Suruhanjaya Komunikasi dan Multimedia Malaysia
Malaysian Communications and Multimedia Commission

Deployment of Power Line Communications Systems in Malaysia

Public Consultation

February 2005

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OBJECTIVE

Malaysia's Communications and Multimedia Act 1998 (CMA) contains provisions for the regulation of the converging communications and multimedia industries. The CMA, in essence, provides for a regulatory framework to harness the potential of convergence and to drive the growth of the communications and multimedia industry. This regulatory framework is intended to enable and facilitate the development of a more flexible and liberalised market for the communications and multimedia services.

The CMA is based of the following principles;

a) protection of consumer interest,
b) transparency of process,
c) promotion of self regulation,
d) the creation of a competitive environment for the communications and multimedia industry, and;
e) technology-neutral licensing to facilitate convergence.

The objective of this Public Consultation Paper is to ascertain the views of the public on the introduction of Power Line Communications (PLC) systems in Malaysia and gauge public readiness towards its deployment. This consultation also seeks to determine if the Commission should regulate the provisioning of PLC services and the manner in which it should be regulated. The Commission is aware that should it permit PLC deployment, it has to consider the broad implications of PLC to the Malaysian communications environment and would like to ensure that the appropriate regulatory framework is in place.

INTRODUCTION

The Commission has received expressions of interest from companies to deploy PLC systems in Malaysia. The Malaysian Communications and Multimedia Commission (Commission or MCMC) is initiating this public consultation in an effort to gain a comprehensive understanding of the issues involved with the deployment of Power Line Communications (PLC).

PLC refers to a variety of broadband services provided over the electricity power grid. There are numerous benefits to PLC and one of them is the provision of the end connectivity to the final subscriber that will increase the availability of broadband thus improving the competitiveness of the broadband service market.

Where broadband access has lagged notably in rural areas, PLC opens up a new communications infrastructure as electricity is more prevalent in homes than telephone lines. Along with telephones (via DSL) and broadband fixed wireless access (BFWA) type of technologies, PLC offers an alternative for the last link for the delivery of broadband services. Communities that are serviced by the power grid but not by broadband providers can now gain access to the Internet.

Through this consultation paper, the Commission invites submissions from interested parties to respond to the issues which may arise so that the Commission may be able to obtain a wide representation of viewpoints. Accordingly, the Commission also requests comments on any other matters or issues in addition to those discussed in this consultation paper, which may be pertinent to the deployment of PLC. Any submissions in response to this consultation paper should be substantiated with proper reasons as well as references. Information received will be used toward formulating the policies involved in implementing PLC in Malaysia. Written submissions should be sent in both hard and soft copy. Submissions may be made no later than 12 noon on March 31, 2005 and should be addressed to;

Malaysian Communications and Multimedia Commission
Persiaran Multimedia
68000 Cyberjaya
Selangor

Attention: PLC Working Group
Industry Development Division

Tel: +60 3 8688 8000
Fax: +60 3 8688 1000
E-mail: plc@cmc.gov.my

The MCMC reserves the right to make public all or parts of any written submission and to disclose the identity of the source made in response to this consultation as it deems appropriate. The Commission shall take all views into consideration before making any firm conclusions on the regulatory approach towards PLC and would like to thank in advance interested parties for their participation in this consultative process.

BACKGROUND

1. One of the alternative technologies for communications that is currently being debated widely across the globe is Power Line Communications (hereinafter "PLC") technology. Power Line Communications is a term used to identify technologies, equipment, applications and services aimed at providing end users with communications means over existing "power lines" (cables transmitting electricity)[1]. PLC is also referred to DPL (Digital Power Line), PLT (Power Line Transmission) or BPL (Broadband over Power Line).

2. The concept of running data over electrical wiring is not new. PLC is a technology that has been around for many years. Since the 1950s, power companies have been using PLC to send control messages and had been limited to low data rates for the power company's own internal applications. It was never seriously thought of as a medium for communications due to its low speed, minimal functionality and high deployment cost. The major challenge was trying to use the same wire that carries strong current, to also accommodate data signals. However, new modulation techniques supported by recent technological advances have finally enabled the power line to become a means for high-speed, broadband communications over low and medium voltage lines.

3. Previous PLC systems used by the power company are for the transmission of specific information concerning the state of the power network, for remote monitoring and SCADA[2] applications. All this information is transmitted using relatively low frequencies, and thus having relatively low speed. Recent technical achievements in the area of PLC make it possible for data to be sent at a much higher speed. This new PLC system uses a much higher frequency i.e., between 1 MHz to 30 MHz which enables a higher transmission rate at around 1 Mbit/sec. However, at a higher frequency than the 50 Hz electrical current, the PLC systems raise a number of issues including interference by PLC equipment to radio-based services.

4. Concerns regarding potential interference to licensed radio users are mainly raised by users of the short wave spectrum, with amateur radio operators being the most vocal opponents.

5. The Commission recognizes the concerns of some radio service users and radio licensees on the possibility of potential interference from PLC systems with their operations. It is important for the Commission to address the concerns with the public and find ways to prevent interference and, if it occurs, identify a solution that will address this harmful interference without affecting the services of existing licensees.

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[1] As per the definition by OPERA (Open PLC European Research Alliance)

[2] SCADA (Supervisory Control And Data Acquisition) is a utility information system used for monitoring and controlling a process without requiring an operator's supervision, and which can notify personnel of current or potential alarm situations.

What is PLC?

6. PLC refers to the provisioning of communications services such as internet access and telephony over the electricity grid. It uses existing power cables and extensions to enable two-way broadband and phone connectivity between a user and a service provider.

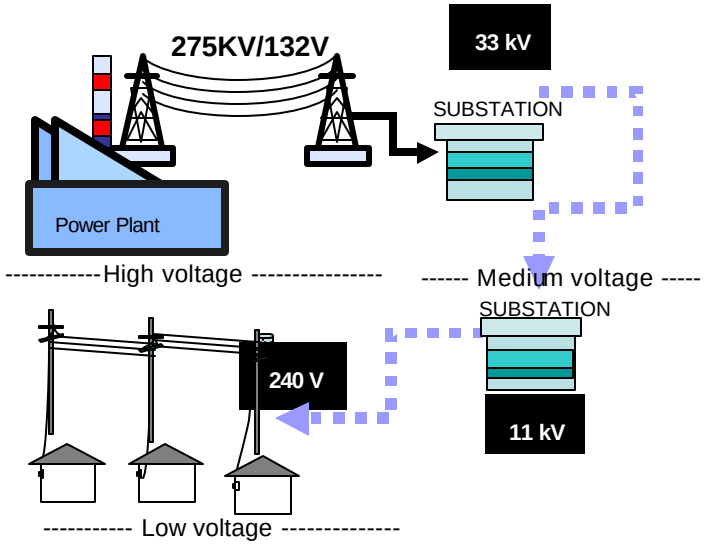
7. Current PLC systems use the low and medium voltage power lines like the ones installed along our roads to distribute broadband services on the frequency range of 1 MHz to 30 MHz. In theory, plugging a computer device into an existing power outlet would connect the user to the Internet by tapping into established national power grid networks. As such, it is also referred as the "third wire" in addition to phone and cable, and has the potential of providing a solution to the "digital divide" issue.

