National
Internet of Things (IoT)
Strategic Roadmap

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Strategic Roadmap

MOSTI

KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

MIMOS

in alignment with

SCIENCE
to ACTION

f MIMOS

in MIMOS Berhad

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▶ MIMOS Malaysia

acknowledgement

NATIONAL IoT STRATEGIC ROADMAP an overview

IMPACT OF IoT

	MOBILE DEVICE PENETRATION	INTERNET USERS	MOBILE BROADBAND PENETRATION	SOCIAL NETWORK PENETRATION	MOBILE SERVICES (US$)
2025	↑280%	↑195%	↑167%	↑135%	↑US$16B
TODAY	143.7%	65.8%	13.34%	45%	US$8B

IoT SPENDING

IoT
ICT

Traditional ICT spending
IoT spending

2013 2020 2022 2024 2026 2028 2030 2032
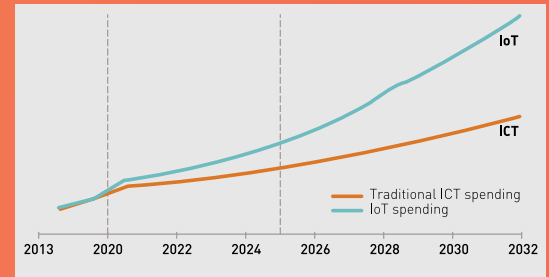
3 GOALS

1. Create a conducive IoT industry ecosystem
2. Strengthen technopreneur capabilities in Apps & Services layer
3. Malaysia as the Regional Development Hub for IoT

SHORT-TERM STRATEGIES

1: Transformation of SMEs
2: Alignment with existing initiatives

LONG-TERM STRATEGIES

1: IoT MALAYSIA

2: OPEN INNOVATION FRAMEWORK

3: OPEN COMMUNITY DATA FRAMEWORK

strategic technology requirements

open data promotion

strategic technologies

1

2

3

COMPONENTS of IoT

5%
COMMUNICATIONS
& NETWORKING

5%
COMPUTING
& STORAGE

10%
THINGS: HARDWARE,
POWER & PROTOCOLS

80%

APPS, SERVICES
& ANALYTICS

MISSION

To create a national ecosystem to enable the proliferation of use & industrialisation of IoT as a new source of economic growth

VISION

Malaysia to be the Premier Regional IoT Development Hub

3 GOALS
9 STRATEGIES
29 KEY INITIATIVES

ECONOMIC IMPACT

ECONOMY: 2020 GNI GLOBAL: **RM7.8B** | MY: **RM1.7B**

EMPLOYMENT: JOB CREATION **14,270**

EDGE: INTELLECTUAL PROPERTY **146** PATENTS FROM MALAYSIA INVENTORS

EDITORIAL TEAM

Ahmad Helmi Abdul Halim

Yoong Siew Wai

Dr. Mohammad Shahir Abdul Majed Shik

Jamal Hamzah

Francis Goon Wooi Kin

Mohd Faizal Amin

Laurence Sebastian

Norazrina Jaafar

Zalina Sayuti

Nur Farahin Musa

Zainal Mohamad Nor

Ng Yeok Hong

Messages

Our everyday lives are filled with the benefits of the accelerated pace of science. Smartphones keep us connected to friends and family, work and the wider world. Agricultural advances help ensure we are fed. Antibiotics and vaccines save lives. Transport systems enable us to travel locally and internationally.

Time and again, we also have seen that science leads countries to greater heights and propels them forward, thereby increasing both their economic status as well as their quality of life. In years to come, science will play an even more central role in our knowledge-driven economy.

Dato' Sri Mohd Najib bin Tun Abdul Razak
Prime Minister of Malaysia

> The ability to create, distribute and exploit knowledge through science, technology and entrepreneurship has become a major source of competitive advantage, wealth creation and improvement in the quality of life.

> I strongly believe the successful implementation of the many science, technology and industry programmes will depend heavily on the close understanding and collaboration between the industry and the Government.

Message from

Datuk Dr Ewon Ebin

Minister of Science, Technology and Innovation, Malaysia

ICT has a pivotal role in the national aspiration of becoming a High Income Nation by 2020. From the strategic role as an enabler, ICT has become a key economic sector of the country. As such, it is imperative to position ICT as an industry with a sustainable national innovation ecosystem. The advent of ICT has conceived the Internet of Things (IoT), the next evolution of the Internet.

The Review of National Strategic ICT Roadmap 2008 and Technology Roadmaps identified six technology focus areas; specifically Cloud Computing, Wireless Intelligence, Big Data and Analytics, Security, E-Services and Ubiquitous Connectivity. Accordingly, IoT technology being the convergence of the six technology focus areas will galvanise the Government machinery and the country's ICT industry alike in forging ahead with our technological transformation, and increase Malaysia's global competitiveness.

Malaysia's IoT Strategic Roadmap is part of our continuous efforts in harnessing science, technology and human capital to create a new source of economic growth. IoT will create boundless opportunities for the R&D community to thrust homegrown technologies for commercialisation to a higher level.

The proliferation and the industrialisation of IoT in Malaysia will lead to market creation, and in turn, job creation as well as accumulation of intellectual property. With the right direction and policies, this will bring Malaysia further towards a knowledge-based society.

The National IoT Strategic Roadmap that has been thoughtfully formulated will be the fruit of a collective national endeavour, where each and every stakeholder has critical role to play. I am confident that it will rejuvenate vigour and energy to various implementation agencies in the Government and the Malaysian ICT industry towards achieving Vision 2020.

I congratulate MIMOS for driving this initiative. I would also like to thank all our partners in the private and public sectors for their strong support and contributions to realise the aspirations as contained within this Strategic Roadmap. The document will be the impetus towards mapping our national strategic direction as we embark on the new technology.

Message from

Dato' Sri Dr Noorul Ainur Mohd Nur

Secretary General of the Ministry of Science, Technology and Innovation, Malaysia

ICT has been a major driver of the national economy because of its transformational effects spread horizontally across other sectors. Hence, the ICT sector will continue to be the key focus for Malaysia and is expected to grow progressively driven by the convergence of industries due to digitalisation.

MOSTI takes the view that the Internet of Things (IoT) is key to the transformation of Malaysia's digital economy. IoT gives rise to the interconnected world and is made possible by technologies and research disciplines that enable the Internet to reach out to the real world of communicating objects. With its ubiquitous intelligence, it would be the cornerstone for Malaysia towards a new era, one that will

radically transform business, community, government and personal spheres. IoT will be technologically and economically feasible to transform the way people interact with objects and enrich the digital user experience.

A strategic focus on laying the groundwork for IoT is consistent with the Government's innovation agenda. By the creation of Open Innovation Framework and Open Community Data Framework, Malaysia can reap the future benefits of scientific and technological advances in IoT and compete globally through increased productivity and sustainability, as well as subsequently boosting economic growth, and enabling higher income for the nation.

Message from

Prof Tan Sri Zakri Abdul Hamid

Science Advisor to the Prime Minister of Malaysia

The Internet of Things (IoT) is a testament of the powerful effect of science. It will permit us to see advancements in the way we communicate and share information via man-made objects and devices. Although this has been happening since the day the Internet was created, IoT will present a totally different means of doing so.

It will digitise the world and connect people, processes, data and things. We are evolving from human-to-human and human-to-machine connections to embedded intelligence. From 200 million 'things' or devices being connected globally, we have progressed to connecting 10 billion things, and with the advent of IoT, we can expect 50 million things connecting to one another.

The Internet of Things will be part of the Science to Action (S2A) initiative championed by the Prime Minister. S2A is an initiative to intensify the application of science and technology for industry development, people's well-being and governance of science, technology and industry that aligns to the New Economic Model which was introduced in 2010.

Message from

Datuk Abdul Wahab Abdullah

President and CEO of MIMOS Berhad

On behalf of the Technical Working Group, it is our pleasure to present the National IoT Strategic Roadmap for Malaysia, a document that will chart the steps of the development of a sustainable IoT industry, generate continuous enrichment and create positive spillover for the country in decades to come.

The National IoT Strategic Roadmap is a set of recommended actions that we believe can effectively propel Malaysia to the same league as industrialised and prosperous nations. This document engages stakeholders in public and private sectors, and outlines clear strategies for action on building a successful IoT ecosystem for Malaysia that fosters Open Innovation, smart collaboration and long-term development.

We have arrived at this stage after a series of consultations, brainstorming sessions and a huge amount of hard work by the task force made of relevant government officials and the region's top industry players. The resulting document has been prepared based on careful assessments of various factors and trends. Most importantly, it took into consideration the reality of the challenges facing the national economy now and in the future. Implemented with fidelity, the recommended initiatives will complement the Government's own action plans and transformational programmes.

It has been a great privilege to work with such a dedicated and selfless team of government and industry professionals in drawing up this National IoT Strategic Roadmap. With the necessary funding, facilities and pool of talent that we have already put in place and continue to develop, I can attest that Malaysia is in for an exciting era of game-changing technologies.

We look forward to continue to work with all of you in bringing this critical public-private initiative to fruition.

Methodology

1 CONFERENCE
IoT Techical Working Group Workshop

2 MULTI-STAKEHOLDER
Partnership Engagement Sessions

2 TASK FORCE
Engagement Sessions

20 ONE-TO-ONE
Sessions

KEY CONTRIBUTORS

Logo	Contributors
Alcatel·Lucent	• Mathew Simon
celcom	• Akram Mackeen • Goay Heow Khoon
CISCO	• Rajvinder Singh • Khairul Nizam
CREST	• Dr Khoh Soo Beng • Dr Mohd Norazmi Alias
CyberSecurity MALAYSIA	• Mohd Zabri Adil Bin Tabib

Logo	Contributors
EAST COAST ECONOMIC REGION	• Mohammad Afini Mat Rani
IBM	• Lee Yu Kit • Hasnul Nadzrin Shah Abdul Halim Shah
IEEE	• Assoc. Prof Dr Norliza Mohd Noor • Dr Chong Yu Zeng
intel	• Mohd Parid Sulaiman
kontron	• Seeni Mohamed • Shanmuganathan Palaniasamy

KEY CONTRIBUTORS (CONT'D)

MaGIC	• Cheryl Yeoh • Andi Suswandi
maxis	• Claire Margaret Featherstone • Noor Musaddik Mokhtar
MCMC	• Tengku Zaib Raja Ahmad • Md Rusli Haji Ahmad
MDEC	• Hasannudin Bin Saidin • Ong Chuan Poh
Microsoft	• Dr Dzaharudin Mansor
MIDA	• Rosedalina Ramlan • Aziawati Ismail
MiGHT	• Robert C.V. Tai • Norhasrizam Hashim • Kavintheran Thambiratnam

MIMOS	• Ahmad Helmi Abdul Halim • Dr Dickson Lukose • Gopinath Rao Sinniah • Dr Mazlan Abbas • Saat Shukri Embong • Yoong Siew Wai
.myNIC	• Mohamad Zamroh Bin Mahmud
PIKOM	• Ong Kian Yew • Shaifubahrim Mohd Saleh
SIRIM	• Dr Wan Abd Rahman Jauhari Wan Harun • Dr Wan Sazaley Wan Ismail
SMECORP	• Zaky Bin Moh
TeAM	• Bikesh Lakhmichand
WANNASSER	• Mohd. Zahrom Bin Zain

Internet of Things

Intelligent interactivity between humans and things to exchange information and knowledge for new value creation

Internet of Things

DEVICES/THINGS
Data Acquisition

APPLICATIONS, SERVICES & ANALYTICS
Transformation of Data into New & Actionable Knowledge

CONNECTIVITY & STORAGE
Seamless Data Sharing, Transmission & Storage

INCREASE IN PRODUCTIVITY

INCREASE IN GROWTH

ENHANCE COST EFFICIENCY

CREATION OF NEW BUSINESS MODEL
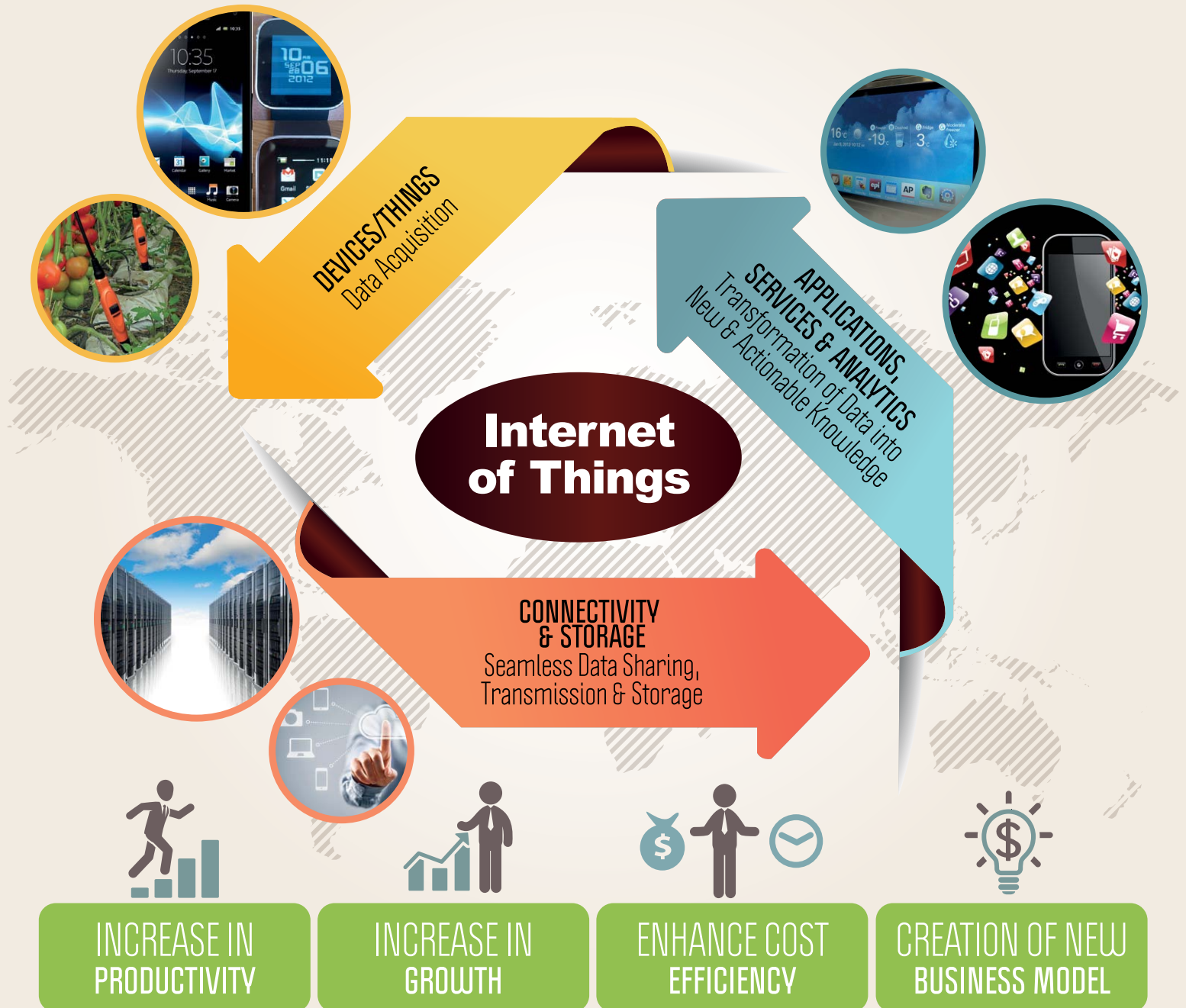
Our Journey

14-15 May 2014

Internet of Things Technical Working Group (TWG) Workshop

Participants' Profile

11%
Multinational Corporations
(MNCs)

6%
Others

19%
Academia

Total
Participants
193

17%
Large Domestic Companies
(LDCs)

17%
Small and Medium Enterprises
(SMEs)

30%
Government/
Agencies
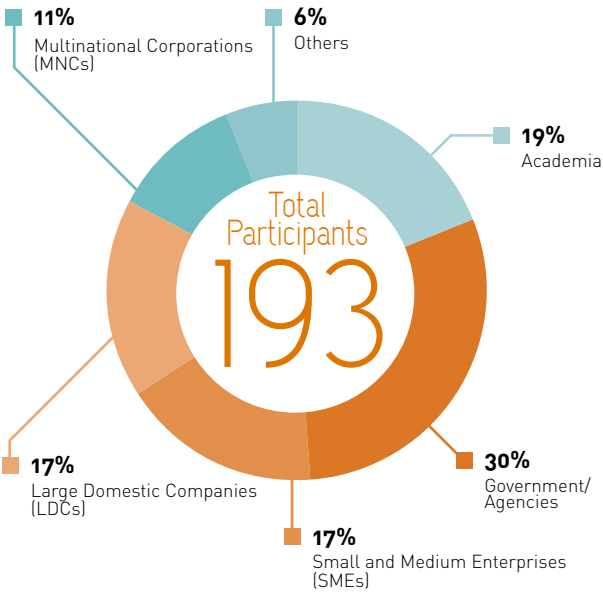
25 June 2014

Multi-Stakeholder Partnership Engagement Session

19 August 2014

Multi–Stakeholder Partnership Engagement Session

9 & 23 July 2014

Task Force Engagement Session

contents

NATIONAL IOT STRATEGIC ROADMAP

IoT INTERNET OF THINGS Powering Malaysia

Environment Monitoring
Monitoring of pre-emptive fire conditions, soil moisture and earth density to define alert zones for forest fire detection and landslide prevention

Water Management
Assessment of water quality and efficiency in water treatment plants to reduce wastage and cost

Air Pollution Control
Control of harmful pollutants from factories and cities

Temperature and Pressure Monitoring
Monitoring of temperature and pressure in oil well downhole tubing

Hospital Patient Management
Monitoring of health status of patients

Water Quality Study
Study of water quality in rivers and seas for wildlife sustainability and ecological preservation

Health Monitoring Trackers
Tracking personal health status on-the-go

Agriculture and Aquaculture Management
Control of micro-climate conditions to maximise production and quality of produce and livestock

Automotive Emission Control
Detection of emission levels to aid engine efficiency and to regulate carbon footprint

Why Internet of
Things (IoT)?

chapter 01

Why Internet of Things (IoT)?

1.1 INTRODUCTION

Internet of Things (IoT) envisions that everything in the physical world is connected seamlessly and is securely integrated through Internet infrastructure. When things react to the environment or a stimulus, data will be captured and transformed into valuable insights, which can be utilised in various application domains, ranging from automated home appliances to smart grids, smart homes and smart manufacturing, to name a few.

1.1.1 Definition

The term "Internet of Things" was first coined by the co-founder and Executive Director of MIT's Auto-ID laboratory, Kevin Ashton, in the mid-1990s[1]. Major vendors and technology leaders have announced initiatives to leverage IoT opportunities, and define IoT differently, aligning to their own area of speciality (refer to Appendix 1). Nevertheless, there are salient attributes across the array of definitions; such as sensors, things, people, processes, automation, data, networks, connectivity, convergence and intelligence. IoT, in this document, will be defined as "Intelligent interactivity between human and things to exchange information and knowledge for new value creation".

1.1.2 Components

Characterising IoT by referencing the number of connected devices or connections would be oversimplifying the phenomenon. IoT is a complex solution encompassing all aspects of the Internet; including analytics, the cloud, applications, security and much more; besides devices and connectivity.
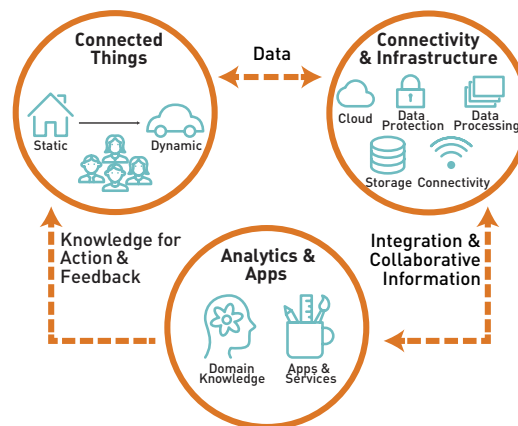
Figure 1.1: Components of the Internet of Things

Technologically, connecting things to the Internet can be accomplished with the existence of three main technology components (refer to Figure 1.1), namely:

i. Connected things with embedded sensors: Sense first-hand and multidimensional information and conditions of an event autonomously – without human intervention. In addition to capturing information, these connected things can act and react. As such, the environment context will be modified according to the information received by the sensors, and this cycle will be repeated continuously.

ii. Connectivity and infrastructure: Infrastructure such as cloud, security, storage, privacy and processor units facilitate continuous, real-time data and information flow and feedback loops.

iii. Analytics and applications: Transform sensor-generated information as new and key sources of knowledge for action-taking. These analytics and applications leverage on the data gathered, converge the information for further analysis and in turn provide actionable insights, then offer unique solutions for users to gain additional or enhanced life experiences.

1.2 MEGATRENDS

Megatrends are pivotal external variables to stakeholders in a business ecosystem. Through the lens of megatrends, we are able to understand the interplay of environmental, economic, social, political and other factors in the next five to 10 years. A nexus of megatrends will reshape the social structure, and human needs and wants. It channels information for all stakeholders to predict possible events or creations of the future; identifies and taps preferable conditions for business opportunities.

We have identified four megatrends salient to the paradigm shift and shape of the world in the coming years. The megatrends are highly interrelated and will influence changes in the status and expectations of individuals, global economy and physical environment.

1.2.1 Demographic shift

Population structure and composition are expected to be different from today, with a projected global population of 9.4 billion in 2050 (refer to Figure 1.2). There are four significant phenomena worthy to note: increasing aging populations in developed countries; developing countries will host increasing young populations with India projected as a nation with the highest young populous[2]; Muslims will be one-third of the world population in 2050[3]; and rise of women's power in economic creation.

