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Broadband Wireless Technologies in Malaysia: A review

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ABSTRACT

Malaysia is one of the fastest growing Information and Communications Technology (ICT) markets in Asia, with ICT contributing 9.8% of the nation's GDP in 2009. The number is expected to reach 10.2% by 2015 with the convergence of industries towards digitalization. Given the importance of broadband and its association with FDI, the Malaysian Government had started making substantial investments on the infrastructure and communication services as early as the 1990s. Multimedia Super Corridor (MSC) was formed in 1996 with the aim to become a high technology destination for local and overseas operations. The MSC initiative and Vision 2020 have paved the way for Malaysia to face the new digital world. Thus, the study discussing over the literature review and reports related to wireless broadband in Malaysia. The study is referring to different types of wired and wireless broadband technology available in Malaysia. This paper also review different categories of broadband technologies in Malaysia including fixed lines, wireless broadband and satellite connection. It is hoped that this study will contribute to batter understanding and knowledge over wireless broadband in Malaysia. Besides, a comparison is then made with other developing countries towards wireless broadband. This is shows that broadband in Malaysia has made Malaysia stand in the global arena of wireless broadband technology.

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INTRODUCTION

Broadband is defined as "a network infrastructure capable of reliably delivering diverse convergent services through high-capacity access over a mix of technologies" (Broadband Commission, 2010) or "a new generation of high-speed transmission services, which allows users to access the Internet and Internet-related services at significantly higher speeds than traditional modems"(Federal Communication Commission, 2010). It is stipulated that the speed of broadband is "faster than primary rate Integrated Services Digital Network (ISDN) at 1.5 or 2.0 Megabits per second" (International Telecommunication Union, 2003). Broadband offers faster download speeds, better support of data traffic, streaming capabilities and television and radio signals (Sim, Garry,W.H.T., Ooi, K.B., Lee, V. H., 2011). In Malaysia, there are three (3) types of broadband technology used namely fixed-line, wireless and satellite.

2. Malaysia Broadband:

Broadband in Malaysia started as early as 1994 when the National Information Technology Commission was established to identify possible barriers to an IT-led leapfrog towards a developed nation status. One of the findings was "too many regulations that did not suit the needs of industry". As such, the Communications and Multimedia Commission was established in 1999 under the Communications and Multimedia Act (UK Trade and Investment, 2010) that lead to the growing ICT in Malaysia. Malaysia is one of the fastest growing ICT markets in Asia, with ICT contributing 9.8% of the nation's GDP (2009 statistics). The number is expected to reach 10.2% by 2015 as industries turn to digitalization (Skmm.Gov.My. 2005).

3. Fixed-line Broadband Technology:

This section will present fixed-line broadband technologies that available and implemented in Malaysia. Fixed-line broadband can be defined as "Internet connection that relies on a direct physical connection to the subscriber's or business" (Broadband Technology Overview, 2005).The Government of Malaysia has launched the National Broadband Plan where they expected with the completion of the first phase of the National High

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Speed Broadband project (HSBB) at the end of 2012 about 1.3 million premises will have access to HSBB services (Yee, L. H. 2011).

There are FOUR (4) types of fixed-line broadband technologies in Malaysia namely *Hybrid-Fiber Coax*; *Digital Subscriber Line*; *Broadband Power Line*; and *Fiber-to-the-Home*. These services are discussed in greater length below.

Hybrid-Fiber Coax:

Hybrid-Fiber Coax (HFC) is a flexible access and transmission system that combines coaxial and fiber optic cable, offering best features of each. It is less expensive than full fiber or switched digital video solution, while offering increased bandwidth needed for emerging broadband applications. It supports simultaneous analog and digital transmission and can incorporate existing plant (Broadband Technology Overview, 2005). HFC digital cable TV network is able to offer bi-directional data transfer bandwidth in addition to voice. HFC is also used in CATV transmission systems: fiber optic cable at the head and feeder distribution system; and coax at the customers' end. These systems offer high-speed backbone data interconnection lines to interconnect end user video and data equipment (ALTHOS, 2011).