The Power Grid

8. In order to understand how PLC works, a brief understanding of the features of the electricity grid is essential. The power grids distribute electricity generated at the power station via high voltage lines. In areas where power needs to be distributed to consumers, transformers are used to convert or step down this high voltage into a much lower voltage at the substation. Before entering the customer's house or premises, another transformer is used to drop the voltage down to more manageable levels.

9. Power grids typically transmit electricity in three levels of voltage: high voltage (HV), medium voltage (MV) and low voltage (LV).

   - LV: 1 to 1000 Volts (240 Volts, single phase; 415 Volts, 3 phase)
   - MV: 1,000 Volts/1 kV to 100,000 Volts (11 kV, 33 kV and 66 kV)
   - HV: 100,000 Volts upwards (132 kV, 275 kV and 615 kV)



How does PLC work?

10. The main characteristics of PLC involves sending high frequencies using a PLC Carrier Unit (PLCU) over power lines and injecting the frequencies (or picking them up) via a coupler linked directly to the power grid. The communications signal is separated from the 50 Hz power supply by means of a band pass filter. The components involved in PLC are the;

    - Power Line Carrier Unit – provide signal transmission and reception
    - coupler – for "clamping" around a live wire thus injecting the communications signals into the power line.
    - PLC modem

11. In the PLCU, a Low Pass will filter the 50 Hz signal to the electricity meter at the home and a High Pass will filter the signal above 1 MHz for data communications. Using the coupler, the communications signal is injected into the electricity supply cable.

12. PLCU as well as the couplers are therefore required at every node where communications via power line is to be established. Other components of the PLC are the transformer bypass and the PLC modem which is a Customer Premise Equipment (CPE) located at the end user/subscriber's end. It provides Ethernet or USB connection for the end user to connect to the Internet.

13. On longer MV or LV lines repeaters may be required to boost the signals by amplifying weaker PLC signals along the line thus extending the distance covered. At the end-user's location, the PLC signal is sent via the electricity cable to the PLC modem which modulates and demodulates it into a communications signal. It is to be noted that being a point-to-multipoint technology, the bandwidth is shared by as many users in a building or within an area that is connected to one power substation. This reduces the actual bandwidth available to each user.

14. There are two types of PLCU[3];

    a. Capacitative PLCU -
       connect and inject the signal into the cable core for delivering the signal transmission. It is physically connected to the electrical circuit.

    b. Inductive PLCU -
       induce signal to cable sheath or cable core.

[3] Capacitive coupling requires the physical connection to the power network. However, inductive coupling avoids any physical connection to the network although there will be several decibel losses to the signal. This makes it a safer and often easier way of installing than the capacitive coupling.

Types of PLC System

15. There are 3 types of PLC equipment;

a. Access (Outside) PLC

It provides communications between homes and equipment outside the home. It uses either the overhead or underground electrical distribution lines. Radio Frequency (RF) will be radiated by the house wiring unless suitable RF filters are fitted at numerous applicable locations. Since the electricity grid is vast and extends across entire neighborhood, access PLC systems pose a significant interference potential to over-the-air radio services.

The Commission sees several possible applications for Access PLC, among others;

- As a final link for connecting the end users with the communications service providers or internet service providers (ISPs).
- As an alternative platform for broadband communications capability which is comparable to digital subscriber line (DSL) technology.
- As an easy access for providing communications services to underserved rural and remote areas with minimal additional capital outlay.

b. In-House PLC

In-house or In-building PLC systems provide communications between equipment within the home. The RF signal is injected into the house wiring and uses the electrical wiring within a building to network computers. In-house PLC operations may provide for Internet sharing or other external service connections independently of Access PLC service. For example, an in-house local area network (LAN) could interface with an Internet connection that may be provided from a variety of sources such as cable, DSL, or dial-up analog line, not necessarily just from an Access PLC service. In other words, the operation and external networking functions of In-house PLC do not depend on the subscriber having Access PLC service.

Thus, the In-house PLC system will allow the 3-pin electrical outlets to provide internal links in a home or office network allowing easy integration of all devices in the building.

c. Control PLC

These are PLC systems that operate below 500 kHz, and used by electric power companies to control their equipment using the power-lines as transmission lines. This type of PLC does not pose any significant interference risk to high frequency (HF) operations.

PLC Trials and Deployments

16. There are various stages of PLC activities taking place globally. Currently, more than 60 sites[4] worldwide are offering PLC services commercially. Countries with significant PLC activities include Austria, France, Germany, Iceland, Italy, Poland, Portugal, Spain, Sweden, Switzerland and the UK[5].

17. Leading deployments are in Mannheim, Germany; Fribourg, Switzerland; as well as in Zaragoza and Barcelona in Spain. Appendix A contains the various ongoing trials and deployments around the world.

ISSUES FOR CONSIDERATION

A. REGULATORY

18. The communications service provided by PLC system is enabled by using the electricity transmission network of the power supply companies that are the licensees of the Energy Commission of Malaysia. As such any provision of PLC services essentially falls within the domain of;

    a. The CMA 1998

    b. The Electricity Supply Act, 1990 (ESA)

    This PC Paper focuses on the issues from the perspective of the CMA. There may be concerns or matters related to the ESA but they fall out of the scope of this consultation by the MCMC.

19. Section 126 of the CMA, prohibits, subject to any exemptions, any person from owning or providing network facilities or providing a network service or applications services without a valid individual licence or a class licence which expressly authorises the ownership or provision of the facilities or services.

20. Under the CMA licensing regime, an entity that provides any of the following four elements; network facility, network service, applications service and content applications service, or a combination of these elements will require a license.

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[4] PLC forum, "Summit Declares Increasing Support of the European Commission for Power Line Communication (PLC)", 12 December, 2002, www.plcforum.com/docs/PLCforum-PR_Mannheim.pdf

[5] Engineering Talk, "Global Progress on Powerline Communications", 30 June 2003, www.engineeringtalk.com/news/plc/plc100.html

a. Network Facilities

A network facility is defined in the CMA as an element or combination of elements of physical infrastructure used principally for, or in connection with, the provision of network services, but does not include customer equipment or equipment which lies on the customer side of the network boundary.

Although the power company's physical infrastructure is not used primarily for network services nor is it for communications purposes, it is on the other hand clearly used '***in connection with***' a network service.

