privacy, location, payment and inter-operability have been identified. A National Trust Framework (NTF) will be set up to address issues related to privacy, security and identity. The NTF will leverage on existing infocomm security efforts such as the Infocomm Security Masterplan. It will put in place new initiatives to foster a trusted infocomm environment to enhance Singapore's economic growth such as a National Authentication Framework and National CyberThreat Monitoring Centre.

No.	Programmes	Brief Description
Create an environment for the Innovation and Commercialisation of New Applications and Services		
40	Stage Alpha	The programme seeks to showcase next-generation infrastructure and enabling platforms through phased deployment of new infrastructure with vertical sector applications.
41	Fast-track Adoption	This programme will involve working with anchor users of the next-generation infocomm infrastructure for deployment of new applications and services.
Develop an Infocomm-savvy Workforce and Globally Competitive Infocomm Manpower		
Develop Infocomm Competencies in Key Economic Sectors		
42	CXO Programme	Under this programme, opportunities will be created for decision makers at the "C-level", such as chief executive officers and chief information officers, in user organisations to share views on how infocomm can be used as a strategic tool to sharpen their competitive edge. Overseas business experts and technology gurus could be engaged to share at such business roundtables. Further help will also be extended to businesses that lack experience finding the right infocomm solutions for their businesses.
43	Infocomm Competency Development Initiative	This involves developing the necessary competencies for key sectors or occupations for maximum national impact. This plan will provide training and certification opportunities for non-infocomm workers to build more sophisticated infocomm skills that are relevant to what they do and can even empower them to put into action their own ideas on improving job tasks using infocomm.
Develop Globally Competitive Infocomm Professionals		
44	National Infocomm Competency Framework	The skill requirements and the corresponding training available for the various infocomm occupations will be clearly set out at the national level. Individuals can use this framework to assess their level of competency, and map out their training and career path. Employers can use it to better articulate their job requirements, understand the competency and skill gaps of their workers. Furthermore, to encourage companies and people to make use of the framework, agencies like the IDA can provide incentives for them to take up the training courses suggested through its existing Critical Infocomm Technology Resource Programme (CITREP), which defrays a proportion of the course fees.
45	Work-study Opportunities	Fresh infocomm graduates will be equipped with advanced technical skills while they are schooling so that they get some experience under the belt before they enter the workforce and are able to move more quickly to higher value-added jobs.
46	Talent Exchanges and Partnerships	The sharing of talent and ideas between local and overseas infocomm enterprises, research institutes and tertiary institutions will be strongly supported. In particular, foreign talent will be persuaded to study, work and live in Singapore, and help foster a culture of innovation and entrepreneurship.

No.	Programmes	Brief Description
Develop, Attract and Retain Infocomm Talent		
47	Scholarships	Top students, whether local or foreign, will be drawn to pursue infocomm as a field of study. The IDA's extension of its National Infocomm Scholarship to support overseas studies and foreign students who have the intention to stay and pursue an infocomm career here, are steps in this direction.
48	Flagship Infocomm Courses	More flagship infocomm courses offered jointly by local and top overseas universities will be made available, including "fast-track" bachelors and masters programmes that attract more students to pursue post-graduate degrees. Local universities will be encouraged to further develop their infocomm schools so they rank among the best in the region.
49	National Campaign	To raise the interest in infocomm among the young, the first step is to launch a national campaign to start people talking about a career in infocomm. The campaign can include competitions to create excitement and recognise students skilled in infocomm, as well as a speaker series to inspire students as they hear about the trials and successes of renowned infocomm leaders.
50	Infocomm Co-curricular Activities	Learning about infocomm can be made engaging through co-curricular activities offered in schools. In such settings, students can acquire competencies that will serve as a life skill by being involved in interesting projects and competitions. Regardless of what career they embark on, infocomm will be essential to them at work and at play.

Annex B: Technology Trends Towards 2015

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
COMMUNICATION NETWORKS – Towards All-IP Converged 'Giga' Broadband and Mobile Services				
Communications Wave	**Cellular Mobile**	• 3G mobile networks see increased deployment • Trials and early deployment of 3.5G, like CDMA2000 1xEV-DV, HSDPA and HSUPA/E-DCH • Trials and early deployment of IP Multimedia Sub-system (IMS) for telecom operators to rollout fixed/mobile converged services emerge • Less than US$20 cellular phones emerge to resolve digital divide [Infineon & TI]	• 3G mobile networks enter mainstream • 3.5G mobile networks sees increased adoption • IMS enters mainstream • Leading telecom operators begin trials of 3GPP Long Term Evolution (LTE) • 2.8 billion cellular lines by 2009 [Yankee Group]	• Deployment of LTE (100Mbps, 3GPP) and 4G (1Gbps, WWRF) systems take-off • Emergence of all-IP cellular network
	Broadband Wireless	• Initial WiMAX networks being deployed • Non standard-based metropolitan-mesh Wi-Fi networks see increased deployment • Rectification of high speed WLAN, 802.11n standards, certified products emerge	• WiMAX networks see increased deployment • Increase deployment of Wi-Fi mesh networking standard, IEEE 802.11s • High speed WLAN, IEEE 802.11n enters mainstream • Increase deployment of 802 networks inter-working with cellular networks i.e. IEEE 802.11u and Unlicensed Mobile Access (UMA)	• Seamless inter-working between cellular networks and broadband wireless networks enter mainstream

