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A STUDY ON PLC PERFORMANCE UNDER REAL CONDITIONS FOR VIDEO S URVEILLANCE

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ABSTRACT

Video Surveillance also known as close-circuit television (CCTV) is close system for not public distributed but used monitor in local area network, the function for security purposes and surveillance. CCTV has problems on its implementation since it needs many cables and difficult to implement. This study proposed method of power line communication (PLC) with under real conditions, to solve the problem in the using of cables and reduce the cost. PLC is a tool that is used to transfer the data information as the information channel. The implementation was used in the four floors - building. The scenarios that used are; direct wired L3 Switch and direct wireless. The results showed that direct wired has the better value on throughput and delay performances, while the direct wireless has the worst, but still continued to transfer data.

Keywords: PLC, CCTV, throughput, delay.

INTRODUCTION

Technological progress such as local area network (LAN), a personal area network (PAN), smart grid and home networking have become the limelight at the speed of access and easiness in implementation, but not everyone can apply them since their capability is different. CCTV relies on strategic placement of cameras and private observation of the camera's input on monitors, the system is called "closed-circuit" because the cameras, monitors and/or video recorders communicate across a proprietary coaxial cable run or wireless communication link. Access to data transmission is limited by design. Close-circuit television (CCTV) is one of the difficult cases besides requiring UTP cables; it also needs a substantial cost. The other problem for transferring the data in home network is the wiring infrastructure, installation and maintenance, extensibility, security automatic protect, connecting one PC to another PCs with UTP cables.

The researchers provided the solution by using PLC, and then the UTP cables can be minimized. PLC is a technology that can transmit data information by using the carrier of electricity, then it makes PLC can replace the data cable function.

Channel method that used in this study is multipath interference since the system can be implemented on existing conditions in a building. In the study [1] discussed about the influence of multipath interference, explained that the distribution box with apartment in no more than 10 meters to increase system capacity and reduce interference occurs, the system is also more stable when using 1 MHz The study on standards for street lighting control by using a PLC modem inG3 and PRIME PLC [2], discussed about narrowband power line communications, field test discussed about the data rate measurements to be sent through switchgear, complicated topology and noisy topology. The study [3], examined about the implementation of microcontroller-based temperature measurement by using power line communication; this product technique need less hardware and more flexible to change control management over the three-phase power lines.
There are some challenges for PLC; the electricity network, the frequency used on every country that based on any policy, the transmission that is used since it affects the mismatch impedance. This study will be modeled on PLC network so it will not inhibit and delay the speed of the data received on the receiver. The focus of this study is the use of CCTV with a PLC based on a storey building with background traffic under real conditions. The scenarios that used in this study are direct wireless, L3 Switch and direct wireless.

The generic structure of this paper are section I for the problem of PLC based on CCTV, section II for Model System, PLC Standards, Power Distribution Standards, section III for experimental setup, how to integrated between CCTV and PLC, section IV for results and analysis, and then section V for the conclusion.

Model system

PLC Topology

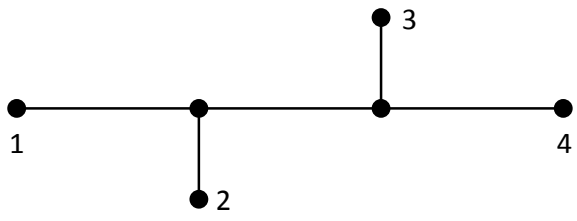

Figure-1. PLC noise tap.

Figure-1 is about the process of communication between node 1 and node 4 that can be affected by various channel conditions occurring on the node 2 and node 3 then the communication process can be interrupted.

PLC has been categorized with several parameters: modulation, frequency, transmission speed,

distance, etc. The most attractive is frequency band, since the electrical line and the data are embedded each other, in order to overlap need in frequency scenario.

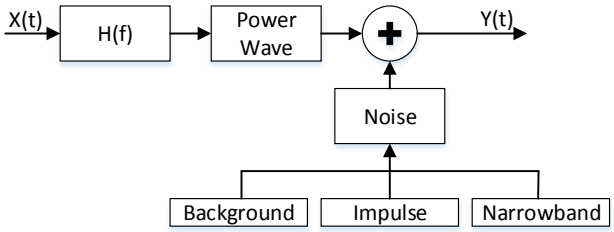

Figure-2. Block Diagram PLC Communications.