The physical infrastructure elements within the PLC network include the PLCUs and Couplers which introduce the communications signals into the electrical transmission and distribution network and the repeaters which are required to be placed in the electrical transmission and distribution network to address communications signal attenuation issues. There may also be elements of the PLC operators' network operations centre which could fall within the definition of network facilities.

b. Network Services

A network service is defined in the CMA as a service for carrying communications by means of guided and/or unguided electromagnetic radiation. The physical electrical network like that of a communications network is by itself 'dumb' or devoid of any intelligence. Intelligence is required and is introduced in the form of a network service element which provides the ability to distribute or otherwise route the communications traffic that is travelling along the physical infrastructure. This service is necessary to ensure that the communications signals get to its required destination.

c. Applications Services

An applications service is defined in the CMA as a service provided by means of, but not solely by means of, one or more network services. It essentially refers to the use or function of the communications service e.g. a fixed line telephone service or internet access etc. and will be closely linked to the network service being operated.

d. Content Applications Services

Content is defined in the CMA as any sound, text, still picture, moving picture or other audio-visual representation, tactile representation or any combination of the preceding which is capable of being created, manipulated, stored, retrieved or communicated electronically. In the case of PLC, content applications services may not be applicable since content applications cover traditional broadcasting services and online services that provide content. The provision of internet content is exempted from the licensing regime. Content applications service providers include broadcasters, online service providers that provide content such as on the Internet, closed circuit/television broadcasting services as well as local and wide area networks.

The type of licences that will be required

21. Under the CMA, there are three categories of licensable activities that may be applicable to the prospective PLC service providers;

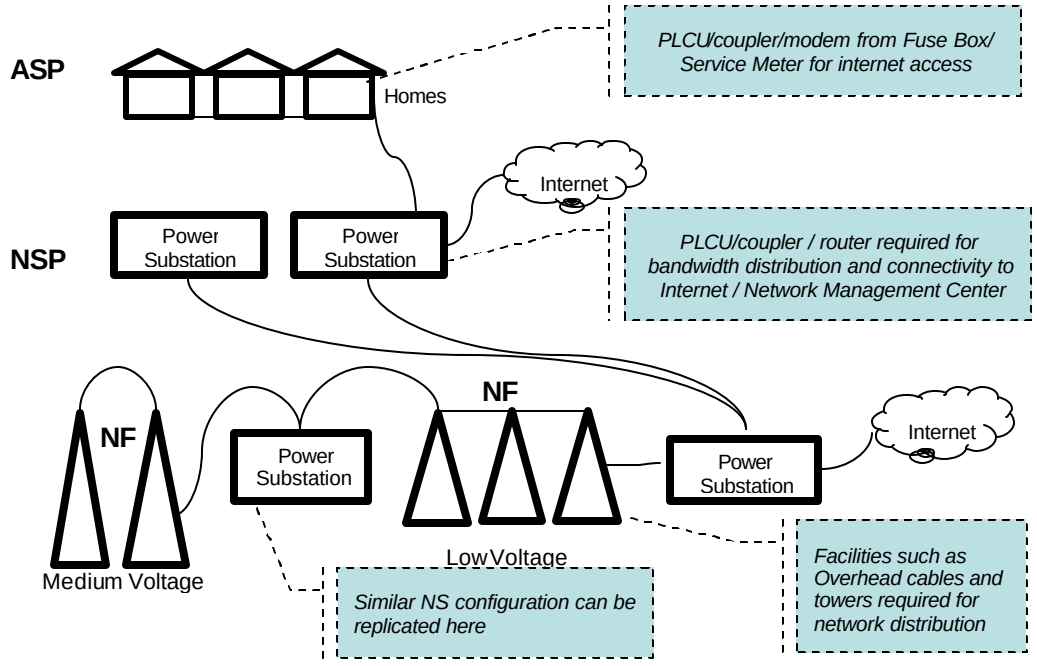
a. Network Facilities Providers - owners of facilities such as fixed links and cables, satellite earth stations, broadband fibre optic cables, telecommunications lines and exchanges, radiocommunications transmission equipment, mobile communications base stations, broadcasting transmission towers and equipment, towers, poles, ducts and pits used in conjunction with other network facilities.

b. Network Services Providers – providers of the basic connectivity and bandwidth to support a variety of applications. Network services enable connectivity or transport between different networks. A network service provider is typically also the owner of the network facilities. However, a connectivity service may be provided by a person using network facilities owned by another.

c. Applications Service Providers – providers of particular functions such as voice services, data services, content-based services, electronic commerce and other transmission services. Applications services are essentially the functions or capabilities, which are delivered to the end-users.

22. From the foregoing, a Network Facility Provider (NSP) and a Network Service Provider (NSP) licence may be required at the minimum with an ASP licence depending on the applications and business model involved. In order to make an assessment on the type of licences that would be applicable, an overview of the elements that reside in the PLC network topology is necessary, focussing on the network facility connectivity and the end-user applications involved.

CMA licensing framework mapped onto PLC requirements



Individual or Class Licence

23. Depending on the business model shown above, the NF/NS portion may either be individual licences or class. If a limited roll out is planned then the NF/NS Niche licence framework may be applicable subject to compliance with the Niche Guidelines[6]. However, a nationwide roll out will rule out the Niche framework in which case an NF/NS individual licence will be more appropriate.

24. Individual licences are granted for activities where a high degree of regulatory control is required. Although the general policy for licensing under the CMA has been to move towards lesser regulation i.e., from Individual to Class, it maybe necessary to maintain the Individual category for PLC services in view of the fact that this is a new technology and has broad implications for the industry as well as the users.

25. The actual licensing requirement can only be ascertained by the Commission upon the assessment of applications from the prospective PLC applicants. This Public Consultation exercise is the first step in obtaining the public's view on the deployment of this technology and to determine the licensing obligation. The licensing requirement is not the only factor under consideration. Prospective PLC service providers may also need to obtain approvals from the regulator that has purview over the power companies.

B. DEPLOYMENT

Three (3) Possible Business Models

26. The Commission is of the view that there could be three possible types of business models that may enter the market. The characteristics of each type of PLC service provider are discussed below.

i) The Service Provider model

In this model, a PLC solution is installed on the power company's network. The power companies act as a service provider to provide broadband service to its customers. The power companies also operate the infrastructure. The power company is now in a position to offer the same kind of services that are offered by the ISPs whereby end users purchase delivered Internet services from the power company which, in turn, purchase Internet service from the ISPs.

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[6] The following sites refer to the Ministerial Guidelines related to the issuance of the Network Facilities Provider (NFP) and Network Services Provider (NSP) Class licences and the related Guidelines on Niche Services
www.mcmc.gov.my/facts_figures/codes_gl/guidelines/pdf/MG%20NFP_CL1.pdf
and www.mcmc.gov.my/facts_figures/codes_gl/guidelines/pdf/MG%20NSP_CL.pdf

ii) The Retail model

In this model, a PLC solution is installed on a power company's network. Here, the power company in turn leases its network to another party that will be responsible for the providing and managing the PLC service to the end-users.

iii) The Wholesale model

This model is almost similar to the Retail model whereby a PLC solution is installed on a power company's network, the power company in turn leases its network to another party e.g., Company A.