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
Communications Wave	**COMMUNICATION NETWORKS – Towards All-IP Converged 'Giga' Broadband and Mobile Services**			
	Short-range Wireless	• Ultra-Wideband (UWB) systems become available with regulatory framework established worldwide • Emergence of Consumer Electronics (CE) products based on Wireless USB • ZigBee standards-based wireless sensors see increased adoption, with 80 million ZigBee-compliant devices by end 2006 [ABI] • Near Field Communication (NFC) mobile phones emerged as a new platform for mobile payment and transaction • Bluetooth Ver2.0 +EDR (Enhanced Data Rate) emerges. Bluetooth-enabled handsets shipment reach 140 million [Gartner] • UWB node/chipset shipments reach 10 million in 2006 [Gartner]	• UWB technology enters mainstream in CE appliances • ZigBee standard enters mainstream for wireless sensor application • NFC mobile phones enter mainstream. Shipments reach 200 million units by 2009 [ABI] • UWB-compatible Bluetooth supporting higher data rate emerges. Bluetooth-enabled handsets shipment: 583 million [Gartner]	• Shipment of UWB chipsets to reach 250 million by 2010 [Gartner]
	Devices & Systems	• Mobile devices evolve from multi-band to multi-modal; single device able to access different networks • Emergence of Software Defined Radio (SDR) base stations • Mobile phones with hard-disk take-off and capable of digital broadcast reception (DVB-H/DMB/FLO) • Increased deployment of hybrid positioning technologies (e.g. assisted-GPS and cellular-based location methods) to improve accuracy and availability • RF MEMS hits US$300 million in 2006 [WTC GmbH]	• Increased deployment of SDR base stations; Global market for SDR to reach US$10 billion by 2009 [Pioneer] • Global mobile commerce market, excluding mobile entertainment, becomes a US$40 billion industry by 2009, fuelled by growth in micro-payment [Juniper] • Mega-SIM that provides high memory capacity emerges • RF MEMS market US$1.1 billion in 2009 [WTC GmbH]	• Availability of Galileo satellite navigation system to improve positioning accuracy and reliability. Devices supporting GPS and Galileo systems emerge • Mega-SIM enters mainstream

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
Communications Wave	**COMMUNICATION NETWORKS – Towards All-IP Converged 'Giga' Broadband and Mobile Services**			
	Last Mile Access	• High-speed DSL technologies (ADSL2/2+ and VDSL2) and cable technologies (DOCSIS 3.0) see increased adoption • Standards compliant and inter-operable EPON Fibre-to-the-Home (FTTH) and GPON FTTH platforms become available, deployments take-off • Access networks up to 1Gbps emerge • Worldwide broadband Internet subscribers surpass 215 million in 2005 [CIA]	• FTTH enters mainstream for greenfield deployments • Emergence of converged fixed-line and mobile wireless network • Worldwide fibre access equipment market reaches US$1.9 billion in 2009, as users migrate to higher speed data services and innovative new services such as IPTV, HDTV, and VOD [IDC]	• End-to-end Quality-of-Service (QoS), security, inter-operability, manageability and scaleability become more established • Deployments of WDM-PON FTTH in the last-mile access areas emerge • Deployment of FTTH enters mainstream, typical access speeds in the range of Gbps • Worldwide broadband Internet subscribers will surpass 500 million by end of 2010 [CIA]
	Backbone	• Leading telecommunication operators make initial migration from PSTN to all-IP for better provisioning of services • Deployment of dual IPv4/IPv6 network routers sees increased adoption • 10 Gigabit Ethernet (10 GE) sees increased adoption	• IPv6 emerges, improving security, QoS and range of IP addresses for devices • Wavelength services emerges for large enterprises with high bandwidth requirements	• Migration of PSTN to all-IP sees increased adoption • IPv6 routers enter mainstream • Deployment of optical (lambda/photonic/wavelength) routers emerge • Emergence of standard-based 100GE products • Fast optical switches using photonic crystals enter mainstream