Besides the increase in population size, 65 percent of the 2050 population will be urban dwellers[4] and the emergence of mega cities (minimum 10 million population), mega regions (above 10 million population) and mega corridors by linking two mega cities or mega regions[5], which will take place primarily in Asian cities[6]. From the gender perspective, women are a cohort that will change the landscape of decision making processes and priorities.

IMPLICATIONS: The increase in population size and geographical distribution will pose high competition for shelter and security, and demand for healthcare as well as better nutrition. An aging society will increase spending on long-term care for independent living and mobility.
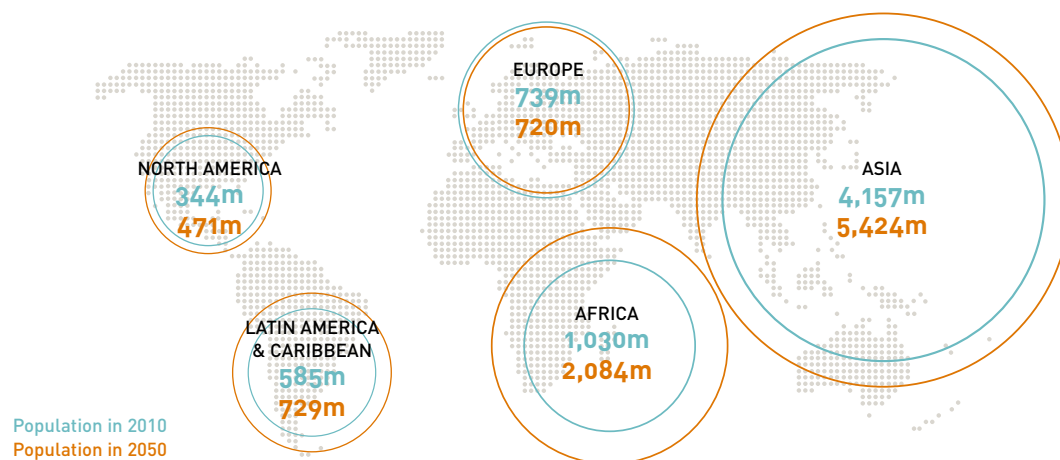
Figure 1.2: Global population of the future   **Source:** http://www.theguardian.com

1.2.2 Individual empowerment

With the impact of population growth and emergence of mega cities, the middle class will expand in absolute percentage of the global population, particularly in developing countries.

The increase in wealth and knowledge leads to a paradigm shift in terms of lifestyle and needs. There will be new styles of consumer desires and moves towards diets rich in food and beverage products.

Organisations are under pressure to connect and resonate with market needs, and strive to engage and retain with their target markets, with effective and efficient targeted marketing by offering personalised products and services, instead of a mass approach.

IMPLICATIONS: Living standards improve with higher literacy rates and the ability to access products and services based on individual needs, with "the-world-revolves-around-me" mentality as one of the key drivers of consumer desires.

1.2.3 Food, water and energy nexus

With population growth and expansion of the middle class driving the rapid industrialisation in developing countries, scarcity of finite resources and environmental degradation will be further intensified. This warrants immediate, effective and efficient strategic actions to curb pressure on natural resources and protect biodiversity for the future.

It is predicted that 30-50 percent of all food grown worldwide may be lost or wasted before or after it reaches the consumers[7]. To achieve sustainability, future improvements in agriculture will require radical changes in increasing agriculture yield, zeroing wastage within the food chain, and enhancing techniques in food production, storage and transportation. Studies also found that there would be no overwhelming obstacle to feed a global population of 9.4 billion in 2050, provided food yields are boosted, waste is cut both after harvesting and in the kitchen, and food distribution is improved[8].

IMPLICATIONS: Green Revolution through Sustainability will be the win-win approach in meeting the demand of 9.4 billion people by 2050. Innovative and efficient agricultural practices are critical to produce more with 'less and lesser' resources without damaging the environment through soil degradation or water pollution.

1.2.4 Diffusion of power

Clearly, there is a significant implication of demographic shift and population growth to the market ecosystem. The transition of the next economy powerhouse from the West to the East and South in addition to the rise of networked societies fuelled by technology advancements and democratised information will encourage people to participate actively and become prosumers (consumers who become involved with designing or customising products for their own needs) rather than passive receivers at the end of the value chain.

New paradigm shifts happen when a globally interconnected world – one that is open and neutral with free sources of information – generates an informed, educated population with the tools and desires to bring about institutional change. The pace and possibility of communication has never been greater; the Internet, television and radio provide universal platforms for collective thinking, where everyone wants their voice to be heard and counted. New media has accelerated the timeline for sharing information and is putting unprecedented demands on the accountability of politicians and leaders around the world.

IMPLICATIONS: The distribution and sharing of information lead to widely distributed and shared power, and informal networks will undercut the monopoly of traditional bureaucracy. The ever increasing speed of the Internet demands governments to be more transparent and efficient in their operations in return for political mileage.

1.3 MARKET VALUE SHIFT DRIVEN BY MEGATRENDS

Global megatrends will produce opportunities and challenges for the future and urge transformation for the business process to deliver market needs. The effects of megatrends will happen concurrently but impact a wide spectrum of market segments in different magnitudes. For the agriculture segment, natural resource scarcity and growing population size will pressure the agriculture sector for reformation to minimise impact to the environment yet able to feed the

growing population. Therefore, minimising the reverse impact to the environment from agriculture and other human activities are critical to reduce further pressure and deterioration of the natural environment. The effectiveness of protection and restoration efforts are attributed to the collaboration and concerted efforts from ecosystem stakeholders for a sustainable future.

Transformation in education sector is deemed essential in providing knowledge workers as a catalyst for economic growth. Factory model education will not be able to pace with future talent needs and a learner-centric approach, where a collaborative, active, engaging and interactive model helps students increase their knowledge and develop the skills needed to succeed in the knowledge society. Future learning would be instant feedback and

adaptive learning orientated in all stages of learning and education processes.

The megatrends which underscore future human developments are complex and resultant of a reciprocal effect due to population growth and economic activities. Existing standard management and reactive modes of government service deliveries are not able to match with citizens' needs. In order to achieve balance and inclusive development of society, governments need to create a sustainable environment to enable businesses, communities and citizens to learn, create and prosper in an open and collaborative way, through the provision of city governance, platforms and spaces, which integrate and leverage intelligence across communities, through the efficient in use of scarce resources. Table 1.1 illustrates market value

Vertical Market	As Is	To Be
Agriculture	Resource dependency & serves as economic power	Knowledge-based & sustainable agriculture businesses
Education	Structures & curriculum	Open & personalised lifelong learning
Healthcare	Curative & disease treatments	Wellness management: Self-care & self diagnosis (prognosis)
Government Service Delivery	Standardisation	Open & smart government services
Smart City	Reactive management	Integrated & seamless service delivery
Environment	Reactive management	Preservation & restoration

Table 1.1: Market value shift

shift scenarios for several vertical markets due to the influence of megatrends.

In order to address future needs, IoT fits well by leveraging its convergent technologies (things, connectivity and infrastructure, analytics and applications) to enable enterprise and individuals to be accurately informed of an event, optimise resource usage, and respond strategically.

1.4 TECHNOLOGY TRENDS

The Internet has had significant impact in almost every facet of our lives. It is the window to new ideas, information, and a whole new world of communication. It has grown and evolved to influence how we interact, conduct business, learn, and proceed day to day. As much as it has reformatted our lives, in the process, the Internet itself has changed too.

The Internet is evolving (refer to Figure 1.3). It becomes an ever more pervasive and critical infrastructure underpinning society and commerce around the globe. In 1990, with the creation of World Wide Web (a method of publishing information on the Internet) by Tim Berners-Lee, the Internet became the richest source of information, and since then the number of websites and webpages have exploded.

As a result, the Internet has graduated from a mere access point for information. Online and offline were once two very separate worlds. But with the rise of e-commerce and in particular mobile e-commerce, the distinction between online and offline is blurring rapidly. The Internet has transformed economic activities from the physical world to the virtual world through digitisation of the business process. E-commerce burst onto the scene in the mid-1990s. Subsequently, the Internet has become increasingly mobile and a socialising platform for businesses and individuals that seek mobility and convenience.

The Internet of yesterday is a growing universe of interlinked humans and creates new generations of interaction experiences. Internet usage has exploded since 1995 where the first billion users were reached in 2005. The second billion was in 2010, and the third billion is expected to be reached by the end of 2014[9].

The next phase of the Internet is on its way: a world of networked smart devices equipped with sensors, connected to the Internet, all sharing information with each other without human intervention, known as the Internet of Things (IoT).

Key markets signal the increase of connected devices or things globally attributed to signify the presence of IoT. This is indicated by the number of Internet-connected devices surpassing the global population, and by 2020, Internet-connected devices are expected to number between 26 billion and 50 billion, and clock 880 million unique mobile subscribers. Table 1.2 details several key market signals.

With the dramatic rise in the number of connected devices and connected individuals, market experts forecast that four interwoven and interactive technology pillars will fuel and shape IoT, specifically:

i.   Big data technologies will be the cornerstone in extracting meanings and
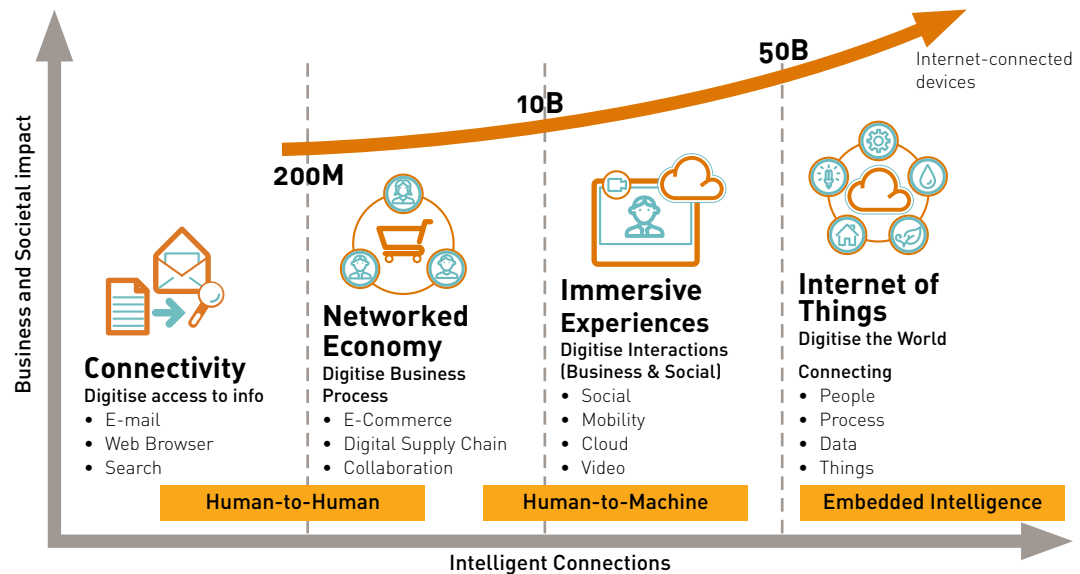
Figure 1.3: Internet evolution   **Source:** Adapted from CISCO

insights from the diverse, enormous and continuously expanding data and information collected by things and sensors, enriching user experiences and enabling new business processes and models. The relevant and valuable intelligence derived from data will open up possibilities of new processes and functions previously deemed not feasible. The intelligence obtained through big data are able to perform complex tasks including remote controlling, monitoring, sensing, decision making, and reacting to specific situations.

ii. Cloud computing will serve as platform for the delivery of information and functionality to users. The technology will allow information and knowledge to be accessed and delivered to anyone, anytime and anywhere.

iii. Social media is transforming the interaction and communication between individuals in new and unexpected ways. The information sourced from physical movements and online interactions will promote interconnected societal engagements, sharing of information, collaboration and innovation.

iv. Mobile devices and things i.e. physical objects are platforms for social communication and networking in both

Source	Market Signal
Gartner	26 billion connected devices[10]
Frost & Sullivan	Connected devices amounting to 40 billion connected "things"[11]
IDC	28.11 billion of IoT units installed[12]
Cisco[13] & Ericsson[14]	50 billion devices
GSMA	25.7 billion connected devices; 10.8 billion mobile connected devices[15]
GSMA	880 million unique subscribers[16]
UTMS Forum	Global mobile subscription reach 9.7 billion[17]

Table 1.2: Markets signals for IoT

living and work spheres. The readiness of IPv6 will be key to drive the proliferation of IoT-enabled things across industry-specific activities. With the diminishing cost of devices driving the revolution of sensors and connected things, data capturing will no longer be restricted by location or limited to a single dimension. The data collection process can be scaled and multi-dimensional variables can be captured simultaneously within a given environment.

1.5 OPPORTUNITIES IN IOT

Universally, IoT is expected to transform our lives, enabling horizontalised and verticalised applications across a wide spectrum of vertical markets and spur the growth of technologies.

The applications of IoT can be segmented into two perspectives; enterprise and end users, as summarised in Table 1.3.

1.5.1 Market potential for IoT

IoT opportunities are multifaceted and by 2020, Gartner forecasts that 26 billion units of connected devices will deliver an overall global economic value add of US$1.9 trillion, of which 80 percent will be derived from services[19], while IDC estimates US$7.1 trillion within the context of the IoT ecosystem, including intelligent and embedded system shipments, connectivity services, infrastructure, purpose-built IoT platforms, applications, security, analytics, and professional services[20].

Enterprise Perspective	End User Perspective
Optimisation of resources for operational efficiency, improved availability and increased yield.	Availability of excellent devices with user-friendly interfaces, location and contextual-based applications with minimal learning curves to empower individuals. Gartner forecasts by 2017, 80 percent of consumers self-collect and track their personal information and are willing to "trade" for greater cost saving, convenience and personalised services[18].

Table 1.3: IoT opportunities

Cisco highlights a "value at stake" (potential bottom line value that can be created) generated by IoT amounting to US$14.4 trillion over a 10-year period from 2013 to 2022[21], driven by five key areas of transformation; specifically, asset utilisation (US$2.5 trillion); employee productivity (US$2.5 trillion); supply chain and logistics (US$2.7 trillion); customer experience enhancement (US$3.7 trillion); and innovation (US$3.0 trillion).

1.5.2 Value creation in IoT

The potential of IoT towards enhancing human well-being is significant. For individuals, IoT value creation focuses on 5Ps:

i. **Personalisation.** Each person is genetically and physically unique and must be considered as a unique individual — not as a statistical average. Individuals should be empowered to determine what suits them perfectly. Premised on this value, the concept of a quantified self emerges, where individuals track data about their body and conduct their own personal monitoring, and investigate and research their bodies, minds, selves and indulge in self-experience.

ii. **Participatory.** Each individual will have greater stakes in all products and services they consume. Therefore, instead of being passive receivers at the end of a value chain, characteristics of pre-IoT era, activated and networked consumers will demand more effective service delivery – where they will help lead the necessary

changes to achieve it. Crowdsourcing will be such a win-win situation and yield many benefits for all stakeholders within the value chain.

iii. **Proactive.** Proactive enterprises, which are continuously aware of possibilities that abound in relevant business contexts – and optimise their resources to achieve what "should be the best action", are emerging. In order to move forward and stay ahead of the competition, enterprise operations are shifted from being reactive-oriented, which is event-triggered, to a proactive mode. Enterprises will be able to mitigate or eliminate undesired future events or conditions, or to identify and take advantage of future opportunities, by using prediction and automated decision-making methods proactively, thus enabling continuous monitoring of the need for service adaptation and propose corresponding changes in an automatic way.

iv. **Prescriptive.** Enterprises always strive to improve customer care and reduce overall operation costs; therefore they consistently look out for technologies which can address both needs by enabling real-time communication and access to data from remote locations and devices. Machine data collected from connected things will be unleashed and the value that the data can provide will be unlocked through massive "historical events" processing and iterative analysis of the system.

v. **Productivity.** Enterprises must be equipped with situational awareness and real-time

market information transmission to relieve the demands on operation and field forces that would increase industry efficiency and improve response times. Connecting all things strategically enables enterprises to drive not only reductions in service cost and improved service levels, but through the analysis of machine data, it also improves business decisions, product design and manufacturing processes.

1.5.3 IoT maturity level

Since its introduction by Kevin Ashton in 1998, the concept of the Internet of Things has come a long way and now has taken

centre stage. Figure 1.4 depicts an overview of the IoT evolution path that is gaining ground; from the introductory stage of wired and wireless communication for machine-to-machine, which later goes through the harmonisation of technology protocols, which is the tipping point for IoT to march into the development stage.

With more granular data being collected through the integration of technologies, harmonisation of information technologies is critical to integrate multifaceted data and information, where IoT transits to the growth stage. In the growth stage, IoT proliferates through consumerisation. With IoT,
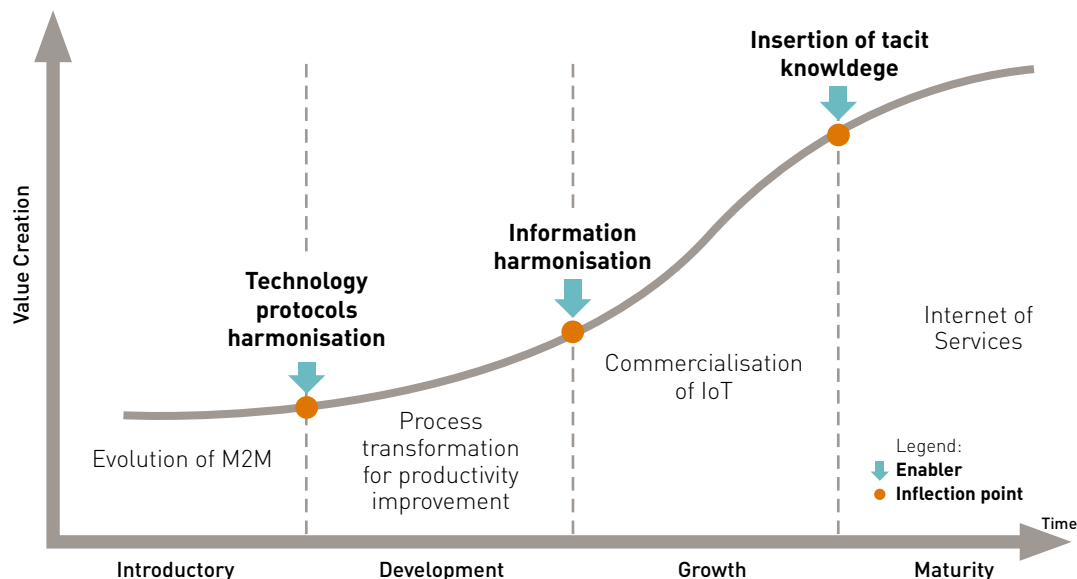
Figure 1.4: Overall of IoT evolution

technology advancement enables the insertion of tacit knowledge leading to the unleashing of greater opportunities. This is where a paradigm shift happens – from the provision of products to the provision of services – where individuals no longer purchase products for utilitarian purposes, but will subscribe to services without owning any product.

1.6 GLOBAL IOT IMPLEMENTATIONS

Across the world, a majority of countries are envisioning smart city initiatives that focus on

energy, water, transportation, buildings and government. Frost & Sullivan predicts that smart cities or connected cities will contribute the largest percentage to the overall economy at 54 percent, with an estimated market potential of US$392.94 billion[22]. Eighty-four percent of the initiatives are led by five countries including the United States, European countries, Japan, China and Korea[23]. Other countries including India, Australia, South Africa, Canada and Singapore are also now moving towards building digital and connected infrastructures.

Canada:
- Started in 2010: i-CANADA
- Healthcare, TeleWork, e-commerce, education & government
- Public Sector
- Smart City

Europe:
- Started in 2011
- Smart Cities & Community
- Cognitive IoT
- Smart objects
- Smart transportation

Europe & Japan:
- Started in 2013
- ClouT: Joint European-Japanese ICT project for smart cities

Russia:
- 2020 target: US$980M
- Vehicles, smart parking, smart cities' payment terminals, devices and sensors

Korea:
- Started in 2003
- Smart city & smart government
- 2014: 5G network technology (intelligent networks)

Japan:
- Started in 2010
- Home energy management: Yokohama city, Kansai Science City & Kitakyushu city
- Transport: Toyota City
- Applications: Vending machines, transportation management, surveillance & e-wallet services

USA:
- Started in 2010: SmartAmerica
- Areas: Manufacturing, healthcare, energy, transportation & disaster response, government, aeronautics & social media

China:
- Started in 2005
- Traffic systems & IoT
- 2011: Food safety & healthcare in remote & rural areas

South Africa:
- Started in 2010
- IoTEG (IoT Egineering Group), CSIR Meraka
- Applications: Connected devices, energy efficiency, enabling smart environments

India:
- Started in 2010
- Areas: Water, energy & waste resource efficiencies, environmental governance

Singapore:
- Started in 2013
- Areas: Wireless technology, smart products & smart nation

Australia:
- Started in 2010
- Renewable energy & electric vehicles
- Healthcare, government & infrastructure

Figure 1.5: Global IoT initiatives indicating the starting of each inititiave with respective focus areas (Note: This is a non-exhaustive scenario)

By the end of this decade, billions of devices will become smarter and will significantly improve the way we do things. Into the 2020s, Frost & Sullivan forecasts the market potential for total "connected living" to reach US$731 billion[24].

Tens of millions of people will be connected by trillions of things and applications as a result of the "connected things" industries. Figure 1.5 provides an overview of global IoT initiatives in different spots around the world while Appendix 2 provides the details of the implementations.

Several strategic alliances have been established among industry players which further intensify the development of IoT globally. This phenomenon highlights that the wave of IoT will not be a single-player game nor will it be dominated by a single technology. In capitalising on IoT opportunities, end-to-end solutions and collaborations are critical.