Digital Subscriber Line:

The 'copper access technology' is the multiple variants of Digital Subscriber Line technologies dubbed xDSL. xDSL carry data in one direction, at the speed greater than 2 Mbps, implying 'broadband' access technology (Skmm.Gov.My, 2007). Advanced xDSL providers offer services such as high speed Internet access, voice over Internet protocol (VoIP), video on demand (VoD), and high definition television (HDTV) to their standard service.

Very high bit rate digital subscriber line (VDSL); asymmetric DSL (ADSL2+); and VDSL2;enable very high-speed Internet access up to 100 Mbps, to support a wide deployment of triple play services such as VoIP, video, data, HDTV, and interactive gaming. VDSL and VDSL2 bring huge increase in bandwidth from ADSL. These technologies are not end-to-end fiber networks but essentially a '*fiber-extension*' - enabling fiber-like bandwidth to premises not directly connected to the fiber-optic segment of a network. A VDSL network has a twisted copper pair with fiber coming to the curb or basement (Skmm.Gov.My, 2007).

Broadband Power Line (bpl):

Broadband Power Line (BPL), also known as Power Line Telecommunication system, is a new type of Power Line Communications (PLC) system capable of providing significantly higher data rates than previous PLC systems (Australia Communication Authority, 2003). BPL technology started at the electric power substation where a fiber optic backbone is connected to the medium voltage electric grid. The grid spans utility lines that power offices and homes. Data on the network is converted to signals in the electric current, not affecting power usage (Malaysia Technical Standard Forum, 2005). Data transfer speedon Medium-Voltage electric grid is within the 100 Mbps range. Motorola has developed Power Line MU to workwith the *Canopy* wireless broadband Internet platform. The Canopy system provides the backbone for the system, creating a wireless transport system to hotels, apartment buildings, or other multiple dwelling units (motorola, 2007).

Fiber-To-The-Home:

Fiber-to-the-Home is an example of technology that brings fiber closer to the subscribers. Other fibers in provision in the network are called FTTC (Fiber-to-the-Curb) or FTTN (Fiber-to-the-Node). The fiber is brought as far as a building and then distributed amongst the subscribers over twisted cooper pair or using wireless technology (Skmm.Gov.My, 2007). This technology is capable to provide all classes of services, voice, video and data over a common protocol or IP (Discuss Tech, 2011). FTTC uses wires that carry high-speed signals in short distances. Twisted pairs or coaxial cables have decent loss and bandwidth within the distance of a few hundred feet, which is the basic idea of fiber to the curb technology (Discuss Tech, 2011).

4. Wireless Broadband Technology:

Wireless broadband technology is a network concept that provides high-speed wireless Internet and data access (Youell,N, 2008). There are FOUR (4) types of wireless broadband technology in Malaysia namely *GPRS*, *UMTS/HSPA*, *LTE* and *Satellite*. These technologies are discussed in greater length below.

Gprs:

GPRS is a packet data overlay onto existing GSM networks (Srinath, N., 2011). It applies a packet radio principle to transfer data in an efficient manner between GSM mobile stations and external data network using 2.5G/2.75G standards, providing up to 384Kbps throughput, at an average coverage of 1 to 5 miles, with a frequency range of up to 1,900MHz (Scarfone, K., Tibbs, C., & Sexton, M., 2010). GPRS services fall in one of two categories: PTP (Point-To-Point) or PTM (Point-To-Multipoint) (Intelliclear, 2005). In PTP, GPRS support

applications based on IP while in PTM the subscribers are provided with the capability of sending data to multiple destinations in a single service request.

Enhanced Data rates for GSM Evolution (EDGE) is a radio based high-speed mobile data standard which acts as an enhancement for GPRS networks. EDGE provides GSM the capacity to handle 3G services with the transition rate of up to 472kbps.