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
COMPUTING HARDWARE – Towards an Era of 'Tera' Computing, Embedded Multicore Computing with Wearables and Smart Materials, with Long-lasting Portable Energy for IT Mobile Devices				
Computing Wave	**Computing Platform**	• Emergence of multicore processors, creating impetus for better parallel programming tools and languages • Multicore processors market: US$13.2 billion in 2006, US$23.2 billion in 2007 and US$32.5 billion in 2008. Shipments 97.7 million, 193.9 million and 284.1 million units respectively [iSuppli] • Cell Broadband Engine processor for high performance computing applications emerges (e.g. PS3 game consoles, servers) • ITU-T H.264 standard for video codec sees increased adoption • Global microchip sales: US$245 billion in 2006 [SIA] • Government funding for nanotech R&D globally: US$5.2 billion in 2005 and US$8.07 billion by 2010 [Cientifica]	• Multicore devices become commonplace for mobile, desktop and server platforms • Cell-style processors enter mainstream use in HDTV, high resolution medical imaging system and servers platforms • Printable (plastic) electronics emerges; Market size: US$7 billion in 2010, driven by demand for printable display, RFID, photovoltaic and computer memory [NanoMarkets] • Global microchips sales: US$309 billion in 2008 [SIA] • Global nanotechnology market: US$29 billion by 2008 [ITU]	• Many-cores processors, from dozen to hundreds of cores emerge for massively parallel computing applications • Plastic electronics enters mainstream in mobile and CE products • ITU-T H.265 digital video codec standard completes by 2010 • Emergence of silicon manufacturing that exploits nano-material properties i.e. carbon nanotube & nanowire transistors, and 3D stack & silicon photonics • Self-assembled molecular electronic devices prototyped, paving the development of cheap and powerful computer & storage • Nanotechnology creates a trillion dollars business by 2015 [NSF]
	Storage & Memory	• Perpendicular Magnetic Recording (PMR) technology emerges. i.e. 200 Gbit/in^2 areal density • Emergence of new optical storage technologies: 30GB HD DVD and 50GB Blu-ray discs. By 2007, holographic storage of 200GB to 300GB per disc emerges • Emergence of new non-volatile memories (e.g. MRAM and PRAM)	• Emergence of PMR technology with storage areal density reaches about 400-500 Gb/in^2 • 3D holographic disc with terabyte storage emerges • Emergence of instant-on computers employing high-densities MRAM chipsets	• Storage above 500 Gb/in^2 areal density enabled by HAMR (Heat Assisted Magnetic Recording) technology takes-off. Self-Organised Magnetic Array (SOMA) and nano-MEMS probes emerge for storage beyond 1Tb/in^2 • Ubiquitous data on-the-move as terabytes of content can be loaded into a mobile personalised server • Nano-enabled memory (MRAM, Ovonic, Holographic and Nano-crystalline) market surpasses US$7 billion in 2010 [NanoMarkets]

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
COMPUTING HARDWARE – Towards an Era of 'Tera' Computing, Embedded Multicore Computing with Wearables and Smart Materials, with Long-lasting Portable Energy for IT Mobile Devices				
Computing Wave	**Power**	• Micro Fuel Cell (MFC) restricted in niche market, as regulatory issues by ICAO & IATA and standard-based fuel cartridges by IEC/TC105 not ready before 2007 • Emergence of better lithium-ion and polymer battery, based on new nano-material, providing faster charge times, greater capacity, and longer life cycle	• By 2008, MFCs with 10 times more energy density than lithium (>1000 Wh/L) emerge to power 4 million mobile devices [F&S] • New thin film batteries exploit nano-particles for longer lasting power at less weight and size than existing batteries	• Highly efficient conformal solar cell emerges, use for powering sensors, wearable and mobile devices • Energy harvesting from human activity (kinetics and bio fuel cell) emerges • MFCs see increased adoption, with market value of US$2.6 billion by 2012 [NanoMarkets]
	Display & Material	• Emergence of mobile gadgets with active-matrix Organic Light Emitting Diode (OLED) display; Passive-matrix OLED dominates active-matrix OLED for small screen size • Global OLED market grows 64 per cent by volume and 45 per cent by value in 2006, reaching 100 million units and US$900 million [DisplaySearch]	• Mobile gadgets with OLED display enter mainstream. Emergence of desktop, laptop and TV with large active-matrix OLED display • Active-matrix OLED displays hit 289 million, with 88 percent used by mobile phones [iSuppli] • Emergence of flexible screen OLED, paving development of wearable electronics devices • Carbon nanotube (CNT) field emission display emerges, giving rise to a new generation of thin, bright and low-power display	• Emergence of ultra-large TV screen and wireless wall-to-wall display enabled by OLED/CNT field emission display and UWB • 3D holographic display emerges • Flexible OLED display enters mainstream. Global OLED market: US$2.9 billion with 341 million units sold by 2011 [iSuppli]