Figure 2 is an overview of the PLC work process, by using a transfer function $H(f)$, wave power, and background noise. While on the transfer function H is multipath fading channels that can be written as the following equation:

$$H(f) = \sum_{i=0}^{T-1} \alpha_i e^{-2\pi f \tau_i} \quad (1)$$

$$\tau_i = \frac{I_i}{v_p} \quad (2)$$

Where H (f) as the transfer functions of a multipath communication channel, α_i is attenuation, τ_i time delay, $I_i$is the length of the track, v_p is the propagation velocity [1].

$$v_p = \frac{c}{\sqrt{\varepsilon_r}} \quad (3)$$

Where c as the speed of light 3.10^8 m/s, ε_r= 4, so the propagation velocity is 1.5.10^8 m/s, with a range of frequencies used up to 1 MHz.

PLC Standards

In general, there are two standard types of power line communication; NPLC (Narrowband PLC) and BPLC (BPLC), the fundamental difference between them are the speed and the different uses of the operating frequency [4], the Narrowband PLC uses the maximum park voltage equals to 120 dB and the operating frequency is divided into two parts, based on the US FCC to 500 KHz, while the Cenelec-A uses the operating frequency in range between 9-95 KHz. In increasing the speed of data, the used of frequency must be higher. The important standards of PLC are PRIME, G3, S-FSK, LonWorks, KNX, Cebus. The Broadband PLC uses the operating frequency between 1.8-250 MHz, the maximum peak voltage equals 134 dB, while the maximum speed that can be achieved is 220Mbps [5]. These high frequencies can be achieved for small distances, usually with small building.

Power distribution standards

In Europe, 3-phase 240 V system is used with the operating frequency about 50 Hz, USA uses 2-phase 220 V system with the operating frequency about 60 Hz, and Japan uses 3-phase 200 V system with the operating frequency about 50 Hz.

CCTV

CCTV is security equipment and recording that is important to use in security monitoring system, since it is not only can record crimes but can also record all the activity surrounding the location, and then it can be used as evidence for the future. By progressing of this technology, more people use this tool besides it is affordable to be purchased. This tool is commonly used for office, police, banks, traffic, and others. The problem most occurs is the use of the cable that connects to CCTV with the server, then not everyone can implement these tools in their neighborhood.

Experimental setup

This stage is divided into 3 sections measurement; direct wired, L3 switches, and wireless direct. The three scenarios are a real topology on building O, floor 1, 2 and 3. There are 7 pieces of CCTVs, while for the traffic nuisance on electrical system has used the real conditions.

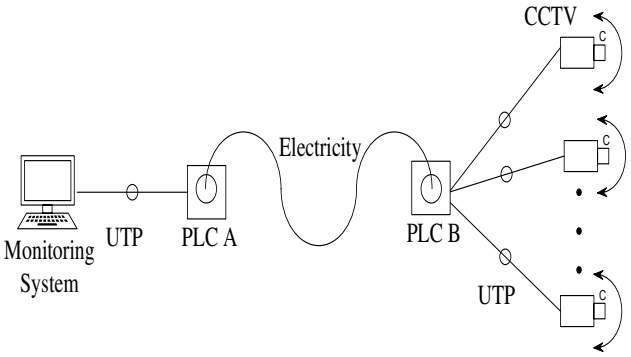

Figure-3. Direct wired.

Figure-3 is an illustration of the use of PLC on communication between CCTV and monitoring system. The outset scenario is the whole monitoring system are using UTP cables to connect the CCTV with the server, but the researchers did the system replacement by using PLC on each end node, and it was expected by doing this replacement could provide the efficiency and cost incurred. In the scheme, the direct-wired PLC B with CCTV is connected with UTP cable.

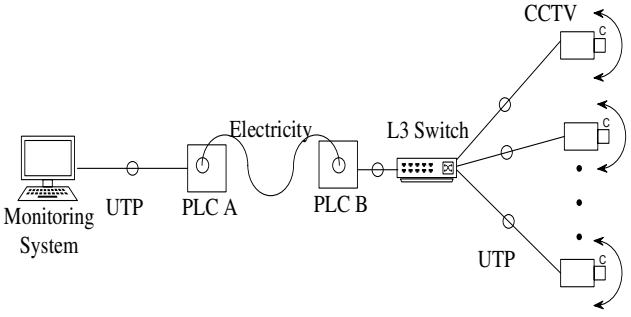

Figure-4. L3 Switch.

Figure-4 is an illustration of the use of PLC, on communication between CCTV monitoring system. The outset scenario is the whole monitoring system are using UTP cables to connect the CCTV with the server, but the researchers did the system replacement by using PLC on each end node, and it was expected by doing this replacement could provide the efficiency and cost incurred. In the scheme of L3 switch PLC B with CCTV are connected to the switch firstly and then the data is sent by using UTP cable.