Umts/hspa:

UMTS employs a wideband CDMA radio-access technology. The primary benefits of UMTS include high spectral efficiency for voice and data; simultaneous voice and data capability; high user densities with low infrastructure cost. UMTS is not a replacement but an upgrade for GSM networks. WCDMA radio channel can adjust the allocation of code space every 10ms, allowing the network to dynamically assign resource for different users (Sicher, Heaton, 2002).. HSPA has been standardized and used to enhance the competitiveness of UMTS. HSPA is a software upgrade of UMTS' transmission technology, bundling data packages and making efficient use of frequencies. HSPA also refers to both the improvements made in the UMTS downlink, referred to as High Speed Downlink Packet Access (HSDPA); and improvements made in the uplink, referred to as High Speed Uplink Packet Access (HSUPA). HSDPA provides a two-fold improvement in network capacity and boost data speedup to 14Mbps. Both HSDPA and HSUPA can be implemented in the standard 5MHz carrier of UMTS network and can co-exist with the first generation of UMTS based on the 3GPP Release 99 (R99) standards (Ghribi, Logrippo, 2000).

Lte:

The recent increase of mobile data usage and emergence of new applications such as streaming contents have motivated the 3rdGeneration Partnership Project (3GPP) to work on the Long-Term Evolution (LTE). LTE radio access is known as Evolved UMTS Terrestrial Radio Access Network (E-UTRAN), and expected to substantially improve end-user throughputs; sector capacity; and reduce user plane latency; significantly improving user experience with full mobility. LTE uses orthogonal frequency division multiplexing (OFDM) as its radio access technology, with advanced antenna technology (ericsson, 2005). LTE is the next step on a clearly-charted roadmap to so-called 4G mobile systems. LTE offers scalable bandwidths, from 1.4MHz up to 20MHz (ericsson, 2005).

5. Satellite Broadband Technology:

Satellite broadband is primarily a direct-to-home digital TV broadcasting wireless solution. However, newer Direct Broadband Satellite services also provide two-way-high-speed data transmission services [10]. The satellite services known as Smart Ku-band and Smart C-band. Ku-band provides a technology such as Surfbeam that uses new standard based on DOCSIS1.1. This satellite enables broadband internet access to SMI/SME and SOHO. The satellite could cover immediately wide coverage. The components include Outdoor Unit (ODU) similar to DTH satellite television dish and Indoor Unit (IDU) comparable in size and function to the desktop ADSL or cable modem. The ODU include compact satellite reflector and feed, transmit and receive electronics and associated mounting kit to affix the unit to the customer home. The IDU is just 23 by 23 by 3.8cm with a sleek design to fit with other modern personal computing and telecommunication equipment and interfaces to the customer computer or home network via a standard Ethernet connection. While for C-band, it was using the technology from viasat which provide the LinkStar VSAT network ground system. LinkStar VSATs have been built on a foundation of open standard DVB technology, including a DVB-S forward link and DVBRCS return. A LinkStar RCST can operate on either of two downloadable software personalities. The optional DVB-RCS software enables interoperability with other manufacturers. LinkStar features a total capacity of nearly 60 Mbit/s on the forward channel. Return channels to the hub operate at speeds up to 1.67 Mbit/s, with an optional upgrade to 3.33 Mbit/s. With this return channel capacity, remote sites can be server locations, content providers, multimedia sources, video teleconferencing participants, and corporate headquarters (Airtight Networks, 2005).

6. Wireless Broadb and Implementation:

This section will present the implementation of various broadband technologies in Malaysia including *WLAN*, *WMAN* and *WWAN*.

Wireless Local Area Network (wlans):

WLAN consists of several elements including the client and access point. The client represents the group of devices within the WLAN that are connected to the single point of aggregation – the access point – that connects to the Internet or other network infrastructure. WLAN uses RF (Radio Frequency) signals in 2.4 GHz and 5 GHz spectrum as a transmission medium. Wi-Fi (or IEEE 802.11) is the set of standards established to define wireless LANs. A number of different protocols are defined in the 802.11 family of standards, addressing

various operating frequencies and maximum throughputs (Ogilvie, 2003). Table 1 summarizes the three versions of the standard (Ogilvie, 2003).