Enabling Technologies	Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
COMPUTING SOFTWARE – Towards Personalised, Collaborative and Trusted Service Economy			
Computing Wave – **Web Services & Service-Oriented Architectures**	• Web Services and Service-Oriented Architectures (SOA) enter mainstream • Web Services security, trust and identity standards established (e.g. XML Encryption, XML Digital Signature, SAML, WS-Security, WS-Trust, WS-Federation, etc.) • Web Services business process transaction and orchestration standards established (e.g. WS-Transactions, WS-Coordination, BPEL, etc.)	• SOA tools and methods mature, making it easier for developers to support Web-based SOA • Adoption of Web Services management standards and Business Process Management (BPM) enter mainstream • UDDI registry/ repository services see increased adoption, enabling enterprises to publish, search and use Web Services from other enterprises	• Complex and integrated end-to-end enterprise services emerge as Web Services repositories containing enterprise business process resources for easy application development becomes available
Grid Computing	• Enterprise Grid sees increased adoption • On-demand access to computing resources takes-off • Global spending on Grid: US$714.9 million in 2005 [Insight]	• Multi-site Enterprise Grid enters mainstream • On-demand access to software services sees increased adoption	• Multi-site Enterprise Grid evolves to a flexible and dynamic inter-organisational collaborative infrastructure leading to vibrant infocomm Grid marketplaces • Global Grid/Utility IT infrastructures emerge • Global spending on Grid: US$19.2 billion in 2010 [Insight]
Business Software	• "Software as a Service on the Web" and "Web as a Platform" emerge with Web 2.0 and Mashup concepts • Emergence of business software-on-demand services (e.g. Salesforce.com, 24SevenOffice) • Content and data syndication take-off with standards such as Really Simple Syndication (RSS) and Atom • Speech recognition software for call centres sees increased adoption • VoIP enters mainstream for enterprise usage	• Enterprise services leveraging on Web 2.0 concepts see increased adoption • Natural language speech recognition technology emerges, enhancing speech recognition capabilities for call centres • VoiceXML 2.x standard emerges. Market size of VoiceXML reaches US$300 million by 2009 [Datamonitor]	• Emergence of cyber-giants for business software services • Truth verification and emotion analytics application emerges from niche (used in government and military today) to enterprise applications • Real time multi-lingual speech to speech translation emerges • Worldwide residential VoIP subscribers:197.2 million in 2010 with US$24.5 billion revenue [iSuppli]

Enabling Technologies	Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
COMPUTING SOFTWARE – Towards Personalised, Collaborative and Trusted Service Economy			
Computing Wave – **Semantic Web & Agent Technologies**	• Enterprise Semantic Web takes-off in the areas of asset management and enterprise integration • Enterprise-scale implementation of Resource Description Framework (RDF) and Web Ontology Language (OWL) take-off • Foundation for Intelligent Agents (FIPA) established standards related to description, registration and communication of agents	• Enterprise Semantic Web sees increased adoption • Key standards related to Semantic Web access control rules, logic and proof established • Inter-operability framework for agents, Web Services, and Semantic Web established • Key standards related to human-agent communications, mobile agents, and peer-to-peer nomadic agents established	• Semantic World Wide Web emerges • Multi-agent collaboration technologies and services enter mainstream for proactive computing and collaborative business applications • Personalised services enabled by intelligent agents become available (e.g. personalised digital concierge, personalised patient-centric healthcare services, etc) • Expert knowledge and data integration support decision-making processes i.e. physicians during diagnostic and treatment process
Computing Wave – **Security & Trusted Infocomm Infrastructure**	• Contactless security and biometrics take-off: ISO/IEC 14443 contactless chips used for secure identification and authentication services (e.g. biometric e-passports) • Global PKI infrastructure deployed for biometric e-passports under auspices of ICAO (International Civil Aviation Organisation) • Development of international (ISO/IEC 7816) standards for inter-operable multi-application smart card frameworks • Emergence of media players that support multiple DRM format, but without full inter-operability	• Biometric chip-based passports sees increased deployment • Elliptic curve cryptography sees increased adoption • From software security to hardware cryptographic security for PC/PDA operating systems as chip costs decline • Adoption of multimedia standard such as MPEG-21 takes-off, which include support for inter-operable DRM technologies	• Majority of bank cards migrate from magnetic stripe to chip-based EMV standard compliant cards • Quantum cryptography products to emerge starting with security, government and finance sectors • Trusted devices that support inter-operable DRM technologies sees increased adoption

Enabling Technologies		Short-Term (1 – 3 Years)	Mid-Term (3 – 5 Years)	Long-Term (5 – 10 Years)
CONTEXT-AWARE INTELLIGENT SYSTEMS – Towards a Value Ecosystem of Pro-active Smart Things and Environment				
Sentient Wave	**Sensor Applications**	• Emergence of homeland security sensor-aided applications and infrastructure deployment (e.g. SensorNet in US) • GPS and sensor-based applications enter mainstream (e.g. car sensors for passenger safety, geo-fencing and route planning applications) • Emergence of vital sign monitoring using wireless sensors deployed in hospitals • New intelligent home appliances enabled by sensor and smart designs for future living concepts. Personal robots see increased adoption • Emergence of personal wearable sensory devices to monitor health, sport performance, lifestyle, etc.	• Emergence of enterprise asset management with condition-based monitoring via embedded wireless diagnostic sensors • Remote diagnostics for vehicle maintenance take-off • Emergence of remote preventive healthcare at home with sensor-enabled healthcare devices • Emerging mixed reality applications enabling infocomm themed attractions (e.g. mixed reality in tour buses and digitally themed attractions devices)	• Increased adoption of condition-based monitoring, safety & security applications • Smart electronics, driver assistance, cars that understand environment and driver • Traffic management systems to improve the on-time performance of public transit systems • Smart fabrics for healthcare applications take-off. From preventive to predictive healthcare, focusing on early detection and treatment of illnesses • Emergence of brainwave controlled applications for people with disabilities • Personal immersive and mixed reality applications emerge (e.g. seeing portal for tourists)

