NATIONAL BROADBAND STRATEGIES FOR SRI LANKA

Munasinghege Bhathiya Jayalath

(118460G)

University of Moratuwa, Sri Lanka.
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Thesis/Dissertation submitted in partial fulfilment of the requirements for the degree

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Declaration of the candidate & Supervisor

"I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Signature of the supervisor: Date:

Dedication

I dedicate my dissertation work to family. A special feeling of gratitude to my loving wife, Sandamali whose words of encouragement and push for tenacity ring in my ears. My Parents, M.A.Jayalath and W.Seelawathie and my sister, Priyanwada Jayalath have never left my side and are very special.

I also dedicate this dissertation to my mother and father in low, Heny Gunarathe and Leela Gunarathne who have supported me throughout the process.

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Abstract

Objective of this study was to propose a set of national broadband strategies that suits to Sri Lankan context. Strategic planning process is used as the model to build up national broadband strategies. Initial step of the model is to set some strategic objectives. Therefore, set of strategic objectives, goals, targets for broadband were proposed. It is required to conduct an environmental scanning process which can be used to identify internal and external factors of the broadband environment. Environmental scanning process was done by a questionnaire which was administered among industry personnel and also the face to face interviews were carried out with government body personnel which represented from TRCSL and ICTA. Interviews which were carried out, revealed about existing broadband strategies and also the national broadband policy which has been drafted by a committee of broadband experts. Then the set of broadband plans were formulated and proposed and output of literature was used a platform to build up broadband plans. Literature survey was carried as an analysis of approaches that leading countries have taken in expanding their broadband markets, with a focus on the Republic of Korea. In addition, case studies covered Finland, France, Japan and the United States. Another case study of broadband implementation of Nigeria was also discussed in literature survey. Then this study revealed some set of broadband initiatives and policies that can be aligned with broadband plans. Those initiatives and policies are validated by the outcome of the literature survey and the discussion which had with government body personnel.

Key words:
Broadband initiatives, broadband plans, broadband policies, environmental scanning, strategic objectives, strategic planning process

Table of Content

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Description
ITU	International Telecommunication Union
TRCSL	Telecommunications Regulatory Commission of Sri Lanka
ICTA	Information and Communication Technology Association
IPTV	Internet Protocol Television
OECD	Organization for Economic Co-operation and Development
ICT	Information and Communication Technology
GDP	Gross Domestic Product
LTE	Long Term Evolution
HSPA	High Speed Packet Access
FLAG	Fiber Link Around the Globe
SEA-ME-WE	South-East Asia, Middle East, Western Europe
SLT	Sri Lanka Telecom
FTTH	Fiber To The Home
FTTB	Fiber To The Building
ADSL	Asymmetric Digital Subscriber Loop
GSM	Global System for Mobile
CDMA	Code Division Multiple Access
LLU	Local loop unbundling
EU	European Union
ARCEP	Regulatory Authority for Electronic Communications and Postal Services
BWA	Broadband Wireless Access
DSL	Digital Subscriber Loop
FCC	Federal Communications Commission

RoW	ROW Right of Way
S.M.A.R.T	Specific Measurable Achievable Realistic Time-bound
GIS	Geographic Information System
QoS	Quality of Service
NGN	Next Generation Networks
ROI	Return on Investment
LGN	Lanka Government Network
VPN	Virtual Private Network
IPSEC	Internet Protocol Security
ISP	Internet Service Provider
HTTPS	Hyper Text Transfer Protocol Secured
CAPEX	Capital Expenditure
OPEX	Operational Expenditure
GIC	Government Information Center
LGC	Lanka Government Cloud
WCDMA	Wideband Code Division Multiple Access

List of Appendices

1   INTRODUCTION

1.1   Problem Statement/Motivation

The development of broadband infrastructure and services should represent one of the top priorities of governments. For any country to be economically competitive in the global market, its population, businesses and non-for-profit organizations need access to high-speed broadband services. Most countries have preferred the more proactive approach of implementing a national broadband plan. The approach adopted by a government depends on whether it seeks to intervene to drive or facilitate development, or whether it prefers to rely on market forces to increase coverage. Most of the developing and developed countries like South Korea; Canada etc. have broadband national strategies. All the telecommunication operators' focus on those national objectives to accomplish and their organizational broadband strategies are building upon the national wise strategies. For developing country like Sri Lanka, it is required and enabling factor to have national broadband strategies. The government of Sri Lanka has an objective to make Sri Lanka a `knowledge hub'. Implementation of national broadband strategy will be a catalyst, in the process of making Sri Lanka a knowledge hub.

Broadband services were introduced to Sri Lanka in the year of 2009. According to statistics of ITU [1] still fixed broadband penetration (Figure 1) mobile broadband penetration (Figure 2) and internet usage is in low position when it's compared with developing countries. According to the statistics of 2015 which his published by ITU [2], fixed broadband penetration is 2.6% and internet penetration is 25% But on the other hand Sri Lanka has a very high mobile phone usage of 103% in the year of 2014 [3]
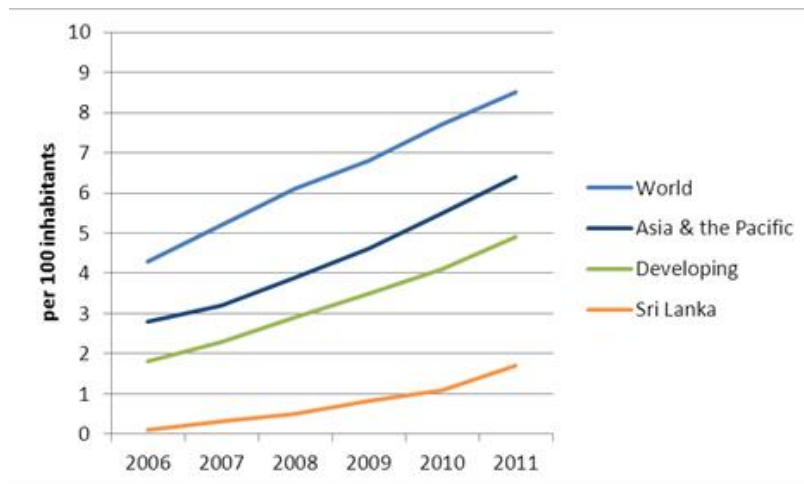
Figure 1: Fixed broadband penetration

Source: http://www.itu.int/
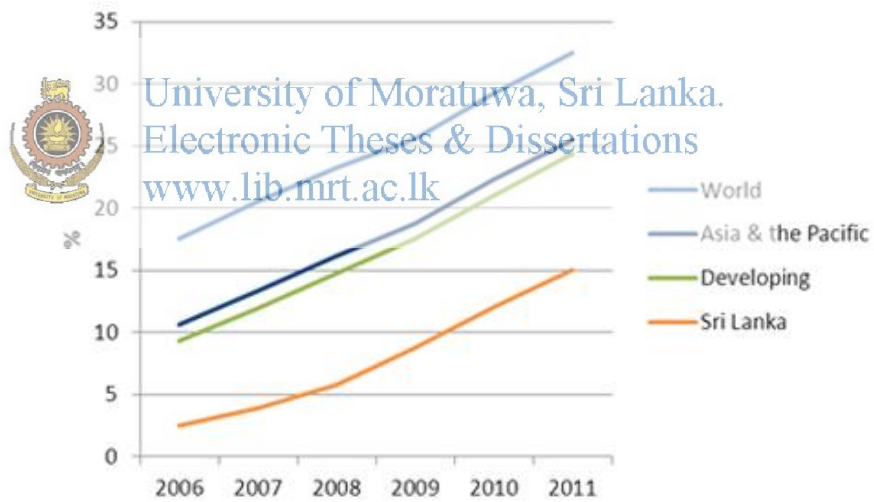
Figure 2: Mobile broadband penetration

Source: http://www.itu.int/
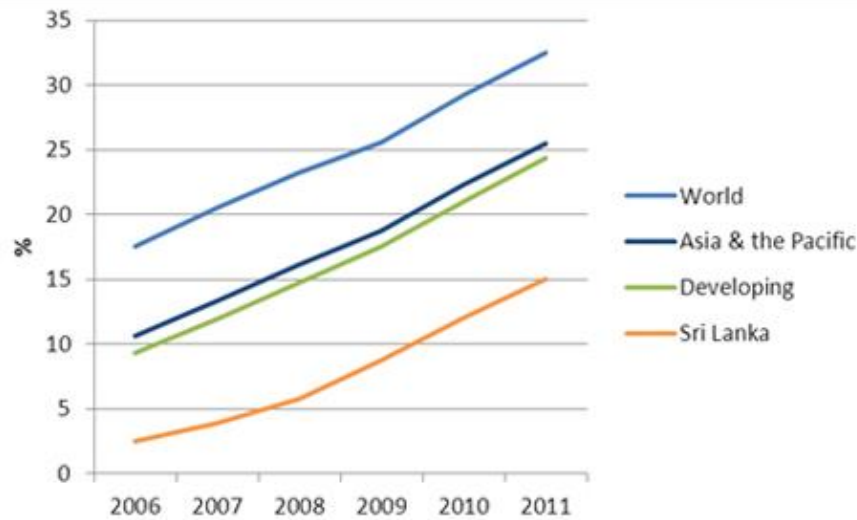
Figure 3: Percentage of individuals using internet
Source: http://www.itu.int/

According to the statistics of mobile handset penetration and mobile broadband penetration, it clearly seen factor that, even though Sri Lanka has higher number of mobile phone penetration, still Sri Lankan are not get used to internet access via mobile. This is also evident from the low percentage of internet access of Sri Lanka (Figure 3). Computer literacy rate is another good indicator which links with broadband penetration. Computer literacy rate of Sri Lanka in 2014 is 25.3% [4]

Therefore it is required to have set national broadband strategies in order to develop broadband services and promote broadband among communities in Sri Lanka. Implementation of national broadband strategies will help government and broadband service providers to develop broadband services and increase the broadband penetration in Sri Lanka.

1.2 Research Objectives

Researcher has identified following research objectives in order to overcome above mentioned research problems

- Develop set of broadband objectives and goals for Sri Lanka
- Recommend set of broadband plans
- Recommend set of broadband initiatives
- Propose set of broadband policies in order to support broadband plans and initiatives

1.3 Research Scope

Research will be cover following;

- Analysis of existing broadband strategies which cover broadband plans, policies and initiatives of Sri Lanka
- Analysis and review of successful case studies of broadband implementation of developed countries in the literature survey
- Identify broadband development strategies of some developing countries in the literature survey
- Collect data from broadband services providers
- Collect data from TRCSL and ICTA
- Identify initiatives for broadband promotion and development which have been taken by broadband operators and government.
- Carrying out an environmental scanning based on the collected data in order to identify issues which operators face in taking above initiatives
- Provide recommendations to overcome above issues.
- Identify and propose set of broadband goals and objectives which suit Sri Lanka
- Identify suitable broadband plans for Sri Lanka
- Guidelines to develop broadband policies and initiatives

4

2 LITERATURE REVIEW

2.1 Defining and Understanding Broadband Context

Despite its worldwide growth and promotion by policy makers, network operators, and content providers, broadband does not have a single, standardized definition. The term "broadband" can refer to various aspects of the network and services, including user for providing services, high-speed access to the Internet infrastructure or "pipe", as well as services and applications via broadband networks, such as Internet Protocol Television (IPTV) and voice services can be bundled together in a "triple play" package of broadband Internet access. Further, many countries have established definitions of broadband based on speed, typically in Mbit/s or kilobits per second (kbit/s), or on the types of services and applications that can be used over a broadband network (that is, functionality). Due to the unique needs of each country, including the impact of economic, geographic and regulatory factors, the definition of broadband is very different. Traditionally, however, it is often broadband data transmission speed (i.e., the definition, the amount of data can be transmitted over a network connection in a given time period, typically one second, also referred to as the data transmission rate or throughput). Defining broadband in terms of speed has been an important element in understanding broadband, particularly since the data transfer rate determines whether users are able to access basic or more advanced types of content, services, and applications over the Internet.

Broadband speed definitions vary among countries and international organizations, generally ranging from download data transfer rates of at least 256 kbit/s on the low end, as in India, South Africa, the International Telecommunication Union (ITU), and the Organization for Economic Co-operation and Development (OECD), to faster than 1.5 Mbit/s on the high end, as in Canada [5, p. 3]. Based on the speed to keep up with advances in technology may not be defined or with a normal operating speed, services and applications required for application In other words, what is considered "broadband" today it may be considered slow in the

future, as more advanced application technology development. Thus, any speed-based definition of broadband will need to be updated over time.

2.2 Importance of Broadband

With appropriate policies, broadband can impact on information and communication technology industry, as well as it can be provide a platform for other economic sectors. It can be clearly attributed to the economic and social benefits of broadband accurate and may challenge has been found to have a great impact study, few people can refute the fact that broadband has greatly changed our personal lives, our businesses and our economy. Further, as an enabling platform for information and communication technologies and also broadband can promote the growth and innovation of the ICT sector and economy as a whole, as an important input for each enhancing the overall economy. Broadband multiplier effect can pull GDP, productivity and employment growth; however, support for the supply and demand components of ecosystems and the absorptive capacity of learning and incorporating broadband capabilities to the policies of other departments must all in place in order to achieve such benefits
.