Table 1: IEEE 802.11 Standards

Standard	Year	Data Rate	RF	Range	RefClk (typ)
802.11a	1999	54 Mbps	5 GHz	short	20, 40, 80 MHz
802.11b	1999	11 Mbps	2.4 GHz	med	22, 44 MHz
802.11g	2003	54 Mbps	2.4 GHz	med	20, 40, 80 MHz

Although the 802.11a was the first standard created in the 802.11 family, 802.11b became the first widely accepted wireless networking standard, followed by 802.11a and 802.11g (Booz, Allen, & Hamilton. (2007). Fig. 1 represents a typical WLAN network configuration (Ogilvie, 2003).

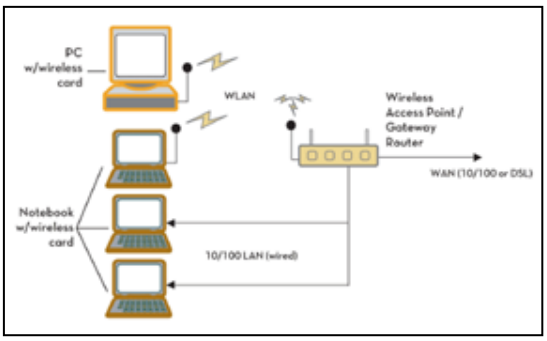

Fig. 1: Typical WLAN Environment

Wireless Metropolitan Area Network (wmans):

WMAN is a form of wireless networking that has an intended coverage area, a range of approximately the size of a city (Verizon Wireless, 2009).WiMAX is a wireless digital communications standard, also known as IEEE 802.16, which is intended for WMANs and last-mile wireless broadband services (backhaul) (Booz, Allen, Hamilton. (2007). It promises very high data rates, high reliability, good efficiency and lower cost. WiMAX provides a coverage radius of up to 50 km; data rates of up to 70 Mbps; and working in both licensed and license-exempt spectra and high spectral efficiency. There are four primary topologies for IEEE 802.16: point-to-point, point-to-multipoint, multi-hop relay, and mobile (Booz, Allen, Hamilton. 2007). and two versions of WiMAX: 802.16d (fixed users – Residential, SOHO, Enterprise) and 802.16e (portable users – Nomadic, Mobile) (Scarfone, Tibbs, Sexton, 2010). They differ in terms of expected benefits and the time frame for deployment. Many of the 802.16d deployments are expected to follow a Frequency Division Duplexing (FDD) frequency plan driven by the 802.16d WiMAX profiles. The prioritized profiles for 802.16e are expected to follow a Time Division Duplexing (TDD) frequency plan.

Wireless Wide Area Network (Wwans):

WWAN covers a much broader area than Wi-Fi or WiMax, with coverage usually measured on a nationwide or even global basis (Scarfone, Tibbs, Sexton, 2010). WWANs provide broadband data networks with a far greater range, using cellular technologies such as GPRS, HSPA, UMTS, 1xRTT, 1xEV-DO, and LTE at different speed depending on the technology used.

Discussion Among Developing Country:

Malaysia's telecommunications and broadband network has advanced significantly compared to other countries in South-East Asia. Broadband usage has increased dramatically but current infrastructures are insufficient to cope with market demand and the need of next-generation mobile telephony.

The National Broadband Plan had set a target of 25% household penetration by 2006 and 50% by 2008, but the rate is less than 3% in 2006, and a mere 5% in early 2010 .These figures are relatively small compared to neighboring countries. The slow take-up of broadband has been exacerbated by the fact that the broadband speed is perceived notoriously slow with costly services compared to other developing countries.

Global industrial production declined by 20 percent in the fourth quarter of 2008, as high-income and developing country activity plunged by 23 and 15 percent, respectively (World Bank, 2009). Developing

countries are also facing the challenge as to how, with fewer resources, to establish policies that can protect or expand critical expenditures, including on critical infrastructure, in order to sustain growth.