Annex C: Acknowledgements

Sub-Committees

iN2015 Digital Media and Entertainment Sub-Committee

Name	Designation
Mr Frank Brown (Chairman)	Director Colorzip SEA Pte Ltd
Mr Mark Brimblecombe	Chief Executive Officer i-Pop Networks Pte Ltd
Ms Valerie Cheng	Director Strategic Planning Group Media Development Authority
Mr Matthew Godfrey	Chief Operating Officer Bates Asia
Ms Goh Min Yen	Managing Director Eng Wah Organization Ltd
Mr Thomas Lim	Director Education, Learning, Digital Media & Entertainment Infocomm Development Authority of Singapore
Mr Mock Pak Lum	Chief Executive Officer MediaCorp Technologies Pte Ltd
Mr Mauro Montanaro	Vice President Sales and Channel Management Multimedia, Asia-Pacific Nokia Pte Ltd
Mr Ricky Ow	General Manager SPE Networks – Asia Pte Ltd
Mr Chris Thompson	Vice-President & General Manager Southeast Asia Publishing Electronic Arts Pte Ltd
Mr Yong Lum Sung	Chief Operating Officer StarHub Ltd

iN2015 Education and Learning Sub-Committee

Name	Designation
Mrs Tan Ching Yee (Chairman)	Second Permanent Secretary Ministry of Education
Dr Mukesh Aghi	Chief Executive Officer Universitas 21 Global Pte Ltd
Mr Hee Joh Liang	Executive Director and Chief Executive Officer Popular e-Learning Holdings Pte Ltd
Associate Professor David Hung Wei Loong	Head Learning Sciences and Technologies, Academics Group National Institute of Education
Dr Koh Thiam Seng	Director Education Technology Division Ministry of Education
Mr Barney Lau	Managing Director Microsoft Singapore Pte Ltd
Mr Lee Kwok Cheong	Chief Executive Officer Singapore Institute of Management
Mrs Lim Lai Cheng	Deputy Director Languages & Literature, Curriculum Planning & Development Division Ministry of Education
Professor Low Teck Seng	Principal and Chief Executive Officer Republic Polytechnic
Dr N Varaprasad	Chief Executive National Library Board
Professor Bernard C.Y. Tan	Professor and Head Department of Information Systems, School of Computing National University of Singapore
Mr Kenneth Tan	Director (HQ) Education, Environment & Professional Services Economic Development Board
Ms Yip Yuen Fong	Deputy Director IT In Learning Infocomm Development Authority of Singapore

iN2015 Enterprise Development For Singapore-based Infocomm Companies Sub-Committee

Name	Designation
Mr Stephen Lim (Chairman)	Chairman Singapore infocomm Technology Federation Chief Executive Officer & Managing Director SQL View Pte Ltd
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iN2015 Financial Services Sub-Committee

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Mr Ching Wei Hong	Executive Vice President Group Operations & Technology Overseas Chinese Banking Corporation Ltd
Mr Bill Chua	Executive Vice President Delivery Channels & Operation United Overseas Bank Ltd
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Mr Chew Hock Yong	Deputy Secretary Ministry of Community Development, Youth and Sports
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Mr Ong Khiaw Hong	Deputy Commissioner (Corporate) Inland Revenue Authority of Singapore
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Ms Yeoh Chee Yan	Deputy Secretary (Development) Public Service Divisions, Prime Minister's Office

iN2015 Infocomm Infrastructure, Services and Technology Development Sub-Committee

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Mr Bill Hope	Executive Vice President Networks Singapore Telecommunications Ltd
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Mr Low Huan Ping	Executive Vice President Technology Singapore Press Holdings
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Mr Tan Tong Hai	President and Chief Executive Officer Singapore Computer Systems Ltd
Mr Wong Heng Chew	Managing Director, Singapore Sun Microsystems Pte Ltd
Professor Lawrence Wong	Executive Director Institute for Infocomm Research
Associate Professor Wong Poh Kam	Director NUS Entrepreneurship Centre National University of Singapore
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iN2015 Infocomm Competency Council

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Mr Lim Swee Cheang	Chief Executive Officer & Director Institute of Systems Science
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Mr Andrew Sansom	Director DP Search Pte Ltd
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iN2015 Manufacturing and Logistics Sub-Committee