However, unlike the Retail model, Company A wholesales the bandwidth to other communications service providers, ISPs etc. As such, Company A does not directly provide any type of services to the end users; it leaves the communications service providers and ISPs to interact with the end users. In this model, the end users purchased delivered Internet services from the communications service providers/ISPs.

Question A. Based on our study, the above appears to be the most likely business models that may emerge when PLC systems are deployed. Do you foresee any other business models apart from the three identified above? If so, please provide details.

Access Arrangements

27. PLC introduces a way of providing the "last connectivity" to deliver broadband services and possibly becoming a viable competitor to services such as DSL. This technology offers an alternative means of delivering voice, Internet access, VoIP, video-on-demand and other PLC-type of services to the end users.

28. As such, for the PLC system to provide an end-to-end network, the system has to be interconnected with other communications networks by means of optical fibre, via wireless connection, a satellite link or other types of connections. As such services such as a telephone call or an Internet connection almost always require a combination of a number of separate components such as call origination, transportation and call termination.

29. In all of the abovementioned business models, access arrangements have to be in placed to enable PLC service providers to gain access to the network of another communications service providers or ISPs.

Question B. In the Service Provider model, the Commission is inclined to believe that the "last connectivity" should be subjected to the access regime [7] as outlined in the CMA e.g., access list. Do you agree?

Question C. What would be the access issue considerations in the Retail and Wholesale business model?

C. EMISSION & INTERFERENCE

Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI)

30. EMC means "Electromagnetic Compatibility"[8]. The main issue raised by the use of PLC systems is the risk of interference to radiocommunications services caused by their generation of electromagnetic emissions from the power lines over which they operate. Open or unshielded wire aerial power lines in particular freely radiate high frequency signals being passed along their length. In Malaysia, 30% of all power lines are bare overhead. The remaining 70% are shielded cables with half of them buried underground. There are indications that by the year 2008, most power cables will be buried underground. Those that are not buried will be of the shielded type.

31. The technique developed to transmit digital signals on power lines use frequencies from 1 MHz to 30 MHz. These frequencies also overlap the short wave radio spectrum segment (1.5 MHz – 30 MHz). The short wave radio band are used by short wave broadcasters, amateur radio, aeronautical and maritime communications, the military and navigation services, broadcasting and several security services depend on this part of the radio spectrum. As such, due to the overlapping of the frequencies, there are concerns that PLC systems will interrupt the services of these licensed services.

32. In other parts of the world, there have been incidents where PLC systems have caused major interference to existing services. In 1998, the Canadian electronics company Nortel with the British electricity provider, United Utilities decided on a joint venture in the PLC business. In the same year, this venture called Nor.Web conducted trials in the U.K. Within a few months it

[7] Access regime provides for a) List of network facilities and services that are to be offered or open for access by access seekers [currently the list is being reviewed to include more facilities and services], and b) Transparent standard terms and conditions. See Part VI, Chapter 3 of the CMA.

[8] The European Union has defined EMC as the ability of a device, unit or equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to any devices in that environment. This includes both immunity to outside noise (the device function satisfactorily), and emission of noise (the device does not disturb other devices). While Electromagnetic Interference (EMI) refers to the disruptive electromagnetic waves that are radiated by the cables that are used to transmit electronic signals.

was discovered that street lights near the test site were acting as antennas for the 2-10 MHz band and interfered with BBC's World Service, the Civil Aviation Authority and even the GCHQ[9] which is the government's electronic surveillance centre. As a result, the project was disbanded and Nor.Web was shut down at the end of 1999[10].

33. While some companies such as Nor.Web gave up their PLC venture due to interference that they were unable to contained, other companies continue to generate interference on the high frequency band. Austria's PLC deployment in Linz is on unshielded overhead cable. In 2003, the deployment created massive interference in the Red Cross service during a disaster response drill[11].

Question D. This issue relates to the manner in which interference can be contained. In view of the fact that by the year 2008 most power line cables in Malaysia would be buried underground and any remaining overhead will be shielded, would it be prudent to allow PLC deployment now? Or, should deployment be postponed until all the power cables in this country are either buried or shielded?

[9] GCHQ (Government Communications Headquarters) is one of the three key intelligence services in the UK, and along with MI5 and MI6 they have a combined budget of £1 billion. They use some of the world's most sophisticated technology to intercept telecommunications and electronic signals from around the world.

[10] Computing, "Powerline Telecoms: Data over the mains" by Barry Fox, 12 January, 2005, www.computing.co.uk/features/1153611

[11] "Broadband Power Line telecommunications & the amateur service", www.astrosurf.com/lombry/qsl-rfi-bpl.htm

How extensive is this unintentional radiated emission?

34. The extend of these unintentional radiated emission depends on many factors such as the different type of AC power main supply configuration from one country to another and the physical layout of the electricity wiring. The management of unintentionally radiated emission from PLC systems is being addressed under the electromagnetic compatibility regimes in various countries.

35. In the U.K. and Germany, radiation limits related to PLC have been drafted in an attempt to ensure the coexistence between PLC and the radio spectrum users. Until this day, these norms have not been satisfactorily tested in real situations where PLC is deployed full scale in densely populated areas.

36. Major European standardization bodies such as CENELEC and ETSI have been given the mandate by the European Commission to develop harmonized electromagnetic compatibility standards for telecommunications network encompassing telephone lines, coaxial cable as well as power lines. The European Commission believes that once EMC standards governing PLC are established, the efficiency and viability of PLC system can be clearly determined.

37. There are also concerns that PLC may mar the performance of some sensitive equipment. In Switzerland where PLC has been deployed and is currently in service, the regulator has imposed special condition whereby PLC installation must be some 500 meters away from the so-called "sensitive sites" such as medical facilities and military sites.

Question E. There have been claims that PLC causes interference to sensitive equipment as well as standard telecommunications equipment, as such, should the Commission restrict its deployment? Is it viable to restrict its deployment considering the benefit to the public from this technology? In addition, what criteria should be taken into consideration in restricting the deployment? Should the Commission establish a listing of "sensitive sites"; if so what are the sites that should be considered?

Work that is currently being developed by the various EMC standardization bodies in Europe

38. Although there have been standards instituted to ensure electromagnetic compatibility between devices, it is probably the establishment of the limits of electromagnetic field radiated (by data transmission signals through distribution lines) that has been the most controversial subject. Different countries that have their own standardisation bodies have proposed different limits in terms of electric field.

39. The rationale for these various limits varies from case to case. For example, the Radio Society of Great Britain that represents the interests of the British radio amateurs is aiming for 0 dB limit, which is almost equivalent to the noise level in a very quiet rural area. On the other hand, Germany's NB30 is based on an ITU-T limit recommended for the planning of radio stations whereby it should not create disturbance with each other within a given location.