2.3 Sri Lankan Broadband and Telecommunication Environment

It is required to analyze broadband and telecommunication environment in Sri Lanka in the process of developing broadband strategies. Sri Lankan broadband environment was analyzed using the case study; Strategies for the promotion of broadband services and infrastructure: A CASE STUDY ON SRI LANKA done by ITU [6]

There are three Fixed Access Operators, five Cellular Mobile Operators14, six Data Communication Providers (Facility-based), nine Data and Internet Service Providers (Non-facility based) and 33 External Gateway Operators. The telecommunication sector consists of approximately 3.6 million fixed access

6

subscribers, 18.9 million mobile cellular subscribers, 1.1 million Internet connections and 6145 public payphones spread across the country [6, p. 9]. The rapid expansion of cellular mobile services over the last ten years has contributed to a considerable growth in the telephone penetration. Considering the significant user benefits inherent to 3G systems, the Telecommunications Regulatory Commission of Sri Lanka (TRCSL) facilitated the introduction of the 3G mobile services on test frequencies for 3G in 2003 and on a commercial scale in 2006, becoming the first country in South Asia to offer 3G services. High-Speed Packet Access (HSPA) 3.5G systems were deployed on top of existing 3G networks, making Sri Lanka the first country in South Asia to offer 3.5G services.

In 2010 mobile operators have requested the 700MHz frequency band for Long-Term Evolution (LTE) technology, but it will not be available until TV broadcasting is digitalized. However, a 20MHz slot was allocated in the 2.6 GHz band to each operator for trial LTE Networks. According to the operators, tests were successful and some operators are testing further in the 1800MHz band already allocated to them. Free slots in the 1800MHz band are to be allocated by a closed bidding process to existing mobile operators. In the technology continuum, Sri Lanka has been on par with the developed world embracing new and evolving technologies such as 3G, 3.5G HSPA, HSPA+ and now LTE networks, which are fast becoming relevant to the country.

Sri Lanka has international connectivity through two major submarine cable systems and there are three submarine cable landing stations. The major Submarine Cables are South-East Asia – Middle East –Western Europe (SEA-ME-WE) and the Fiber-Optic Link around the Globe (FLAG) Two landing stations are operated by SLT and the other by Lanka Bell. There is also connectivity through two regional submarine cables, Bharat Lanka and Dhiraagu [6, p. 12]

Case study further highlighted that fiber has not been used widely in Sri Lanka and the majority of the fiber networks in the country are being used only for the purpose of transporting backhaul traffic. TRCSL has entrusted SLT to undertake the

provision of broadband services for the implementation of a National fiber backbone network that can be shared by all operators. The first phase of this project is currently being implemented. Case study further pointed out the lack of having fiber to the home (FTTH) in the country to serve individual customers. Only Metro Ethernet services are available in the corporate sector and fiber to the building (FTTB) can be seen in areas where fiber is available.

According to the case study, Broadband was introduced by the incumbent operator Sri Lanka Telecom (SLT) in 2003. In 2007, the second operator, Dialog Broadband Networks, joined the market. The new entrant chose wireless technology based on Worldwide Interoperability for Microwave Access (WiMAX) (IEEE 802.16d) to provide broadband services to subscribers, initially in urban areas. In late 2007, mobile operators also joined the market to provide wireless broadband using 3G technology (HSPA). Mobile broadband services based on 3G HSPA have captured a significant share of the market within a short period of time. In 2012 Sri Lanka's mobile broadband (3G) market comprises five operators. Table1 sets out the fixed and mobile operators providing broadband.

Table 1: Broadband operators and technology

Operator	Technology	Mode	Mobile/Fixed
SLT	ADSL, ADSL2,ADSL2+	Wired	Fixed
Lanka Bell	CDMA2000/WiMAX	Wireless	Fixed
Dialog Broadband	CDMA2000/WiMAX	Wireless	Fixed
Dialog Mobile	GSM/WCDMA/LTE	Wireless	Mobile
Mobitel	GSM/WCDMA/LTE	Wireless	Mobile
Etisalat	GSM/WCDMA	Wireless	Mobile
Airtell	GSM/WCDMA	Wireless	Mobile
Hutch	GSM/WCDMA	Wireless	Mobile

Source: - M. Jayasekara, "Strategies for the promotion of broadband services and infrastructure: A CASE STUDY ON SRI LANKA," Broadband Commission of ITU, 2012.

2.4 Previous Researches and Case Studies

2.4.1 Building broadband: Strategies and policies for the developing world

This case study done by Yongsoo Kim, Tim Kelly, and Siddhartha Raja (2010) [7] pointed out Korea's exceptional success in developing broadband, and ICT. This report offers policymakers and regulators an analysis of approaches that leading countries have taken in expanding their broadband markets, with a focus on the Republic of Korea. This reflects a unique mix of highly competitive private-led markets and government leadership, use, support, and regulation. This case study explores how the Korean government has intervened in many ways in the market, in a focused and strategic manner. The government involvement in developing broadband strategies was critically important to trigger or guide private sector development and tie them to the government's sector objectives and particular country conditions.

The Korean government developed a vision of the information society and raised awareness among citizens and businesses. Strategic development framework has been established to support broad policy objectives and instructions to create supply-side and demand-side policies, such as lower market entry barriers and stimulate demand. Efforts included public investment in broadband infrastructure policies and private investment, measures to gather and expand demand for broadband services, policies to promote universal access to broadband and support industrial and competition policy.

The researchers have brought forward the evolution of broadband in various spheres. Although earlier this was limited to online stock trading, education services, and games, as uptake increased, there was a move toward more interactive services such as shopping, email, and participation in cyber communities. Nowadays this has focused much on music download and gaming, E-government, e-commerce, e-learning which are the drivers of high broadband adoption in Korea.

Mobile broadband has also been successful in Korea, though some networks lag in adoption. This makes the Korean case useful for the many developing countries that will likely see broadband diffuse over wireless instead of wireline networks. In Korea mobile broadband took off in late 2000 following the award of 3G licenses

Other social and economic functions also makes a useful case study of South Korean broadband development. First, the country's use of information and communication technologies as a catalyst for social and economic development, especially in education and e-government. Thus it suggests emerging best practice for other countries—especially those with few natural resources other than the skills of their people

Further researchers have identified strategic initiatives that have brought Korea's broadband market to where it is today. This study further explains the model of broadband eco-system which conceptualizes broadband as an interconnected, multi-layered ecosystem of high-capacity communications networks, services, applications, and users. This ecosystem for the retail or access segment is represented in Figure

The ecosystem includes the networks that support high-speed data communication and the services which these networks provide. It also includes the applications provided by these services and the users who are increasingly creating applications and content. Investments—by public or private investors and agencies—and user demand expand the reach of high-speed networks. These networks increase the availability of high-quality services to both users and application providers. Applications access these services to reach users, who respond to the affordability of the services and relevance of the applications. Users then grow in number and sophistication, demanding and driving greater investments in networks, creating the virtuous circle for broadband.
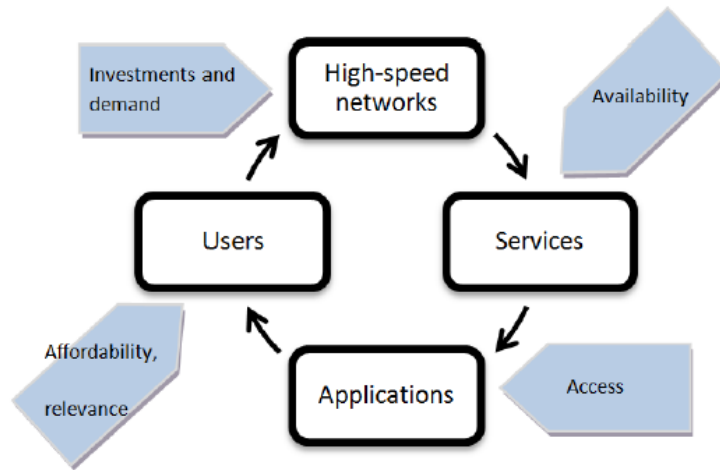
Figure 4 : Broadband Eco-System

Source: Y. Kim, T. Kelly and S. Raja, "Building broadband: Strategies and policies for the developing world," World Bank, 2010.

Further the study explores Numerous policy developments and initiatives brought Korea's broadband market to where it is today. Appendix 1 summarizes the strategies, policies, and regulations that Korea has used to develop its broadband ecosystem.

According to the research, Korean government has established several policies on par with the broadband strategies which are summarized below;

- Plans for public investment in broadband infrastructure and incentives for private investment;
- Initiatives to aggregate and expand demand for broadband services through for example e-Government services and the promotion of e-commerce and digital literacy;
- Policies to promote universal access to broadband; and

- Various supporting industrial policies such as R&D promotion and incentives to revitalize venture capital markets.

In the case study, researchers have mentioned how the achievements of the master plan have been assessed and the objectives and goals revised to establish updated plans for the following years. Using these master plans and supporting policies, the Government has often sought to promote specific market sectors by first providing an initial impetus through strategic public investments and initiatives and then encouraging this impetus to evolve into larger investments and actions in the private sector.

In addition to providing frameworks for market development, the Government's role has also extended to the implementation of competition policies and the provision of regulation deemed appropriate and proportionate to foster long-term sustainable growth in the broadband market. These polices can be categorized in to supply side polices and demand side polices

2.4.1.1 Supply-side policy

Through its informatization master plans, Korea has promoted supply-side broadband policies that can be categorized as:
- Infrastructure and application development policies.
- Content promotion policies.
- Industrial policies
- Regulation and competition policies.

Korea has implemented three key groups of broadband infrastructure policies since the mid-1990s (Table 2)

Table 2: Korea's broadband infrastructure development policies

| Year	Initiative	Speed	Underlying Technologies
1995–2005	Korea Information Infrastructure	2 Mbit/s	ATM, ADSL, cable modem
1995–97	Phase 1		
1998–2000	Phase 2		
2001–05	Phase 3		
2004–10	IT839 Strategy and Broadband convergence Network (BcN)	50–100 Mbit/s	VDSL, FTTB, FTTH, WiBro, W-CDMA, HSDPA
2004–05	Phase 1		
2006–07	Phase 2		
2008–10	Phase 3		
2009–13	Ultra Broadband convergence Network (UBcN)	100 Mbit–1 Gbit/s	FTTH, WiBro, W-CDMA, HSDPA

Source: Y. Kim, T. Kelly and S. Raja, "Building broadband: Strategies and policies for the developing world," World Bank, 2010

2.4.1.2   Content promotion polices

Initiatives to develop the broadband market in Korea have included a number of content promotion plans and support (Table 3)

Table 3: Content promotion plans in Korea

Year	Initiative
Framework plans and supporting policies	
1992	Information use promotion plan
1998	Multimedia content industry promotion plan
1999-2002	IP and ISP promotion plans
2000	Digital content industry promotion plan
2001	Digital content technologies developed in collaboration with the Ministry of Culture
2001	Internet broadcasting industry promotion plan
2002	Digital Multimedia Content Investment Partnership
2003-2008	First and second basic plans for online digital content industry advancement
Supporting legislation and bodies	
1993	Korea Database Promotion Center created
1997	Korea Multimedia Content Promotion Centre created
1998	Korea Software Industry Promotion Agency (KIPA) created
2000	Software Industry Promotion Act
2000	Management of Digital Content Act
2002	Online Digital Contents Industry Advancement Act

Source: Y. Kim, T. Kelly and S. Raja, "Building broadband: Strategies and policies for the developing world," World Bank, 2010

2.4.1.3 Industrial policies

Supply-side broadband policies also include a number of supporting industrial policy and other policies to encourage research and development of information and communication technology, international joint research, tax incentives and rent reduction for the emerging Internet industry, the deregulation of high-tech start-ups, promote overseas IT market penetration, promote the wider use of IT in

traditional industries such as agriculture, fisheries and measures to promote standardization and etc.

2.4.1.4 Regulation and competition policies

Korea's broadband regulations were shaped by the liberalization policies adopted starting in the 1980s, which included licensing Dacom and Hanaro as competitors to fixed line incumbent KT in domestic and international markets (Table 4).

Table 4: Korea's regulations for broadband

Year	Regulation
1997–	Broadband designated as a value added service
2000	Quality monitoring extended to broadband
2000–01	3G licenses granted
2002	Service level agreements introduced for broadband
2002	Network access regulations imposed
2002	KT privatization completed
2002	Local loop unbundling (LLU) introduced
2004	Network access regulations extended to fiber
2005	ISP peering regulation introduced
2005	Rights granted to provide WiBro services
2005	Pricing regulation introduced
2005	Broadband re-categorized as facilities-based service
2007	Roadmap issued for telecom regulation
2007–08	Bundling regulation eased
2008	Number portability introduced for VOIP
2008	Regulations removed on handset subsidies

Source: Y. Kim, T. Kelly and S. Raja, "Building broadband: Strategies and policies for the developing world," World Bank, 2010

2.4.1.5 Demand-side policies

Researchers have further explained demand side polices which are mentioned below;

- Aggregating demand for broadband among public bodies to provide an established initial market for services.
- Promoting e-commerce as a way to facilitate widespread adoption of broadband by businesses.
- Providing key public services online and encouraging the development of applications such as e-learning to promote widespread public use of broadband.
- Implementing digital literacy initiatives to narrow the digital divide and ensure maximum participation in the broadband market.