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Dr Richard Tan	Chief Technology Officer Bax Global
Mr Teh Chit Pin	Senior Director e-Business Supply Chain Seagate Technology International
Mr Teow Boon Ling	General Manager Cargo Community Network Pte Ltd
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Mr Tan Eng Pheng	Director Manufacturing & Services Cluster Infocomm Development Authority of Singapore
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Mr Tan Tong Hai	President and Chief Executive Officer Singapore Computer Systems Ltd
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Dr Roger Tay Yew Siow	Director Advance Engineering Motorola Electronics Pte Ltd
Mr Teo Han Yong	Director Service & Technology Innovation Bridge Mobile Pte Ltd
Ms Wan Mee Fem	Country Manager Open Computing Centre IBM Singapore
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Professor Lawrence Wong	Executive Director Institute for Infocomm Research
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Infocomm Development Authority of Singapore

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Mr Louis Tan	Executive Consultant
Ms Lee Wan Sie	Senior Consultant
Mr Derek Lim	Senior Consultant
Ms Tina Chua	Consultant
Mr Ong Lih Tar	Consultant
Mr Pooi Choon Poh	Consultant
Mr Tan Kiat How	Consultant
Ms Tan Poh Ling	Consultant
Ms Lim Lay Phing	Associate Consultant
Ms Tanya Tang	Associate Consultant
Mr Teo Yi-Wei	Associate Consultant

Annex D: Glossary

Term	Definition
Acute care	Medical care generally given in a hospital setting for more serious conditions that often arise over a short time frame and are usually of periodic or temporary nature.
Backhaul	In the context of communications, backhaul means getting data to a point of aggregation, where smaller lines interconnect into a larger transmission line or network backbone.
Chronic disease	A long-term disease that is non-infectious. This kind of diseases often has many causes. Examples include high blood pressure, diabetes and heart disease.
Decimalisation	The process that converted stock prices from fractional pricing to pricing in decimals; that is, in increments from eighths or sixteenths of dollars to nickels or pennies.
eXtensible Business Reporting Language (XBRL)	XBRL is an XML based taxonomy with which users can prepare, publish (in a variety of formats), exchange and analyse financial statements and the information they contain.
Identity	It refers to the electronic representation of a real-world entity, to be used in a distributed network interaction with other machines or people. The purpose is to restore the ease and security human transactions once had, when we all knew each other and did business face-to-face, to a machine environment where we are often meeting each other for the first time as we enter into transaction over vast distances. A digital identity only needs to be as complete as a particular transaction requires.
Infocomm Industry	This is an activity-based definition. The main categories of activities included are: • Wholesale of infocomm products such as telecommunication equipment; computer equipment, hardware and software; office equipment etc; • Retail sale of infocomm products; • Telecommunication services; • Computer and IT services; and • Content services. Activities pertaining to the manufacture of infocomm products are not incluided.
Internet Protocol	A data-oriented protocol used for communicating data across a packet-switched internetwork.
Inter-operability	Inter-operability is the ability of a system or a product to work with other systems or products without special effort on the part of the customer. Products achieve inter-operability with other products using either of both approaches: (1) By adhering to published interface standards (2) By making use of a "broker" of services that can convert one product's interface into another product's interface on demand.
Medico-legal	Pertaining to legal aspects of medical practices.

Term	Definition
National Broadband Network (NBN)	The National Broadband Network (NBN) is the wired component of the NII. NBN is an ultra-high speed wired network that is that is capable of access speeds of 100 Mbps to 1 Gbps as early as 2008. The next-generation network will be open access and carrier neutral. It will be opened to all service providers, so that they can reach out to connected customers or consumers. This will lower the entry barrier for service providers and costs to consumers.
National Enabling Platforms, Policies and Standards (EPPS)	Consists of nationwide platforms that enable new services to be deployed in the Next-Generation National Infocomm Infrastructure (Next GenNII). National Enabling Platforms complement the capabilities of the wireless and wired networks. National Enabling Platforms include physical infrastructure, standards, policies or regulations that can be leveraged on or referenced by multiple service providers. Initial sets of NEPs identified include those in the area of privacy, identity, security, location, payment and inter-operability. National Enabling Platforms are part of the National Infocomm Infrastructure.
National Infocomm Infrastructure (NII)	The National Infocomm Infrastructure is Singapore's new digital super-highway for super connectivity. The Next Gen NII will entrench Singapore's infocomm hub status and open the doors to new business and social growth for the country. It consists of both the physical infrastructure and soft infrastructure. The physical Infrastructure has two components: a wired broadband network (NBN) that will deliver ultra-high broadband speeds to all homes, offices and schools, while a wireless broadband network (WBN) will offer pervasive connectivity around Singapore. The soft infrastructure includes policies and standards pertaining to those in the National Enabling Platforms. The Government will adopt a Public-Private Partnership approach (PPP) to set up the NII.
National Trust Framework (NTF)	Framework consisting of nationwide enabling platforms of privacy, security and identity. The NTF was developed to enable, on a national scale, the exploitation of infocomm technologies for economic competitiveness through a multi-pronged response to cyber-attacks, privacy infringements and identity theft. The National Trust Framework is part of the National Enabling Platforms, Policies and Standards under the National Infocomm Infrastructure.
Offshoring	The relocation of business processes (including production/ manufacturing) to a lower cost location
Peer-to-Peer (P2P)	A peer-to-peer computer network is a network that relies on the computing power and bandwidth of the participants in the network rather than concentrating it in a relatively low number of servers. P2P networks are typically used for connecting nodes via largely ad hoc connections. Such networks have become increasingly common for sharing content files (file sharing) in digital format.
Pervasive	A pervasive network is a ubiquitous "fabric" of computing, information, entertainment and telemetry capability all tied together by high-speed wired and wireless networks. The concept of pervasive networks takes the "anytime, anywhere" concept of mobility to its logical end – "all the time and everywhere".
Phishing	The act of tricking somebody into providing bank or credit-card information for instance, by sending a fraudulent e-mail purporting to be from a bank or Internet provider and then asking for verification of an account number or password.