For Malaysia, there are also pockets of IoT-related activities and initiatives in place to kick-start the National IoT Strategic Roadmap (refer to Appendix 3).

Strategic Alliance	Players	Objective
Open Interconnect Consortium (OIC)[25] [July 2014]	Samsung, Intel and Dell	• Solve the challenge of interoperable connectivity for IoT without tying the ecosystem to one company's solution • Establish a single solution that covers interoperability across multiple vertical markets and will work on various OSes
Smart City Global Strategic Alliance[26] [Feb 2014]	Cisco Systems and AGT International	• Cost-effective and efficient delivery of services that enhance the daily lives of citizens and improve urban services – from transportation and healthcare to utilities, infrastructure, disaster preparedness and personal safety.
Industrial Internet Consortium[27] [Jan 2014]	AT&T, Cisco Systems, General Electric, IBM, Intel, Ei3[28]	• Coordinate the development of common architectures and platforms for the widespread enablement of the Industrial Internet.
AllSeen Alliance[29] [Dec 2013]	51 members	• Fast-track the development of device-to-device communication. • To drive the widespread adoption of connected products that support an open, universal development framework based on the AllJoyn™ open source project.
Global M2M Association (GMA)[30] [July 2012]	TeliaSonera, Orange, Deutsche Telekom and Telecom Italia	• Offer enhanced quality of service, M2M roaming services and interoperability.
M2M World Alliance[31]	NTT DoCoMo, SingTel, Telstra, Etisalat, Telefonica, KPN and Rogers	• Deploy seamless international M2M solutions through a single point of contact.

Table 1.4: Strategic alliances in IoT

With the complexity of IoT, the formation of consortia is necessary to address the rise and success of the technology. Formed by industry leaders, the consortia will facilitate devices and systems to securely and reliably interconnect, and ensure optimum interoperability, agility and security in information sharing. Table 1.4 lists the features of several recent establishments of strategic alliances in IoT.

1.7 MARKET ANALYSIS

The four aforementioned prominent megatrends are the significant and interlocking fundamental elements that have profound impact on human needs in different spectrums; the trends provide lenses to project a shift in the way people think and consequently act, which in turn will chart the way forward for Information and Communications Technology (ICT) industry.

Coupled with advancements in the Internet and other communication technologies, convergence and interactions of the megatrends will be manifested in various forms in different market spaces; under the influence of a global nexus of forces. This provides a perspective on ICT in its bid to offer values of Personalisation,

	Demographic Shift	Individual Empowerment	Food, Energy & Water Nexus	Diffusion of Power
Characteristics	• Aging society • Urbanisation & migration • Rise of women power	• Growth of global middle class • Higher education level	• Scarcity of natural resources • Competitive demand for natural resources	• Diminishing of monopoly • Highly connected & networked society
Implications	• High competition for shelter & security • Demand for healthcare & better nutrition	• Personalisation of products & services	• Sharing of resources • Demand for productivity & efficiency • Zero waste	• Transparent society/ market • Consumerisation of ICT
	Shift in market & demand structure	Personalisation on common collaborative platforms	Management of limited resources	Transparencies & understanding WHY

Personalisation
• Address individual needs & preferences
• Customisation

Participatory
• Multi-party collaboration

Proactive
• Ability to predict
• Manage situations

Prescriptive
• Understand WHY

Productivity
• Efficiency & sustainability

Figure 1.6: Global nexus of megatrend implications to human needs and advancement

Participatory, Proactive, Prescriptive and Productivity (refer to Figure 1.6).

The nexus of megatrends pressures industries to recognise the paradigm shift and warrants their attention to make a qualitative leapfrog from passive to proactive, and product-centric to value-creation orientation towards sustainable growth. The global nexus of megatrends also empowers individuals' active participation in the process of value creation and enables self-management and self-sufficiency. Future transformation will most likely not resemble that of yesteryears', as the whole ecosystem will be very different. IoT will be the core enabler in facilitating firms

and workforces to develop the capabilities they need to manufacture new products, to enter new markets, and to move up the value ladder. With an increasingly diverse range of devices and communication streams that leverage the vast potential of data, the roles of individuals can be extended with IoT.

The convergence of things, rich data generated from things, knowledge availability and autonomy by IoT solutions drive demand – individuals and the business community are racing to boost their intelligence, efficacy and productivity to enhance customers' confidence and quality of life.

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chapter 02

Where We Are

chapter 02

Where We Are

2.1 MALAYSIA IS READY FOR IOT

2.1.1 Malaysia's demand factors

Generally, Malaysia has an encouraging environment and a strong starting point to foster and spur IoT within the domestic market, proven by the following evidence:

i.   Mobile penetration per 100 inhabitants in Malaysia is beyond 100 percent and clocked at 143.7 percent[1] in Q1 2014, and multi-handset ownership is observed

ii. 65.8 percent of Malaysians are Internet users[2]

iii. Relatively active online behaviour where 59 percent of Malaysian Internet users download mobile apps compared to the Southeast Asian average at 67 percent[3]

iv. Annually, Malaysians spend an average of US$2,000 on online purchases[4]

v.   Close to one in every two Malaysians are active in social networking and lead to 45 percent social penetration[5]

Domestic ICT consumption is projected at RM118.6 billion in 2015 and will register RM176.9 billion by 2020, with a compound annual growth rate (CAGR) of 8.32 percent between 2015 and 2020 (refer to Figure

2.1). Telecommunication services remains dominant in local ICT spending in coming years, with the content sector's projected above average CAGR at 10.1 percent. This positive growth of domestic consumption provides opportunities to showcase local technologies and innovations.
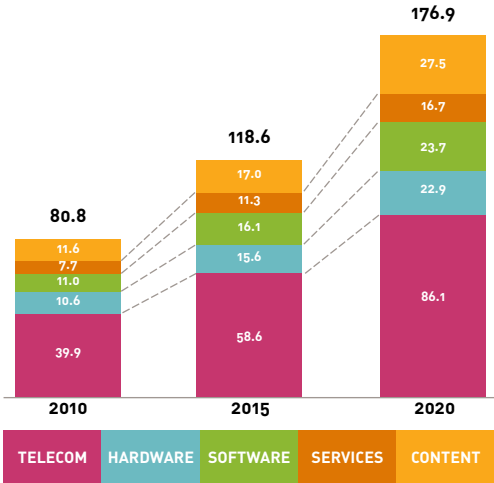
Figure 2.1: Domestic ICT spending (RM billion)

Source: Frost & Sullivan[6]

The aforementioned key Internet and mobile indicators, in addition to domestic ICT spending, reveal demand factor conditions in

	Today	Impact of IoT (2025)
Mobile device penetration	**143.7%**	**280%**
Internet users	**65.8%**	**195%**
Mobile broadband penetration	**13.34%**	**167%**
Social network penetration	**45%**	**135%**
Mobile services (US$)	**8B**	**16B**
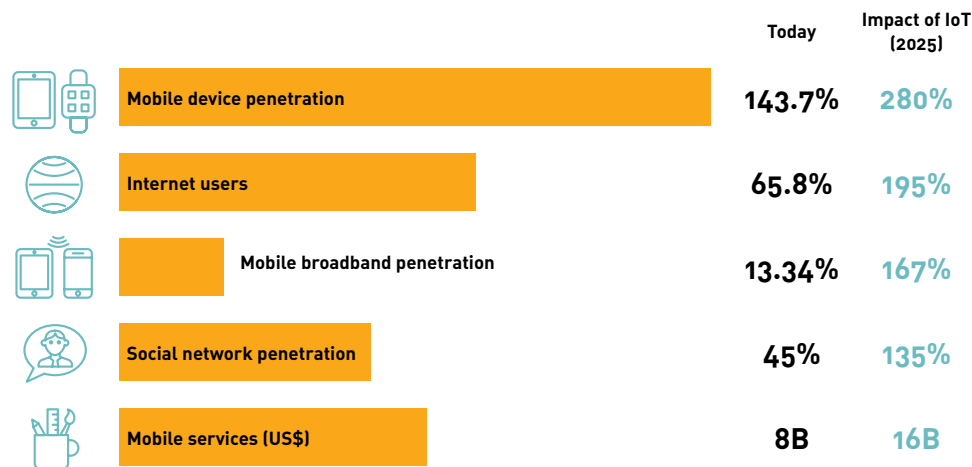
Figure 2.2: IoT-accelerated Internet usage

Source: Gartner, Frost & Sullivan

Malaysia which is encouraging and amicable for IoT to take place.

Worldwide, the number of Internet-connected devices had surpassed the number of human beings in 2011, and by 2020, Internet-connected devices are expected to number between 26 billion and 50 billion[7]. In the case of IoT, people will not just be interacting with other people and things, but the things themselves will also interact with one another. With the increasing use of mobile devices and wider penetration of the Internet, Malaysia will become fertile ground for IoT implementation. Following this, the Malaysian digital landscape will grow exponentially, as depicted in Figure 2.2.

2.1.2 IoT opportunities in Malaysia

It is forecasted that the initial IoT potential in Malaysia will register RM9.5 billion

RM190.7B
RM42.5B
RM110.7B
RM9.5B
RM37.5B
RM72.4B
RM26.0B
RM62.1B

■ Traditional ICT spending
■ IoT spending

2013   2015   2020   2025

Figure 2.3: Malaysia IoT opportunities (2020-2025)

Source : Gartner and Frost & Sullivan

Figure 2.4: Malaysia IoT spending will surpass traditional ICT market by 2025

by 2020, which tops up values on the traditional ICT industry and leverages on existing economic initiatives such as the Economic Transformation Programme (ETP), Government Transformation Programme (GTP), Digital Malaysia (DM) and Digital Lifestyle Malaysia (DLM). Supported by continuous promotional campaigns and strengthened by market value appreciation, IoT in Malaysia is expected to experience exponential growth beyond 2020 and reach RM42.5 billion in 2025 (refer to Figure 2.3). IoT growth will outmanoeuvre the traditional ICT market by 2025 and subsequently reshape Internet usage behaviour and generate Internet growth in Malaysia (refer to Figure 2.4). This is assuming that the IoT growth rate in the Asia Pacific region at 34.1 percent[8].

Technology opportunities that can be created by IoT in Malaysia are concentrated in applications and services, and analytical-related technologies, with forecast technology opportunities amounting to RM34 billion

in 2025, compared to RM7.5 billion for 2020. Second to application and services, and analytics technologies is the revenue generated by device producers which is projected at RM4.3 billion (refer to Figure 2.5).
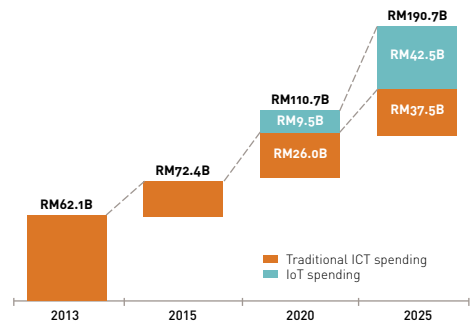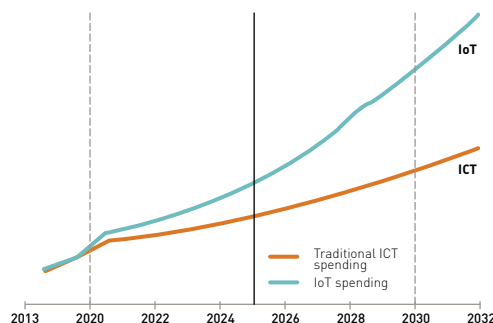
Besides delivering financial impact to the nation, the poential of IoT can serve as a good platform for the research community to commercialise R&D outputs. As of 2012, there are 146[9] potential patents from Malaysia which can be licensed to investors to enhance the competitiveness of their IoT applications and services.

Furthermore, the growth of IoT in the Malaysian market is projected to generate a total of 14,270 high-skilled employment opportunities by 2020. Entrepreneurs who create unique value on top of commodity hardware, connectivity and cloud services will reap profits in IoT. The demand for IoT technology will not come from a single killer app, but from thousands of unexpected new use cases by solution developers who pull intelligence from data which is fundamental in making IoT a big, profitable market[10].

2.2 ENVIRONMENTAL SCAN

In a nutshell, Malaysia is blessed with favourable conditions to participate in IoT. However, for Malaysia to advance in this emerging market, there are several critical areas that should be driven further, which have been identified as follows (refer to Table 2.1):

• To assess the root causes to Malaysia's innovation paradox

	Global Scenario		Malaysia Scenario	
	2020		2020	2025
Layer 5: Analytics	RM890 Billion	% of IoT		
Layer 4: Apps & Services		80%	RM7.5B	RM34.0B
Layer 3: Computing & Storage	RM61 Billion	5%	RM0.5B	RM2.1B
Layer 2: Communications & Networking	RM58 Billion	5%	RM0.5B	RM2.1B
Layer 1: Things: Hardware, Power & Protocols	RM105 Billion	10%	RM1.0B	RM4.3B
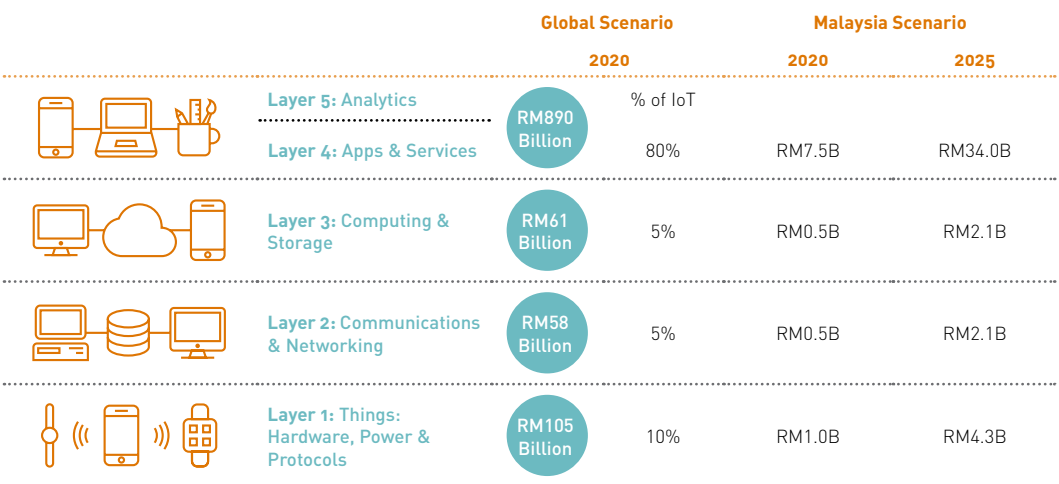
Figure 2.5: IoT technology opportunities   **Source:** Gartner (2014)

- To promote market-driven policies to enable innovation
- To develop funding instruments to support innovation initiatives
- To establish linkages across industries and public research institutes
- To foster a vibrant innovation culture and outstanding human capital

2.3 CHALLENGES

While acknowledging the advantages of IoT technology convergence, several challenges should be addressed in order to facilitate the capturing of new competencies, capacities and market opportunities by Malaysian industry players so that a higher growth rate in IoT can be achieved.

Generally, four thematic challenges are acknowledged by various stakeholders of the ecosystem, specifically:

2.3.1 Infrastructure

Infrastructure is the catalyst to reach an interoperable, trustable, mobile, distributed, valuable and powerful enabler for emerging applications such as smart cities, smart grid, smart buildings, smart homes, intelligent transport systems, and ubiquitous healthcare, to name a few. The massiveness of sensors and smart things to be connected to the Internet will pressure the spectrum and availability of IPv6.

Herein, the presence of smart objects in the Internet realm and people living in a connected

Factor	Strengths	Weaknesses
Technology	• Well-established mobile operators and five operators licensed to provide 3G services	• Technology complexity • Legacy systems • Security and privacy concerns • Data accessibility and knowledge sharing availability
Resource	• Creation of new MSC cybercities and cybercentres • SMEs as source of endogenous growth and innovation • E&E industry is leading in terms of investment, industrial output, value add, exports and employment	• Fragmented funding instruments unable to generate required impact • Barriers to free market competition exist
Societal	• High phone and Internet penetration rates • Sophisticated consumers are eager to use mobile data and value-added services	• Rural adoption and adaptation fear - technology phobia
Political	• Various incentives like pioneer status, tax exemptions and allowances to promote ICT investment • Intellectual property protection and cyberlaws	• Dedicated performance management entity exists to monitor and drive performance of innovation initiatives • Broken linkages across industry and public RIs • Multiple public agencies working in silos on innovation initiatives

Table 2.1: Environmental scan

world will pose new challenges to existing IPv6 deployments. IoT's needs for connectivity, reliability, security and mobility will accelerate and propagate the use of IPv6, which is considered an essential technology for IoT, as it offers scalability, flexibility; and tested, extended, ubiquitous, open, and end-to-end connectivity[11].

For infrastructure, "enabling all things" infers that devices and objects can communicate and interact with each other, but they may have several physical constraints in terms of memory capacity, computation capability, energy autonomy, and communication capabilities. This generates the next great market opportunity for cloud providers for processing power, storage and interconnectedness. Cloud technology needs to synergise with all thing-generated data by filtering, analysing, storing and accessing information in useful ways. Therefore, exploiting the true potential of the interface between mobile, cloud and smart objects with sensors will elevate the market space for cloud computing to further capitalise on.

2.3.2 Data and information

With the vastness of things connected to the Internet, individuals and businesses will be

able to collect more detailed information. The Web of Things will expand the types and quantity of data collected, gathering everything from location information to demographic, psychographic and social details.

The proliferation of sensors will facilitate self-tracking data which is outside the mainstream and traditional data collection manner. Self-tracking data can provide better measures of everyday behaviours and lifestyles, and can fill in the gaps for existing high quality traditional data collection. Therefore, it is critical to aggregate and manage self-tracking data for knowledge advancement.

The trend for data sharing and self-tracking data for greater public good (such as those done by the Quantified Self movement) extends to opening up personal data to see what insights others might see in them. Several key issues have emerged, which revolves around the importance of trust in establishing the ecosystem that will support individuals donating their data for public research. Specific issues include privacy related to personal data and data sharing[12].

With so much data flowing in from potentially millions of different sensors and things, the diversity and precision of the knowledge about the world will reach a new level never before imagined. The challenge then is in the viewing and management of the enormous and wildly-varied data. As of today, there are already deployments of big data technologies to find value in the data exhaust – those that can be quickly ingested and analysed for enterprises to further utilise. The ability to see the value of the data is important. Analytics-enabled data is one of the solutions sought after for use by IoT.

2.3.3 Security and privacy

Connected devices can communicate with consumers, transmit data back to companies, and compile data for third parties such as researchers, healthcare providers, or even other consumers.

Findings from TRUSTe Internet of Things Privacy Index reveals that UK consumers' comfort levels varied widely depending on responsibility, ownership and usage of collected personal data. Privacy and security concerns along the information supply chain will be a potential barrier to the growth of the IoT market as only 18 percent of respondents agreed that the benefits of smart devices outweighed any privacy concerns[13].

2.3.4 Talent

The biggest challenge in materialising the greater benefits of IoT is the human factor, where the capabilities of industry players in swiftly creating new and differentiated products will be a primary determinant of their success.

Human capital challenges can be segmented into two broad categories, namely strategic issues (e.g. programmes to cultivate success stories of IoT deployment) and tactical issues (e.g. identifying pools of IoT talent, attracting talent participations in IoT,

and identifying niche areas to attract talent across different disciplines).

2.3.5 Ecosystem

"Things" (for example, everyday objects, environments, vehicles, healthcare instruments and clothing) will have more and more information associated with them, and are beginning to sense, communicate, network and produce new information, and are becoming an integral part of the Internet. Value-added services using IoT could reach £200 billion a year worldwide[14], with new business models, applications and services developing across different sectors of the economy. These will also stimulate innovation and growth in areas such as components, devices, wireless connectivity, system integration and decision-support tools.

The full economic potential of IoT has been held back by systemic issues such as fragmentation and barriers to application and service development at scale. The challenge is in the formation of an ecosystem for IoT to unlock new markets and help Malaysia to gain a competitive advantage in the technology.

The current scenario is such where multiple public agencies work in silos on research initiatives and funding mechanisms, subsequently having multiple strategic focuses with limited resources. The lack of a common direction make the initiatives unable to generate the required impact. A lead agency on IoT is the turnkey to drive coherence and

coordination across multiple stakeholder groups in the innovation ecosystem.

2.4 DRIVERS/ENABLERS

The technology routes for IoT realisation include:

i.   Interoperability: Internetworking of heterogeneous networks

ii. Security and privacy: Integration of security and privacy protection

iii. Quality of service: Secure and reliable real-time network infrastructure

iv. Data and information: Analytical opportunities arising from massive streams of potential real-time information

v.   Multi-sensory super-web: Ability to access the world's entire stock of information, communication, learning, entertainment and leisure activities in full sensory glory, hence an increased, easier and more open availability of data from "things"

vi. Access: Easy and harmonised access to data across organisations and sectors, enabling greater innovation and development at scale

vii. Research and development: Experimentation and innovation in applications and services, and testing of business and user models, in order to increase adoption, build investment propositions and value realisation

From stakeholders' perspectives, the key enablers of IoT can be described as follows:

i. A market-savvy and influential national centre of excellence is needed to play a proactive role in orchestrating efforts in ramping up the nation's IoT agenda such as by:

a. Creating incentives and opportunities for local industry players to participate and collaborate with MNCs. The centre should promote private-public R&D partnerships and push for competitive corporate tax incentives focused on specific sectors.

b. Establishing a cooperative framework to tie up technology SMEs with leading MNCs. Such tie-ups are invaluable to integrate startups and SMEs into the value chain of larger players, and to project these startups and SMEs as credible service providers in the market.

ii. SMEs – known for their ability to "leapfrog" technology innovation due to their unencumbered organisation structure and speed of decision making. SMEs are critical IoT enablers on account of their competent managerial capacities and technical know-how in enabling technology diffusion.

iii. Funding – while not a silver bullet, it is a critical public sector tool to accelerate IoT development.