2.4.2 Cases from developed world

In addition to the Republic of Korea, the researchers survey 4 other countries to identify different approaches to developing broadband markets. These four countries—Finland, France, Japan and the United States—are all global leaders in broadband access and use. Significant portions of their populations subscribe to wireline broadband, and they are major markets for 3G and other advanced wireless broadband services. In addition, they represent a range of political arrangements and approaches to economic and telecommunications development. And in response to the economic crises of the late 2000s, some have initiated broadband stimulus plans. This chapter summarizes the various approaches to developing the broadband ecosystem in these countries. It concludes with an analysis of the common elements seen in these approaches [7, p. 28]

2.4.2.1 Finland

Finnish approach involves significant broadband reliance on market forces, reinforced by public support. Government has identified broadband as a legal right of the citizens, that is to say, it will be defined as part of the universal service obligation. As of June 2010, when the law took effect, every Finnish citizen can expect to have at least 1 Mbit / s connection available. Finland aims to cover 99 percent of residences with 100 Mbit/s connectivity [7, p. 28]

Finland's broadband development mainly depends on market forces, reinforced by a significant public sector intervention, when necessary. Finnish way for a public-private partnership, often concentrated, rather than centralized planning was taken by one country or government agency operators at the local level. Federal funding flows only to projects deemed not viable for 100 percent private investment [8]. But even for such instances of market failure, the federal subsidy amount cannot exceed one-third, with additional EU and municipal support capped at another one-third—thereby requiring private participants to invest at least one-third of the cost.

Finnish telecommunications industry based on market competition to drive growth. This was possible because the people have never had a single national service provider who is qualified for the political and economic guarantees, including the isolation of the entrance to the market. The market is more competitive and fragmented than any other in Europe.

The Finnish government expected mobile broadband to play an important role in the implementation of short-term and long-term goals set out in the national strategy of accessing broadband in 2008 [9, p. 17]. The penetration of wireless telephony has reached 50 percent in 1998, prompting an early and sharp decline in core wireline subscriptions. Interestingly, recent data also indicate that the DSL connection is currently in decline by substituting mobile broadband. Today, Finland has a robust mobile market, with TeliaSonera Finland, Elisa, and DNA, offering attractive prices for services, including mobile broadband [10] . Moreover,

17

the presence of a major wireless manufacturer, Nokia, contributed to ICT employment and broad appreciation for the personal and social benefits accruing from widespread adoption of wireless and broadband services. Finland's ICT sector includes about 6,000 firms and accounts for 10 percent of GDP [11].

The government has foreseen fixed WiMAX broadband services, serving 5 per cent of Finnish households by the year 2015 the rate of connection of 5-40 Mbit / s, Mobile WiMAX, serving 60 per cent with rates + 5-100 Mbit / s, and the usual wireless fed 93 percent from rapidly + 5-100 Mbit / s. The government expects to achieve its goals with the financial mechanism, including private investment, federal grants and funding from the local government and the European Union [7, p. 28]

The government expected 99 percent all permanent residences to have access, within two kilometers, to an optical fiber or cable TV network delivering 100 Mbit/s bit rate connections. This would push the universalization of broadband. The government expects to achieve its goals with a funding mechanism that combines private sector investment, federal subsidies, and funding from local governments and the European Union. The government expected that for 95 percent of the population, market conditions will support the evolution of such access. [7, p. 28]

2.4.2.2   France

France pursued broadband, balancing long-standing concept of public service with the need to facilitate the privatization of the telecommunications and public access, in accordance with EU directives. The government framed the development of broadband in the context of equal treatment of all citizens and ensure service availability and continuity. In practice, this means that the French government considers necessary and appropriate to intervene when the market is to achieve social objectives such as universal service. In June 2009, fixed broadband penetration rate was 30 percent, and the penetration of 3G market is 23 percent.

France has a population of about 62 million people, 77 per cent in urban areas. In 2008, GDP per capita was $ 45,981 [7, p. 29]

France recognized the importance of information access early. The government launched the Minitel videotex service in 1982, offering information and e-commerce services well before Internet-based options became available [7, p. 29]. The government continues its efforts to expand access to broadband by including it in universal service programs and promoting the deployment of next generation networks.

Growth in the broadband market promoted competition rules on the basis of objects that contributed to the local loop unbundling (LLU). Initial efforts to the mandate of the division, met with resistance from the incumbent France Telecom, but accelerated after heavy regulatory measures for the separation. Since 2003, it accelerated the division led to a rapid expansion in the provision of broadband services and subscriptions. The government began to encourage municipalities and dominant providers to open the passive infrastructure such as ducts and conduits to competitors, providing a low-cost deployment of new fiber-optic networks. Although the prices of channels, as stipulated in the regulations of ARCEP are quite low, France Telecom stated that they did not have any maps showing their location and it caused a bottleneck of competitive entry into the market.

The French government expected that market forces would take the lead in the development of broadband. After it became clear that this approach was not enough, the government had given local authorities a greater role in the development of broadband infrastructure. The Caisse des Dépôts et Consignations (CDC, a government-owned bank) provided concessional loans to municipalities for broadband development. Though municipalities could establish broadband infrastructure, they could not provide services until 2003—and even then only if there were no other available providers [7, p. 29]

Digital France 2012 plan offered broad and affordable access to broadband. The plan consisted of three main components: providing universal access to the Internet, completing the transformation of digital television, and bridging the digital divide. The government estimated that up to 2 million French citizens cannot participate in the information society because of lack of access to affordable broadband. The government has set itself the goal of providing access to 100 percent of the population by 2012 to achieve this goal, the Government will increase the network by setting the monthly cost to access a maximum of 35 euros, at least 512 kbit / s connection speed. The French government had also announced a new plan (―Grand Emprunt‖) worth some EUR 4.5 billion (US$6 billion) through a loan program for high-tech companies, with some of that going to new broadband [7, p. 29]

Wireless Broadband market in France offers a competitive alternative to fixed services through readily available 3G access in most parts of the country. There are currently 8 million customers 3G. The government encouraged greater competition in the service sector with the award of the fourth 3G license in late 2009, the telecommunications equipment maker Ericsson, testing the next generation of wireless technology, LTE, at the end of 2008.

2.4.2.3 Japan

Japan‘s broadband market has benefited from consistent, effective government stewardship. Japanese residents enjoy the world‘s fastest broadband services at some of the lowest rates [12] . This is partly because of the strategy of the country to support wide distribution of fiber-optic cable, including the replacement of a copper-based digital subscriber line and compulsory sharing fiber lines. In June 2009, fixed broadband penetration rate was 24%, while the market penetration of 3G services was 76% [7, p. 30]. Japan leads the world in fiber optic subscriptions, with more than half the market served by fiber optic networks. Surprisingly, despite having some of the world‘s fastest speeds and lowest prices for broadband, its penetration rate is still below the OECD average [7, p. 30]. Japan had a population

of about 128 million people in 2008, with 66% in urban areas. In 2008 GDP per capita was $38,443 [7, p. 30]

Japan has regularly improved its ICT strategy. The Government has developed a strategy for ICT in tandem with liberalization and privatization initiatives that changed the industry and to promote a competitive alternative to the current carrier NTT [13]. In the span of six years since the start of the decade, the Japanese government has generated six significant strategic documents addressing ICT development. The focus on ICT is supported by the presence of a large domestic high-technology industry that includes firms such as Canon, Mitsubishi, Nintendo, Panasonic, Sony and Toshiba.

The country's leadership was committed to developing advanced ICT. In 2000 the government set a national goal of creating a society based on highly advanced telecommunications networks, [reducing] gaps in opportunities to access information and communications technology, and the ability to use such technology [14] The government has also considered broadband development in the larger context of promoting digital literacy [7, p. 30]

To achieve its goal of ubiquitous access to ICT, the Japanese government had established policies designed to facilitate complete national access to high-speed Internet services by 2010 [7, p. 30]. The Government had developed regulatory policy to encourage competition and cooperation, additional spectrum for wireless broadband services, and subsidies for terrestrial and satellite broadband backbone networks, with an emphasis on reaching unserved rural areas. Japan was likely to reach almost ubiquitous broadband access by 2010, thanks to the structure of competition on the basis of objects and with the participation of the government. [15]

Competition was supported by low-cost access to incumbent carrier facilities. In recent years, the Japanese government had significantly deregulated prices and tariff regulation, where the competition was based on existing facilities, while

maintaining exchange line and the requirements of accession, separation facilities at rates that are favorable for the market, as well as the establishment of dispute settlement procedures. Japan also continued to fund the universal service program that subsidized basic services and supports fiber-optic deployment of municipal governments. Recording cable television networks in the broadband market had also helped to stimulate the initial growth of broadband.

Finally, Japan was a leader in wireless broadband. It demonstrated emerging good practice in its wireless broadband network services marketplace in such key features as bit rate, price, and features. In February 2009 there were 107 million mobile subscribers in Japan, resulting in a penetration rate of 83% [16]. Some 92 million mobile handset users have Internet access, a 72% penetration rate. Critical operating and market participants did not carry any debt auction spectrum in the protection of a license to provide wireless service. This allowed the maximization of investment in infrastructure. However, the beauty contest method of allocating spectrum has had the negative effect of limiting market entry, especially from foreign investors, and this may have limited innovation in the marketplace. The Japanese government now aims to bolster broadband capacity, performance, and competition by licensing new Broadband Wireless Access (BWA) systems in the 2.545–2.625 GHz band. KDDI will provide WiMAX and Willcom Next Generation Personal Handiphone Service, offering download speeds of 20–30 Mbit/s and upload speeds of 10 Mbit/s [7, p. 30]

2.4.2.4 United States

Although in many ways the United States has one of the world's most sophisticated telecommunications markets, it has been lagging behind in broadband growth. Accordingly, the government begun developing its first national broadband strategy. This marked a significant shift in the country's approach to broadband from a *laissez faire* strategy to a more state-directed and public-private partnership approach. Existing competition in the market and a large user base create significant opportunities for expansion. In June 2009 fixed broadband penetration

was 28% and the market penetration of 3G services was 34%. The United States has a population of 304 million people, with 82% in urban areas. In 2008 GDP per capita was $46,716 [7, p. 33]

Unlike its early, active and effective incubation Internet through subsidies and incentives, the US government did not address many activities for broadband used by other nations before 2009. Lack of participation and public underwriting contrasts with that in the United States had long shown an expensive and comprehensive funding mechanism universal service to facilitate access to affordable narrowband Internet [7, p. 33] . In 2009 public fiscal support for broadband totaled $7.2 billion and was part of the economic stimulus package developed in response to the recent economic crisis.

The United States has two major advantages for broadband development: extensive R&D for ICT and competition between DSL and cable networks, both of which have extensive coverage. They have similar market shares. Cable modem service accounts for 29% of high-speed lines, DSL for 23%, and fiber optic lines reaching end users for 2%. The other 46% use other technologies, including satellites, terrestrial fixed or mobile, and broadband over power lines. Lines connecting homes and businesses to the Internet at transmission speeds exceeding 200 kbit/s in both directions increased from 80.3 million to 88.4 million in the first half of 2008 [17]

The presence of major telecommunications and IT manufacturers and service providers in the United States supports the growth of advanced ICT. Recently major commitments have been made to broadband networks. For example, one major service provider has committed $25 billion to rolling out fiber optic services to homes and wireless broadband networks [7, p. 33] . Service-based competition was attempted in the 1990s with a move toward regulated unbundling of networks. But much of that has been reversed, and only a few segments of the wholesale market continue to have regulated unbundling.

The lack of government leadership was one reason the United States lags in broadband. Broadband development in the country has not achieved global leadership in terms of accessibility, affordability, and other evaluative criteria. Many factors had contributed to the comparatively poor performance, including low computer ownership, low population density (which leads to long local loops which, in turn leads to low DSL speeds), high service costs and limited competition in some locales, and the government's failure to implement a coherent national broadband strategy.

There have long been calls for the government to play a more active role in promoting broadband [7, p. 33]. But the country stuck with a deregulated approach, assuming that the market would build enough capacity to meet the demand [18]. This model did not lead to the expected results because it failed to link the short-term profitability of service providers with the long-term macroeconomic benefits of widespread access to high-speed, low-cost broadband. The 2008 change in administrations, concerns about deteriorating global competitiveness, and the recession of the late 2000s led to rethinking of this strategy. The economic stimulus plan, which marks a change in the role of the public sector, provides the staging ground for a revised broadband strategy.

The strategy being prepared aims to facilitate and expedite the development and use of high-speed broadband infrastructure. The regulator, the Federal Communications Commission (FCC) is developing the strategy with attention to a range of issues. These include identifying the most effective and efficient ways to ensure broadband access for all Americans, finding ways to achieve affordability and maximize use of broadband infrastructure and services, evaluating of the status of broadband deployment (including related grant programs), and using broadband to create jobs and advance economic growth. The FCC has recognized that the $7.2 billion allocated for broadband development would not achieve all the goals for broadband deployment [7, p. 33] . Accordingly, it must develop a plan that aims for ubiquitous broadband access, with benchmarking to measure progress toward that goal.

2.4.3 Outcomes of the case study: A cross-country comparison

After the country analysis researchers further carried out a cross-country comparison of selected performance indicators to evaluate the success of the various strategies that countries profiled in this report followed. They have used penetration of broadband subscribers per 100 inhabitants as criteria. From this analysis it is revealed that, Republic of Korea has a high penetration of both wireless and wireline broadband services. In addition to having the highest overall subscriber rate, Korea also has the highest penetration of fiber or metro Ethernet subscribers in the user base. This is one reason why it also has some of the fastest speeds and lowest unit prices (Table 5). At the other extreme, US consumers have the lowest speeds and pay next to the highest unit prices among the case study countries

Table 5: Average prices and speeds in case study countries

Country	Average broadband monthly price per advertised Mbit/s, USD, PPP	Average advertised broadband download speed, kbit/s
United States	$10.02	9,641
Finland	$9.63	19,226
Japan	$4.79	92,846
France	$3.30	51,000
Korea	$0.85	80,800

Source: Y. Kim, T. Kelly and S. Raja, "Building broadband: Strategies and policies for the developing world," World Bank, 2010

2.4.4 Outcomes of the case study: Common elements

The surveyed countries have followed a range of approaches, drawing on their political, economic, social, and industrial endowments. The role played by the public sectors in these countries ranges from active with significant intervention to passive with private stakeholders driving the broadband agenda. In the middle is a hybrid approach involving public and private stakeholders working together.