The stimulus effect that infrastructure expenditure is expected to rise in developing countries incretion of new job. With respect to long-term impact on the economy, investments in telecommunications typically generate positive returns and growth in developing countries. A considerable amount of empirical work concludes a positive and significant link between telephone infrastructure and long-term growth (Hardy, Andrew. 1980, Madden, Gary,Scott Savage. 1998, Roller, Lars-Hendrik, Leonard Waverman, 2001. Priowirjanto, Gatot Hari, 2005).

In Indonesia's, Directorate of Technical and Vocational Education (DTVE) of the Ministry of National Education is executing an important program of 'block grants" to qualifying schools to help fund the establishment of ICT Centres which draw wireless connectivity and help connect neighbouring (mainly secondary) schools within a district (Priowirjanto, Gatot Hari, 2005). The program aims to establish 100 such ICT Centres in 2005.

Meanwhile, in India, the Department of Electrical Engineering of IIT-Madras (www.iitm.ac.in/) and its research group (www.tenet.res.in/) is dedicated to bringing ICT services to all of India's villages. Their work covers: i. Development of applications that add value to the ICT experience of low-income rural users; and ii. Incubation of business enterprises, based on the commercial exploitation of the technologies developed. The Tenet website (www.tenet.res.in/Activities/Products/index.php) describes the principal technologies developed, which include: i. Wireless connectivity CorDECT technology developed and commercially exploited by Midas Communication Technologies (www.midascomm.com/). CorDECT functions as a telephone exchange to distribute Wireless connections. ii. Low bandwidth video conferencing system that enables medical consultations, agricultural technical assistance online, distance learning and interactive communications; iii. Medical diagnostic kits to serve rural communities remotely; iv. Banking teller machines is suitable for rural service.

Refer to Malaysian Government, they has taken vital steps, with a huge allocation of MYR 12.9 billion in the 9thMalaysian Plan, with the intention of turning Malaysia into an international hub for IT (Devcentral White Paper, 2003). In 2009, four 3G players, four WiMAX operators and Telekom Malaysia came together in the HSBB project, making the broadband industry more competitive, thus boosting broadband penetration.

Telekom Malaysia (TM) has a monopoly in the fixed line market and a considerable share of the mobile communications market after its acquisition of Celcom in 2003 and merger with its mobile operation arm, TM Touch. TM offers DSL broadband connectivity through its ISP subsidiary TM Net, under the Streamyx brand. Due to its near monopoly of last mile connections, TM Net is now the biggest DSL broadband provider in the country.

The Government has also supported strategic projects such as the Multimedia Super Corridor, promoting the establishment of high-tech companies in Malaysia. According to a study by the Asia-Pacific Carriers' Coalition in 2010, Malaysia topped 4 out of 5 categories – differentiated by network speeds – covering Ethernet broadband monthly rental and installation costs (Meerman, 2007).

Conclusion and future work:

Broadband has become an important utility like water and electricity these days. Broadband is a high speed transfer of data, voice and video over the Internet. Broadband can be divided into fixed-line and wireless, with varying technologies offering unique advantages in speed, reliability and affordability. Fixed-line technologies broadband such as Hybrid-Fiber Coax, DSL, BPL and FTTH are more stable as they run on fiber or cable but are constrained by geographical locations. Wireless technologies, are relatively unstable but it offers more accessibility and higher speed. These technologies are increasing at a rapid pace compared to wired ones. Examples of wireless broadband services available in Malaysia today are through GPRS, UMTS and LTE. Satellite technology carries more transponders offering higher capacity and provides higher bandwidth. It has the unique ability to deliver bandwidth exactly where and when it is needed, irrespective of geographic location and local infrastructure. Depending on the location and requirement, satellite is the best method for either by-passing or extending terrestrial network. However, due to cost, satellite broadband is only used by the large company. Malaysian broadband usage has increased dramatically but current infrastructure is insufficient to deal with the market demand. However, several measures have been taken to improve broadband the connectivity in the 9thMalaysian Plan including computerization and digitization programs by the relevant ministries and agencies. During the 2010-2020 periods, it is anticipated that most states in Malaysia will aspire to reach a developed state status to keep pace with Vision 2020. The key to this vision lies largely in the availability of high speed affordable broadband to channel and power the growth in ICT in the country.

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