Strengths
- Demand factors: Mobile penetration of 143.7 percent; 65.8 percent of population are Internet users; active online behaviours
- E&E industry advancements (investment, industrial output, value add, exports and employment)
- Premiere ICT as economic sectors in various government inititiatives
- Strong SME base as source of endogenous growth and innovation
- IP protection
- Well-established mobile operators

Weaknesses
- Fragmented funding instruments
- Rural adoption and adaptation fear - technology phobia
- Broken industry-public RIs - academia linkages
- Silo innovation initiatives
- Talent competencies
- Legacy systems
- Data accessibility
- Knowledge sharing availability

Opportunities
- Sophisticated consumers
- Technology complexity
- Innovation initiatives
- Strong market potential in Asia Pacific region with 34.1 percent growth rate

Threats
- Security and privacy challenges
- Data governance policies
- Regional Smart City/Smart Nation initiatives

Figure 2.6: SWOT analysis for realising IoT in Malaysia

2.5 GAP ANALYSIS

In a nutshell, the SWOT analysis (refer to Figure 2.6) highlights the strengths that Malaysia should focus on, opportunities that should be optimised, as well as weaknesses and threats that may constrain the growth of IoT and subsequently frustrate the participation of industry players.

To capitalise on the huge potential of IoT, Malaysia needs to embed success factors and a proper execution plan. The following list briefly highlights recommendations to realise IoT in Malaysia:

- Develop an IoT standard-compliant ecosystem to reduce the cost of development and foster execution

- Support standardisation initiatives across different technology layers

- Initiate cross-industry fertilisation to address niche markets and deliver full-service strategies

- Expand the roles of ecosystem members by leveraging their respective proven core competencies such as partnerships, device compliance, network deployment, commissioning and maintenance, end-to-end system integration

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What We Want to
Achieve

chapter 03

What We Want to Achieve

The overriding objective in realising the value of IoT is to position Malaysia as a key player on the world map while enabling inclusiveness of benefit distribution to Malaysians through locally-engaged, nationally-relevant and internationally-recognised initiatives.

3.1 VISION AND MISSION

The vision and mission are formulated to provide a clear strategy and common direction for the implementation and growth of IoT initiatives in Malaysia. It serves as a guide and declaration of purpose for Malaysia to work in a synergistic manner that will lead it to be the Premier Regional IoT Development Hub and make IoT a new source of growth, subsequently creating job opportunities and be the catalyst and energiser for all stakeholders.

> ### VISION
> Malaysia to be the Premier Regional IoT Development Hub
>
> ### MISSION
> To create a national IoT ecosystem to enable the proliferation of use and industrialisation of IoT as a new source of economic growth

3.1.1 Mission elements

The mission comprises the following elements:

- Developing and sustaining a globally-competitive IoT industry with capabilities, innovations and values surpassing those of regional competitors

- Enabling strategic collaborations and sustaining productive partnerships

- Facilitating the industry in developing and deploying cost-effective IoT technologies

- Attracting, developing and retaining leading edge skills in IoT technologies and elevating small and medium enterprises to the next level in the IoT space

- Strengthening the industry's capacity to sustain robust economic performance

3.1.2 Market implications

It is worthwhile to look at how IoT is changing the terrain in all walks of life. IoT will make possible for everybody and everything to be connected at all times, and receive and process information in real-time. The result will be new ways of making decisions, backed by the availability of meaningful information. The emergence of a new generation of consumers through the option of being connected and traceable

at all times, will demand new products and services based on ubiquity and interconnection, leading to increasingly open and collaborative business models.

The impact of IoT on all stakeholders, ranging from the Government, business community and society at large will be multifaceted. IoT promises numerous benefits to the general public such as:

- Increasing economic efficiency and productivity through the automation and prescription of activities

- Reducing risks of the environment through real-time sensing and providing "just-in-time" information

- Facilitating the Government in developing better infrastructure and in utility planning, and monitoring and management through data augmentation

- Enhancing knowledge by enabling people to understand and monitor previously inaccessible domains through the availability and visibility of information in every aspect throughout the world

3.2 GOALS OF THE MALAYSIA IOT STRATEGIC ROADMAP

The goals of the Malaysia IoT Strategic Roadmap are to integrate all efforts from various stakeholders in Malaysia to focus on areas of identified significant value creation. The initiative aims to create the foundation for the success of the Malaysian ICT industry and other industries

that are built on ICT and IoT technologies. By aligning all efforts in the ecosystem, Malaysian companies will become prime players in both local and global IoT business ecosystems.

To achieve the aforementioned mission and fulfil the vision, this document proposes three strategic goals as the main breakthrough targets for Malaysia as a key global player in IoT.

3.2.1 GOAL 1: Create a conducive IoT industry ecosystem

An ecosystem conducive to new ideas, innovation and collaboration is imperative to ensure an effective implementation of IoT. The goal is to identify all possible significant roadblocks, and formulate strategies to provide assistance and coordination to facilitate the development and growth of IoT. Correspondingly, to ensure all facets of IoT-supporting facilities and systems remain healthy, vibrant and are able to effectively support the needs of the industry, key strategies to achieve the goals are identified as follows:

- To formulate an interoperability framework that harmonises the heterogeneity and complexity of standards and technologies to enable fast development and deployment of IoT

- To institute a centralised regulatory and certification body to address privacy, security, quality and standardisation concerns

- To establish strategic collaborations between MNCs and local players to foster the development, diffusion and adoption of IoT technologies

3.2.2 GOAL 2: Strengthen technopreneur capabilities in the Applications and Services layer

Sustainability is a function of an industry's competitiveness, of which talent is one of the key contributing factors. By building on the necessary competencies and capabilities, technopreneurs will be able to expand their product portfolio vertically and horizontally to take on global markets. Key strategies to achieve the goals are as follows:

- SMEs to act as IoT enablers who foster the generation of globally-competitive IoT products and services

- The industry to develop generic solutions that can be used across verticals

- The industry to introduce "flagship" projects to nurture startups and SMEs in developing novel solutions and businesses for IoT

- The industry to nurture IoT talents to further strengthen Malaysia's position in the IoT industry

3.2.3 GOAL 3: Malaysia as the Regional Development Hub for IoT

This proposition is to encourage local IoT players to tap on external markets for continued growth, with the following strategies:

- To position Malaysia as the preferred location for IoT outsourcing services for the Malaysian industry and the world at large

- To build an integrated centre for IoT

solutions, equipped with supporting services and facilities such as for interoperability testing and development of IoT products and services

- To leverage on the local market's complex characteristics as a demonstrator of cutting-edge IoT technologies and position Malaysia to be promoted as a "showcase" country for IoT

3.3 TARGET BENEFICIARIES AND VALUE CREATION

To a notable extent, IoT brings endless possibilities of value creation. The growth of IoT will be widespread and bring beneficial effects by 2025[1]. Amplified and ubiquitous connectivity will influence nearly everything, everyone and everywhere. The immediate value creation will benefit three key target beneficiaries:

3.3.1 Industry

The impact of IoT to the industry comprises many folds. The most prominent impact will be efficiency. This is centred on cost reduction and improvement of asset utilisation. Data analytics through smart devices will enable companies to better understand customers and their business processes. This will lead to improvements in product and service design and subsequently lead to the creation of more value for customers which typically means more revenue for the companies.

Activities of SMEs and other local players will bring local industries to the forefront of IoT.

Knowledge of local markets and the proximity to these will give local players the edge. Equipped with these competitive resources, local players can partner with MNCs in developing market-driven IoT solutions and at the same time exploit market opportunities for locally-developed IoT solutions.

3.3.2 Government

The network connection that citizens establish with data, processes and things will create new values. Herein, improvements in the delivery of public service will improve citizen relationship management.

The leverage on IoT will break down silos of legacy systems and enable the sharing of information across different government agencies. The interexchange of information will reduce cost and ease information gathering. With IoT, the needs of society will become more visible and the Government system will become more agile and innovative. Poverty, public health, crime, and many more critical areas will be easily tracked.

3.3.3 Society

In the National Strategic Framework for Bridging the Digital Divide, there are nine segments of societies which were identified as underserved communities. They are the elderly; women; indigenous; rural and urban poor; youth; small, medium and micro enterprises (SMME); children; rural; and the disabled. It is important to ensure that all segments

of society are able to enjoy the benefits of technology advancement equally and fairly, and no one is left out of the equation.

The societal inclusiveness will premise on issues surrounding accessibility, availability and affordability. IoT will be a platform for inclusiveness – "Internet for Everyone" where everyone in society can participate equally and make substantial contributions to economic and social development.

With its pervasiveness and omnipresence characteristics, IoT has greater potential to help provide hard-to-reach groups with the kinds of services available to people in advanced places. For example, consider remote diagnoses and medical monitoring through mobile phones or wearable devices coupled with existing infrastructure such as Community Broadband Centres (CBCs). IoT may provide populations located far from doctors with the kind of medical care and expertise similar to those available in areas with easy access.

For rural communities, IoT technologies are potential new income generators. With the connectivity and availability of information, this will raise interest from visitors, residents, workers and entrepreneurs to previously unknown areas and renew the lives of existing businesses by expanding markets. A community on the map can be located and new connections in and among communities can be created. Communities can work together to unlock local opportunities, build new skills and markets, and create a more vibrant local economy.

3.3.4 Academia and research communities

Academia and research communities will conduct front line research. They will develop and disseminate new techniques, reference data and materials, test methods, standards, and other infrastructural technologies and services required by the Malaysian IoT industry to maintain its competitiveness.

3.4 IMPLEMENTATION GAP ANALYSIS

IoT is real and is progressing aggressively. The real value of IoT is attained through the integration of things and the knowledge in support decision making will be embedded into the fabric of our business, personal and societal environments. While acknowledging the vast potential of IoT, there are a myriad challenges that need to be addressed. IoT is enabled through the convergence of technologies – devices, intelligence, network analysis, thus success factors in its implementation necessitate ecosystem efforts, ranging from various government agencies, academia and industry players.

IoT will evolve over time – with new uses, new requirements and new technologies. Evolution incurs, and interoperability will be a major concern, in terms of protocol design and extensibility. There are also gaps in building products that can work well together with other devices, and the setting of standards. Ensuring interoperability and connectedness of heterogeneous technologies (e.g. devices, connectivity, and business intelligence) is therefore of utmost importance to successfully

kick-start IoT in Malaysia. Through this mechanism, a collaboration platform for MNCs and local players to develop IoT solutions can be formulated on the basis of improving lives in terms of security, comfort, and the general quality of life. This will be one of the key building blocks for Malaysia as the Premier Regional IoT Development Hub.

The success of IoT in Malaysia entails the creation of new and sustainable business models that are able to produce new entrepreneurs and enterprises. The Government can realise this through flagship programmes that can amalgamate the involvement of public and private research institutions as well as the academia, SMEs and MNCs.

Therefore, the Government's role in the development of IoT industry is crucial and meaningful. The availability of seed funds for nurturing and incentivising local players to actively participate in IoT and utilise the technology to revolutionise their business processes will expedite the diffusion of IoT in Malaysia. In addition, guidelines and policies in defining the ownership of information, privacy and security must be put in place to gain market confidence and protect the nation's sovereignty.

Endnotes

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Implementation
Strategy

chapter 04

Implementation Strategy

The influence of IoT in both enterprises and consumers is significant and notable. However, the development of IoT is still in its infancy and greater efforts are required to horizontalise IoT to a greater extent. This chapter details the manifestation of IoT efforts in the Malaysian market by outlining the idea of technology convergence supported by the nestedness of national ecosystem coherence factors to increase the participation of local ICT players as well as foreign investments.

4.1 SEEDING EXISTING INITIATIVES

It is incontestable that in expanding IoT, there are enormous benefits and potential impacts to an individual's quality of life, an enterprise's bottom line and huge opportunities when, in current times, most things are connected to the Internet and have embedded intelligence. Currently, many industry players are not familiar with the implementation of IoT. IoT itself is a big idea and there are many elements contributing to the realisation of the

	ECONOMIC TRANSFORMATION PROGRAMME	GOVERNMENT TRANSFORMATION PROGRAMME	DIGITAL MALAYSIA	DIGITAL LIFESTYLE MALAYSIA Living • Healthcare • Commerce • Commuting
Objective	Creating digital opportunities	Effective delivery of Government services	Creating new opportunities in the digital economy	Uplift quality of life
Digital Opportunities	**10** Entry Point Projects (EPPs) under Communications, Content & Infrastructure (CCI) National Key Economic Area (NKEA)	**6** National Key Result Areas (NKRAs)	**8** projects as the initial set of initiatives to drive the growth of the digital economy	**6** digital lifestyle ecosystems with 4 focus areas

Figure 4.1: Quick view of existing initiatives

	Alignment with Digital Lifestyle Malaysia (DLM) Initiative		Transformational Steps for the Development of IoT as an Industry
Why?	• Early market engagement to reap the future benefits of a user-centric and global Internet of Things • Improve the way benefits of IoT are administered	Why?	• Sustain the development of IoT for greater effects and greater business values
How?	• Enhance today's solutions with major simplicity for usage, interaction and efficacy to empower citizens to transform lifestyles	How?	• Strengthen key enablers to scale up cross-pollination across companies and industries in a cohesive ubiquitous manner

Figure 4.2: Short-term IoT implementation strategy for Malaysia

IoT concept. It is akin to a jigsaw puzzle that requires all pieces to fit together in the right way to achieve defined goals. Therefore, the values powered by the potential of IoT can be based on an evolved approach, or in a totally novel value proposal.

The implementation of IoT builds on the strengths of existing ICT initiatives expedited by supporting infrastructure and auxiliary facilities with the following advantages:

• Existing initiatives with minimum systemic challenges and accumulated domain knowledge shall provide a strong support towards widespread advances of IoT in identified strategic focus areas.

• The validation and fine tuning of action plans, growing body of experiences, best practices and knowledge shall garner growing support and deliver massive effect and business value at even greater scales in IoT-enabled projects.

The key challenge in managing and fostering

rapid technological innovation is in convincing users to willingly adopt emerging technologies such as IoT. Therein comes MCMC's Digital Lifestyle Malaysia (DLM) initiative which it targeted at accelerating the adoption of a connected lifestyle and the Internet of Things. This provides a strategic platform to exteriorise IoT benefits to end users via demand to drive supply opportunities through value creation.

Therefore, a two-pronged implementation strategy is formulated, namely (i) Alignment with Digital Lifestyle Malaysia (DLM) initiative, and (ii) Transformational steps for the development of IoT as an industry. Figure 4.2 details the implementation strategy.

4.2 ALIGNMENT WITH DIGITAL LIFESTYLE MALAYSIA[1] (DLM) INITIATIVE

Aligning to DLM provides a framework and migration path to manifest visible value and illustrates how an array of technologies relate to each other with the configuration

of IoT deployments in different scenarios. This facilitates stakeholder adoption of new solutions and reduces implementation complexity.

DLM's objective is to provide a better quality of life for all people in Malaysia by utilising ICT applications. It is targeted at three main areas as follows:

i. Economic: Increase GNI contribution, wealth generation, market capitalisation, productivity and high value jobs

ii. Social: Infusion of technology to uplift quality of life and accelerate the adoption and smarter use of technology to improve productivity and sustainability

iii. Governance: Enable governing entities a greater outreach to constituents,

transparency and people focus (citizen-centric approach)

Digital Lifestyle Malaysia is conceptualised with six mega lifestyle ecosystems that comprises Work, Learning, Agriculture, Transport, Entertainment and Districts that
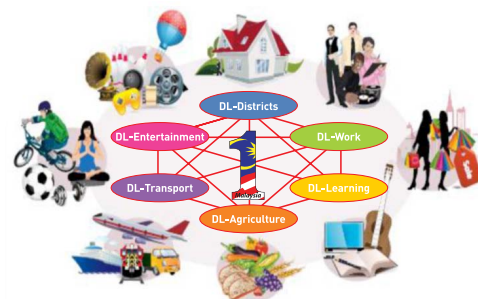
Figure 4.3: MCMC's Digital Lifestyle Malaysia
Source: MCMC's Digital Lifestyle Malaysia slides (2013)

Digital Lifestyle – Transport	Digital Lifestyle – Agriculture	Digital Lifestyle – Districts
• Make Malaysia one of the top five in the Asia Pacific container track and trace business • Improve trade facilitation and boost Malaysia's competitive advantage in terms of supply chain management practices • Project(s): Secure trade facilitation (JKDM), MyPUTRAS	• Emphasis on food traceability • Strengthen Malaysia's reputation in food quality assurance and as a Halal hub • Project(s): e-Halal, Traceability	• Lifestyle-oriented township/city/state management for a wide spectrum of service delivery such as traffic, utilities and public amenities • Project(s): Digital Concept Home (MMU), Digital Communities (Pekan)
Digital Lifestyle – Entertainment	Digital Lifestyle – Learning	Digital Lifestyle – Work
• Foster the growth of the creative content industry • Project(s): My1Content	• Create conducive learning environments • Cultivate lifelong learning • Project(s): U-Pustaka	• Provide intelligent working environments to promote work-life balance • Outsource routine operational activities with IoT solutions • Project(s): GMBO

Table 4.1: Six ecosystems of Digital Lifestyle Malaysia

Focus Area	Objective	Possible IoT Applications & Solutions
Connected Healthcare	To promote healthy living and wellness assisted by digital lifestyle services through enhanced service availability everywhere and at any time	Applications in healthcare and wellness such as: • Mobile health apps • Remote patient monitoring • Sensor-based e-health technologies for wellness
Traceability	To increase applications of traceability in asset and supply chain management, improve safety and efficiency, and promote a higher value for Malaysian-made products	Applications in asset and supply chain management; retails shoppers equipped with mobile applications for tracing and mobile payment
Home & Community Living	To provide support to SMEs/entrepreneurs/developers to create and innovate in building ecosystems based on a smart connected digital lifestyle in homes and communities To empower communities with the power of ICT and broadband enabling creation, innovation and leverage for a better future	Applications and solutions for the environment in homes and communities such as: • E-agriculture (e.g. supply & demand platform) • Smart community (e.g. e-bistro, e-laundry, m-hawker) • Local e-learning (virtual learning, m-tuition, u-Pustaka) • Localised community advertising • E-municipalities (e.g. snap & report) • Entertainment
People-friendly Commuting	To provide new information services via mash-up data created from existing and planned multimodal transport systems and associated services to commuting travellers or tourists on items such as traffic information, food, shops, travel routes/mode choices and places of interest in real-time via smart devices	• Bus transportation information • E-parking • Taxi booking • Fleet management • Travel tips and rail information with real-time info to facilitate travelling and commuting

Table 4.2: Summary of Digital Lifestyle Malaysia focus areas

represents the daily activities of Malaysians. This will enable Malaysians to compete at the global arena by increasing productivity and sustainability through the adoption of intelligent IoT applications and services and ultimately providing a ubiquitous way of life for the masses through technology. The embedded connected intelligence of IoT will benefit the general public via relevant and sustainable link ups with the current lifestyle within a dynamic lifestyle ecosystem, with greater sustainability with economies of scale and greater omnipresence.

An overview of the six key ecosystems is summarised in Table 4.1. The four focus areas identified for the acceleration of development and adoption of IoT are summarised in Table 4.2.

In aligning with DLM's guiding principles, the IoT implementation approach will leverage on existing infrastructure i.e. community broadband centres (CBCs) to serve as focal points to promote the pervasive use of IoT to create valuable applications and services for the benefit of the rakyat with an improved quality of living.

OVERVIEW OF DIGITAL LIFESTYLE MALAYSIA OPPORTUNITIES IN IOT

1. **Connected Healthcare**: Remote Patient Monitoring pilot project

   - With the growth of medical technology, aging population and improving infrastructure, the potential and demand in remote patient monitoring in Malaysia is expected to gain momentum in due course.

   - Allowing patients to stay at home rather than in hospitals for chronic disease and post-acute care management could translate to huge savings for a healthcare system. Accordingly, the exploration of a remote patient monitoring mechanism is timely, capitalising on the development of digital technologies to improve the delivery of healthcare services to the masses.

   - This initiative is led by MCMC and targets Mahkota Medical Centre and Ministry of Health (telehealth division) to introduce home-based

healthcare services that would deliver an array of e-health apps to increase quality of life and savings in healthcare expenditure.

2. **Connected Healthcare**: Pusat Internet 1Malaysia E-Healthcare pilot project (PI1ME-H)

   - PI1ME-H is intended to facilitate access to health services for people living in rural areas through integrated healthcare services by combining ICT and broadband. It is also aimed at empowering rural communities towards proactive health awareness.

   - MCMC has so far established 426 Pusat Internet 1Malaysia (PI1M) throughout the country to collectively provide Internet access to underserved broadband services areas identified under the Universal Service Provision (USP). Each PI1M was equipped with a minimum bandwidth of up to 2Mbps, computers, a training room and ICT facilities.

   - Besides the main aim of providing Internet access, PI1M also serves as a one-stop centre to organise monthly activities for the rural community. With the addition of primary healthcare services in PI1M, this adds a convenience, expands the healthcare ecosystem, and

provides for continuous monitoring between communities and selected government clinics.

3. **Connected Healthcare**: CBC E-Healthcare

- The main focus of the proposed service is to facilitate access to healthcare services for people living in far-flung districts via an integrated care service combining remote and face-to-face contact made available through the CBC. It is also aimed at increasing traffic flow to the CBCs, thus optimising the usage of the centres and creating efficiency in the use of the resources made available there by MCMC and the communications service provider as well as the various empowerment programmes available to promote a digital lifestyle.