Although, United States has mostly taken a passive approach they have started moving towards the hybrid approach. On the other hand, France, Japan, Korea, and Sweden have given the public sector a more active role in the broadband agenda, through a public/private partnership.

Many factors are involved in the development of broadband, and no two countries to follow the same path. However, in broadband, there are some success stories which show that these countries have developed a common broadband access ecosystem components.

Broadband strategies are a common feature among the surveyed countries. More important, all the surveyed countries have implemented policies to encourage competition and introduce wireless broadband service through responsive spectrum policy. Most of them have used public financing to support network rollout or facilitate demand for broadband.

Thus it is possible to split the overall approach into two components: broadband strategies, which lay out broad goals, vision statements, and frameworks and programs to achieve them; and policies and regulations, which follow the strategic framework while implementing the program as the market evolves.

The survey finds that strategies and policies evolve through three stages. At first, they focus on promoting incipient markets through a range of supply- and demand-side policies. These policies reduce entry barriers, support large infrastructure

projects, and help reduce the costs of broadband subscriptions for users. In the second stage, the government steps back and allow competition and market forces drive growth. In this stage, the government exercises oversight through competition policy. Finally, as markets move toward maturity, the focus shifts to universalizing broadband to include under-served or un-served populations and communities.

2.4.5 Nigeria's national broadband plan

2.4.5.1 Vision of Nigeria broadband

Presidential committee submitted a white paper on Nigeria's national broadband plan (2012) [19]. According to the white paper, first thing the Nigerian government has done was articulating a vision for broadband with respect to Nigeria begins with the overarching context of an existing National vision, Vision20:2020.

"By 2020, Nigeria will have a large, strong, diversified, sustainable and competitive economy that effectively harnesses the talents and energies of its people and responsibly exploits its natural endowments to guarantee a high standard of living and quality of life to its citizens" [19, p. 9]

According to the paper, key objectives of the Nigerian National Broadband Plan are to promote pervasive broadband deployment; increase broadband adoption and usage; and ensure availability of broadband services at affordable prices. These are aimed at maximizing the socio-political and economic benefits of broadband to the people.

So the intentions of the government to fulfil of these objectives are to [19, p. 21]

- Capitals and urban cities have metro fiber infrastructure installed.
- Certain estates and business districts within major cities shall have fiber to the home

- Facilitate full rollout by operating companies of 3G networks with the potential for immediate transition to 4G/LTE as spectrum becomes available.

2.4.5.2 Nigerian broadband target

The other important thing in Nigerian case is that they have set national targets for cities (Table 6) and communities (Table 7) [19, p. 57]

Table 6: Broadband Targets for Cities

Target Type	Medium	Current (2013)	Short Term Targets (2015)	Medium Term Targets (2018)	Long Term Targets (2020)
Availability (Coverage)	Wired	1.5%	10.0%	16.0%	25.0%
Penetration (Usage)	Wired	0.5%	3.3%	5.3%	8.3%

Source: Presidential Committee for Broadband, "Nigeria's National Broadband Plan 2013 - 2018," 2012

Table 7: Broadband Target for Communities

Target Type	Medium	Current (2013)	Short Term Targets (2015)	Medium Term Targets (2018)	Long Term Targets (2020)
Community Public Access Venues	Wired or Wireless Hotspots	15.0%	25.0%	65.0%	100.0%

Source: Presidential Committee for Broadband, "Nigeria's National Broadband Plan 2013 - 2018," 2012

2.4.5.3 Roles for government and stakeholders

Writers have properly identified each other's responsibilities and roles in the process of strategy implementation. According to the writer, the government has a critical role to play in the drive to have pervasive broadband infrastructure across the nation. Government no doubt has interest in converting the nation into a digital haven that will be fully networked and ready to be integrated into the new world order of digitally enabled citizens in an environment of e-governance, e-health, e-commerce and e-agriculture among others.

The Federal Government's primary role is focused on Policy formulation and direction as well as legal and regulatory functions. Government is therefore focused on providing overall policy, legal and regulatory platform for attracting the required investment for the sustainable development of the sector to support national development goals and plans

As the Federal Government does its part, states and local governments must also do their part in ensuring their citizens have access to the necessary infrastructure vital for connecting to the information superhighway of the digital age. There have been reports about some areas of the country where government agencies at State and Local government levels create bottlenecks in the deployment of ICT facilities by operators, either by imposing taxes arbitrarily, or obstructing, delaying, or denying right of way applications. There are on-going efforts to ensure that these incidences are minimized

.

The Local Government is a focal point for community development and it is recommended that Local Governments can facilitate broadband growth and adoption by working with communities to reduce disruption to infrastructure build and operations and creating innovative schemes to encourage adoption and usage of the internet to enhance development.

2.4.5.4 Set of strategies for Nigerian broadband

Then the Nigerian government develop a strategy that supports the objectives and targets of this National Broadband plan is anchored on the pervasive rolling out of wireless broadband networks nationwide based on 3G and 4G access technologies as the paramount objective. List of strategies that have been implemented can be summarized as follows [19, pp. 58-65]

- Define Served, Under-served and Unserved Areas
- Develop Clear Policy, Regulation, and Roles for the Government
- Ensure Resilient Submarine Cables
- Promote Enabling National Infrastructure
- Provide Required Investment
- Critical National Infrastructure & Cyber Security
- Optimise Spectrum Utilisation
- Employ an Open Access Model for Network Infrastructure
- Provide Transparent Costs & Capped Pricing
- Develop a National Fibre & Wireless Broadband Coverage Map
- Drive Demand through Digital Advocacy, Literacy and Inclusion

Further this case study explores how Nigerian government formulates a roadmap for broadband. It is the intention of government that the national broadband roadmap addresses not only the broadband challenges of today, but is flexible enough to evolve over time in line with emerging realities in technologies and the market.
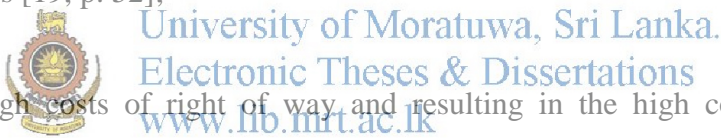
This national broadband roadmap recognizes short-term (2013), mid-term (2015) and long-term (2018) performance milestones and emphasizes quick wins in terms of broadband infrastructure deployment, service pricing, as well as adoption and utilization, particularly in schools and tertiary institutions of learning.

The implementation of a National Broadband plan requires long-term commitment and significant action by Federal, States and Local Governments, as well as, the Executive and legislative branches of government – alongside strong private sector participation.

Driving the implementation of a national broadband plan and measuring its impact over time is a critical challenge. Many countries have depended on long-term and high-level coordination and collaboration efforts across government agencies to implement their broadband plans. Until now, the responsibility for implementing broadband policy in Nigeria has been circulated across many federal agencies. However, successful implementation of this plan will require the need for coordination among all the actors.

2.4.5.5 The Challenges of broadband operators

The writer has identified the challenges faces by operators which can be highlighted as follows [19, p. 52];

- High costs of right of way and resulting in the high cost of lease and transmission

- Long delays in obtaining permits

- Backhaul capacity constraints

- Multiple and illegal regulation and taxation at Federal, State, and Local Government levels

- Damage to fiber infrastructure during road works

- Lack of reliable, clean public electricity supply

- Lack of major green energy initiatives and support

2.4.5.6 Outcome and summarization of the case study

Nigerian plan for broadband can be summarized as follows;

- Establish policies that regard ICT networks and installations as critical national infrastructure that qualify for special government protection.
- Promote transparency of pricing and reduction of build-out costs by encouraging an increased level of infrastructure sharing and interconnections and introducing price caps where necessary or when market forces fail.
- Take necessary regulatory measures to ensure better performance levels in the delivery of broadband services.
- Facilitate rapid rollout of wireless and wire-line infrastructure and provide incentives to encourage a national 3G wireless coverage to at least 80% of population by 2018 [19, p. 91]
- Timely release of more spectrums for broadband services.
- Foster attractive investment climate by targeted schemes for stimulating demand and providing targeted concessions, tax incentives, grants or support where needed.
- Raise digital literacy & inclusion by using existing national assets for community access.
- Advocate and demonstrate the benefits of broadband within the levels of government and also among the people.

In order to execute the plan, they have elaborated tactical solutions and strategic solutions which are summarized below [19, p. 92]

Tactical solutions
- Promote Instant Shared Infrastructure amongst existing operators
- Introduce Transparent Cost-Based Price Caps
- Establish a SMART CITY Anchor Project with select and qualifying States
- Secure 4-Year ROW Waiver Agreements

- Mandate pre-installation of ducts when constructing new roads and buildings
- Publicize the ROW Guidelines and Build Standards established with the Ministry of Works
- Produce a GIS-based National Fiber Infrastructure Map
- Classify the NBN as Critical National Infrastructure
- Introduce Low Cost Wireless & Satellite Solutions To Hard To Reach Areas

Strategic solutions
- Initiate LTE-Ready Spectrum Directives including fast-tracked release of spectrum
- Review spectrum pricing to lower the cost of spectrum for broadband rollout
- Establish Centers for Community Access using Public Property like Post Offices, School Computer Labs, and Local Government Headquarters
- Build Awareness Campaigns for Digital Advocacy and emphasizing the need for Digital Literacy and Inclusion
- Help licensees negotiate reduced right of way fees for fiber builds or secure ROW waiver agreements and also simplify the right of way application process.
- Pre-pay for public sector broadband to stimulate demand; for example pay for four years' worth of broadband supply for public sector offices upfront to enhance usage and stimulate patronage of private sector providers.
- Promote cheaper access devices from OEMs.
- Explore opportunities for use of TV White Spaces / unlicensed spectrum to achieve last mile connectivity especially in rural areas.

2.4.6 Broadband for India

A report was published by Mahesh Uppal and Naresh Ajwani [20] in 2012 on broadband status of India providing recommendations to promote and to develop broadband in India. Researchers have used broadband ecosystem model which was

described under Korean case in simple manner in developing strategic initiatives for broadband. According to the report broadband eco-system consists with followings [20, p. 5]

Carriage/Physical infrastructure

Deployment of the physical network. They include:

- Backbone networks
- Access Networks

Content

Gamut of information and other services of user interest that can be delivered using the carriage network. This includes:

- Government controlled or mediated content such as e-Governance, public services, emergency, municipal services, taxation, health etc.
- Private sector created or mediated content e.g. entertainment, e-Commerce

Devices

Various devices such as phones, smart-phones, computers, tablets, smart pod etc. that people can use to access the many applications and services electronically.

Skills

Information and skills needed to identify and use the services of interest. The relevant inputs include:

- Familiarity with devices and services
- Training to use or exploit Internet and related data services.

Researchers have highlighted what improvements need to be made in each perspective in eco-system model [20, pp. 5-12]

Carriage/Physical infrastructure

- Substantial investments are required in the backbone.

- The Government of India's Bharat Broadband project meets a critical need by connecting over 2.5 lakh Panchayat villages by optical fibre

- A framework is necessary for use of Bharat Broadband resources by wireless access providers.

- There is a critical need to ensure that the fibre network works seamlessly with the tower infrastructure.

Content

- National e-GovernancePlan (NeGP) will expand access to government information and services using the broadband network.

- Private Sector mediated content will meet other needs and help commercial viability of broadband networks.

Devices

- NTP-12 (National Telecom policy 2012) [20, p. 2] proposes to Reposition the mobile phone from a mere communication device to an instrument of empowerment.

Skills

- Those without technical literacy need intermediaries for information and skills.

Further the report points out the importance of having an enabling policy and regulatory which can be a catalyst for the broadband development and promotion in India. Further it's quite important have a public/private partnership in order to develop infrastructure. Broadband networks cannot deliver value without active government partnership with private players [20, p. 30]

2.4.7 Thesis publication on broadband model on communities

This research thesis was published by T.M Wijesinghe for his MBA in Information Technology; University of Moratuwa on 2006 [21]. The objective of the research was to develop broadband models and make recommendations on implementing of those models [21, p. 4]. The main focus on the research is to identify correct broadband model for the relevant area of Sri Lanka. At the end of research, researcher has given recommendations for government as well as private sectors. Some important recommendations are highlighted below [21, p. 88];

- Remove policy barriers and establish long term broadband plan.
- Central government should made available required funds to expand broadband services.
- Contents should be developed to fit to the local needs
- Encouraging international players to set up gateways with in Sri Lanka.
- Provincial councils should work with service providers in order to expand broadband services within the respective areas.
- Recommend to use WiMAX technology for the service providers in order to expand their broadband networks.

