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The emission characteristics and interference analysis of Power Line Telecommunication ☆

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ABSTRACT

This paper describes characteristics of PLT emission with experiment in semi-anechoic chamber and suggests the method for aggregating multiple interferences based on probabilistic approach in the situation in which multiple PLT modems are operating in close proximity to the radio receiver. The levels of the conducted and radiated emission and the APD characteristics are presented. And compatibility between PLT and radio receiver is analyzed with suggested method. This will be useful for assessing interference effect in the field of radio communication and electromagnetic compatibility.

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1. Introduction

The data communication by using telephone lines is not suitable for high speed data and wide area. The Cable TV networks provide high data transfer but serve limited range that user can connect to the cable TV network. On the other hand, PLT (Power Line Telecommunication) is rapidly developing technology using the existing electricity power lines for data transmission.

The main purpose of PLT system is internet access which connects to the outside world and home networking which is interconnecting apparatus within the home. As PLT uses existing power line, it is very cost-effective with no additional installation, therefore, PLT is highly recommended in large territory of countries and is popular technology in terms of smart grid.

As PLT has obvious economic advantage, telecommunications regulators is more favorable to use it because, it is a way to have competition in the market for providing broadband services. Service providers hope this will make domestic broadband access both cheaper and more readily available. Recently, in order to obtain higher data rate, OFDM (Orthogonal Frequency Division Multiplexing) and MIMO (Multiple Input Multiple Output) technology is considered in PLT system [1].

However, the electrical power line has been designed to transfer power with frequency of 50 or 60 Hz and is not designed to transfer data. This unshielded and unbalanced power lines can be a good radiator and cause unwanted emission of wide band noise which interfere radio communication services in HF band. Before the technology can be deployed on a large-scale, this potential to cause harmful interference with other users must be resolved. In order to solve the interference problem, several studies are investigated based on measurement and numerical analysis [2–8].

In this paper, the conducted and radiated emission levels are measured in semi-anechoic chamber. And the emission characteristic of PLT is analyzed whether the characteristic of radiation is Gaussian or non-Gaussian.

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The potential interference of PLT is expected by using measurement value in below 30 MHz. The probabilistic method to assess aggregated radiated emission from PLT is proposed and the interference from PLT into radio receiver is analyzed with the suggested method. The method for aggregating PLT interferences is required to consider multiple interferences of PLT with a number of modems. The result will be useful for assessing interference effect in the field of radio communication and electromagnetic compatibility.

2. Emission measurement with experiment

2.1. Conducted emission

An experiment associated with conducted emission of PLT modem is carried out to verify the interference level.

As shown in Fig. 1, configuration is set up to investigate the conducted emission level connected to main cable. We measure the voltage (dBuV) using receiver and compare with Certified Information System Security Professional 22 limit for Information Technology Equipment (ITE) devices [9].

The experiment is performed with Line Impedance Stabilization Network (LISN) to provide precise impedance to the power input of the PLT modem, and to prevent interference from external noises. The two PC with PLT modem is connected with wiring each other and LISN is located between wires that are connected with PC. Then, the PLT voltage in wire was measured.

The measurement is performed in 3-mode (data, idle, background) respectively, and those emission levels are compared with CISPR 22 limit as in Fig. 2.

As a result, high level of PLT is in the frequency band of 3–20 MHz and the notch filtering is considered for protecting amateur radio service. The frequency of amateur radio is summarized in Table 1 [10].

2.2. Radiated emission

An experiment associated with radiated emission of PLT modem is carried out as in Fig. 3. It is performed in a semi-anechoic chamber to prevent interference from external interference. The electric field strength of PLT is measured by using loop antenna and the separation distance is 30 cm between cable of PLT and loop antenna.

Emission level at each mode is presented in Fig. 4, the high level of PLT is in the frequency band of 3∼10 MHz.

It is found out that not only radiated emission of PLT can be interference to amateur radio but also it is possible to give interference to AM broadcasting service. Table 2 shows the frequency band for AM radio broadcasting.

2.3. Amplitude Probability Distribution

If it is possible to figure out emission characteristic of source, in aspect of victim which is affected from source, mitigation technique for interference can be established

Fig. 1. Configuration for conducted emission.

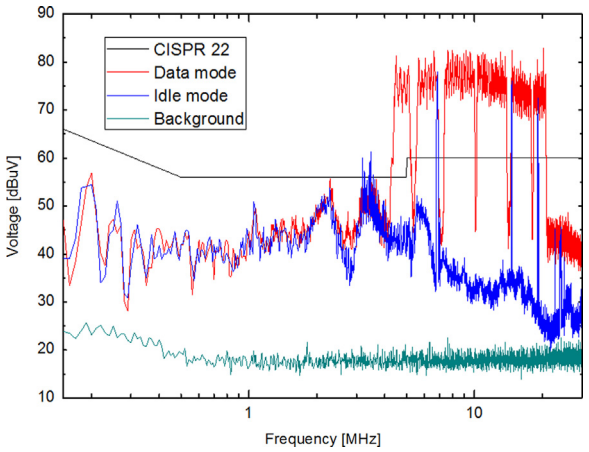

Fig. 2. Conducted emission levels.

Table 1
Frequency band for amateur radio.

Frequency (MHz)		
3.50∼3.80	7.00∼7.20	10.10∼10.15
14.00∼14.35	18.068∼18.168	21.00∼24.45
24.89∼24.99	28.00∼29.70	

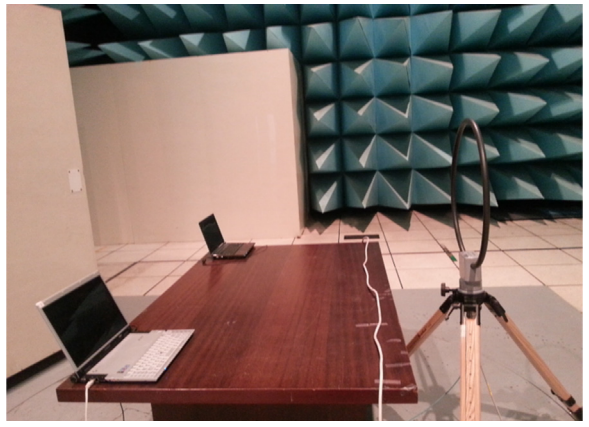

Fig. 3. Configuration for radiated emission.

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