40. Currently, there are a lot of activities within the relevant EMC standardization committees to address the compatibility issues between radio services and PLC. The following are the list of considerations that different EMC standardisation committees undertake in an effort to derive comprehensive standards applicable to PLC;

- Identify the frequency ranges over which PLC and cable transmission are likely to operate now and for the future;
- Identify those services that are likely to be affected by PLC and cable transmissions in general (broadcasting, maritime, radio navigation, radio amateur etc.) and evaluate their protection needs;
- Investigate methods of measuring the emissions from PLC and cable transmissions;
- Perform compatibility studies to derive limiting values for emissions from PLC and cable transmissions to protect primary services;

The European Community's EMC Directive

41. The EMC Directive is just one of the many pieces of European legislation that has been designed to ensure uniform technical regulations throughout Europe, with the aim to simplify market access amongst all the EU countries. Basically, it is a requirement for apparatus protection and leaving it to standards (primarily European harmonized standards) to define the technical requirement to achieve the level of protection required. The EMC Directive requires products to generate no harmful electromagnetic emissions and be immune to defined electromagnetic disturbances and phenomena. Apparatus manufactured in accordance with the EMC Directive are guaranteed free movement within Europe.

The United Kingdom's MPT 1570

42. The MPT 1570 is a specification which the United Kingdom had used for measurement of radiation limits of electromagnetic radiation under the EMC Directive[12] from material substances[13] forming part of a telecommunications system. As stated in MPT 1570, any material substances, when used to carry radio frequency signals as an essential part of a telecommunications system, can be a source of interference to a wide range of radio services that use the radio frequency spectrum. MPT 1570 was used as an enforcement standard by allowing the British Radiocommunications Agency to take action against any telecommunications systems that are found to be emitting electromagnetic energy above the levels specified.

43. To manage the issue of PLC emissions, the United Kingdom had used the MPT 1570. However, it was withdrawn by the U.K. regulator due to commercial protests against it as being not practical and anti-competitive. Until this day, the United Kingdom has not managed to implement new regulations to prevent interference from PLC.

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Germany's NB30

44. Germany's national regulators RegTP[14] issued NB30 limits to control radiation emission below 30 MHz in the shortwave user spectrum. The NB30 was implemented for the purpose of protecting sensitive military and government monitoring and communications services. Early results of PLC field trials in the United Kingdom, Germany, and Switzerland have shown that injecting such signal levels results in excessive radiated emissions. Despite using the NB30 that clearly showed that PLC's emission level exceeded the limits of NB30, deployment of PLC is still allowed. However, NB30 is not imposed for PLC.

The United States

45. Federal Communications Commission's (FCC) Part 15 sets exact limitations on the amount of electromagnetic interference (EMI) allowable from digital computing and other electronic devices (as diverse as wristwatches and musical instruments, typewriters and telephones). This is to regulate the airwaves, especially to limit interference with broadcasting. Part 15 clearly states that the interfering source should be shut down.

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[12] EMC Directive is a new-approach directive laying down apparatus protection requirements and leaving it to standards, primarily European harmonised standards, to define technical requirements to achieve the level of protection required.

[13] Material substances refer to metallic mediums, such as cables and wires that do not form part of any equipment and are "conveyed by means of electromagnetic energy".

[14] RegTP (Regulierungsbehoerde für Telekommunikation und Post) is the regulatory authority for telecommunications and posts of Germany.

46. On October 14, 2004, the FCC announced a ruling that allows the power utilities to provide broadband to their customers via PLC systems. However, there are no measurement procedures in place and the FCC will be developing standard measurement procedures to ensure consistency of test data. Basically, the FCC is not establishing or proposing any standards for PLC nor reducing Part 15 radiated emission limit for PLC systems. It is making changes to Part 15 to accommodate this technology, thus opening the door for the deployment of PLC.

Switzerland

47. Electrical safety concerns are under the jurisdiction of the Office of Energy, while the regulator, Bakom looks into the electromagnetic compatibility of the equipment. General requirements by the Bakom for PLC service license are;

- Devices should comply with EMC essential requirement laid down in the European Union's harmonized standards (e.g., EN 55022)
- PLC installation is only allowed for underground cable.
- Bakom's NT-2721 covers the possibility of specific geographical restriction relating to sensitive sites such as the military and airport, and that any PLC installation must not be within 500 meter radius from these sensitive sites.

Australia

48. The Australian Communications Authority currently has no mandatory standards for PLC equipment that transmits information on frequencies above 525 kHz. There are no standards at the moment, penalties are still imposed in accordance to its section 1992 of the Radiocommunication Act 1992 to anyone or any entity that knowingly or recklessly causes interference to radiocommunications services.

International Telecommunications Union (ITU)

49. ITU was created with the intention of regulating rules concerning spectrum usage. Since access to spectrum is essential to provide radiocommunications services, it is understandable that the spectrum is already used intensely and every single frequency segment of the radio spectrum is fully pre-assigned.

50. Previously, PLC was not within the realm of ITU. This is because it is a fact that metallic networks such as the power grid that transmit digital communications are not supposed to radiate electromagnetic energy in space. As such, there is no requirement to request for access to the radio spectrum. Technically, radiation can be contained to acceptable levels by shielding the conductors. The coaxial cable used by CATV has outer sleeve

protecting the metallic cable. Similarly, high frequency current in perfectly parallel wires such as the telephone line twisted pairs present limited radiation and are suitable for digital telecommunications. However, in the case of PLC, since RF signal is injected at a much higher frequency, unintentional radio emission occurs. ITU is currently addressing the issue on PLC and the development on the related regulatory issues is currently being looked at by ITU-R[15].

D. STANDARDS

51. Unlike DSL and cable that have standards that work to various levels of effectiveness, PLC has no standard for interoperability at this time. The Commission understands that the non-existence standard for PLC system will pose another challenge in addressing PLC. Although PLC has also been in use around Europe for quite sometime, there is no one standard but a number of proprietary systems and each with its advantages and shortcomings.

52. Another importance to having a standard or standards in place is that the standard will define the tests that must be conducted. This is to ensure that the device or system meets the specifications or other significant or applicable parameters.

OPERA

53. To make PLC a viable business, the EU believes that its standardisation is essential. Through a project called the OPERA (Open PLC European Research Alliance), the EU's executive arm, the European Commission (EC) has made a pledge to be the main sponsor of this program. Thirty-five European energy companies, telecommunication equipment manufacturers, consultancies, and universities currently represent OPERA[16]. OPERA officially began in February, 2004 and is a 4-year program; it is also part of EU's "Broadband for All"[17] initiative. The EC is sponsoring € 9 million (US$ 11.2 mil /RM 42.5 mil) for this effort. The first phase which last 2 years, has a € 20 million budget. One of the primary goals that OPERA members hope to achieve is the migration from the current PLC proprietary systems to one that can be used throughout Europe.

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[15] ITU-R is the radio sector of the International Telecommunication Union whose function is to standardise and regulate international radio and telecommunications. ITU-R manages the radio frequency spectrum and so reduces the interference between radio stations in various countries.