3 METHODOLOGY

3.1 Strategic Management Process: Model That Can Be Used to Formulate Strategies

In order to identify national broadband strategies, it is quite important to have some clear understanding of strategic management process which is commonly used management theory [22]
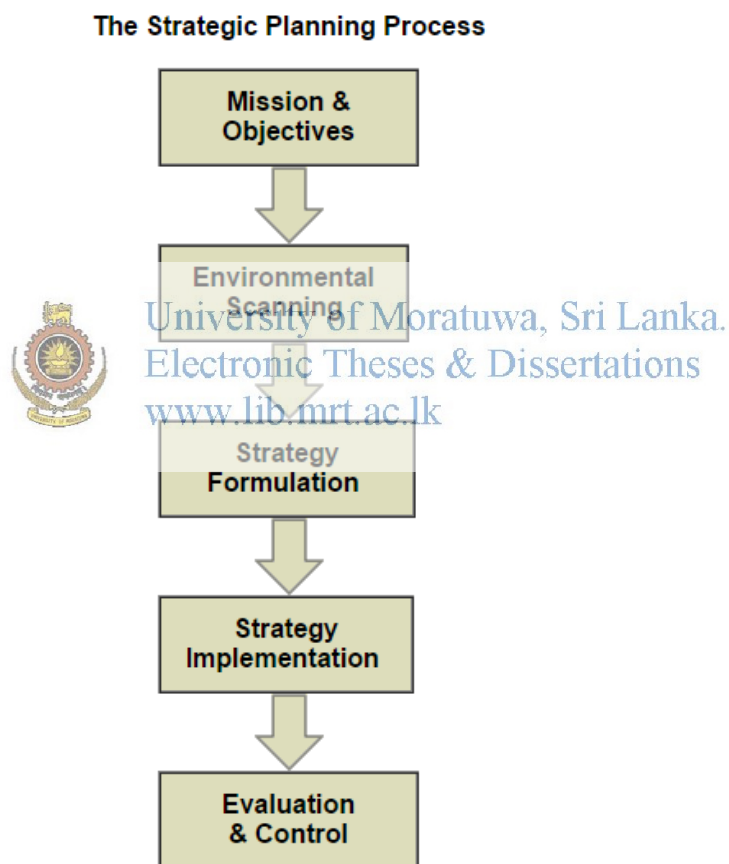

Figure 5: Strategic Planning Process

Source: http://www.quickmba.com/strategy/strategic-planning/

3.1.1 Mission and objectives

First, define both short- and long-term objectives. Second, identify the process of how to accomplish objective. Typically, the final step in this stage is to write a mission statement that succinctly communicates goals

3.1.2 Environmental scanning

Analysis is a key stage because the information gained in this stage will shape the next two stages. In this stage, gather as much information and data relevant to accomplishing vision. The focus of the analysis should be on understanding the needs of the business as a sustainable entity, its strategic direction and identifying initiatives that will help business grow. Examine any external or internal issues that can affect goals and objectives. Make sure to identify both the strengths and weaknesses of organization as well as any threats and opportunities that may arise along the path

3.1.3 Strategy formulation

The first step in forming a strategy is to review the information gleaned from completing the analysis. Determine what resources the business currently has that can help reach the defined goals and objectives. Identify any areas of which the business must seek external resources. The issues facing the company should be prioritized by their importance to success. Once prioritized, begin formulating the strategy. Because business and economic situations are fluid, it is critical in this stage to develop alternative approaches that target each step of the plan.

3.1.4 Strategy implementation

Successful strategy implementation is critical to the success of the business venture. This is the action stage of the strategic management process. If the overall strategy does not work with the business' current structure, a new structure should be installed at the beginning of this stage. Everyone within the organization must be made clear of their responsibilities and duties, and how that fits in with the overall goal. Additionally, any resources or funding for the venture must be secured at this point. Once the funding is in place and the employees are ready, execute the plan.

3.1.5 Evaluation and control

Strategy evaluation and control actions include performance measurements, consistent review of internal and external issues and making corrective actions when necessary. Any successful evaluation of the strategy begins with defining the parameters to be measured. These parameters should mirror the goals set in Stage 1. Determine progress by measuring the actual results versus the plan. Monitoring internal and external issues will also enable you to react to any substantial change in business environment. If you determine that the strategy is not moving the company toward its goal, take corrective actions. If those actions are not successful, then repeat the strategic management process. Because internal and external issues are constantly evolving, any data gained in this stage should be retained to help with any future strategies.

3.2 Target Population

The major method of qualitative data collection in this study was collected from the industry and also from government bodies such as TRCSL and ICTA. The perspective on broadband strategies of the industry and government bodies was

taken into consideration when collecting data. Since, it's quite important to collect data from the above mentioned perspectives to identify sets of most suitable strategies and polices for broadband development, several personnel representing government bodies namely ICTA and TRCSL and personnel from industry were chosen.

Initially, a face to face interview was conducted with ICTA and TRCSL personnel in order to collect data. The selected ICTA personnel was project engineer – ICTA by designation working under ICT based projects that have been carried out by the ICTA. The particular respondent has a sound knowledge in Engineering and project management. His major task was to oversee and manage the assigned tasks of the project. But, the selected subject hasn't been exposed to an adequate technical environment since most of the project implementation had been outsourced by the ICTA.

Then a face to face interview was conducted with the consultant in TRCSL for broadband. Meeting TRCSL personnel is quite important since TRCSL plays a critical role for the broadband development in Sri Lanka. The interviewed TRCSL personnel is responsible in formulating national broadband policy for Sri Lanka. Further he is responsible in QoS monitoring and benchmarking process of the broadband services offered by fixed and mobile telecom operators.

Then a well-structured questionnaire to be administered among industry related personnel. Then a set of engineers were selected representing different telecommunication companies in order to get responses to the questionnaire. The sample was selected according to the convenience sampling method where the sample is made of people who can be reached easily [23]. Since the environment of the telecommunication companies is more complex than government ICT bodies, the questionnaire related to broadband strategies was sent via email. Following are the telecommunication organizations which were taken into consideration when distributing the questionnaire.

- Sri Lanka Telecom PLC
- Dialog Axiata Group
- Mobitel Pvt Ltd
- Etisalat Private Ltd

3.3 Test Instrument

Interviewing and questionnaire were the two test instruments utilized in this study. The first test instrument, preparing a set of questionnaire was a challenging task, because it was required to collect data from the personnel of the industry where the researcher could identify different novel perspectives on broadband strategies. The set of questions were designed in order to capture the existing broadband environment. The second test instrument was a well-structured interview. Since the topic is based on national broadband strategies, questions which were asked during the interview should be capable enough to collect data on existing strategies of the government and industry for the development of broadband of Sri Lanka. Famous strategic management process model was used as a basis for preparing questions for personalities attached to the government bodies and for the company personnel belonging to the telecommunication industry.

The Objectives of the questionnaire and interview are as follows;

Questionnaire for industry personnel:
- To collect data on existing broadband strategies of broadband operators
- To collect data for environmental scanning in order to identify issues which operators face in implementing above strategies

Interview with TRCSL Broadband consultant [24]

- To collect data on existing strategies taken by TRCSL

Interview with ICTA project Engineer [25]

- To collect data on existing strategies taken by ICTA\

The five processes of strategic management model which is mentioned in Section 3.1, namely Mission and objectives, environmental scanning, strategy formulation, strategy implementation and evaluation and control were taken into consideration when designing the questionnaire.

3.4   Data Collection

A face to face interview was conducted with the TRCSL/ICTA personnel to collect data. Important comments made by them were noted and this was a friendly discussion which led to generate quite useful and resourceful data. Questionnaire for the industry was distributed among selected set of engineers via emails. Samples of responses which were received are attached in appendix 3.

4 ANALYSIS OF DATA AND RESULTS

4.1 Data Analysis

4.1.1 Analysis of interviewed data

During the interviews conducted with government body personnel, the initiatives that have been taken by the government in order to boost ICT to fuel the local industry were revealed. According to the views of the interviewed government personnel, E-Government initiatives already in the pipeline, coupled with the growing take-up of general Internet usage, are expected to generate substantial demand for ICT infrastructure and connectivity [25]. Another major objective of the Government is to elevate Sri Lanka to the level of a knowledge hub in the Asian region, the foundation of which is ICT and broadband connectivity [24]

During the discussion with government body personnel, it was identified, Sri Lanka has been able to record a positive growth in key areas of ICT over recent years. During this period, the country's IT literacy rate has grown steadily, stimulating the development of ICT. This upward trend in ICT development in Sri Lanka is a clear indicator affirming the success of the plans and strategies adopted by the Government of Sri Lanka on its way to make Sri Lanka a digital wonder of Asia. [24]

During the discussion it was also mentioned about NGN, which is a reliable social infrastructure to deliver broadband applications. The development of NGNs and the regulatory and policy frameworks that enable their deployment are inextricably linked to a country's national broadband policy. Taking these factors in to consideration the TRCSL developed a NGN Policy and Regulatory framework and then a policy on broadband. [24]

During the interview [24], following set of initiatives were revealed in order to promote and develop broadband;

- Encourage investments directly in broadband deployment.
- Provide guidance and encourage operators to deploy fiber networks right up to the customer premises using alternative and cost effective methods. The TRCSL is expecting Sri Lanka's first Fiber to the Home (FTTH).
- To encourage stakeholders to deploy high-speed broadband services in underserved areas where Returns on Investment (ROI) would be low.
- Promote broadband in schools and other educational institutions while encouraging distance learning program development.
- Reduced price of data
- Data speed benchmarking process

TRCSL is now ready to focus on policies, standardization and broadband deployment plans to boost broadband penetration in Sri Lanka. TRCSL mainly focus on especially in underserved areas. [24]

TRCSL began monitoring broadband QoS in late 2010. Figure 6 and Figure 7 show the QoS measurements carried out by the TRCSL broadband unit in August 2010 and August 2011 respectively [26]. Due to the benchmarking process, gradual but momentous QoS improvement was recorded in fixed broadband operations soon after the TRCSL's broadband benchmarking process. Operators started to compete for higher speeds and have taken all efforts to be at the top of the graphs published by the regulator regularly over its website. Sri Lankan subscribers have been able to enjoy high-speed broadband as a result of this action.
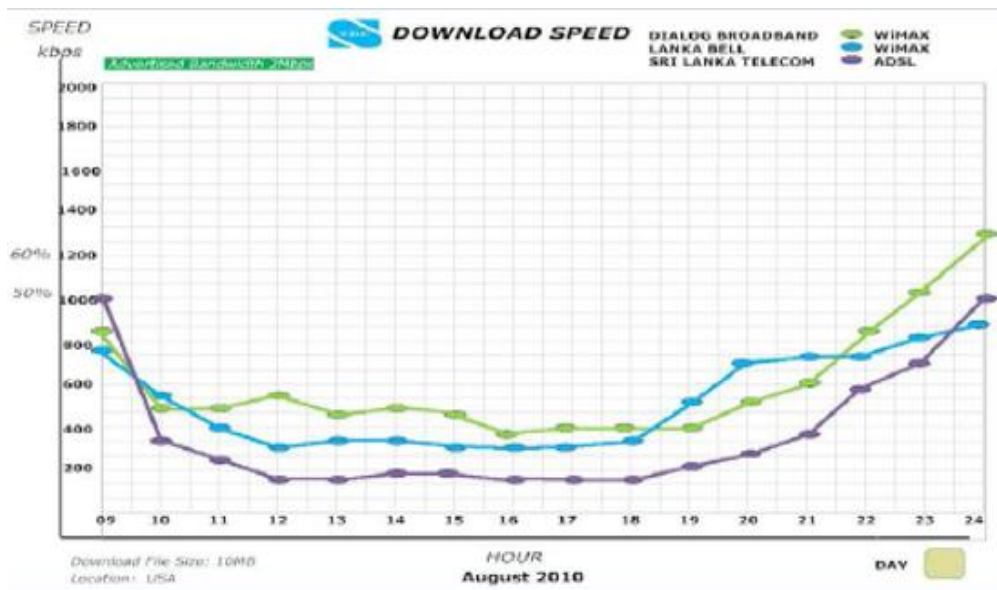
Figure 6: Speed Test results on August 2010 for Fixed Broadband

Source: http://www.trc.gov.lk/old_site/broadband/broadband
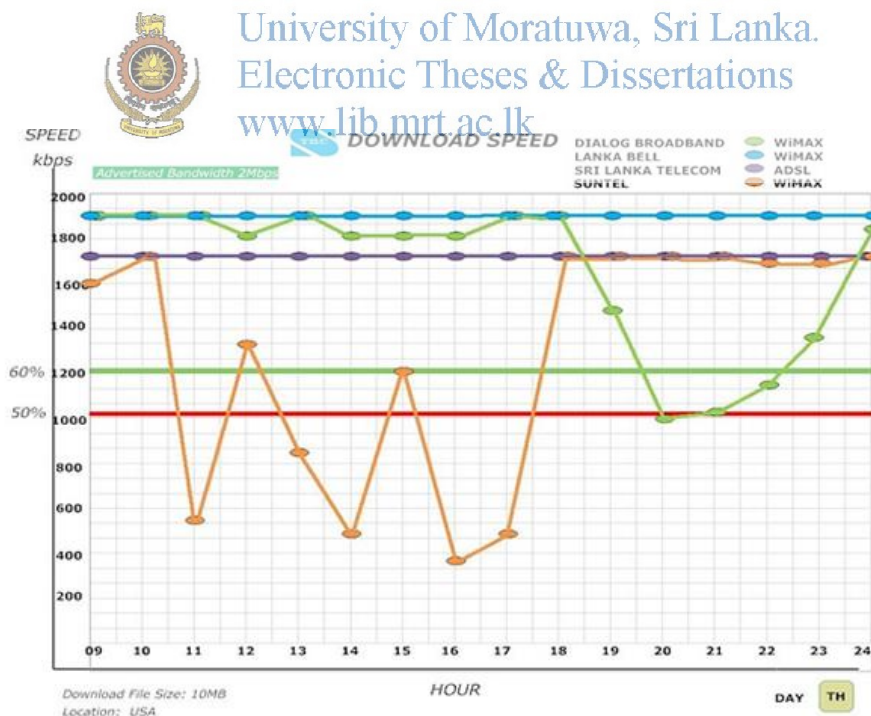
initiative.html

Figure 7: Speed Test results on August 2011 for Fixed Broadband

Source: http://www.trc.gov.lk/old_site/broadband/broadband

initiative.html

45

The TRCSL has introduced a smart mechanism to the broadband market segment by creating competition among operators. Introducing competition has not only reduced the price per GB, but also increased the bandwidth of fixed broadband services successfully to a capacity exceeding 15 Mbps in the downlink. Subsequently, the entry level price has fallen approximately to rupees 1500 per month for speeds of up to 8Mbps. However, packages with greater data volume capacities cost more compared to other countries in the region. The TRCSL anticipates a price drop in packages with greater volume capacities, as the market matures.