- Through a collaboration with the Ministry of Health and BP Healthcare, MCMC would leverage on 12 selected CBCs across six states – Pahang, Perak, Negeri Sembilan, Johor, Sabah and Sarawak – for this pilot.

4. **Traceability**: Secured Trade Facilitation System

- Smartag Solutions Berhad has set up Smartag Secured Trade (Container Security and Trade Facilitation System), which entails the setting up of a radio frequency identification (RFID) infrastructure to provide security and automation of paperless Royal Malaysian Customs (JKDM) checkpoints throughout Malaysia.

- Under this project, containers entering, leaving and moving within the country will be tracked under the RFID system based on ISO 18186:2010 and the GS1 EPC global EPCIS standard. The reusable RFID seal affixed to containers are scanned by RFID readers set up at strategic locations to retrieve container information.

- Among the advantages of this system are the improvement in the efficiency of container clearance which will reduce queuing times at customs check points, improvement of security through automatic detection of compromised or open containers and optimisation of human resources for better services.

5. **Traceability**: Swiftlet nests

- Jointly led by MCMC and the Department of Veterinary Services of the Ministry of Agriculture and Agro-Based Industry, the aim of this project was to develop, test and implement a new system and standard for tracking and tracing

the delivery of swiftlet nests for the global market. This effort was carried out in collaboration with the associations of swiftlet nest producers in Malaysia.

- Using radio frequency identification (RFID) as the primary technology, a traceability platform was set up for the Government and swiftlet nest producers, who were able to trace their products along the supply chain from harvesting to production while being transported to high value markets in China and eventually Japan and Taiwan.

6. **Home and Community Living**: u-Pustaka

- u-Pustaka is an initiative that links the country's knowledge assets and modernisation of services which culminates in a single point of contact with no limitation of time and place for citizens.

- u-Pustaka Consortium, in collaboration with u-Pustaka strategic partners, created the u-Pustaka model as a knowledge ecosystem for continuous learning in the digital lifestyle for an inclusive knowledge-based society. Sustainable support was given by 18 organisations, i.e. MICC, MCMC, National Library of Malaysia, INTAN, Pahang State Library, Selangor State Library, Negeri Sembilan State

Library, Sabah State Library, Kuala Lumpur Library, Sarawak State Library, MAMPU, Economic Planning Unit (EPU), National Registration Department, Centre of Excellence for Sensor Technology at UPM, Pos Malaysia, Touch 'n Go, MyClear, and Bank Islam Malaysia Berhad.

- The Sabah State Library is the eighth u-Pustaka consortium member that went through the process of implementation in 2012. The overall participation and joint activities from various agencies is encouraging.

- Currently, u-Pustaka is popularly known by citizens. Usage trends indicate that the u-Pustaka portal is continuously accessed by visitors from home and abroad from 104 countries and 734 cities covering neighbouring countries, Asia Pacific, the United States of America, Europe, Russia, Poland and even up to Iceland. The total membership of u-Pustaka has reached 300,000 while more than 11,000 loan transactions and book returns were recorded since the launch of the u-Pustaka on 31 March 2011.

7. **Home and Community Living**: Get Malaysian Business Online (GMBO)

- GMBO was launched in November 2011 to encourage micro, small and medium-sized enterprises to promote

their products or businesses online. Google's platform offered a free, quick and easy self-help website builder and a sustainable support network to help businesses participate in the digital economy.

- This project aimed to bring at least 50,000 Malaysian SMEs online and make them successful on the web within one year. At the end of 2012, almost 30,000 SMEs signed up for the programme where almost 10,000 successfully launched their website under the .com.my domain.

8. **People-Friendly Commuting**: My Journey

- My Journey is a joint project led by MCMC and the Land Public Transport Commission (SPAD) to develop an ecosystem to provide information to the public and tourists to encourage the usage of public transport via information via smartphones and web portals.

- Applications will provide multimodal transport information on buses and trains, and integrate with existing taxi applications for Greater Klang Valley/Kuala Lumpur. Eventually, the services will be expanded to include parking, tourism, places of interests and communication facilities.

4.3 PILOT PROJECT PROPOSALS

IoT offers many advantages such as cost reduction for solution development through the reuse of existing technologies for interoperability, control and monitoring capabilities. This results in the flexibility to compose a wide array of applications for market verticals from healthcare to agriculture to smart cities. The following sections attempt to enhance awareness on possible applications and implications of IoT in these industry sectors. The sections show the resultant achievements of various business models via IoT.

The pilot projects act as catalysts for industry players to apply forward-thinking approaches on how IoT applications are built, used and displayed while increasing the industry's participation in economic activities by utilising IoT technologies. The projects flag areas that require further attention from IoT implementation teams and highlight underpinning issues that should receive more attention and countermeasures.

The following sections also describe each pilot project proposal in terms of its objective and relevance towards the IoT implementation plan. Each pilot project will steer collaborations on IoT design and architecture and demonstrate how IoT contributes to quality of life and engages public spaces and destinations. The idea of a pilot project is to create a design that enables people hence making them feel empowered, important and excited to be in the places they inhabit

in their daily lives. The identified projects are initiatives that already have potential investors, defined implantation plans, articulated investment requirements and scopes of work.

It is important to emphasise that this National IoT Strategic Roadmap is a living document. The pilot projects defined here are not intended to be an exclusive listing of detailed implementation plans for the identified projects; these serve to kick-start IoT. The number of projects will evolve and grow and many new initiatives and activities that may have not been thought of being possible could be added to the listing.

4.3.1 Agriculture and aquaculture

Crop quality is a combination of weather, environmental and other related factors such as understanding the impacts of seeds, soil and practices which can give a producer an edge in the marketplace. Farm operators, in recent years, have also discovered that they could also benefit from technology. Also, efficiency is of utmost importance with the increase in world population and decrease in resources to feed the growing number of people. Global population is projected to reach 9.4 billion by 2050 which almost doubles current world food needs. This fact alone presents a challenge to those in the supply chain. Adding to this, competition for land and water, climate change, maintaining biodiversity and a host of other environmental issues make it clear that technology is the key to get the job done[2].

Once separate sectors, technology and agriculture now coexist. With the help of technology, farm operators will now have a holistic approach to their operations from identifying seed genetics, evaluating suitable fertilisers, and selecting the right pesticides; to analysing the impacts of decision making through a growing season on the next as well as the impact on the environment, and deliver the final produce to the food supply chain. Also, the knowledge base on production practices will be required by regulatory agencies and growing public consumers. This is coupled with upstream supply chain pressure to be fulfilled with daily on-farm operations with accountability and traceability.

Figure 4.4: Overview of aquaculture traceability system

DLM focus area alignment	Traceability
Project	Aquaculture Farming: From Pond to Plate
Lead	Aquagrow Corporation Sdn Bhd
Collaborator	MIMOS Berhad
Ministry	Ministry of Agriculture and Agro-Based Industry (MoA); Ministry of International Trade and Industry (MITI)

Table 4.3: Aquaculture traceability application project profile

Therein, IoT plays an important role in modern aquaculture. Real-time and accurate reports can be at the farmers' fingertips via the huge amounts of data generated by field sensors stored in efficient and secured storage solutions. New areas for business can be created by solutions that provide efficient data access and processing. With IoT solutions, farmers can focus to look into new methods to increase production quantity while maintaining affordability and sustainability in the value chain. Using this method, crop cultivation is done using an automatically balanced nutrient-rich diet and precise amounts of water thereby using less resources and inputs and allowing farmers to harvest more and better quality crops.

There are numerous foreseeable benefits by integrating IoT technologies in the aquaculture sector such as:

• Increased levels of productivity which lead to higher producer income and lower consumer prices.

• Efficient usage of chemical inputs and reduction of environmentally harmful inputs such as additives thereby aligning with sustainable aquaculture in increased environmental friendliness and cost efficiency.

• Enhanced food security through reduced yield fluctuations by bacterial infection or climate change.

IoT application: Aquaculture traceability

Traceability's biggest benefit through the implementation of IoT is greater visibility of business operations and performance. In aquaculture, every crop species will have a "passport" with its history and its entire provenance. This will enable operators to know an animal's history and identify those that are doing well to output better and higher quality produce. Operators are also informed on the mitigation of environmental problems with more consciousness on riparian and sensitive areas that need protection.

Using connected devices, operators can easily measure air and water quality as well as an animal's well-being and type. In a nutshell, IoT increases farm operation efficiency without the use of chemicals or altering the natural crop life cycle. It is noted that trace elements are equally important to an animal's well-being and helps them to thrive.

The objective of this IoT-enabled application and service is to enhance the track and traceability function of the breeder, and subsequently enhance supply and demand visibility, optimise production and quality control in order to build competitive powers.

The aforementioned project is aimed at improving the sustainability and livelihood security of aquaculture stakeholders, the quality and traceability of aquaculture products, and sustaining or expanding trade in aquaculture products to premium markets. Table 4.3 summarises the project profile.

4.3.2 Healthcare

It is of utmost importance for individuals and primary care providers to understand the reality and holistic health conditions of a person in order to provide the right medical advice and care. Often, when a patient attends a medical consultation session, he or she is required to inform a medical consultant on health symptoms or signs that cause discomfort. Information quality and reliability is solely subject to the individual's articulation

and capability of preciseness. Therefore, quantified self and holistic wellness is important and in the near future, a focal point for all individuals.

The future of healthcare will reverse the skyrocketing costs of healthcare services through cause treatment rather than symptomatic treatment by utilising data for prevention and wellness. Medical experts can utilise IoT technologies ranging from wearable devices that track daily activities, vital signs and diet habits to further merge, dissect and crunch data for biomarkers or measurable indicators that help them create a baseline for accurate diagnostics and precision treatment.

IoT contributes to individuals in many important ways that transform our ability to monitor and optimise wellness by:

- Generating predictive and actionable models of health and disease for individual health by the enabling of new tools for mining, integration and modelling of data sets of heterogeneous biological data.

DLM focus area alignment	Connected Healthcare
Project	Continuous Health Monitoring
Lead	CREST
Collaborator	Kontron
Ministry	Ministry of Health (MoH)

Table 4.4: Continuous health monitoring application project profile

- Enabling wellness and disease assessments for individuals via digitised biological and social information.

- Creating patient-driven social networks for wellness optimisation and disease management.
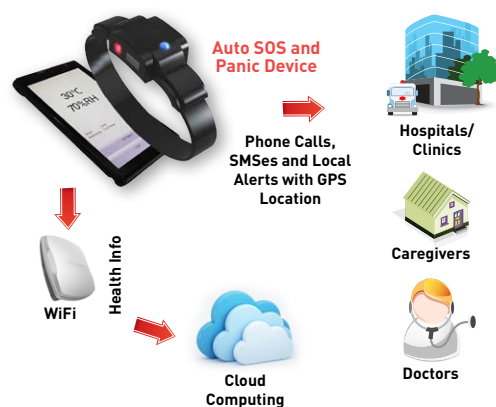
Figure 4.5: Overview of continous health monitoring system

IoT application: Continuous health monitoring

The growth of a child in areas of mind development, intellectual capacity and physical growth are positively related to nutrient intake. Mind development and intellectual capacity can be hindered by insufficient intakes of essential nutrients. Physical growth, in turn, will be affected as well.

A study was conducted in 2011[3] to measure the nutritional status, dietary intake and habits of Malaysian children, apart from physical activities and blood biochemistry which resulted in the following findings:

- Approximately 50 percent of children are experiencing nutrient deficiency in vitamin D and calcium

- One in every 10 children in urban areas show signs of malnutrition; on the contrary, a lower percentage was observed in rural areas

- For every 10 children, one child does not have the right physical growth

- One in five children has overnutrition issues

Close monitoring of adequate and proper nutrition is required for a child's well-being before the age of 10 as balanced food and nutrient intake are of highest importance for growth and intelligence.

As of 2011, the participation rate of the female labour force in Malaysia stood at 47.9 percent[4], and 11 percent of the total children population was aged between zero to four years. The rising costs of living resulted in urban families of dual-income earners that lead to the increasing demand for childcare services for children aged below seven[5]. This indicates that parental monitoring on the well-being of children is merely based on inputs from childcare centre operators. Therein, more effective, multi-component monitoring is needed, ideally addressing both areas of diet and physical activities.

Acknowledging market needs, a homegrown wearable device is to be developed and

targeted at parents who wish to monitor the growth of children below two years old via the tracking of physical properties such as weight, height, physical activities, diet and other important measurements. This collaboration is shown in Table 4.4.

4.3.3 Government

70 percent of the world's population will be living in cities by 2050[6] as populations become more concentrated in larger urban areas. This phenomenon will reshape the interactive, engagement and representation management model for local governments.

Twenty-first century smart cities are equipped with IoT-driven services to improve citizens' quality of life through measures that promote eco-friendly and sustainable environments. Via the smart city platform, sustainable partnerships and cooperation strategies among main stakeholders are encouraged to ensure the effective sharing of common city resources among its citizens and business communities.

The indicators on the conditions and "health" of a city are continuously generated by geo-tagged or geo-located sensors, devices, systems and services. To make a city more liveable, economically competitive and sustainable, future city managements require intelligent systems and a single city command and control centre to manage its citizens and services. The city also requires thorough planning and management in terms of utilities, the production renewable and clean energy, traffic and transport solutions that reduce congestion and air pollution, and real-time monitoring and surveillance for security. Municipalities may efficiently achieve a better way of managing urban traffic and utilities with sensor-based data collected across the city that provide real-time geographic coverage at low costs.

IoT will be as part of a holistic, services-oriented approach to revitalise cities with the following points on sustainable and inclusive growth:

• Economic development and job creation

• Resource efficiency and climate change mitigation

DLM focus area alignment	Home & Community Living
Project	Smart Village: Lanchang, Pahang
Lead	Archpac Corporation Sdn Bhd
Collaborator	Universiti Malaysia Pahang (UMP), MIMOS Berhad, Pahang State Government
Ministry	Ministry of Tourism & Culture

Table 4.5: Smart Village project profile

- Liveable places for life, work and leisure
- Effective city management
- Community support

Figure 4.6: Overview of Smart Village deployment and devices

IoT application: Smart Village

Smart Village is an adaptation of the Smart City concept in rural areas and villages that will eradicate rural poverty, reduce urban migration and provide for self-sustainable production and consumption (e.g. rural electrification), through the utilisation of natural resources. This is as village communities are usually of a lower education background and lack the practical knowledge of certain business domains.

Connectivity will enable Community Broadband Centres (CBCs) to become a new business model in helping local communities develop and maintain promotional webpages; a channel for local authorities and local governments to disperse information to targeted groups, be a surveillance centre point for security or systematic monitoring, and provide for the tracking of visitor or animal movements on real-time basis.

In addition, IoT technologies will spur location-based services for the local community to leverage on promoting local tourism-related businesses such as homestays, tourist guides or tourist hotspots and so on. Besides this, location-based information for local stores and cottage industries such as local specialty handicrafts and local delicacies will further boost a tourist-friendly environment. This collaboration is shown in Table 4.5.

4.3.4 Environment

Humans and the environment are interdependent and correlated with each other. Therefore, it is of paramount importance to create a prosperous and equitable society that lives in harmony with the environment. Environment management through IoT will enhance environmental protection, efficiency in natural resource management, diminish waste and emissions, and mitigate climate change and conservation.

IoT enables sensing strategies featuring real-time data perception, resource concentration and sharing, system integration as well as effective supervision and decision making to reduce waste, improve the environment

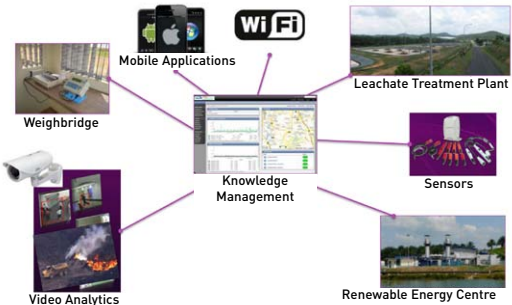| DLM focus area alignment	Home & Community Living
Project	Intelligent Landfill Management
Lead	KUB-Berjaya Enviro Sdn Bhd
Collaborator	TBC
Ministry	Ministry of Energy, Green Technology and Water (KeTTHA)

Table 4.6: Intelligent landfill management application project profile

and prevent environmental accidents. Specific tasks in this area include intelligent waste discharge and automatic monitoring, monitoring of pollution, water quality and air, and regional ecological monitoring.

Therein, IoT is able to provide a structured approach to planning and implementing environmental protection measures by:

- Effective management and control of environmental impacts by resource conservation and reduction of product or energy wastage that translates into cost savings.

Figure 4.7: Overview of intelligent landfill management system

- Ensuring the efficient use of inputs and consumed resources by minimising non-compliance with environmental legislations, and reacting positively to environment issues if they occur.

- Delivering a market edge as many customers now favour suppliers who have an environmental base.

IoT application: Intelligent landfill management

Landfill operators have to fulfil a tall order to maximise operational efficiency using minimal cost while ensuring worker safety and promoting positive public perception of its site. The importance of compaction, site operation management and equipment selection are all part and parcel of the job.

Landfills pose environmental hazards due to potential greenhouse gas emissions or groundwater contamination besides odour, wind scatter and regular fires. Communities who live close to landfills often face risk from these negative impacts.

Using IoT, landfill operators will be empowered by the positioning of

environmental sensors to monitor environment parameters (water and air quality) to prevent the landfill site from becoming a breeding ground for rodents, flies or other disease vectors. With surveillance cameras, operators can remotely monitor the site which is properly fenced off to keep people and animals out besides monitoring the types and volume of waste being dumped at the site (refer to Table 4.6).

4.4 TRANSFORMATIONAL STEPS FOR THE DEVELOPMENT OF IOT AS AN INDUSTRY

Enterprises stand to profit from IoT through increased operating efficiencies, scalability and agility. The foundation of IoT technologies can also be leveraged upon to align towards a new service delivery and production model geared towards the needs and demands of the global market.

Malaysia's transformational agenda should be the focal point to foster faster adoption of IoT. Transformational activities will necessitate multi-layered changes and investments which entails the development of new capabilities, distinctive strengths (a combination of people, process, and tools) to successfully compete in the global marketplace, and changing how businesses engage their customers.

4.4.1 Business value realisation from modernisation to innovation transformation

Communities of practice (CoPs) could be engaged to introduce transformation to IoT partners that face businesses by bringing more in-depth technology insights and opportunities for businesses. This is accomplished by leveraging on external partners to mitigate skill shortages in transformation delivery while reserving internal resources to focus on core

7.3%
Rental

7.5%
Transport

8.7%
Utilities

17.6%
Labour/staff

6.2%
Financing

7.1%
Others

45.7%
Raw material & other inputs
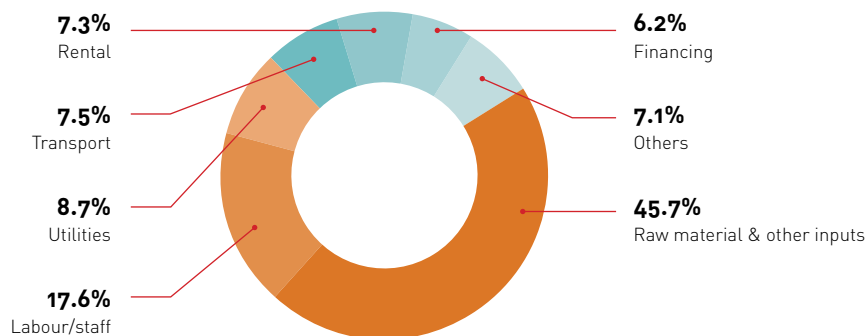
Figure 4.8 : Operating cost structure of SMEs

competencies. With CoPs, expertise from different domains can be augmented to establish IoT solution design capabilities as a prerequisite to identifying technology investments and transformations.

These communities will introduce IoT technologies in an agile approach to spur transformational change and manage information as a strategic asset to support innovation. In addition, these communities will serve in roles for effective governance around transformational business case approvals and support the realisation and prioritisation of transformational projects.

4.4.2 Revitalising SMEs towards a competitive global arena

SMEs have been Malaysia's priority since 2004 and currently contribute approximately 32.7 percent[7] to Malaysia's economy. Enabling the creation of new business opportunities through market information and knowledge accessibility, and expediting reliable business and better customer communications are the underlying motivational factors to adopt new technology. Therefore, it is imperative to address the main concerns among SMEs towards IoT by the following:

i. Financial risk mitigation and incentives

Cost is a consistent hindering factor on ICT adoption by small and medium-sized enterprises. SMEs operate on lean capitals that have little or no room for investments in ICT. In a broad sense, they operate on a hand-to-mouth financial regime. Based on the SMEs operating cost structure[8] (refer to Figure 4.8), input contributes to a big portion of cost. Therefore, SMEs may perceive that the incorporation of IoT into existing business processes will increase pressure on their financial conditions.

Therefore, it is recommended that the Government provide financial incentives (e.g. tax rebates or tax incentives for a 3-year duration (2015-2018)) to motivate SMEs to utilise IoT for enhancements in competitiveness and efficiency and establish a special fund to finance IoT adoption by SMEs.

ii. Awareness campaigns and programmes

The possibility that most SMEs are aware of the existence of IoT is superficial. At the present moment, entrepreneurs are not convinced of the necessity of the use of such technologies for their enterprises. Therefore, the Government should initiate and support awareness campaigns and strategic development programmes to enhance the capacity of SMEs in IoT technologies.

iii. Innovative application and service development

80 percent of IoT-driven market opportunities gravitate towards applications and services[9], thus posing lucrative business opportunities for service-based entrepreneurs to develop applications and services for their

respective target markets such as health monitoring, logistics management, fleet management, asset monitoring management and so on.

iv. Enhanced collaboration

Linkages and collaborations across the innovation ecosystem between industry players, the academia and research institutions must be approached in a systematic way in order for the correct innovative technology to be developed and serve the needs of entrepreneurs effectively thereby granting early access to investors on new promising ideas.