[16] "EU launches Power Line Net Initiative", INFOWORLD, Feb 02, 2004

[17] "Broadband for All" program is formulated by the EU as part of its mission to make broadband accessible to European users, including those in less developed regions. It believes that this is a key enabler to the wider deployment of the information and knowledge-based society and economy.

54. Since formal standardisation procedures are taking too long, some Nordic utilities have decided to create their own *de facto* standard without waiting for an actual standard to be available in 4 years. Some jurisdictions are monitoring the regulatory developments overseas regarding PLC systems, and are looking at ways to apply the arising issues domestically.

55. With no standards on PLC, there is no multi-vendor solution and issues such as interoperability between equipment from different manufacturers and the co-existence of multiple PLC systems within the same environment cannot be addressed. The Commission is of the opinion that any proprietary and fragmented solution would pose a challenge to deploy and support.

> ***Question F.*** The Commission is of the opinion that it has three options to follow before it allows the deployment of PLC i.e., delay the deployment until an ITU standard is in place, delay the deployment until standards from OPERA is in place or just roll out PLC since other countries are moving ahead with PLC in the absence of a worldwide standard. The Commission notes that PLC has the potential to be a new broadband pipe into the homes, as such, would like to consider permitting the implementation of PLC. Do you agree with the Commission's stance? How can the Commission further encourage the deployment of broadband services in Malaysia via PLC?

56. Unless the cables are suitably shielded and screened, terminated and filtered, signals cannot be confined to power distribution cables alone and will be radiated by all connected wiring. Even for cable TV network, it has its own existing limits that are imposed because the emissions from cable TV network have the capacity to interfere with other nearby radio services.

57. Several European standardization bodies are currently working on the development of EMC standards related to PLC. This includes ETSI[18] PLT working with CENELEC[19] and CISPR[20] on Powerline Harmonised Standards to cover;

[18] ETSI – European Telecommunications Standards Institute operate by French rights with the aims to elaborate technical standards that are required for development of European telecommunication market.

[19] CENELEC – European Committee for Electrotechnical Standardization established in 1973 under Belgian law develops standards for the European market.

[20] CISPR is the acronym standing for the Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference) of IEC - International Electrotechnical Commission.

- Emission and immunity related to PowerLine Communications
- Additional Essential Requirements of the R&TTE[21] Directive

Standards that may address PLC's interference and the electrical safety issues

58. The Commission is of the opinion that the following are list of standards which PLC systems could be required to comply with at a minimum while actual standardisation work related to PLC system is still in progress. These lists of standard define the testing procedures or test plans that must be performed with the intention of addressing the issues on electromagnetic emission, electromagnetic immunity as well as the safety concerns when being installed onto the electricity supply network.

Electromagnetic Emission		
No	Item	Test Procedure
1.	AC Mains Terminal Continuous Disturbance Voltage	EN 55022: 1998 /A1:2000
2.	AC Mains Terminal Harmonics	EN 61000-3-2:2000
3.	AC Mains Terminal Voltage Fluctuation	EN 61000-3-3:1995
4.	Common mode disturbance at telecommunication ports	EN 55022:1998 /A1:2000
5.	Radiated Electric Field Strength	EN 55022:1998 /A1:2000

Electromagnetic Susceptibility (Immunity)			
No	Item	Test Procedure	Specification
1.	ESD	EN 61000-4-2:1995 /A1:1998 /A2:2001 Refer to EN55024:1998 Refer to Paragraph 4.2.1 for details of test	± 4 kV contact, ± 8 kV air discharge
2.	RS: Radiated Susceptibility (amplitude modulated)	EN 61000-4-3:1996 /A2:2001	(80-1000)MHz 3 V/m (1 kHz, AM 80%)

[21] R&TTE - Radio and Telecommunications Terminal Equipment Directive is the European radio and telecommunications regulation.

3.	CS: Conducted Susceptibility (amplitude modulated) AC power input ports	EN 61000-4-6:1996 /A1:2001	(0.15-80)MHz, 3V (1kHz, AM 80%)
4.	CS: Conducted Susceptibility (amplitude modulated) DC power input ports	EN 61000-4-6:1996 /A1:2001	(0.15-80)MHz, 3V (1kHz, AM 80%)
5.	CS: Conducted Susceptibility (amplitude modulated) Signal and telecommunications ports	EN 61000-4-6:1996 /A1:2001	(0.15-80)MHz, 3V (1kHz, AM 80%)
6.	EFT/Burst, AC power input ports	EN 61000-4-4:1995 /A1:2001	±1 kV (5/50ns, 5kHz)
7.	EFT/Burst, DC power input ports	EN 61000-4-4:1995 /A1:2001	±0.5 kV (5/50ns, 5kHz)
8.	EFT/Burst, Signal and telecommunications ports	EN 61000-4-4:1995 /A1:2001	±0.5 kV (5/50ns, 5kHz)
9.	Surge, AC power input ports	EN 61000-4-5:1995 /A1:2001	± 1 kV differential, ± 2 kV common
10. 11.	Surge, DC power input ports Surge, Signal and telecommunications ports	EN 61000-4-5:1995 /A1:2001 EN 61000-4-5:1995 /A1:2001	±0.5 kV common ± 1 kV common
12.	Power Frequency Magnetic Field	EN 61000-4-8:1993 /A1:2001	1 A/m, 50Hz
13.	Voltage Dip, AC power input ports	EN 61000-4-11:1994 /A1:2001	-95%, 10ms -30%, 500ms (changes to occur at 0 degree crossover point of the voltage wave form)
14.	Voltage Interruption, AC power input ports	EN 61000-4-11: 1994 /A1:2001	-95%, 5ms (changes to occur at 0 degree crossover point of the voltage wave form)

Question G. While standards related to PLC specifically are being developed, should the above specifications be used instead with the intent of minimizing the interference level that PLC may cause to other communications services in Malaysia? If they are not sufficient, please detail other standards that should be considered.

E. QUALITY OF SERVICE, RELIABILITY, SAFETY AND SECURITY

59. As PLC is ultimately interconnected with the other telecommunications network, it may be necessary to insist that prospective PLC providers demonstrate that this interconnection will not compromise the services of the telephone service providers, its facilities, or personnel. Safety requirements for PLC installation may need to be streamlined to those provisions imposed by the power company and the provider of communications services.

60. Noting also that the last connectivity to the end-user on the power line infrastructure is owned by a power company, the power company might be particularly concerned at the potential pollution of its infrastructure, or the diminished utility of that infrastructure, from signals introduced on it from private households.

61. There are other compatibility issues associated with existing supply authority systems and the electrical power supply network, for example, electrical safety requirements, protection of signalling needs of power line authorities, and potential effects on other electrical devices.

62. Due to the sharing of bandwidth, stronger encryption may be needed. Some PLC service providers have incorporated appropriate measure such as using PLC modems that can encrypt traffic to make it difficult to tap into the data traffic. There are also PLC modems that have IP address and authentication information before any access is allowed. However stronger privacy protection may be needed for office environments or apartment building and hotels use.