During the interviews with ICTA personnel [25], strategies initiatives which have been taken by ICTA was identified

- The Nenasala Project 21 is one of the projects implemented under the above Initiative by ICTA. The project aims to provide infrastructure to address the ICT needs of rural areas through the establishment of tele-centers for the provision of ICT-based services in all parts of the country. There are 676 Nenasala Centers spread throughout the country.

- The creation of an enabling environment through legislation and regulatory reform for e-government and e-commerce.

- The objective of the Lanka Government Network (LGN) is to provide the necessary infrastructure to connect government organizations and local bodies.

- The objective of the Lanka Gate is the provision of online information and services relating to Sri Lanka. This will result in ease of access of information and services and reduced transaction costs for citizens.

- The development of human resources at different levels to support national development.

- Free WiFi initiative which was started with the intention of providing universal broadband access to public. This was done with the collaboration

of Telecom operators. Customer can get a username and password to connect WiFi hotspot by registering with operator.

- Signing agreements with Google for the Google Loon project. Objective of this project is to provide broadband access to underserved area. Pilot project has been carried out by google in mountainous area in New-Zeland

4.1.2 Analysis based on the opinion obtained by the questionnaire

Answers which were given by telecommunication company personnel were also analysed. 34 number of responses were received for the questionnaire. The major objective of the questionnaire given to the company personnel was to collect data for environmental scanning which is one of the major task of strategic planning model. Since most of those questions were open ended questions it was bit difficult and complicated when it comes to analysing data.

It was revealed that Mobitel has covered around 70% of the country with broadband services. Etisalat has started its broadband service recently and still covers around 1/3 of the island. Respondents from other telecommunication organization were unable to provide clear cut answers on broadband service coverage. They suggested to refer coverage map which were included on web site. Coverage maps of surveyed telecom operators were attached in the appendix 4. According to those coverage maps, it was clearly evident Dialog has got the highest mobile broadband coverage and then Mobitel and Etisalat have secured the second and the third place accordingly. Apart from that, Sri Lanka Telecom is the fixed broadband service provider and their technology is based on ADSL. It can be clearly seen that ADSL service has developed in leaps and bounds especially in urban areas.

In terms of broadband coverage expansion initiatives, respondents of all the telecommunication companies mentioned about completed and ongoing coverage expansion projects. Dialog and Mobitel launched LTE technology based broadband services in 2013. Their major objective is to expand LTE coverage in order to

provide ultra-speed broadband services to their customers. On the other hand, they are going to cover underserved 3G areas as well. Etisalat Pvt Ltd is in the verge of expanding their 3G network. SLT is the only service provider who offers ADSL based broadband services. Coverage expansion is basically a radio network expansion. Parallel to the radio network improvement and expansion, it is a must to expand ISP bandwidth as well. Respondents have mentioned about ISP bandwidth expansion. This is very much important to achieve a good end to end QoS.

Respondents from Dialog, Mobitel and SLT have mentioned about the WiFi based broadband service which is a government project under the supervision of ICTA. Telco operators work with ICTA collaboratively in order to provide WiFi coverage in public areas such as railway stations, government offices, shopping malls, schools and etc. This project is very much important to achieve universal broadband access for Sri Lanka.

Telecom operators take lots of initiatives to increase the QoS of their service. Coverage expansion may reduce the congestion of sites. On the other hand all the telecom operators have recruited engineers in order to operate and maintain their network. They monitor network KPIs and network alarms and take preventive and corrective actions in order to provide better QoS for their customers.

Telecom operators have application and service based platforms which were developed and maintained by themselves. For example Mobitel has some services such as m-learning, m-cash m-taxi service which are being used with the view of promoting educational, commercial and transportation perspectives. Dialog has also launched an e-commerce application based service namely eazy-cash which is equivalent to Mobitel m-cash. Mobitel has also developed a platform for online gaming.

It is quite important to pay attention on cyber security as well when it comes to building up strategies. Telecom operators have also taken some initiatives to

improve the cyber security. Telecom companies have deployed high end firewalls in order to ensure network security. Only well-known ports and IP addresses are allowed in their network so that other unknown IPs and ports are blocked. Since most of the web services run on HTTPS protocol, there is an additional network security from web server side as well. Operators are also using technologies such as VPN, IPSEC etc in order to achieve end to end security.

Figure8 summarizes broadband initiatives that researcher received from the respondents
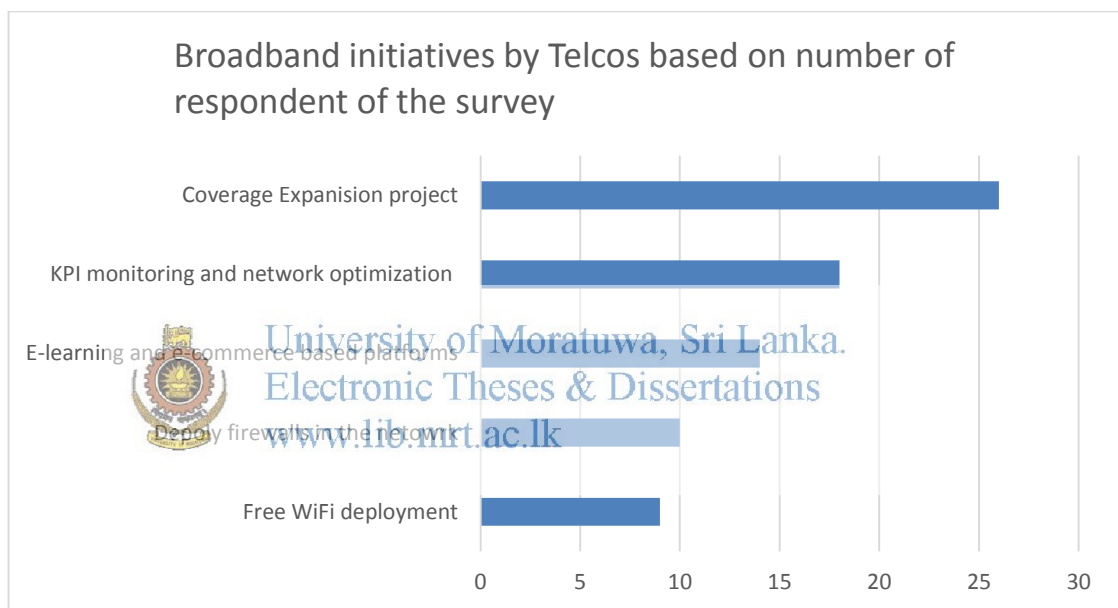
Figure 8: Initiatives which were taken by Telcos vs number of respondents who have mentioned that particular initiative

According to the telecom companies they face difficulties in implementing the above strategies. Broadband coverage expansion for 3G and LTE services requires a lot of capital expenditure. ISP bandwidth expansion requires to pay a large amount of ISP rentals monthly which leads to increase in operational expenditure of the company. Since the broadband technologies are changing rapidly, it is not an easy task for engineers and technical experts to cope up with the technical know-

how. Telecom companies have to invest on training and development of the employees to enhance the technical skills of engineers. Image 9 summarize summarization of issues and challenges in implementing their strategies based on respondents.
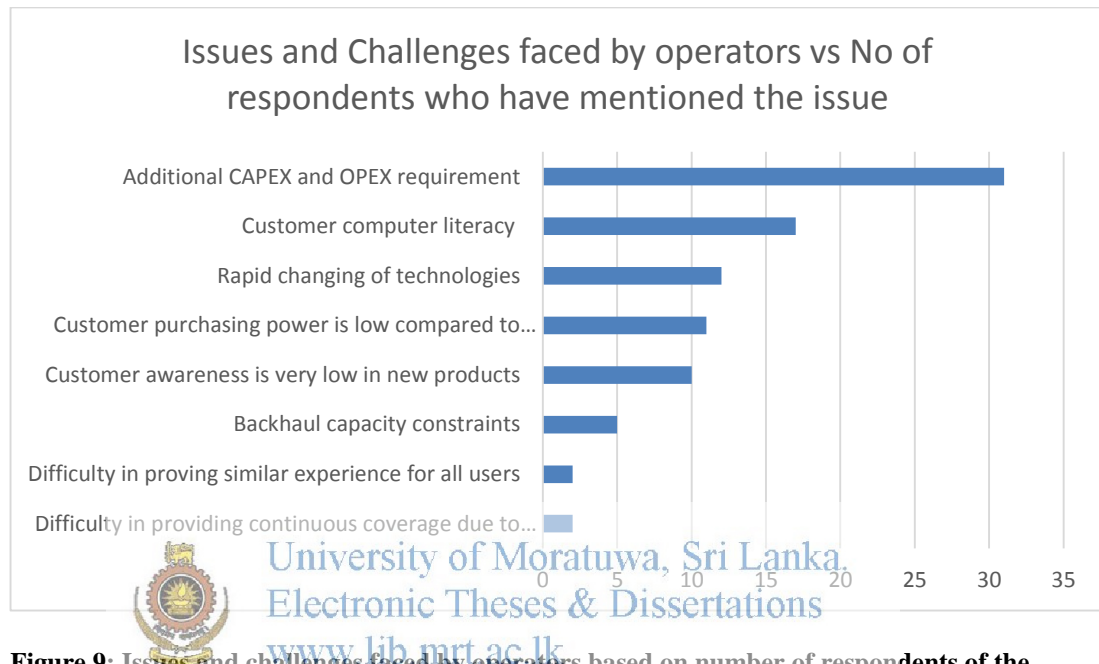
Figure 9: Issues and challenges faced by operators based on number of respondents of the survey

4.2   Critically Analysis of existing Broadband Strategies

It is clearly seen there are no clearly defined mission and vision and set of targets in terms of national broadband. This was evident from the interview [24]. It is also seen there are no clearly defined mission and vision and set of targets in terms of national broadband. TRCSL has developed only a target for fiber infrastructure deployment which is the target speed is 50 Mbps for FTTx [24]. In Nigerian case, we can clearly see how they have defined set of targets and objectives and also mission and vision for broadband (Section 2.4.5.2).

It is a must to have a clear definition for broadband. By defining broadband, setting strategic objectives and target process is much easier. TRCSL has defined broadband as follows [24]

"*Technology neutral high speed data communication service with a broader bandwidth with **not less than 1 Mbps** downlink which enables the operation of wide array of application and services online*"

Further TRCSL has implemented national broadband policy that supports broadband development in Sri Lanka. Strategic initiatives and polices which were discussed in literature survey chapter under Korean case (Section 2.4.1) and Nigerian case (Section 2.4.5.4) is very much similar to the initiatives that have taken by Sri Lankan telecom operators and government bodies. India has also implemented similar policy for telecommunication which is named as NTP-12 [20, p. 2]

It can be identified there are no master plans for broadband development in Sri Lanka. It was mentioned in the Korean case study some master plans namely u-Korea master plan, Cyber Korea and IT839 have been utilized to develop broadband (Appendix 1). It is crystal clear that ICTA has some plans such as smart-Sri Lanka, e-Sri Lanka. But the main focus of these plans is to effectively use ICT in government administration and schools. Therefore these plans are not fully broadband focused master plans. They focus on ICT as a whole.

If a national broadband strategy is implemented by the government, the execution of the plans has to be done via broadband operators in order to achieve objectives and targets. Therefore, government bodies TRCSL/ICTA should direct telecom operators to achieve national broadband objectives. In this context, government role as well as other stake holder's role should be clearly defined. This is very much evident in Nigerian case study (Section 2.4.5.3) as well as Korean case (Section 2.4.1)

It is quite important to identify problems and challenges which are faced by broadband operators when it comes to implementing national broadband plans. In Nigerian case (Section 2.4.5.5), the researcher has clearly mentioned some common sets of challenges faced by Nigerian broadband operators. Some of these challenges are relevant to the Sri Lankan context as well. The issues such as CAPEX and OPEX constraints, backhauling constraints are in both Nigerian and Sri Lankan context. It is clearly evident from the responses obtained from the questionnaire (Section 4.1.2)

Sri Lankan mobile operators still less than 70 % for broadband services. Still there are around 30% of underserved area. Telecom operators mainly contribute towards promoting broadband and developing broadband is by carrying out network expansion projects. Further, new trends can be identified in telecom environment which new platforms are being developed such as easy-cash, m-cash, m-learning which enhance e-commerce and e-education.

When the plan is executed it is very much important to review the result of the plans in order to verify whether the plans are being executed in the correct path. This is a continuous process and should be regularly carried out until the plan is fully executed and implemented. This process is also important to identify the loop holes of the plans and also to do necessary rectification and update the plan for the upcoming years. This control and monitoring of plans is very clearly seen in Korean case study (Section 2.4.1). But in Sri Lankan context, this was not done. This was revealed during the interview which was conducted with TRCSL [24].

When it comes to defining and setting plans, it is very important to have a clear understanding on how broadband can be used to link users services and content. Broadband can be considered as a media which link users with application and services. This is clearly depicted in the eco-System model in Indian case (Section 2.4.6) and in Korean case (Figure 4 : Broadband Eco-System). According to the eco-system model following key factors are can be identified (Section 2.4.6)

- Broadband Infrastructure development
- Provide application and content that can be used to public via the infrastructure
- Devices
- Skills of user

According to thesis publication; Broadband Models for communities by T.M.Wijesinghe [21] it was recommended that government should provide required funds to develop broadband infrastructure (Section 2.4.7). Since Sri Lanka is developing country government cannot accomplish this task alone. Best move is to have a partnership with operators and government which is mentioned in Indian case study (2.4.6)

Free WiFi project is very much important to provide universal broadband access to public. But the registration process is bit difficult since the customer has to go to a Telco branch office. Due to this reason, the service is still not commonly used [25].