Thus, a tripartite coalition helps enable idea generation and development (e.g. linking academics, researchers and industry specialists), capability enhancement (e.g. mentors and support services), access to shared infrastructure (e.g. laboratories and test facilities), and ultimately commercialisation (e.g. investors and customers).

v. Startup accelerators

With agility and scalability capabilities, startups are one of building blocks to create a fertile landscape towards bullish economic growth. The notion of the acceleration seed is to drive economic growth and foster an entrepreneurial culture within local communities. IoT would allow entrepreneurs' creative minds to explore and finance new ideas with

remarkable versatility as well as being solution-oriented. However, startups need to be able to sustain this with a conducive ecosystem comprising the following:

- Talents with "STEM" skills (Science, Technology, Engineering and Mathematics)
- IP system that rewards invention
- Certainty, predictability and an incentive-centric taxation system

4.4.3 Talent building

There is also a need to prepare the workforce of the future in IoT. Educational institutions need to be equipped with relevant syllabus and facilities for the growth and nurturing of IoT professionals. These institution must be able to generate producers not only consumers of technology.

Learning institutions need to provide a strong foundation for Science and Engineering students and enhance it further in order to produce solid IoT professionals. Moving forward, the education industry could give rise to potential talents able to build better solutions for the future.

The creation of an "IoT Centre of Excellence" will serve as a "transition point" to develop more IoT professionals graduating from institutes of higher learning. Students will then be able to adopt new technologies for learning as they will thrive in IoT. The ease of

learning through IoT would also prepare and create new solutions for the future.

4.5 CONCLUSION

Malaysia needs to execute a cohesive national innovation strategy well in order to reap the benefits of IoT and as a booster to reach the Vision 2020 aspiration of a high-income economy. Instead of creating new projects, Malaysia would need to identify selected high-priority sectors that will gain expert domains

in IoT and scale up the IoT-ised sustainable competitive advantage over time.

To be critical, Malaysia's innovation strategy success hinges on excellent execution with the right combination of talent, infrastructure and resources. Herein, market-savvy and influential entities would need to lead the efforts in ramping up the nation's innovation agenda and fixing the current gaps in Malaysia's innovation ecosystem landscape.

Endnotes

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Sustainable Game-
Changing Strategies

chapter 05

Sustainable Game-Changing Strategies

"When billions of 'things' and people are interconnected, it is only natural that they share data, information, knowledge and other resources so that their collective potential can be reaped."

During the development of the National IoT Strategic Roadmap, members of the Technical Working Group (TWG) have called for a set of strategies that would fully transform the prevailing opportunities in IoT technologies into a sustainable industry.

The previous chapter detailed the immediate implementation plans that will introduce the values of IoT to the country through several strategic programmes. The thought process of the proposed strategies presented in this chapter is to bring Malaysia's IoT industry maturity level from the introduction stage to the growth stage, while creating a sustainable and significant industry ecosystem that will position Malaysia as the Premier Regional IoT Development Hub.

5.1 OVERVIEW

As discussed in Chapter 2, there are several challenges and barriers as well as enablers and catalysts to the growth of the ecosystem that is to be formed for the IoT industry in Malaysia. From the data gathered and analysed, there are 13 principal factors that could affect the development of the strategies for the IoT ecosystem in Malaysia:

i.   **Silos of information and data** – In order to have a vibrant IoT industry, especially in the applications and services layer, public data should be made available to the ecosystem. Today, the growth of IoT applications is often hindered by silos of gathered data.

ii. **Pockets of IoT initiatives** – IoT has been recognised as the next step of the Internet. Accordingly, several initiatives have been put in place to promote the proliferation of IoT applications in Malaysia. However, those efforts comprise fragmented pockets of initiatives which bring minimal impact to the formation of the industry ecosystem.

iii. **Concerns of authenticity of information** – The proliferation of IoT will see more data gathered from various devices and sources, especially social media. Concerns on trustworthiness may stall the adoption of IoT.

iv. **Adaptation and adoption fears** – Concerns of security and privacy are further amplified by concerns of adopting new business processes. Resistance related to loss of employment from the implementation of the technology are expected. Further fear is also expected as a result of higher process transparency.

v.   **Concerns of security and privacy** – Security and privacy concerns may prevent the sharing of data to the ecosystem, consequently hindering its growth.

vi. **Funding continuity** – As a result of the aforementioned pockets of initiatives, there is a lack of continuity from one stage of funding to another. Subsequently, local IoT players are facing problems in competing with foreign companies.

vii. **Infrastructure readiness** – Malaysia has an advanced infostructure through the implementation of the National Broadband Initiative (NBI). Nevertheless, the lack of IP addresses will be a deterrent factor towards the growth of the ecosystem.

viii. **Harmonisation of standards** – As IoT is a technology that has evolved from existing technologies, there are a myriad of standards to be dealt with by the industry. Efforts are required to reduce the technology's complexity.

ix. **Local products, apps and services** – The propagation of use of local products, apps and services is critical to the growth of the IoT ecosystem.

x. **Talents in IoT** – For the ecosystem to grow and prosper, a continuous supply of talent is critical. Hence, IoT-specific talent availability is another important factor to be considered.

xi. **Interoperability and testing services** – Interoperability and testing services are to facilitate the interworking of the various IoT components. Testing services will ensure a greater capability for the ecosystem.

> "Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis."
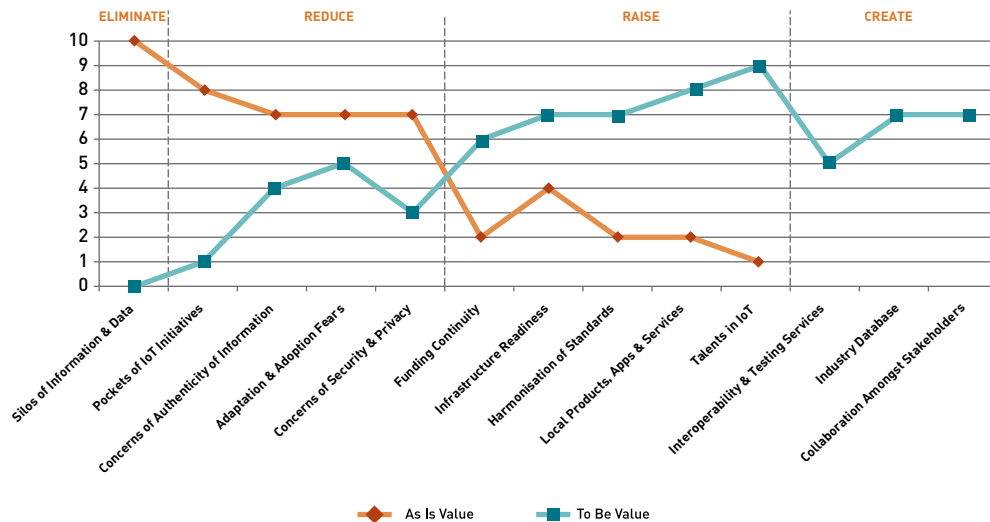

Figure 5.1: Strategy canvas for IoT ecosystem

xii. Industry database – The establishment of an industry database is vital to monitor the growth and development of the industry.

xiii.Collaboration amongst stakeholders (universities, industry players and other government agencies) – Collaboration is an important factor for the ecosystem to grow as networked organisations are able to share knowledge and resources to grow their capabilities especially in facing global competition.
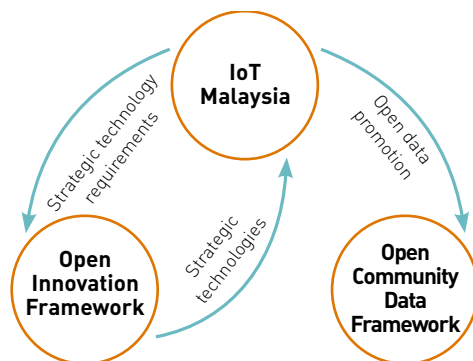
Figure 5.2: Three game-changing strategies

Based on the parameters mentioned above, a study of the perceived value was captured during the TWG workshop conducted in May 2014. The value curve represented in the strategy canvas (refer to Figure 5.1), depicts the relative performance of the critical parameters.

In order to create a strong and competitive industry, Malaysia has to be positioned well above other countries. Hence, it is critical to consider the "blue ocean" approach to tackle the challenges faced by the industry.

Considering the factors depicted in the canvas above, the three key strategies (refer to Figure 5.2) proposed in this chapter are with the intention to create a vibrant and sustainable IoT ecosystem in Malaysia.

5.1.1 Formation of IoT Malaysia

This strategy is to establish a Community of Practice (CoP) for IoT in Malaysia. It will be an entity composed of industry practitioners who share a common interest to build an industry out of IoT technologies. This strategy is targeted to benefit the industry as a whole.

5.1.2 Establishment of the Open Innovation Framework

The second strategy is aimed at establishing a common framework for the development of IoT technologies in Malaysia. The intended Open Innovation Framework is not a standardisation initiative, but rather a common platform or "sandbox" for the industry. This initiative will also be the industry's technological requirement gathering platform for the development of technologies by local researchers, research institutes and universities.

5.1.3 Organising the Open Community Data Framework

The final strategy deliberates on the method of growing the industry to the next level by

opening up public data with the intention of expanding the applications of IoT. This strategy is targeted to primarily benefit small and medium enterprises (SMEs).

The three key strategies will be described further in the following sections of this chapter.

5.2 FORMATION OF IOT MALAYSIA

5.2.1 Introduction

IoT Malaysia shall be the industry body that will be responsible for the development of the IoT industry in Malaysia. IoT Malaysia shall be the Community of Practice (CoP) of IoT-based industries with the vision to help enhance each industry's performance by way of sharing knowledge and insights.

It is envisioned that IoT Malaysia be driven by ICT industry associations such as the National ICT Association of Malaysia (PIKOM) and/or the Federation of Malaysian Manufacturers (FMM) and other related ICT industry-based organisations, and work closely with various Government agencies and ministries.

5.2.2 Purpose

The purpose of establishing IoT Malaysia is to manage the ecosystem built around IoT – the players, technologies and the complex process of creating, utilising, sharing and reusing the said technologies and business knowledge. IoT Malaysia will comprise the industry, the Government and academia. The set-up

will address the 13 challenges listed in the introduction of this chapter.

> **IoT is an emerging concept which is rapidly developing in many parts of the world. Even as Malaysia begins to adopt the concept and explore its possibilities, IoT or its related technologies (such as machine-to-machine) have already made an impact on many research domains by providing new solutions and ideas. The massive amount of data, information and knowledge gathered has to be managed and processed in order to derive value.**

IoT Malaysia will create an IoT ecosystem that focuses on the development of the IoT industry in Malaysia. This set-up will also serve to facilitate collaborations between stakeholders to ensure the continuity of activities within the industry.

5.2.3 Organisation of IoT Malaysia: Initial setup and way forward

To constitute a vital positive element of public policy while representing the authoritative industry constituent, IoT Malaysia will initially be set up as a government-industry partnership (refer to Figure 5.3) similar in nature to the successful Outsourcing Malaysia

and Collaborative Research in Engineering, Science and Technology (CREST). Hence, it is proposed that IoT Malaysia be led by the partnership between the National ICT Association of Malaysia (PIKOM), SME Corporation Malaysia (SME Corp), the Multimedia Development Corporation (MDeC), the Malaysian Communications and Multimedia Commission (MCMC) and MIMOS, aligning to MCMC's existing Digital Lifestyle Malaysia agenda. It is envisioned that IoT Malaysia be kick-started with initial seed funding from the Government.

Moving forward, once operational, the partnership should be an ecosystem that is self-governed and self-sustained by the
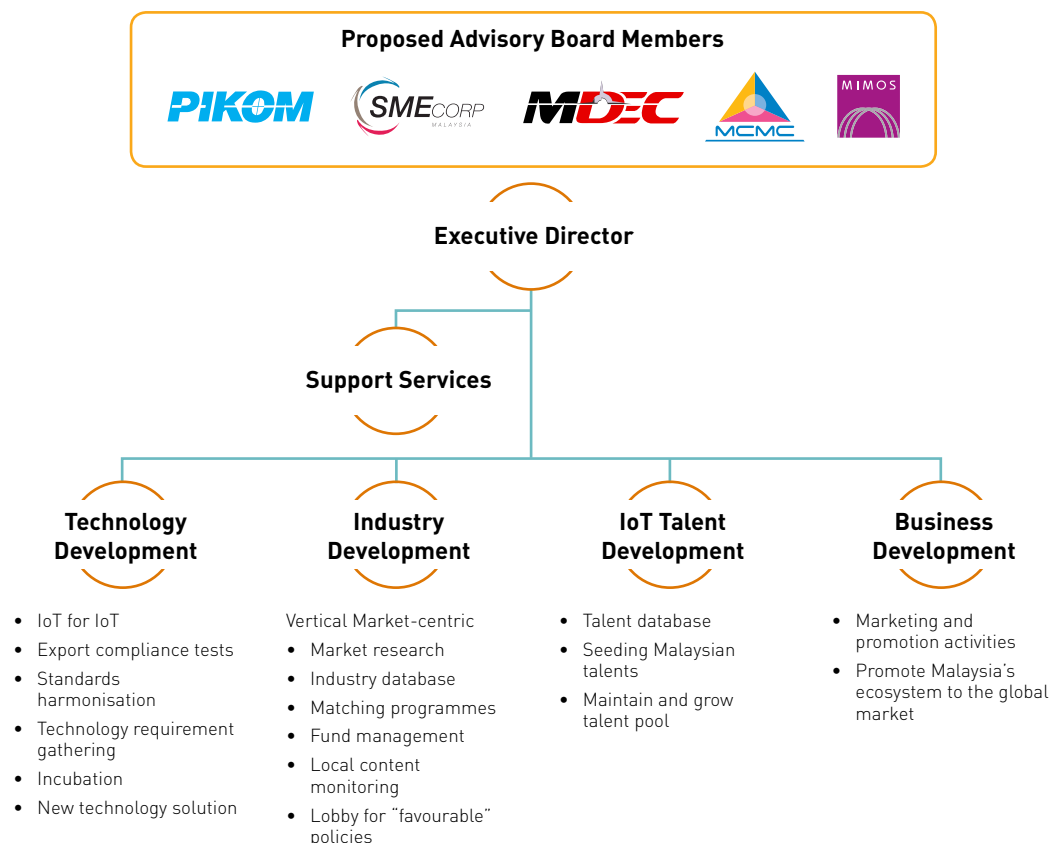
Figure 5.3: Organisation structure operations and governance

industry. To ensure that this community performs its required functions with integrity where benchmarked KPI can be assigned. The community will then move along a value-based roadmap.

5.2.4 Key Roles of IoT Malaysia

The key roles of IoT Malaysia shall be as follows:

5.2.4.1 As Malaysia's Centre of Excellence (CoE) for IoT

i. **Industry database: Managing and promoting the ecosystem**

In order to organise the industry and to take it to the next level, an industry database that consolidates all information on players, products and solutions is to be set up.

   a. **"IoT Yellow Pages"** - The database should serve as a single most comprehensive point of access to the players and supporters of the industry. This database should be the selling point of Malaysia's IoT ecosystem.

   b. **Connecting the dots** - Through the database, IoT Malaysia will be able to connect the players within the IoT value chain and facilitate collaborations as well as sharing of insights to ensure continuity within the ecosystem, locally and internationally.

ii. **Platform to gather the industry's technological requirements**

The fast-evolving IoT technologies across the globe will see the creation and growth of many new technologies and standards. IoT Malaysia can be a forum to capture the industry's technological challenges or problems to be solved by respective experts.

   a. **Technology requirement platform for industry-driven R&D** - IoT Malaysia will be the facilitator to collate technological requirements from the industry, and the focal point of the industry harmonisation platform. The inputs gathered are to be passed to relevant researchers in research institutes and universities. These inputs shall be one of the bases for future industry-driven R&D funding from the Government.

   b. **Point of harmonisation of myriads of standards** - IoT Malaysia will be the lead organisation for the community of IoT developers that is encouraged to work on a common application programming interface (API) so that one enterprise's products or services can communicate with those of another. The platform will thus promote conformity with universal requirements for standards and specifications.

iii. **Shared services for industry development in Malaysia**

IoT Malaysia should establish a centre for IoT shared services with the intent of positioning Malaysia at the forefront of the IoT industry. The services can include:

   a. **Regional and inter-regional interoperability testing laboratory for IoT (IoT for IoT)** – A laboratory to test the interoperability between one system and

another. This is to ensure that imported devices and systems will be able to operate in the region without hiccups.

b. **Export compliance testing laboratory** – A laboratory to test the compatibility and adherence to global standards for export purposes.

c. **Product customisation centre** – A centre of excellence for product customisation activities. This centre will also focus on training to upgrade the skills and competencies of Malaysian-based companies.

d. **Incubation centre** – A centre of activities for startups and small enterprises to incubate breakthrough ideas that have exceptionally high commercialisation potential. Ideally, startups undergoing incubation should also be housed within the same vicinity.

5.2.4.2 As a nucleus for IoT talent development

With the aforementioned initiatives, IoT Malaysia is poised to be the talent development nucleus for the industry. Some of the key roles of IoT Malaysia in developing talents towards building a strong industry ecosystem include:

i. **Seeding Malaysian IoT professionals** – IoT Malaysia together with established players such as MIMOS, Cisco Academy and Microsoft Developer Academy will jointly develop the ecosystem through a industry-designed training curriculum. The training programmes should incorporate IoT technologies, application and service development, system design and system integration. Upskilling programmes should be provided to enhance qualities and skills among existing and new engineers and researchers.

ii. **Maintaining the talent database** – As part of talent development, IoT Malaysia should maintain and manage an IoT talent database so that the country will have a ready pool of competent IoT talent in all domains at all times.

5.2.4.3 As a bureau for IoT industry development

IoT Malaysia is positioned to market an established IoT ecosystem in the region and even globally through the following initiatives:

i. **Market research in new market value creation** - To sustain the growth and development of the local IoT industry, IoT Malaysia should continuously research and explore the latest, not only in technology but also business methodologies in tandem with the IoT industry's exponential growth. It should seek to ensure that all IoT entreprises focus on creating value, such as enhancing the way people live, work and play while reducing the costs of doing things. Finally, the organisation should also ensure that all activities undertaken in the industry are geared towards sustainability and cause no harm to the people and the environment.

ii. **Managing industry development grants**
– In order to continuously drive nurturing programmes for further growth, an industry development fund should be allocated to IoT Malaysia. The fund should be assigned with specific goals and a set of KPI. It should be the role of IoT Malaysia to ensure that a concerted funding programme is available for IoT technopreneurs of all calibres. The funding should be end-to-end – from conceptualisation to commercialisation – initiated at the national level and administered by IoT Malaysia. Priority for funding should go to projects with high commercialisation potential. IoT Malaysia should monitor and report on all fund utilisation and progress of projects.

iii. **Marketing and promotion** – Strategic and active promotion of the Malaysian IoT ecosystem will generate demand which in turn will broaden the market. The Malaysian IoT ecosystem should be promoted not just as a cost reduction-based vendor but as value-based partner to IoT for the world.

iv. **Local content utilisation monitoring** – IoT Malaysia should monitor the utilisation of local content in producing made in Malaysia IoT solutions, to reflect the government's policies. All activities in the IoT value chain should integrate a certain percentage of Malaysian human and material resources. IoT Malaysia should monitor the level of local product/content utilisation across the IoT value

chain to ensure that this burgeoning industry translates into economic growth by means of intensive utilisation of local expertise and resources. Intervention strategies aimed at promoting and boosting the utilisation of local content in IoT should also be developed. This is to ensure that only quality Malaysian products are distributed to the world while the industry creates high-income jobs for local talent.

v. **Voice of the industry** – IoT Malaysia shall be the voice of the IoT industry. The organisation shall endeavour to lobby to the Government for the easing up or removal of any potential "show-stopper" and create enablers to ensure the sustainable growth of the industry. For a start, IoT Malaysia shall look at best methods of releasing "community data" to enable greater application services to be developed by local developers. Examples of community data are traffic conditions, prices of controlled items; and public alert and warning systems on water levels, flood situations, and the environment.

5.3 ESTABLISHMENT OF THE IOT OPEN INNOVATION FRAMEWORK

5.3.1 Introduction

The IoT Open Innovation Framework, in summary, is a conceptual "sandbox" where all IoT-related technologies and standards are to play in a "harmonious" manner. As

The Malaysian IoT ecosystem should be promoted not just as a cost reduction-based vendor but as value-based partner to IoT for the world.

presented in the previous chapter, one of the key challenges in developing IoT technologies in Malaysia is the existence of a myriad of technologies as IoT evolves from existing technologies. As a result of the various standards that exist in this knowledge sphere, it is expected that it will be a challenge for a SME to effectively participate in IoT industry.

The Technical Working Group (TWG) also acknowledges that globally there are several standardisation exercises taking shape, eight of which are becoming prominent standards. However, it is possible that there are several variations of these standards due to economic motivations of the companies or governments that support the standardisation exercises.

Hence, it is of paramount importance to address the issues concerning technology variety to ensure greater participation from technology-based SMEs.