Question H. Since PLC systems utilise electrical wires, safety has to be a fundamental consideration in any implementation procedures, who should be responsible for the PLC installation; the personnel of the Power Company or the PLC provider? If the responsibility lies with the PLC provider, then it is required to provide the necessary training to enable the worker to carry out the task safely. What are the qualifications and/or necessary certification program needed by the installers to ensure their safety?

ADDRESSING THE ISSUE OF INTERFERENCE

63. In the event that PLC is introduced in Malaysia, the Commission's main concerned is protecting the operations of other spectrum uses from interference from PLC operations. As such, it would like to seek the public views on how it could adequately attempt to address this matter.

64. The following are some of the alternatives that are currently being considered and deliberated and is anticipated to alleviate the issue of harmful interference by PLC systems.

a. Frequency Notching

65. An option that can be considered is for the PLC system to have the capability and feature to modifying its operations to avoid instances of harmful interference. PLC system should be intelligent enough to resolve interference at specific location, without disrupting services and shutting down the entire system. For example, a PLC system may have the ability to shift its operating frequency in order to determine whether its system is the source of the interference. By shifting frequency and reset to use other non-interfering frequencies, PLC service disruption can be avoided.

b. Self Power Adjustment

66. PLC equipment can also have the capability for self power adjustment. The modem will measure the power it receives and will self adjust just enough power for the return path. This will minimize if any, unwanted interference.

Question I. In the United States, the FCC has made a ruling to allow power companies to provide broadband Internet access via PLC. However, this is subject to the ability of the system to do frequency notching and power adjustment. These features have not been widely used to enable us to effectively gauge its effectiveness in managing the issue of interference. Should the Commission incorporate these features as part of our requirement?

THE WAY FORWARD AND CONCLUSION

67. As noted in the objective section of this paper, the purpose of this Public Consultation is essentially to determine the market readiness towards the introduction and deployment of PLC systems in Malaysia. It also seeks to determine whether the provision of PLC services should be regulated and the manner in which it should be regulated.

68. As there are currently no applicable technical standards to PLC and that interference is a major issue, the PC Paper seeks to determine whether the Commission should consider allowing this technology to be deployed. This paper also describes the various alternatives such as having PLC systems that have frequency notching capability and power adjustment feature which are currently being considered by other jurisdictions to minimize the issue of disturbance to other radiocommunications users and hence, a means for the Commission to meet its obligation to protect the licensed services.

69. With respect to the regulatory framework, the PC Paper examines the various elements such as the Power Line Carrier Unit (PLCUs), coupler, repeater and PLC modem that constitute a PLC system and considers various possible licensing options that may be needed to deploy the services. The Commission sees PLC's role as both a competitive broadband alternative and as a tool to bridge the digital divide of this country. In the event that PLC is allowed to be deployed in Malaysia, the Commission's next step is to look into aspects such as access arrangements and the broader public policy approaches that would promote competition in the broadband market.

70. Over and above the issues raised in this paper, the Commission would appreciate any additional comments or views that you have on this subject.

APPENDIX A

PLC Trials and Deployment

Germany
Largest deployment is in Mannheim by PowerPlus Communications (PPC) with 6,000 PLC subscribers. Installation in Mannheim is 70% underground, while the remaining 30% is shielded overhead. PLC is also used for setting up a LAN at Willebrand Middle School, in Herten, Germany. It received a reputation of being inexpensive and fast.

A few years ago, besides MVV Energie AG there was other power company that entered the power line fray in Germany. They were Eon AG in Dusseldorf and EnBW Energie Baden-Wurttemberg AG in Karlsruhe. Eon left the PLC venture stating that the technology is too complicated and costly to deploy.

Switzerland
There are some 250,000 PLC-enable households and 1,500 active PLC subscribers in Fribourg. PLC is allowed for underground cables only. It began its pilot testing in 2000 and launched its service the subsequent year. Fribourg has 30% overhead and 70% underground cable. PLC is only allowed for underground cable.

France
There are two successful pilot projects with the local power utility EDF (Electricité de France) and also with Plus in EDF subsidiaries.

Italy
A pilot project is underway in Florence, Italy, with power company Enel.

China
Since around 2001, FibrLINK Networks Co., LTD., a subsidiary of the State Power Corporation of China has been conducting a demonstrative experiment in Beijing, China. They plan to commercialize the service at the end of 2003.

Korea
PLC demonstrative experiment was permitted in 2002. It is currently conducted in locations including Seoul and Cheju Island. Korea plans to deregulate its Radio Law in time for the commercialization in 2003.

Hong Kong
PLC has been made available commercially for over a few thousand locations at hotels and housing complexes in Hong Kong since 2002.

Singapore Communications businesses affiliated with power companies are evaluating the possibility of entering the cost effective PLC market in order to greatly reduce the communications charge.

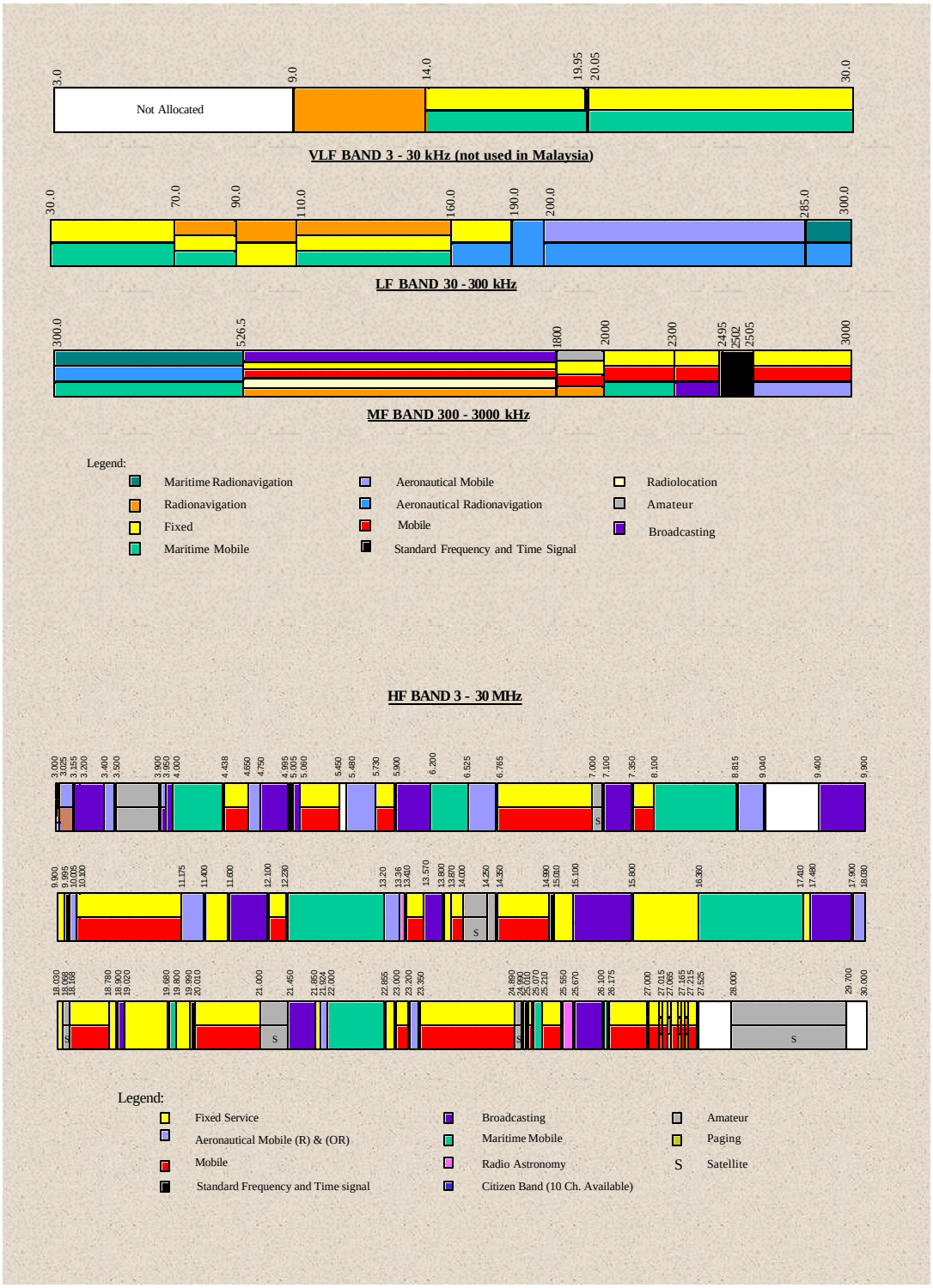
Indonesia
PLC-based IP phones are under evaluation.