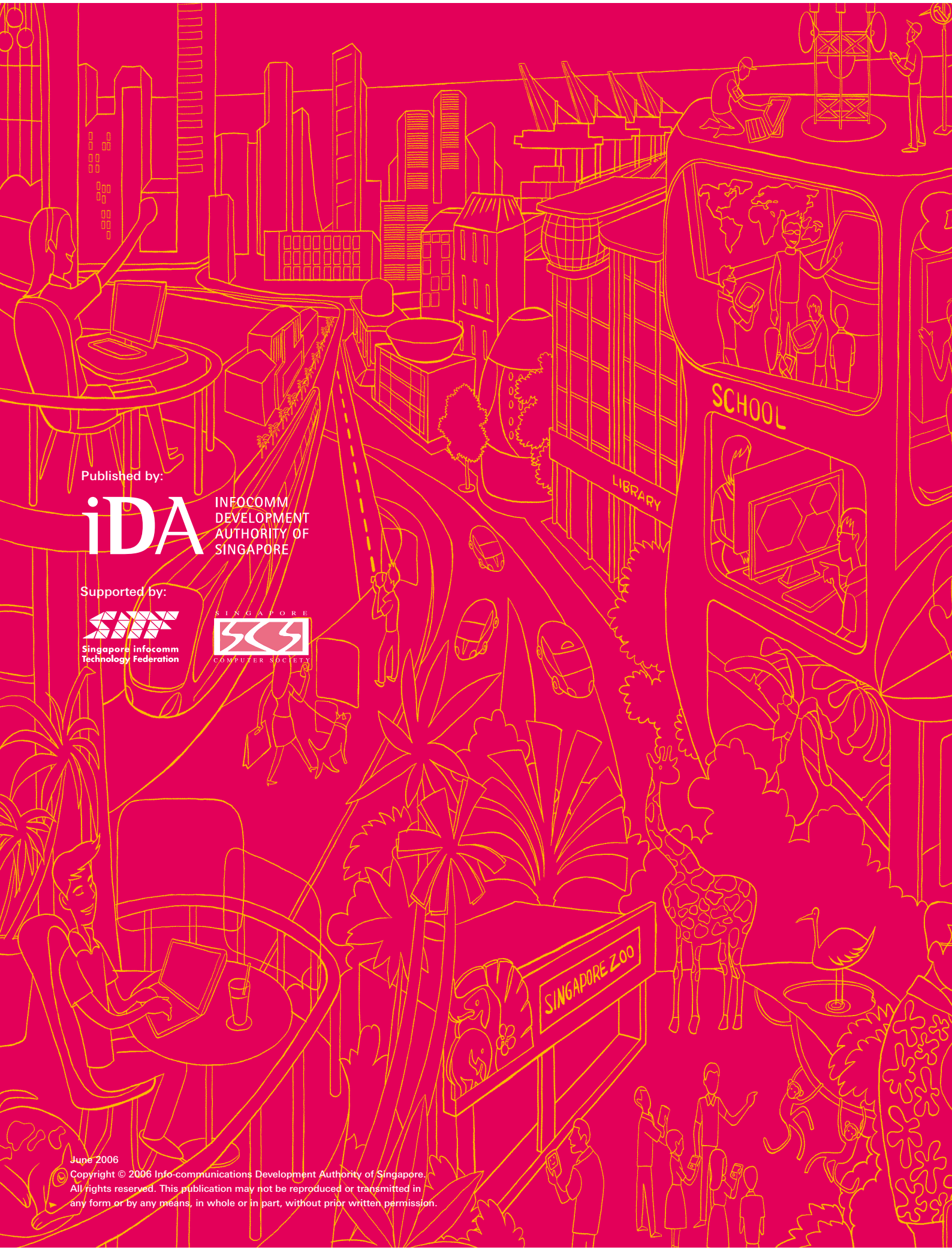
Term	Definition
Point of care	Location at which a patient is treated, e.g. the patient's bedside. Also used to mean the part of the healthcare value chain where the patient receives care, e.g. acute care hospitals, nursing homes.
Primary care	The type of holistic, basic healthcare that would be delivered by a family physician.
Privacy	Privacy is the ability of an individual or group to stop information about themselves from becoming known to people other than those whom they choose to give the information.
Prognostic markers	Biological parameters (e.g. specific proteins or genes) that are used to indicate susceptibility, presence and stages of progress of diseases.
Public Private Partnership (PPP)	An arrangement between the public and private sectors established for the purpose of providing an essential service or facility to the public. PPP is part of the Singapore government's Best Sourcing framework, where the public sector will engage private sector providers to deliver those services which the private sector can provide more effectively and efficiently. Through PPP, the public sector seeks to bring together the expertise and resources of the public and private sectors to provide services to the public at the best value for money.
Radio Frequency Identification (RFID)	RFID is a technology that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal or person. The advantage of RFID is that it does not require direct contact or line-of-sight scanning.
Seamless	The ability for the user or other entities to communicate and access services irrespective of changes of location or technical environment. The degree of service availability may depend on several factors including the Access Network capabilities, service level agreements between the user's home network and the visited network (if applicable). Seamless mobility includes the ability of telecommunication with service continuity, when switching between networks.
Security	The protection of information systems against unauthorised access to or modification of information, whether in storage, processing or transit, and against the denial of service to authorised users or the provision of service to unauthorised users, including those measures necessary to detect, document, and counter such threats.
Short Message Service (SMS)	SMS (Short Messsage Service) is a service for sending messages of up to 160 characters to mobile phones.
Singapore ONE	Singapore ONE (One Network for Everyone) is a collaboration effort between the government and the industry to enable the roll-out of a nationwide broadband infrastructure that encourages the development of interactive broadband multimedia applications and services accessible through a high-speed, high capacity ATM backbone.
Step-down care	An intermediate stage of care between hospital and home-based care. It is provided by community-based institutions like nursing homes, rehabilitation centres and community hospitals.