5.3.2 Purpose

The purpose of this proposal is to create a framework that will harmonise technologies in the current wave of IoT. In addressing this challenge, it is proposed that the Open Innovation Framework be formed, followed by examining and coordinating various smart technology backgrounds – redundancies and unrealised synergies are among other important factors to consider. Next, standardisation work in the sandbox involves

Framework to Harmonise Multiple Standards
- Panel of experts
- Collaborative projects
- Joint architecting
- Shared IPs

Industry (MNCs)

Academia

Anchor Technology Driver (Research Institutes)

Local Industry
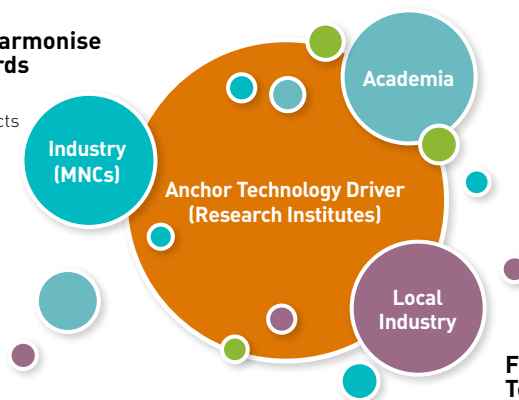
Framework for New Technology Creation
- Market planning
- Collaborative projects
- Solution development
- Shared IPs

Figure 5.4: Open Innovation Framework structure

developing appropriate solutions to produce a common API and implement a management process that would harmonise IoT standards and enable an assortment of smart devices to communicate with each other.

5.3.3 Provisioning of the IoT Open Innovation Framework

The Open Innovation Framework (refer to Figure 5.4) is an effort that combines both technical and management aspects. Learning from the success of the Open Source Initiative in Europe, the Technical Working Group (TWG) recommends that the IoT Open Innovation Framework to be a member-based initiative with a key technology organisations such as MIMOS becoming an anchor of the programme. The IoT Open Innovation Framework will be driven by the anchor organisation together with IoT players, local and international, to form a technical working group with the immediate objective of harmonising the multiple standards of IoT. Members of the technical working group shall comprise MNCs, service providers, academia and the regulators.

The IoT Open Innovation Framework does not just focus on the creation of the "technology sandbox" but also focuses to become the catalyst of new technology creation through the establishment key technologies versus the market requirements of the industry. The outputs from the programmes implemented in the Open Innovation Framework will be managed and marketed by IoT Malaysia.

5.3.4 Key goals of the IoT Open Innovation Framework

From the previous chapter, several challenges related to the technology need to be overcome in order to propel Malaysia as a key IoT country in the region. Here, key goals in the implementation of this strategy are proposed. The goals are broken down into four major goals that will contribute towards the attainment of the vision.

i. **Framework to harmonise multiple standards** - To achieve the goal, the IoT Open Innovation Framework initiative together with the Malaysian Technical Standard Forum (MTSFB) shall invite experts of the Technology Standards committee, such IoT-A, IEEE, IETF and any other organisational standard, to contribute in defining its standards. The intention of this initiative is not to create a Malaysian IoT standard, but rather to create a "framework" that will be the "melting pot" of various standards and find key interfaces that will harmonise multiple standards. The key areas required at the commencement of the initiative are:

- Formation of a panel of experts to define the required technology architecture and the necessary technology interface. The panel of experts shall comprise both local and global players.

- Establishment of collaboration between IoT technologies providers, academia and research institutions in sharing the

Application Programming Interface (API) and data formats.

- Determining the distribution method of the API.

- Architecting and developing a security mechanism for IoT in preserving data privacy for the user and enterprise.

- Determining the commercial arrangement of shared intellectual property (IP).

ii. Framework to strengthen local technopreneurs' competitive capability in the IoT market

The intelligent interconnection of devices and services provides huge benefits to the people and the national economy. However, one of the challenges towards the rapid deployment of IoT services and commerce is the required talent in the development of services and integration of applications and data.

The Open Innovation Framework will provide a platform for industry players to leverage and harness breakthrough convergent technologies to propel Malaysia's transition from starting stage to large-scale development stage. The catalysts to accelerate the initiative are:

- A software application development platform for the development of applications and services in rapid time. This platform provides easy and efficient integration and utilisation of data and applications, enabling the industry to take products to market faster and more efficiently. The IoT-based capabilities of industry players will also be strengthened as the framework allows innovative connected solutions to be built for target markets across industries.

- A software services framework provision to develop and expand market-demand specialised services, value-added services and other new service formats. This framework addresses market needs to offer proven, fully-integrated IoT services for a variety of market verticals, operators and enterprises in order to simplify deployment and ensure reliability.

The combination of the application platform and service framework and industry know-how will create a strong value proposition for industry players demanding fast, efficient and reliable software development. Through the Open Innovation Framework, the industry will be more capable to offer vertical-specific solutions that work seamlessly across a range of applications with flexibility, scalability and compatibility. This framework provides a competitive advantage and new opportunities for industry players to diversify and increase revenue streams.

iii. Framework for new technology creation

– The Open Innovation Framework will be positioned as the channel for IoT Malaysia to resolve industry issues. Based on the inputs from industry players,

the technological challenges that they are currently facing require intense R&D activities such as the development of new devices, integrated circuits (ICs), protocols and materials. The technologies to be created will be the key competitive advantage of the Malaysian IoT ecosystem. Key steps required at the commencement of the initiative are:

• Planning a market entry strategy, and formulating a business and enterprise architecture to fit market needs.

• Establishing collaboration between IoT technology providers, academia and research institutions in formulating solutions.

• Obtaining seed funding from the Government to kick-start R&D activities.

• Determining the commercial arrangement of shared intellectual property (IP).

iv. Driving heterogeneous and mobile system architecture

The explosion in the number of intelligent, connected devices is particularly meaningful as the value of the data generated by these devices is explored.To derive maximum business insight and value out of massive amounts of machine data, it will be critical to quickly analyse and act upon the acquired data.

With numerous standards deployed in the market spreading over multiple connectivity and protocols, this intensifies the

challenges in selecting suitable connectivity technologies to facilitate data exchange and to deliver IoT applications in different vertical markets.

Cloud computing provides many economic advantages such as the elimination of administrative tasks in computer systems and associated costs. Its requirement of high-speed, reliable Internet connectivity with sufficient bandwidth, high latency and security is a double-edged sword which heavily impacts the IoT paradigm that envisages to have every device on the Internet if a link outage or blackout occurs rendering the total system unreachable.

Due to the heterogeneous and multi-standard nature of IoT, some issues are expected to arise. Issues related to quality of service remain the major concern for many IoT applications; especially those with critical latency, network bandwidth, resilience, power, security, or geographic localisation constraints.

These issues can be addressed by making available a federated cloud platform that facilitates high mobility and autonomous service management requirements, one that can respond to the market's requests swiftly while maintaining a strong Internet connectivity. A federated cloud platform is an additional layer of processing, networking and storage between the endpoint and cloud which will help optimise IoT by providing better quality of service with zero-delay, low power consumption,

and significant reduction in data movement across the network resulting in reduced congestion, cost and latency as compared to centralised computing systems. The federated cloud platform offers integrated perspectives on massive data storage and communication needs for the execution of real-time services. It enables computing systems to be deployed very close to end users in a widely distrbuted manner thereby providing the flexibility of on-demand provisioning of compute, storage and network resources across wide geographical areas.

IoT requires both the federated cloud platform and cloud computing to work synergistically and complementarily. The federated cloud boosts emerging network paradigms with faster processing and response while cloud computing markets centralised processing and high-end, low-cost computing.

5.4 CREATION OF THE IOT OPEN COMMUNITY DATA FRAMEWORK

5.4.1 Introduction

In essence, the IoT Open Community Data proposal is a recommendation for the mobilisation of public data to spur the growth of the Malaysian IoT industry. As mentioned in the previous chapter, one of the key challenges that may hamper the growth IoT technologies in Malaysia is the existence of data silos, which

could result in the IoT industry being limited to those that are project-based.

The Technical Working Group (TWG) also acknowledged that the data are subjected to the Personal Data Protection Act (PDPA). However, due to the broad definition of the act, there are some data that is deemed public and can be utilised for the greater good of society. Therefore, it is critical to review the data policies in view of the great benefits that it will offer to society.

It must be emphasised that the proposal will not focus on lobbying for an amendment of the existing PDPA, but rather on achieving a clearer understanding of the process of preserving data integrity within the context of PDPA.

5.4.2 Purpose

The purpose of this proposal is to create a framework that will mobilise the dataset available for greater societal good. In addressing this challenge, it is proposed that the Open Community Data concept (refer to Figure 5.5) be adopted to allow greater data mobility, where the data is shared in an open manner to enable a productive IoT industry.

Using this model, greater value can be realised from data mobilisation. In summary, the proposal is about sharing the data for the use by the IoT industry in general. For a start, generic data such as those related to improvement of society (e.g. traffic information, environmental situations and food- and health-

related) should be opened up for the creation of new apps and services by the industry.
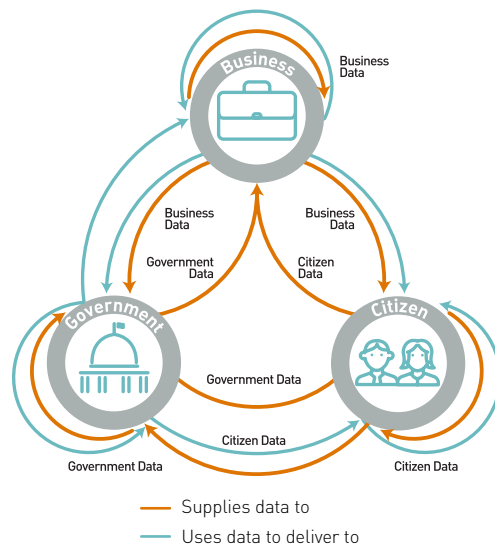
Figure 5.5: Open Community Data concept

Source: Deloitte (2012)[1]

5.4.3 Overview of the Open Community Data Concept

In order to see a robust growth of IoT-based technology, the key challenge that needs to be address is the sharing of public data. Key considerations are:

- The market requirements of public data
- Common commercial policies

- Protection of fundamental rights, with particular reference to the protection of privacy and personal data

To date, several countries have established open data policies. Along with official government-sponsored websites, there are numerous unofficial sources of government data – usually compiled by individuals or communities – or aggregators, such as DataCatalogs.org, which publishes hyperlinks and datasets from many public sector organisations.

A study in 2013 indicates that a total of 49 countries now have more than 220 distinct official or unofficial open data websites, which provide downloadable public datasets at national, local or city level. Leading countries in opening up data are the United Kingdom, the United States and Canada. A research by Policy Exchange (March 2012), a leading European think tank, presented examples of different types of open government data as illustrated in Table 5.1.

The Open Community Data platform can be used to enhance data already held by businesses. This works both for intra-industry and inter-industry. For instance, businesses offering transport services to customers can combine their own data with those from the public transport network to provide tailored itineraries, and healthcare providers can use public healthcare, demographic and social deprivation data in combination with their own data to configure their services more accurately to serve client needs.

Type of Data	Public Sector User	Example
Management of information and other operational data collected or created as part of day-to-day business of the Government	• Various departments • Government agencies and non-departmental public bodies • Local government institutions	• Departmental accounts and organisational structures • Registers of public property • Public spending data • Non-personal data related to health and education systems • Calendars of public holidays and other key administrative information
Geographic and other data describing physical and environmental characteristics of Malaysia	• Emergency services • Military • Coastguard • Smart rescue • Environment agency/departments	• Maps and charts • Meteorological data • Hydrographical data • Postcode and address data files
Administrative data describing the business environment and public realm	• Tax and welfare administration • Planning authorities • Courts and justice system	• Company registrations • Land and property registrations • Planning data • Vehicle and mileage data
Data related to public transport networks and transit systems	• Public transport operators • Public infrastructure bodies	• Timetables • Fare schedules • Planned and emergency works • Transit loading data
National statistics describing Malaysia's economy, state and society	• Whitehall departments • Government agencies and non-departmental public bodies • Local government institutions	• National accounts • Surveys of attitudes and behaviours • Other statistics collected for analysis and/or public record
Data created in the course of conducting publicly-funded research	• Universities and other educational establishments	• Various mass datasets • Published research

Table 5.1: Public data universe

5.4.4 Key goals of Open Community Data

Although the concept of data sharing may be viewed as trivial, there are several areas that need to be addressed, such as the sharing of infostructure, concerns of privacy and security issues, multiple data formats, data validity and veracity, and business models.

This section highlights the key goals for the implementation of this strategy:

i. **Establishment of Open Community Data definition** – The definition of the community data is critical to kick-start Open Community Data initiatives. A consortium of industry experts, academia and the Government is to be formed to derive the definition. The consortium is to be placed under the leadership of the proposed IoT Malaysia and regulated by MCMC.

ii. **Setting up the Data Aggregator System** – The purpose of the Data Aggregator System (DAS) for Open Community Data initiatives is to alleviate the concerns of data security, privacy and traceability. In addition, DAS shall organise multi-data format into a standard format. It is pertinent to note that DAS is not intended to be a public data warehouse or data centre but rather a necessary infostructure to aggregate data from the original source. Hence, the data that is linked to DAS shall remain in its original location and format. Data owners will grant permission to DAS to maximise the allowable dataset. Through DAS, data owners and regulators of PDPA are assured that the data collected is not tampered with.

The DAS operation has been tested in an actual environment in the Ministry of Science, Technology and Innovation (MOSTI)'s KRSTE.my system. It is

envisioned that DAS be jointly managed by all service providers under the supervision of MCMC.

The huge amount of data handled by DAS is only valuable if the data is dissected to its core and analysed to derive valuable and actionable insights. This will further fuel advanced analytics platforms such as Big Data Analytics to respond to the challenges and opportunities created by IoT for specific industries.

iii. **Managing the commercial aspect of data** – As data becomes an economic source, a clear business model is to be defined beforehand for new value creation and new revenue streams for market participation. At this juncture, IoT Malaysia is the most appropriate organisation to coordinate the efforts to define the business model, and valuate and manage the commercial aspects of the data aggregated through the Open Community Data initiatives.

5.5 IMPLEMENTATION

This chapter has presented a set of strategies that will propel Malaysia to the forefront of the regional IoT industry. The set of strategies proposed in building the IoT industry ecosystem will give Malaysia a competitive advantage in the region. Taking into consideration factors of infrastructure, regulatory climate and technology implementation, it is expected that upon the implementation of the strategies mentioned above Malaysia will gain three to five years of advantage ahead of any country with a similar

investment climate. That notwithstanding, the formation of think tank laboratories is still required to further deliberate the details of the implementation.

The following timeline and strategy champions are recommended for implementation:

Strategy	Proposed		Fund	Commencement
	Champion	Manager		
IoT Malaysia	PIKOM, MCMC, SME Corp. & MDeC	PIKOM	• Seeding by the Government of Malaysia • Self-funded operation after fifth year	July 2015
Open Innovation Framework	MIMOS & Industry	IoT Malaysia	• Seeding by the Government of Malaysia	July 2015
Open Community Data Framework	MIMOS & Service Providers	IoT Malaysia	• Seeding by the Government of Malaysia • Industry-funded	Jan 2016

Table 5.2: Implementation plan

Endnotes

1 Deloitte. (2012). Open data. Driving growth, ingenuity and innovation. Deloitte LLP. Available at: http://www.deloitte.com/assets/dcom-unitedkingdom/local%20assets/documents/market%20insights/deloitte%20analytics/uk-insights-deloitte-analytics-open-data-june-2012.pdf

Way Forward and Outcomes

chapter 06

Way Forward and Outcomes

The National IoT Strategic Roadmap will be the opening chapter in preparing Malaysia to be one of the key players in the global IoT arena. In order to ensure the rapid and sustainable growth of the IoT industry, this document outlined the implementation challenges, and action plan proposals to address the challenges in a systematic, principled and solutions-oriented manner.

The strategies proposed in this document have been largely developed based on the Triple Helix model, a dynamic framework for the interaction of research institutions, industry, academia and government towards a knowledge-based economy. The positioning of the institutional spheres with respect to each other and their potential for movement illustrate the dynamics of this model, with one stakeholder serving as a gravitational centre around which the others rotate; the government and academia as ancillary support structures, with the industry being the driving force to unleash the potential and accelerate the growth of technologies; in this instance, IoT.

6.1 WAY FORWARD: DEVELOPMENT OF THE IMPLEMENTATION PLAN

6.1.1 Focus areas

This document has outlined the key strategic initiative and goals towards positioning Malaysia as a key player on the world IoT map. It serves the purpose of getting different parties and initiatives onto a "single page". Despite the challenges of coping with fast-paced technologies and obtaining relevant critical information, the Technical Working Group (TWG) believes that the set of strategies and goals proposed will present an ideal launching pad for the development of more detailed implementation plans.

The immediate step after launching this initiative should be the formation of thinktank laboratories with objectives to shape sector-specific strategies, draw a detailed timeline, and develop implementation plans with project owners. Table 6.1 will serve as a guideline for the thinktank laboratories to deliberate the implementation plans in detail. These plans will include funding requirements, investment and talent, among others.

The focus area proposal has placed emphasis on sectors with the highest potential to contribute to the country's development by 2020. These contributions are based on investments, gross national income (GNI) impact, and job creation. As key economic growth engines of the future, the identified focus areas are expected to receive prioritised policy support and investment. The focus areas also mean that the performance of these sectors can be more accurately measured to ensure timelines and targets are met.

6.1.2 Championing IoT

To attain maximum buy-in and promote mindset change at all levels towards realising IoT at its most optimal level, it is crucial to maintain constant communication and interaction among the stakeholders (i.e. the Government, industry and citizens). "Game-changing champions" – leaders in catalysing thought and behavioural shifts – will be selected to help encourage behavioural change among all Malaysians at large. Efforts will include establishing appropriate thought leadership platforms as a channel of communication, interaction and engagement among stakeholders.

At this juncture, four pilot projects comprising participants from the public and private sectors will be selected. The pilot projects serve as the beacons of change and lead the way for others to emulate.

6.1.3 Delivering pilot projects

To ensure the identified IoT pilot projects are expandable and sustainable, ideation and syndication exercises with relevant stakeholders will be conducted regularly. Focused initiatives will enable stakeholders to address the challenges associated with scale and quality, by leveraging shared resources and jointly mitigating risks.

A system will be developed to collate, track and monitor the progress and development of projects of respective sectors. The information gathered and insights derived will be imperative in forming the basis for refinement of the projects towards efficient delivery of desired results.

6.1.4 Monitoring mechanism

To ensure the IoT initiatives are citizen-driven – ideas from the citizens for the citizens – it is essential to identify priority areas of the people. Input from members of the public – through opinion polls, perception surveys in mainstream and alternative media, media analyses, as well as dialogue sessions involving select academicians, private and public sector leaders – need to be considered.

Action items and timelines are made clear at every stage of implementation, and project owners should be in constant contact with IoT Malaysia. The communication activities for each project team should comprise:

- Monthly IoT Steering Committee meeting to ensure that challenges are resolved, directions are set and decisions are made

- Fortnightly IoT Investment Committee meeting to determine fiscal matters, funding and incentives

- Weekly IoT Council meeting chaired by the Science Advisor to the Prime Minister, to deliberate on unresolved issues escalated from the Steering Committee and Investment Committee meetings

- Annual progress reports for accountability of delivering the targets set in the individual roadmaps, and for the evaluation of achievements

- Open and constant feedback between industry players and policy makers to help enhance features of the initiatives

6.2 OUTCOMES

6.2.1 New industry

Arguably, IoT will be the transformative and pervasive driver of change and improvement. This exciting technology revolution will also add new dimensions to the industry in the following ways:

i. Test facilities

IoT is powered by a convergence of technologies at different layers, ranging from devices, networks and tools. To ensure the success of new products and services based on ubiquity and interconnection, new testing mechanisms are required to validate the interoperability between devices, between software, and between systems. With the ecosystem to be formed, testing facilities will become a new industry spawning out of IoT, and areas such as interoperability, standard compliance and export-related testing can lead to new economic sources. This will further uplift the competitive advantages of homegrown solutions.

ii. Software development standardisation

Standardisation is one of the critical success factors for IoT, and the complexity of IoT resulting from the myriad of technology and standards can turn out to be rewarding for the software industry in Malaysia. The number of IoT standards today is more than it should be, resulting in the same impact as having none at all. Today, there are various alliances attempting to harmonise the numerous standards. Studies have estimated that it will take about five to seven years for the industry to standardise the multiple standards. Thus far, the industry's "quick fix" of the situation is by promoting the use of a common Application Programming Interface (API), which is able to serve as an intermediate solution to address

standard silos and facilitate the creation of niche applications and services.

With the complexity of IoT standardisation and increasing market demand, API development is expected to open up new opportunities in the software development industry in harmonising multiple standards and addressing multiple market implementations.

iii. System integration services

Another prevalent opportunity expected to stem from the proposed IoT ecosystem is system integration services. With the bold strategies proposed in this document, it is anticipated that Malaysia's IoT ecosystem will be able to harness a new system integration experience. The IoT opportunities developed in the country will motivate entrepreneurs to master new skillsets through their interaction with end users, service providers, device manufacturers, technical experts from MNCs, and application developers. Over time, the holistic approach proposed for the ecosystem will produce an army of system integrator experts.

6.2.2 New interaction methods

IoT will make it possible for everybody and everything to be connected at all times, receiving and processing information in

real-time. The result will be new ways of making decisions, backed by the availability of information. Moreover, shifts in production and consumption patterns will be noticeable and will potentially be changing the relations among all members of the ecosystem due to the effect of digitalisation of business processes.

With IoT, entrepreneurs will be equipped with devices capable of identifying efficient problem-solving alternatives and distributing them efficiently thanks to permanent and ubiquitous connectivity. This development enables collaboration and interaction between different agents across the network. As part of the possibility of being permanently connected and traceable, a new generation of consumers – who expect IoT to facilitate everything they do – will emerge. Tapping on the ubiquity and pervasiveness of IoT, new-generation networking and analytical platforms will break down walls between operational domains to spur integration, collaboration and creativity between producers and consumers.