Spain
One of the largest power companies in Spain (Endesa) is conducting a demonstrative experiment at several locations. Several Spanish power companies (Endesa, Iberdrola) are planning on making commercial-based PLC services available domestically in the near future.

USA
Demonstrative experiments for access are conducted at several domestic locations. Local communities are assessing the technology as the strong candidate for the last mile access for the broadband services.

APPENDIX B

Current services available in Malaysia for frequency below 30 MHz



GLOSSARY OF TERMS

Amateur Radio

Amateur radio operators who transmit over short-wave frequencies are called ham radio operators. Ham radio is non-commercial, two-way transmission in which messages are sent by Morse code or by voice. Because amateur [transmissions] interfered with low-wave transmission of commercial and military communications, the United States government instituted controls in 1911. Ham radio enthusiasts were limited to the use of short-wave frequencies, which at the time was deemed to have limited potential.

Broadband Fixed Wireless Access (BFWA)

BFWA allows high-speed data connections using radio links between an aerial location on the user's premises and a base station, rather than using telephone line or a cable television network. BFWA services in urban areas compete with ADSL/cable modem services. The full extent to which BFWA can mirror the coverage of the ADSL and cable modem technologies is limited to the extent that this technology requires "line of sight" which can be disrupted by high-rise buildings.

DSL

DSL (Digital Subscriber Line) technology uses existing 2-wire copper telephone wiring to deliver high-speed data services to homes and businesses. This digital broadband line directly connects your premises to the Internet, via the existing copper telephone lines.

High Frequency (HF) Radio

HF (high-frequency) radio is just a small part of the radio spectrum. Within this segment of radio frequencies are many services, including short-wave broadcasters, ham radio operators, long-range marine and aircraft communications, etc. The HF part of the spectrum is notable for its potential for long distance communications, depending on frequency and time of day.

Home Plug

HomePlug is the specification for a technology that connects devices to each other through the power lines in a home. HomePlug-certified products connect PCs and other devices that use Ethernet, USB and 802.11 "Wi-Fi" technologies to the power line via a HomePlug "bridge" or "adapter". There are products with HomePlug technology built-in.

Internet connectivity

This refers to the ability to access any destination on the Internet from a point of interconnection with an Internet backbone.

Internet Service Provider (ISP)

A company that provides individuals and other companies access to the Internet and other related services.

ITU

ITU is a body of the United Nations that includes members from around the world. There are three specific groups within the ITU are relevant to telecommunications. The ITU-T, the telecommunications standardization sector, develops recommendations for wireline networks. ITU-R, the radio communications standardization sector, deals with the wireless arena. The ITU-D sector works on standards for developing nations. The ITU standards are followed throughout most of the world, including Africa, most of Asia-Pacific, Europe, Latin America, and the Middle East.

Power Line Noise

In communications, interference (static) that destroys the integrity of signals on a line is referred to as “noise”. Noise can come from a variety of sources, including radio waves, nearby electrical wires, lightning, and bad connections. One of the major advantages of fibre optic cables over metal/copper cables are is that they are much less susceptible to noise.

SCADA

Supervisory Control And Data Acquisition is a utility information system used in transmission and distribution networks. The systems can monitor and control a process without requiring an operator’s supervision, and notify personnel of current or potential alarm situations. SCADA systems will count, totalize, trend, data log and calculate valuable information about the process. The gathered information can be utilized to “fine tune” the process, thus allowing it to run at its peak performance. This can help a utility to save money on, man-hours, maintenance, electric power and natural resources.

Short Wave (SW)

The term "short-wave" refers to a range of radio frequencies. Short-wave begins just beyond the end of the medium-wave scale and extends roughly from 2,000 kHz all the way up to 30,000 kHz (2 MHz through 30 MHz). It is called "short," "medium," etc., because it refers to the length of the radio waves that go from the radio station to the receiver's antenna. The lower the frequency, the longer is the wave.

Below medium-wave there is a frequency range called "long wave," and below that "very long wave." There's no such thing as "very short wave;" it's called "very high frequency” or VHF instead, which contains the TV and FM bands. Above that is ultra high frequency (UHF, more TV channels in some parts of the world), then extremely high frequency (EHF) and then "microwave," a term which again refers to the length of the radio wave (and the microwave oven is actually emitting radio frequency energy)

Signal Attenuation

Signal attenuation relates to the loss of signal strength during transmission. If the signal attenuates too much the data becomes unreliable or unintelligible. The farther away from an access point or point of origin, the more signal attenuation will occur.

Unbalanced Line

A transmission line in which the voltage levels on the two conductors are not equal with respect to ground.

Since most domestic power lines are suspended, they tend to be unbalanced. Therefore, when transmitting a high-frequency current, an electromagnetic wave is emitted.

Universal Serial Bus (USB)

This is an external bus standard that supports data transfer rates of 12 Mbps. A single USB port can be used to connect up to 127 peripheral devices, such as mice, modems, and keyboards. USB also supports *Plug-and-Play* installation and *hot plugging*. USB is expected to completely replace serial and parallel ports.