The successful implementation of the projects by the ICTA such as Government Information Centre (GIC), the Lanka Government Network (LGN), the Lanka Gate, the Lanka Government Cloud(LGC) and the e-Population Register amongst others have developed the ICT sector while creating the need for broadband services. But on the other hand it is quite important take some initiatives to improve computer literacy among communities. Low computer literacy rate is also evident from the statistics in 2014 [4]. In order to effectively use applications and services, it is a must of having a better IT literacy. Indian case study also highlighted this as "skills" in the eco-system model (page 39). In Sri Lanka context Nenasala can be considered to be one such project.

4.3 Research Findings

Research findings (RF) can be summarized and listed as below;

1. No clear set of broadband targets and objectives in Sri Lanka context
2. TRCSL has a definition for broadband
3. Lack of master plans to promote and develop broadband
4. National broadband policy which is drafted by TRCSL is very much important to implement strategies and initiatives that drive broadband development
5. Understanding the eco-system model is very much important in formulating plans and polices
    - Infrastructure
    - Content and application
    - Devices
    - Skills
6. It is required to identify problems and challenges faced by operators and issues and challenges can be summarized as follows;

    6.1 Additional CAPEX and OPEX requirement

    6.2 Rapid changing of technologies

    6.3 Difficulty in providing continuous coverage due to terrains and buildings

    6.4 Difficulty in proving similar experience for all users

    6.5 Customer awareness is very low in new products

    6.6 Customer purchasing power is low compared to developed countries

    6.7 Backhaul capacity constraints

    6.8 Customer computer literacy

7. Public and private partnership approach is the viable method for expanding broadband infrastructure in Sri Lanka
8. Still Sri Lanka has a broadband coverage of less than 70%
9. Initiatives should be taken to improve IT literacy in Sri Lanka

10. Free-WiFi initiative is very important to achieve universal access broadband. But the registration process is much difficult for customers

5 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Research findings which are mentioned in section 4.3 are very much important in providing recommendations. It was found that only some areas are being covered by national broadband policy. It was found that there are separate set of plans and polices which were initiated by government bodies and telecom operators in order to develop broadband services. Broadband initiatives taken by government and telecommunication companies are not properly aligned. Thus it is quite important to have national broadband strategies to link government broadband plans and telecom operator broadband plans. Broadband operators face various kind of issues when implementing strategies for broadband development and promotions. National broadband strategies should be able to provide solutions to those issues faced by broadband operators. Therefore set of recommendation will be made in order to overcome the issues and

Therefore National broadband strategies should be formulated by government bodies. Mainly TRCSL has the major responsibility for this task. Moreover, broadband operators can use these strategies to overcome issues they face in developing and promoting broadband.

5.2 Recommendations

Recommendations can be made in order to address issues which were highlighted in the research finding (RF) section (Section 4.3)

Set targets and goals for broadband (RF 1)

Firstly, the broadband vision and mission statement should be defined. Then the broadband objectives targets or goals should be properly set. The broadband goals and targets are clearly evident from the Nigerian case study (Section 2.4.5.2).

Definition for broadband (RF 2)

It is very much important to have a proper definition for the broadband. All the strategy formulation and plan execution won't be successful without having a clear idea about what broadband. According to the TRCL policy, broadband is defined as mentioned in section **Error! Reference source not found.**

According to the ITU [27] broadband is defined as "*transmission capacity that is faster than primary rate ISDN, at 1.5 or 2.0 Mbit/s*". ITU has considered developed countries as well as developing countries when defining a common affordable speed. So, it is reasonable to have a broadband speed of 1 Mbps for a developing country like Sri Lanka.

Broadband strategy formulation: Formulate broadband plans (RF 3)

Then the strategy formulation should be implemented. Normally this should be done as a set of plans to achieve broadband related strategic objectives and goals. Master plans for broadband which were described in the Korean case are some examples for comprehensive master plans (Annex 1). Preparing master plans can be done in a way of consultative approach. TRCSL has a plan to provide 100 Mbps high speed internet access to 4000 schools [24]. This is actually a good master plan initiated by TRCSL and now the project is ongoing with collaboration of telecom operators. But this covers only the educational sector when it comes to national broadband.

Assessing the degree of broadband adoption, benchmarking versus relative comparators and identification of critical binding constraints are all necessary in order to develop a relevant courses of action in the national broadband plans.

Broadband and ICT adoption should be measured as well as the various components of infrastructure (international, national and access capacities and prices), market structure (in wireless, wireline and broadband) and technologies utilized, as well as relevant business and regulatory factors.

Broadband policy implementation and broadband initiatives (RF 4)

Once the constraints to broadband market development have been highlighted, the next step is to match possible policy interventions. This includes reviewing 'best practices' as well as various menus of policy interventions that apply to particular bottlenecks and constraints in the market being reviewed. It is also important to have a set of policies which make the implementation of plans much easier. On the other hand, these policy initiatives are very much important to resolve some challenges and issues which are faced by the operators as well as community. Components of eco-system model namely infrastructure, content, users and skills (Section 2.4.6) can be used to setting policies and initiatives. Appendix 2 sets out some policies and initiatives, categorized under four aspects of eco-system model which address some issues mentioned in research finding section

QoS benchmarking initiative (Appendix 2: No 2)

QoS benchmarking initiative was already taken by TRCSL. Speed is the undercurrent which driving broadband forward. Higher bandwidth capacities and support of multifunctional operations have contributed much to the spread of high-speed broadband services around the world. Therefore, speed is a priority for the telecom regulators. Inadequate or degraded broadband services would cause retardation in usage, due to loss of confidence among users about its potential. Therefore QoS benchmarking is purely based on upload and download data speed.

Data Price Reduction (Appendix 2: No 10)

Having an affordable rates for data services is another good factor that may boost broadband usage and ultimately which leads to increase in broadband penetration.

During the discussion with TRCSL broadband expert [24], this was also highlighted as a positive factor to increase broadband penetration in Sri Lanka in last five years.

Provide key public services online and encouraging the development of applications (Annex 2: No 8)

According to the Korean case, another good example for demand side policies is to increase broadband penetration in Sri Lanka to provide key public services online and encouraging the development of applications such as e-learning to promote widespread public use of broadband. This can be directly applied to Sri Lankan context also.

Increase awareness and computer literacy (Appendix 2: No 12 and 13)

Sri Lanka is moving towards this kind of projects via ICTA e-government services. But still, this is not commonly used in the society. Main reason for this issue is low computer literacy rate in Sri Lanka and lack of public awareness. So it is a solid must to take some initiatives to boost the computer literacy rate of the public. New projects such as Nenasala and Vidu-piyasa have to be initiated accordingly.

Increase the number of skilled Sri Lankan manpower in the ICT sector (RF 6.2)

Another important initiative that can be taken from Nigerian case study with regard to Sri Lankan operators is to increase the number of skilled Sri Lankan manpower in the ICT sector (Section 2.4.5.3). A set of skilled and qualified technical experts can easily face the challenge of rapid changing of technology which is mentioned in RF 6.2. Sri Lanka has a sound university education system and a lot of engineering graduates pass out each year. Therefore, this is easily manageable and doable initiative.

Free WiFi Initiative (RF 10)

Registration process for free WiFi service should be made easier. Web based registration portal is recommended for the registration. Users can get enter the

mobile number in the portal and then the system sends to registration password to the mobile via sms. This is commonly used method and adopted by developed countries such as Switzerland [28], Taiwan [29] in public places.

Reviewing and controlling of broadband plans

Review and control plans is another major important factor in broadband strategy development. This is one of the key steps in strategic management model (Section 3.1.5). Even in the Korean case, it was clearly seen that plans were reviewed after some period and assess the outcome of the plans (Section 2.4.1). Then plans were modified and updated for upcoming years. The main objective is to review and control to assess the plans and identify any issues and drawbacks pertaining to the plans and pledge required rectifications to those issues accordingly.

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Appendix 1: Strategies, policies, and regulations used to develop Korea's broadband ecosystem

Segment	Promotion	Oversight	Universalization
Ecosystem definition and strategy	First National Informatization Promotion Plan Cyber Korea 21 u-Korea Master Plan IT839 Strategy, including Broadband convergence Network (BcN)	Framework Act on Telecommunications Telecommunications Business Act Fair Trading Ac	First and Second Plans for Closing the Digital Divide e-Korea Vision 2006 Broadband IT Korea Vision 2007
Networks	Korea Information Infrastructure: early focus on backbone Broadband technological standards Cyber building certification Promotion of technology standardization Ultra Broadband convergence Network (UBcN)	Government ownership of KT until 2002	Korea Information Infrastructure: later focus on rural connectivity Low-interest loans for network rollout in rural areas

Services	Broadband as a value added service Quality monitoring system and service level agreements	Broadband as a facilities based service Network access regulations ISP peering regulation Local loop unbundling (LLU) Significant Market Power regulation (ex ante pricing and service restrictions) Bundling regulation Number portability for VOIP	Subsidized services for poor citizens
Applications	Content promotion frameworks Informatization promotion funds Industrial initiatives such as tax reductions for emerging Internet sectors, R&D and technology transfer promotion, and promotion of information technology in traditional industries Promotion of demand for broadband services through e-government, ecommerce, and e-learning initiatives	Intellectual property rights protection Strengthening of cyber trust and security systems (such as antivirus software promotion)	Promotions of applications accessible to people with disabilities
Users	Subsidies for computer purchases by low-income households 10 million people Internet education program	Information use ethics	Free Internet access centers in remote areas Broadband access in all schools

Appendix 2: Policies and initiatives, categorized under four aspects of eco-system model which can be used in Sri Lankan broadband context

	Initiative No	Recommendation	Source which was taken	Issue addressed
Infrastructure Development	1	Encourage operators by provide incentives and tax benefits to Broadband operators especially who covers underserved areas	Section 2.4.1 page 12	RF 6.1 and RF 8
	2	QoS benchmarking initiatives helps to maintain a good broadband service	Interview with TRCSL	RF 6.4
	3	Standardize broadband speed. TRCSL has given standardize broadband speed as follows; 30% of the advertised speed for Mobile broadband 70% of the advertised speed for fixed broadband	Interview with TRCSL	
	4	Investments are made in private and public apporach for broadband infra-structure development	Section 2.4.2.1 and section 2.4.6	R.F 6.1 and RF 8

Content and services	5	National fiber network. This is already implemented in certain areas of the country via SLT fiber network	Interview with TRCSL	RF 6.7 and RF 1
	6	E-education and e-commerce based policies	Korean case 2.4.1	
	7	E government policies and projects such as LGN and GIS	Interview with ICTA	
	8	Providing key public services online and encouraging the development of applications	Korean case Section 2.4.1.5	
	9	Policy implementation of cyber security	Nigerian case section 2.4.5.4	
Users	10	Per MB price reduction	Interview with TRCSL	RF 6.6
	11	Reduce tax for communication devices such as mobile phones, tablets and laptops	Interview with TRCSL	RF 6.6
Skills	12	Training and education to use or exploit Internet and related data services.	Indian Case section 2.4.6 and Korean Case study strategies in Appendix 1	RF 6.8 and RF 9
	13	Policies to raise awareness among general public regarding broadband based applications and services.	Korean case 2.4.1 and Nigerian case section 2.4.5.6	RF 6.5

Appendix 3: Responses for the questionnaire

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: ………M.J.M. Fawaz……………………………………………………………

Designation: …Manager – VAS & OSS…………………………………………………..

Company : …Mobitel PVt Ltd………………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

   2G – 90%

   3G – 75%

2. What are the initiatives that your company has taken to improve the broadband coverage?

   - Introduce 3G technology in 2G coverage area
   - Introduce LTE urban area
   - Add new sites in congested and no coverage area

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

   - Increase site capacity and transmission capacity

   - Increase core node capacity

   - Routine speed test in different area & optimizing system/ sites

   - System performance monitoring

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

   - Has launched successfully mLearning projects with different institutes

   - Online payment system for bills

- Supported immigration to launch web portal with notification capabilities
- Introduced Online games, online feature activation self care portals
- Smart phone applications for selfcare, mCash services

5. What are the initiatives taken by your company for cyber security?
   - Regular port scanning by third party for vulnerabilities
   - Use HTTPS for external and internal interfaces
   - Enable virus protections for relevant systems and phones if customer required
   - Use VPN for remote access and external connectivity to internal systems
   - Close unnecessary ports opened to internet
   - Achievement for ISO certification for security
   -

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

   - Yes

7. If yes, what are they?
   - Not supporting HTTPS by some products
   - Limitations in the existing products
   - Difficulty in maintaining continuous constant throughput for a user
   - Difficulty in providing continuous coverage due to terrains and buildings
   - Poor indoor coverage and throughput
   - Congestion issues
   - Internet bandwidth issues
   - Difficulty in proving similar experience for all users
   - Due to interrelated issues for proper broadband service, more time consuming in locating the issues
   - Occurrence of one time issue or single user issues which will not be able to regenerate in order to troubleshoot or solve the issues
   - Difficulty in matching other operator performance and features due to technical limitations

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Buddhi Hettiarachchi…………………………………
Designation: Senior
Engineer……………………………………………………………..
Company : …Mobitel PVt
Ltd………………………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

    75%

2. What are the initiatives that your company has taken to improve the broadband coverage?

    Company has increased 3G and 4G footprint gradually during past 8 years via major network expansion rollouts.