Term	Definition
Taxonomy	Taxonomy is the science of classification according to a pre-determined system, resulting in a catalogue that can be used to provide a conceptual framework for discussion, analysis, or information retrieval. XML taxonomies are "vocabularies" or "dictionaries" created by a group in order to exchange information.
Technologists	Infocomm professionals who are equipped with in-depth infocomm technical expertise to engage in research and development.
Techno-strategists	Infocomm professionals who possess both technical and domain expertise, and are able to develop infocomm solutions to meet business needs.
Tele-consulting	Medical consultation that is carried out using telecommunications rather than in person.
Transhipment	Transfer of goods from one land or sea or air vehicle to another as they are being transported to the destination.
Value-added	Also known as net output, value-added is the gross output less the intermediate inputs used in the course of production. It comprises the compensation of employees, operating surplus, the consumption of fixed capital and the excess of indirect taxes over subsidies.
WiMAX	WiMAX is an acronym that stands for Worldwide Inter-operability for Microwave Access. It is a standards-based wireless technology that provides high-throughput broadband connections over long distances. WiMAX can be used for a number of applications, including "last mile" broadband connections, hotspots and cellular backhaul, and high-speed enterprise connectivity for business.
Wireless Broadband Network (WBN)	The Wireless Broadband Network (WBN) is the wireless component of the Next Gen NII. With the Wireless Broadband Network, users out of their homes, schools and offices can conveniently access wireless broadband services using data-centric computing devices. The WBN will offer access or download speeds of at least 512 kbps.
Wireless Fidelity (Wi-Fi)	Wi-Fi is a set of product compatibility standards for wireless local area networks (WLAN) based on the IEEE 802.11 specifications. The term is promulgated by Wi-Fi Alliance. Any products tested and approved as "Wi-Fi Certified" (a registered trademark) by the Wi-Fi Alliance are certified as inter-operable with each other, even if they are from different manufacturers.
Wireless Personal Area Networks (WPAN)	A WPAN is a personal network for interconnecting devices such as personal computers (PCs), personal digital assistants (PDAs), cell phones, wireless tags and consumer electronics wirelessly.

Infocomm Development Authority of Singapore
IDA is committed to growing Singapore into a dynamic global Infocomm hub. IDA uses an integrated approach to developing info-communications in Singapore. This involves nurturing a competitive telecoms market as well as a conducive business environment with programmes and schemes for both local and international companies.
For more information, visit ***www.ida.gov.sg***

Singapore Computer Society
SCS, established since 1967, is the premier professional body for IT practitioners and IT users in Singapore. With a membership of over 22,000, it is an invaluable network for its members. SCS administers various certification programmes that help individuals gain professional recognition for career development.
For more information, please visit their website at ***www.scs.org.sg***

Singapore infocomm Technology Federation
SiTF is Singapore's national infocomm industry association. It brings together 500 corporate members from MNCs and local companies, who collectively account for over 80% of the industry revenue. The SiTF assists its members in business development, market intelligence, overseas trade missions, networking and alliances.
For more information, please visit their website ***www.sitf.org.sg***



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