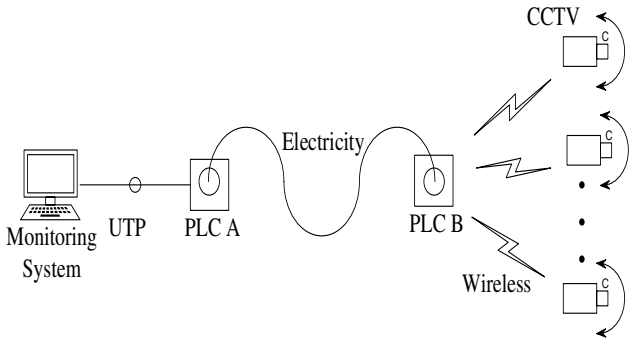

Figure-5. Direct Wireless.

Figure-5 is an illustration of the use of PLC, on communication with the CCTV monitoring system. The outset scenario is the whole monitoring system are using UTP cable to connect the CCTV with the server, but the researchers did the system replacement by using PLC on each end node, and it was expected by doing this replacement could provide the efficiency and cost incurred. In the wireless direct scheme, PLC B and CCTV connected directly to the electromagnetic waves

Results and Analysis

Based on the modeling by using topology in Figure 3, 4 and 5; the researchers did the measurement on throughput and delay value.

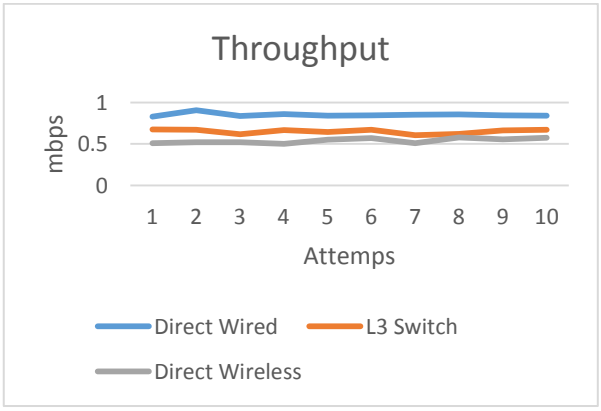

Figure-6. Throughput CCTV.

Figure-6 is the result of the implementation with throughput parameter for measurement on CCTV by using PLC. There are three scenarios on measurement, namely direct wired, L3 Switch and Direct wireless. Direct wired is a measurement that using UTP cables, backbone PLC and L3 Switch is the hop / jump from one network to another, that providing different damping, while the direct wireless is a measurement by using wireless media with PLC as its backbone. Based on the results, direct wired provided the highest scores, on average value about 0.852 mbps, while the L3 switch gave an average value about 0.652 mbps, while the worst outcome obtained for direct wireless, that caused by multipath fading factors that diverse then it disrupted the signal quality level on the average values about 0539 mbps.

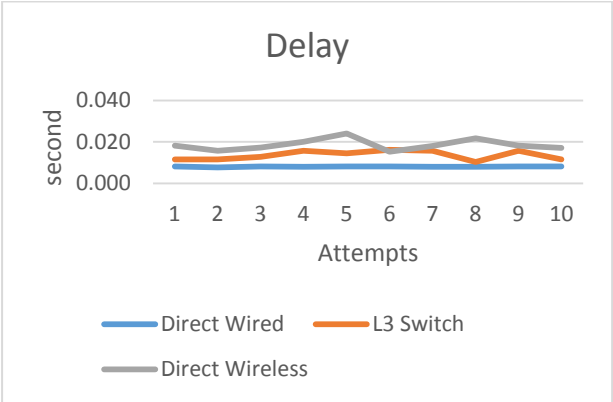

Figure-7. Delay CCTV.

Figure-7 is the result of an experiment on three scenarios in the using of PLC. The client's CCTV with CCTV monitoring system on PLC were used in the first scenario, while the second scenario used the hop system on implementation by using L3 switch, and the third scenario was a measurement of performance between the CCTV wireless and monitoring system. The result from this experiment obtained that the direct-wired scenario provided the least delay about 0.008 seconds, while direct wireless gave the worst value about 0.018seconds.

In throughput and delay scenario, although the worst data are in direct wireless, but it did not give significant impact on the value of quality, then it is still able to provide a good data transfer.

CONCLUSIONS

The benefit of used power line communication (PLC) as the medium data transmission at building has been investigated. The research has been carried out to measure the results of the CCTV using -based power line communication. Based on the results which obtained from the quality components that includes throughput and delay, it can be seen that the direct wired components with PLC is more dominant on throughput and delay, while the PLC that was integrated with wireless networks have worse value than other parameters; but on the existing conditions in a building, it can be tolerated in terms of throughput and delay. Then it can be concluded that PLC is able to use the cables efficiently, and the result that obtained for the quality components for throughput and delay, from the three scenarios (direct wired, L3 switch

and direct wireless), all are well and the value obtained is still above the boundary.

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