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

    Company has monitored broadband usage patterns and accordingly increased backhauling and ISP capacity to guarantee high data rates. Quality degradations in the network monitored continuously and taken prompt actions to rectify issues. QoS configurations used in the network side to prioritize high priority services over low priority services.

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

    Company has launched a comprehensive mobile money platform called "M-Cash" to fulfill demanding e-commerce requirements of the country. "M-learning" is an e-learning platform launched by Mobitel with the partnership with University of Colombo, which facilitate to follow online degree and diploma certifications.

5. What are the initiatives taken by your company for cyber security?

Company has secured its core network from unauthorized access from access network side via implementation of firewalls.

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

Yes

7. If yes, what are they?

It is challenging for the employees to cope up with rapid changes in technologies.

Customer knowledge of IT

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Duleep Thilakarathne
Designation: Manager Packet Core
Company : …Mobitel PVt
Ltd……………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

   50%

2. What are the initiatives that your company has taken to improve the broadband coverage?

   Invest for infrastructure phase by phase.

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

   Introduce latest technology such as 4G.

   Collect broadband speed statistics randomly island wide

   Introduced low cost high capable devices

   Optimize ISP latency

   Maintain IP path capacity 70%

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

   Launch online based applications

   Introduce promotions to encourage online applications

Provide infrastructure to corporate customers

5. What are the initiatives taken by your company for cyber security?

Introduce IPS, IDS
Introduce Antivirus software to end users with reasonable price

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?
Yes

7. If yes, what are they?
High cost
Service quality degrade

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Gayan Dissanayake

Designation: Supervisory Engineer

Company : …Mobitel PVt Ltd……………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

   Not sure .Please refer coverage map in cooperate website

2. What are the initiatives that your company has taken to improve the broadband coverage?

   Get frequent marketing servey information and customer feedback in monthly review meetings

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

4. Introduce new Customer Premises Equipment .introduce DC and HSDPA + and other improvements to 3.5G

5. Introduce 4G LTE

6. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

   Mobitel acquire few e commerce sites like mydeals.lk

   Form new division to empower emerging OTT players

7. What are the initiatives taken by your company for cyber security?

   Conduct frequent network audit by trusted third parties

8. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

   Return on investment is low due to limited customer base

   Customer awareness is very low in new products

   Customer purchasing power is low compared to developed countries

   Backhaul capacity constraints

9. If yes, what are they?

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: …Isuru Heendeniya……………………………………………………………………………………………………
Designation: …………………………………senior engineer-switching…………………………………………………..
Company : …Etisalat Pvt Ltd……………………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service area wise 1/3 of the country population wise 50%

2. What are the initiatives that your company has taken to improve the broadband coverage?

    Focused on covering more urban areas in-building solutions

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

    drive test, fluent customer complain handling system .frequently checking the speed through employee loctions,provide QOS to TRC

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

    Implement lot of e commerce solution(web patashala,e channealing,online solutions location based services.
    USSD menus
    Implineted OTT solutions

5. What are the initiatives taken by your company for cyber security?

    Firewalls are implemented before every gateway

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?because low data rates revenue is low compared to investment than voice .

7. If yes, what are they?

   Focus on more OTT solutions
   Customer knowledge

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Lasitha P. Jayasiri
Designation: Assistance Manager
Company : …Dialog Axiata……………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

   Not sure

2. What are the initiatives that your company has taken to improve the broadband coverage?

   New sites
   Fiber connection to sites

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

   Fiber connection to sites

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

   Self-care app and dialog online

5. What are the initiatives taken by your company for cyber security?

   ISO certification

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

   Yes

7. If yes, what are they?

   Cost and moving subscribers (Home to office)

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Madusanka Sampath
Designation: Engineer, Intelligent Network
Company : …Mobitel PVt
Ltd……………………………………………………………

Questionnaire

8. Mention the percentage of geographical distribution that has been covered by your broadband service

   60%

9. What are the initiatives that your company has taken to improve the broadband coverage?

   - Increase number of nodeBs and eNodeBs
   - Radio network optimization
   - Introduce Wifi service for common places

10. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

    - Introducing new radio access network technologies such as HSDPA, DC HSPA+, 4G, Wifi
    - Introducing user equipment supporting latest access technologies which results in high penetration of new devices
    - Coverage optimization, radio quality optimization

11. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

    i. Introducing new online VAS services
    ii. Introducing promotional packages related to e-services

12. What are the initiatives taken by your company for cyber security?

    a. Introducing child protection scheme
    b. Improving core network security

13. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

    a. Yes

14. If yes, what are they?

    a. Legal and regulatory barriers

    b. Lack of knowledge of customers

    c. UE compatibility issues

Objective

Objective of this questionnaire is to obtain a clearer insight on broadband initiatives that have taken by telecom operators

Name: Uditha Chandrasena
Designation: Senior Engineer
Company : …Mobitel PVt
Ltd……………………………………………………

Questionnaire

1. Mention the percentage of geographical distribution that has been covered by your broadband service

   Follow the coverage Map

2. What are the initiatives that your company has taken to improve the broadband coverage?

   Deploy more and more broadband sites

   Existing site capacity Upgrades

   New technology initiatives (eg- 4G)

3. What are the initiatives that your company has taken to improve broadband QoS (Quality of Service) in Sri Lanka?

   Network Capacity Upgrades

   All IP Conversion

4. What are the initiatives that your company has taken to improve online based applications and services such as e-commerce, e-learning and e-government?

   Introduction of mcash, mlearning, mtaxi, mticketing

5. What are the initiatives taken by your company for cyber security?

   URL Filtering, Network Security audits and take remedial actions (eg – Firewall Policy changes)

6. Are there any practical difficulties your company encounters when you are implementing the above mentioned initiatives?

   Yes

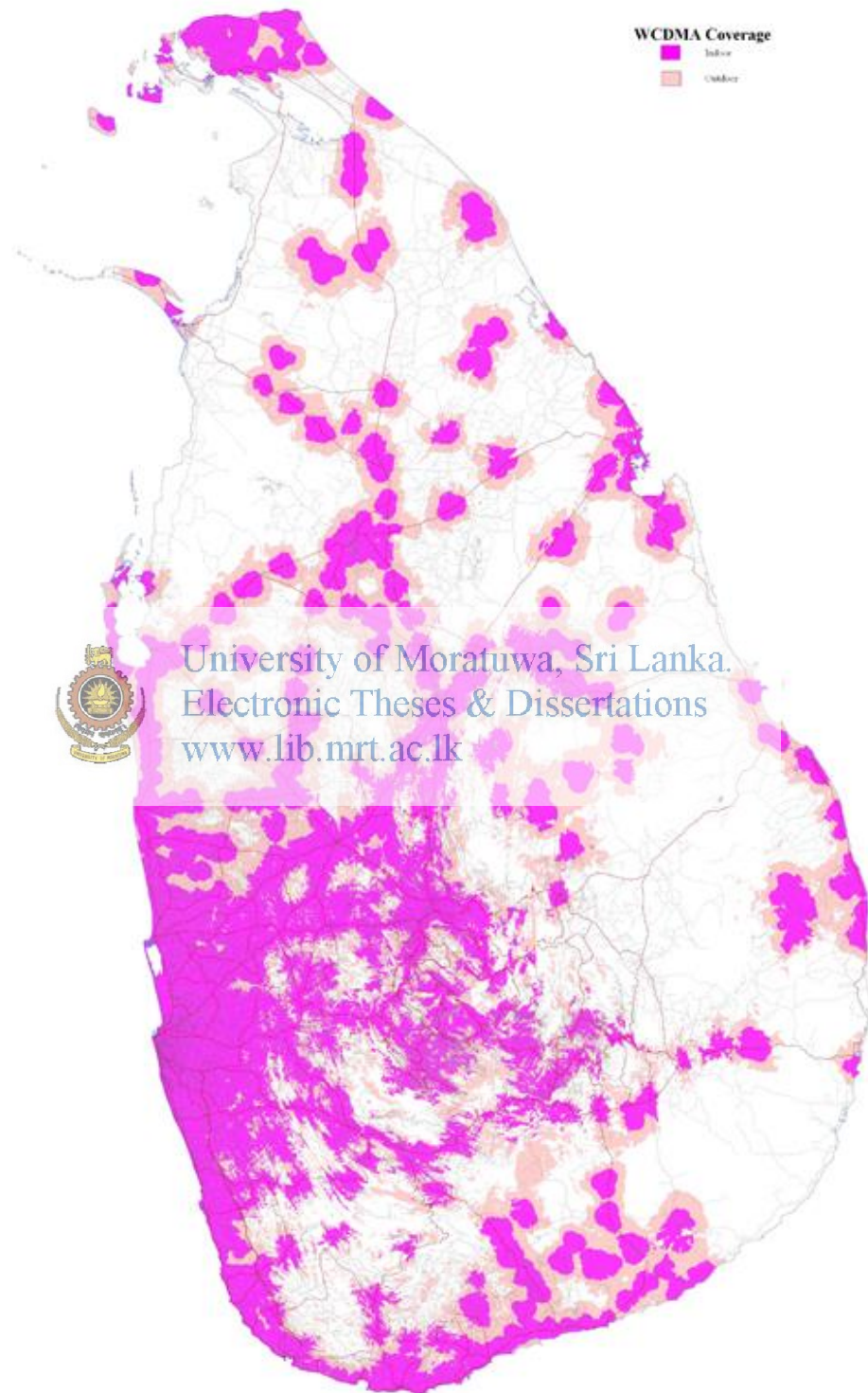7. If yes, what are they?

Additional CAPEX requirements

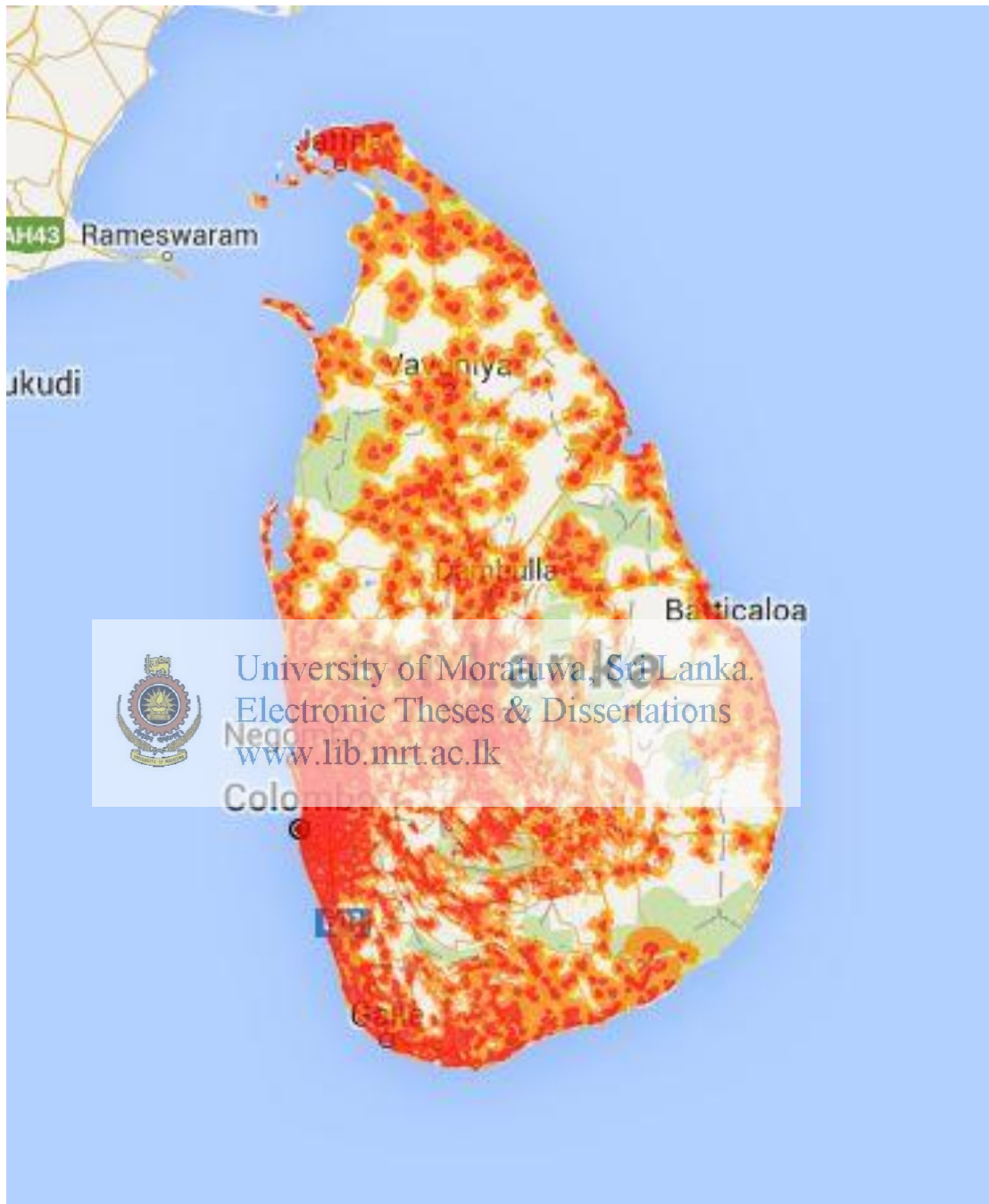Environmental factors for fiber laying and tower building

Appendix 4: Broadband coverage maps of operators

WCDMA coverage of Mobitel Pvt Ltd

WCDMA coverage of Dialog

2G and 3G coverage maps of Etisalat Pvt Ltd