6.2.3 Reconfiguration of regulatory framework

The dynamic of change of the technologies involved in IoT will require removing data sharing limitations and boundaries to maximise the benefits of IoT. Inappropriate regulation could stifle innovation and

Goal	Strategy	Short-Term Initiative (2015-2017)	Mid-Term Initiative (2018-2020)	Long-Term Initiative (Beyond 2020)
1. Create a conducive IoT industry	Enhance the regulatory framework to cater for IoT technologies		5.2.4.3 (iv); 5.2.4.3 (v)	5.4.4 (i); 5.4.4 (iii); 6.2.3
	Strengthen institutional support in areas of technology and standards development	4.4.1	5.2.4.1 (i)	
	Leverage on existing initiatives and infrastructure to facilitate the creation of the IoT industry		5.2.4.1 (ii); 5.2.4.1 (iii); 5.2.4.3 (ii)	
2. Strengthening the capabilities of technopreneurs in the apps and services layer	Develop SME capabilities to kick-start the IoT industry	4.4.2		6.2.2
	Incubate SME competencies through focused 'flagship' projects	4.3.1; 4.3.2; 4.3.3; 4.3.4	5.2.4.3 (i); 6.1.1	6.1.4
	Development of key talents	4.4.3	5.2.4.2 (i); 5.2.4.2 (ii)	
3. Malaysia as the Premier Regional IoT Development Hub	Promote Malaysia as the key 'showcase' country		5.2.4.3 (iii); 6.1.2; 6.1.3	
	Promote Malaysia as the integrator of IoT solutions			5.3.4 (i); 5.3.4 (ii); 5.3.4 (iii); 5.3.4 (iv); 5.4.4 (ii)
	Position Malaysia as the centre for the IoT outsourcing services industry			6.2.1

Remark: The numerals indicate reference points of initiatives detailed in the respective chapters and sections. For example, the first digit indicates the chapter while the second digit is the subsection, the third and subsequent digits are the next levels of the corresponding subsections.

Table 6.1: Implementation plans timeline

cripple the development of IoT business models. Consumers, on the other hand, are uneasy about the potential impact of IoT in areas such as data protection and privacy. Thus, a new model of IoT governance is needed allow to innovation and promote the benefits of IoT, while at the same time protecting consumers. Balancing act is critical to satisfy various stakeholders in the ecosystem.

Among the top concerns are data protection and privacy. With billions of connected devices envisaged within the next decade or so, many of which will be directly linked to citizens in their homes or vehicles,

the scope for personal data requiring protection is vast. The people need a degree of comfort, and businesses need stability. Thus, the Government needs to educate citizens about IoT and how they can take advantage of this technology without fear of security or privacy breaches.

6.3 IOT FOR MALAYSIA

IoT, the talk of the town across the globe with the dynamics of technology designed for hyperconnected things, will likely be one of the major technological advances of this century, and offers "value for many" through embedded and ubiquitous intelligence. More importantly, IoT is evidently taking shape and dramatically changing the lives of individuals and communities. Additionally, increasing numbers of business communities across the world are venturing into the use of IoT to enhance routine operations, and in the pipeline are streams of IoT-related products and services.
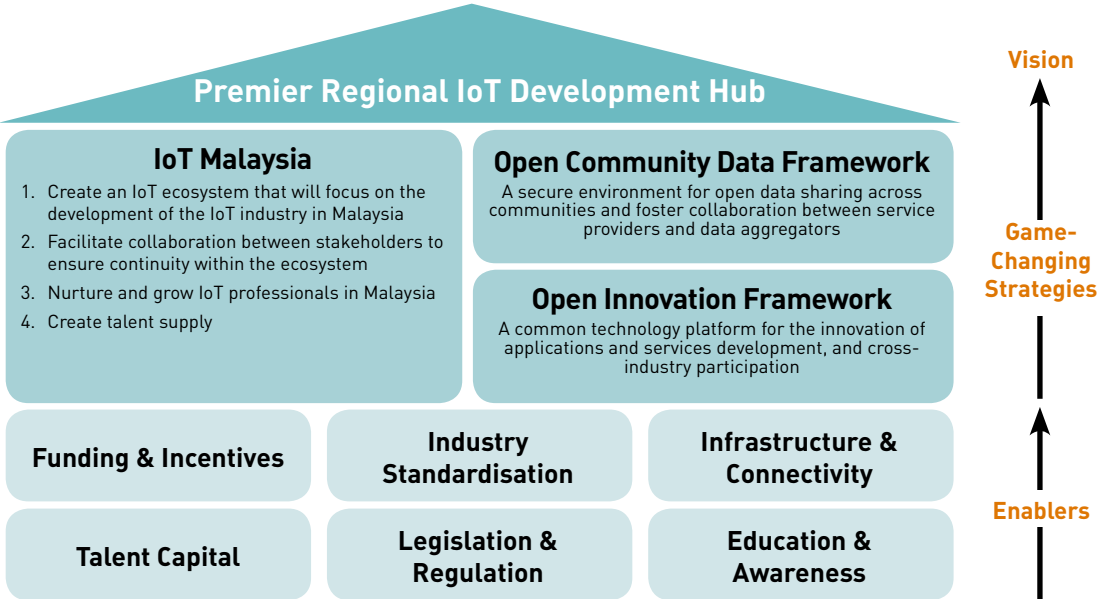

Figure 6.1: Vision of IoT for Malaysia

Looking ahead, consumer, government and business trends are leading toward IoT. This is not without its share of challenges and concerns such as information security and privacy, information storage and management and the digital divide, just to name a few. Therefore, it is imperative that the growth of IoT in Malaysia occur within an ecosystem driven by three key strategic thrusts that establish a framework for its

endeavours. These thrusts comprise: IoT Malaysia to create and sustain the ecosystem, Open Community Data Framework for open data sharing and Open Innovation Framework for a common technology platform. The enablers shall harness the intrinsic values of the three strategic thrusts towards the institutionalisation and recognition of Malaysia as the Premier Regional IoT Development Hub. This is shown in Figure 6.1.

appendices

Information listed in Appendices 1-3 is not exhaustive and only serves as reference points.

appendix 01

Global Concepts of Internet of Things

KEVIN ASHTON
the internet of things and other things

Adding **radio frequency identification** and other **sensors** to everyday objects will create an **Internet of Things**

ITU
Every physical thing in this world can also become a computer that is **connected to the Internet**

Gartner
The network of physical objects that contain **embedded technology** to communicate and sense or interact with their internal states or the external environment

ARM
The collection of smart, **sensor-enabled** physical objects, and the networks, servers and services that interact with them

Microsoft
Internet of Your Things: **Gather data** from the edge of the network, **process it** and **serve it** securely through engaging apps that drive real-time analysis and actionable opportunities that would otherwise be out of reach

BOSCH Invented for life
More and more **devices and systems** will be capable of **sending and receiving data automatically** via the Internet

CISCO
Internet of Everything: Bringing together **people, process, data and things** to make networked connections more relevant and valuable than ever before

ERICSSON
Networked Society where all aspects of people's lives, the operations of enterprises and society in general are impacted by the proliferation of communications

GE
This convergence of machine and intelligent data is known as the **Industrial Internet,** and it's changing the way we work

freescale semiconductor
Connected Intelligence: Transformational shift from the computing nexus to **highly intelligent nodes** – when intelligence massively scales, and the nodes have the power to learn, adapt and communicate

Things with identities and virtual personalities operating in smart spaces using intelligent interfaces to **connect and communicate** within social, environmental and user contexts

A **wireless and self-configuring wireless network** between objects, such as household appliances

An **ultra-connected** environment of capabilities and services **enabling interaction** with and among physical objects and their virtual representations

Improving the ways people **connect** with information

Embedded with increasingly sophisticated software and instrumentation, able to **connect to other devices** and fully capable of **responding intelligently** to user needs

Building intelligent devices, creating **systems of systems** by connecting legacy devices to the cloud, and enabling end-to-end analytics

Increasingly **smart and connected products** which can generate value in entirely new ways as streams of **real-time** operational data are captured, analysed and shared

A **System of Things** - M2M connectivity, cloud platform, device management, big data management, event stream processing, predictive analytics, and apps

An **intelligent, invisible network fabric** that can be sensed, controlled and programmed; IoT products employ embedded technology that allows them to communicate, directly or indirectly, with each other or the Internet

Internet of Everything: We call this the **Digital Sixth Sense**; we believe that when devices, places and people are intelligently connected, the impact on your daily life can be profound

Sources: http://postscapes.com/internet-of-things-key-players-large-companies; http://web.mit.edu; http://kevinjashton.com; http://ec.europa.eu; https://gigaom.com; http://www.ibm.com; http://www.thingworx.com; http://www.ti.com; https://www.qualcomm.com; http://www.itu.int; http://www.gartner.com; http://www.microsoft.com; http://www.bosch.com

Global Implementations of IoT

1. USA

USA, one of the world's IoT leading countries, deployed SmartAmerica to facilitate the smart cities initiative for its citizens. SmartAmerica enables people and organisations to contribute IoT-related innovation with the purpose of technology commercialisation potential[1]. The IoT initiatives for SmartAmerica range from smart homes, manufacturing, healthcare, energy, transportation and disaster response, government, aeronautics, and social media[2]. Global players such as Apple, IBM, GE and Intel are encoring IoT initiatives by launching IoT devices via crowdsourcing initiatives, business accelerators and venture capital funding.

2. EUROPE

In Europe, extensive deployment of IoT is underway to consolidate cross-domain activities of research communities and organisations. Under the European Commision's Seventh Framework (EU-FP7) support, the European Research Cluster on the Internet of Things (IERC), for instance, is now becoming a contact point for IoT research in the world[3]. Other initiatives such as the IoT Initiative (IoT-i) which was established in 2010 is also actively supporting the development of the European IoT community. In European countries such as Russia, smart cities are deployed through a number of pilot projects that use RFID technology, pre-installed GSM/GPRS Glonass equipment for vehicles, constructions of smart parking systems, NFC pilot projects in Moscow Metro and payment terminals, M2M launches of services using special SIM cards, and devices such as GPS trackers for different target groups of consumers. Spain, through their smart city project called SmartSantander, is also developing an IoT testbed in the city of Santander. A project under the Future Internet Research and Experimentation initiative, fully supported by the European Commission, represents a city-scale experimental research facility and supports typical applications and services of a smart city[4]. In Germany, automakers are leading the way to connect drivers and their cars to the Internet. Mercedez-Benz is working on a door-to-door navigation system that allows users to input destinations in Google Glass and connect their phone to a vehicle so data is transferred to an in-dash navigation system. Upon reaching the destination, users can simply disconnect their phone and all navigation details will be transferred back to Google Glass and switch to walking directions as needed. BMW's ConnectedDrive platform connects a car

to the Internet and allows both driver and passenger to get directions, receive real-time information about the car's system and browse the Internet.

3. JAPAN[5]

Japan has ventured into smart city initiatives in four project sites involving large-scale pilot projects on smart grid and smart community. The city of Yokohama and Kansai Science City initiatives focus on home energy management that control energy flows in homes and offices, and also on electric vehicles. The city of Kitakyushu is also eyeing energy management which focuses on new energy sources such as solar, wind and hydrogen. Other than these three cities, the Toyota City initiative concentrates on transportation and household sectors by having a low carbon social system via homes and cars.

4. KOREA

Korea has been progressively pursuing IoT initiatives since the 2000s. Its smart city, Songdo, is nearing completion and once established will be an exemplary model for other smart cities in a world that is wired, connected and monitored by computers, with little or no human intervention[6]. As part of its enhancements in information infrastructure, Korea has also begun to invest in grid infrastructure and joined forces with the European Union to develop a so-called 5G network, which claims to

be the next generation of mobile Internet services[7]. This collaboration will develop systems, set standards and get radio frequencies ready to accommodate the new technology by end 2015[8].

5. CHINA[9]

China's Ministry of Industry and Information and Technology (MIIT) estimated that China's IoT market will hit 500 billion yuan (US$80.3B) by 2015 and will double by 2020. China's latest five-year plan has placed IoT as a key strategic national industry initiative for the country which specifically focuses on smart grid, intelligent transportation, smart logistics, smart home, the environment and safety testing, industrial control and automation, healthcare, fine agriculture, financial services, and military defence. With an investment plan of 5 billion yuan (US$800 million) in the IoT industry in 2015, the government is looking into IoT to deal with food safety issues and healthcare in remote areas. China is also working on a project called Agriculture Internet of Things and Food and Safety Quality that tracks and traces agriculture from the field through the supply chain and food processing environments.

6. CANADA[10]

Canada has started an initiative called i-CANADA to make all its communities into intelligent communities by employing e-health, e-work, e-commerce, e-education and e-government towards sustainable

prosperity via full digital enablement. In addition, Toronto has been selected as the location for one of four global Cisco Internet of Everything (IoE) Innovation Centres which will serve as a global hub for thought leadership and solutions development.

7. SOUTH AFRICA[11]

In South Africa, led by the Council for Scientific and Industrial Research (CSIR), the Internet of Things Engineering Group (IoTEG) aims to position the country in this new Internet. This is to ensure that it capitalises on the opportunities provided in providing a low-risk avenue to evaluate and develop IoT solutions within its context. Its IoT projects focus on connecting smart things through sensors. Technological solutions are also being applied to enhance energy efficiency and enable smart environments.

8. SINGAPORE

Singapore, a highly connected and evolved nation with digital infrastructures and societies, is focusing in areas such as wireless technology, smart products and smart communities. Current efforts from its government and various corporate entities as well as an increasing consumer adoption rate contribute to the growth of its digital domain

in the global market[12]. In 2005, in order to enhance the competitiveness of key economic sectors and build a well-connected society, a high-level steering committee convened to spearhead the development of Singapore's 10-year masterplan (iN2015) focusing on growing and using technologies of the infocomm sector. iN2015, a living blueprint, shall fuel creativity and enable innovation among businesses and individuals by providing an infocomm platform that supports enterprises and talent. In this, businesses, individuals and communities shall be connected by the harnessing of global resources and capabilities for Singapore to export ideas, products and services globally[13].

9. INDIA[14]

In India, the IoT Special Interest Group (SIG) gathered a range of startups and stakeholders to discuss opportunities in IoT, establish an ecosystem for IoT activity and facilitate networking and mentoring. Identified IoT impact areas and sectors include transport, wellness, healthcare, buildings, homes, factories, agriculture, livestock, electric grids, water supply networks and individual consumers. In terms of entrepreneurship, some are at the startup stage such as SenseGiz.com in Belgaum that developed a range of tags and sensors that can be attached to a human body.

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appendix 03

Malaysia's IoT-related Activities and Initiatives

1. GOVERNMENT-LED INITIATIVES

1.1 Malaysian Communications and Multimedia Commission (MCMC)

MCMC, as the regulator for converging communications and multimedia industries, has been tasked with the national policy objective of establishing Malaysia as a global centre for communication and multimedia information and content services[1]. Part of its initiatives include Digital Lifestyle Malaysia which involves nurturing local IT resources and harnessing IoT technologies to promote a society where info-based products and services provide the basis of continuing enhancements in quality of work and life.

1.2 Multimedia Development Corporation (MDeC)

In realising IoT initiatives, MDeC in its role as the driver of national ICT initiatives, has committed to facilitate IoT striving towards a digital economy in Malaysia by 2020[2]. MDeC and Intel are now partners in outlining a strategic vision for the Internet of Things in Malaysia. As a result of this partnership, a framework shall guide Malaysia's digital entrepreneurs to secure stakes in the IoT business[3]. Also, in driving the cloud computing revolution in Malaysia, MDeC

is continuously working with ICT industry players, stakeholders and other government agencies[4]. To further facilitate its development in Malaysia, MDeC incorporated cloud computing as one of Digital Malaysia's eight projects under the Multimedia Super Corridor (MSC) Malaysia initiative[5].

MDeC is also the driver of the National Big Data Analytics (BDA) initiative for MCMC which was mandated by the Prime Minister during the 2013 25th ICM (Implementation Council Meeting) for MSC. Several stakeholder engagement sessions have since been executed and the National DNA Framework will be one of its deliverables for 2014[6].

MDeC has also initiated the Smart City Solution Initiative as an extension of the 'Grow the Embedded Systems Industry' project which incorporates IoT solutions where transport and energy are the current focus areas. As insights for solution providers for application and service development, stakeholder requirements gathering processes have been kick-started among the Iskandar Regional Development Authority (IRDA), municipal councils and property developers.

Under Digital Malaysia, MDeC has formulated a project 'Develop a Trusted Mobile Digital Wallet System' which is a virtual wallet beyond

payment purposes including non-payment applications such as authentication and loyalty. This project supports the direction towards a cashless society and attempts to spur e-commerce and m-commerce and aligns with the National Digital Economy Initiative, for the convenience of society and towards a digital lifestyle[7].

In the National Digital Economy Initiative (NKEA) for the Electronics & Electrical sector, EPP 17 'Grow the Embedded Systems Industry', MDeC, as the public sector champion, developed several ecosystem development strategies, talent programmes and training for the embedded systems industry. The early adopters for embedded systems included transport, energy and industrial sectors. MDeC has since identified more than 100 embedded systems-capable local companies and 20 of which have been profiled. Aside from local players, MNCs were also encouraged to participate in embedded systems. In the pipeline is a roadmap for the embedded systems industry[8].

1.3 Malaysian Global Innovation and Creativity Centre (MaGIC)

MaGIC was designed to become a one-stop centre for entrepreneurs and provide every facility that entrepreneurs would require. These facilities range from obtaining funding from banks or venture capitalists to the provision of incubators for developing startups in product and service improvement[9]. This will be a huge exploitable asset for startups and entrepreneurs to utilise when venturing into IoT.

1.4 Malaysian Investment Development Authority (MIDA)

Backed by over 40 years of experience in the electronics industry, Malaysia has sufficient capabilities and resources to get involved in the IoT segment through design, manufacturing processes, research and development, robotics and software development activities[10]. In an initiative to support IoT, MIDA, a government agency, attracts MNCs to invest in the design and manufacture of IoT devices while the Government plays a catalyst role by supporting via the provision of facilities, necessary infrastructure and human capital[11].

1.5 CyberSecurity Malaysia

In protecting and securing data and information, the national cybersecurity government agency, CyberSecurity Malaysia, has the task of preventing or minimising disruptions to critical information infrastructure to safeguard and protect the public, the economy and government services[12]. Specialised cybersecurity solutions have been developed which provide access to a wide variety of tools and education in order to assist proactive or forensic investigations. For IoT, what this means is that although more and more devices are being connected, citizens can rest assured that their data are in safe hands.

2. INDUSTRY-LED INITIATIVES

2.1 Telekom Malaysia Berhad (TM)

VADS Berhad, a wholly owned subsidiary of Telekom Malaysia Berhad (TM), supports cloud services technology in Malaysia and is Malaysia's largest data centre provider with 14 data centres nationwide and one global data centre in Hong Kong. VADS collaborated with MIMOS to develop an orchestration platform to offer cloud computing services to the public[13]. TM itself also expanded its cloud services through the inclusion of Microsoft Office 365 as part of TM's Software-as-a-Service offering[14].

In terms of IoT initiatives, TM is neck-deep in IPTV and has commenced its forage into delivering better medical support services and security enhancements to Internet-ready homes[15]. In the area of 'sensible and sense-able information', TM has made efforts in data mining, analytics and visualisation solutions, and applying artificial intelligence to data produced by smart appliances. Adding to this, TM, in a joint venture with UEM Sunrise and Iskandar Innovations Sdn Bhd (IISB), a wholly owned subsidiary of Iskandar Investment Berhad (IIB), aims to offer and operate smart services in Nusajaya as part of their IoT initiatives[16].

2.2 Cloud infrastructure-related initiatives

In IoT comes cloud infrastructure where other industry players such as SKALI Cloud Services and JARING offering ultra-flexible and scalable cloud servers and hybrid infrastructure cloud services for mission-critical cloud hosting services and on-demand high-performance computing services respectively[17].

2.3 Energy-related initiatives

As part of Malaysia's smart grid initiative, Tenaga Nasional Berhad (TNB) embarked on a smart meter project to address the demand for power. During the one-year pilot project, TNB has since installed over 1,000 advanced smart grid meters in Putrajaya and Malacca. Its university, Universiti Tenaga Nasional (UNITEN), in collaboration with EnVerv, a US semiconductor manufacturer, will be engaged in IoT in the areas of smart sensors, active lighting, next-generation solar and advanced smart grid in talent development and the delivery of production-grade designs[18]. Over the past four years, EnVerv and UNITEN have been conducting field tests in smart grid communications over low voltage and medium voltage power lines in different cities throughout Malaysia. Herein, UNITEN is uniquely positioned to lead research in smart city technologies, smart sensors and smart grid communications, and rapidly develop, prototype and field trial these technologies within UNITEN's smart city testbed.

3. APPLICATIONS

3.1 Maxis Berhad

Under Maxis' M2M initiative, apps have been successfully deployed in the form of a taxi dispatch service with GPS enhancements. MyTeksi, an app developed by a local social startup, allows users to make taxi bookings wirelessly in real-time. Users download the app and register on the MyTeksi website. Upon turning on the app, the user's location is pinpointed and the user is immediately connected to drivers listed in the system who are equipped with GPS-enabled smartphones[19]. Herein, IoT connects users to most needed services.

3.2 CIMB

CIMB, one of Malaysia's largest banks, is building up its competency and capacity in e-commerce. Businesses of any size stand to benefit from CIMB's state-of-the-art mobility for Internet banking solution that provides affordability and security in managing electronic payments using smartphones and tablets. Transactions can be safely conducted using plug-and-pay mobile apps via a solution that can be plugged into a plug-and-pay card reader that readily accepts chip or signature-based credit and debit cards. This paves the way for more IoT-related services to come into the foray.

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