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Design and implementation of high data rate system for the diffuse indoor channel using vlc

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ABSTRACT

The limited modulation bandwidth and the non-linearity nature of LEDs are the key challenges to visible light communication. In general, one LED lamp consists of multiple LED chips. In this letter, these LED chips are used for parallel transmission though multi-LED phase-shifted OOK (MP-OOK) modulation. For MP-OOK, the bandwidth efficiency is approximate N times that of conventional OOK (N is the number of LED chips). For each branch, the modulation format is OOK. Hence, MP-OOK has a better anti-nonlinearity performance than other high-order modulation formats, such as DC-biased optical orthogonal frequency-division multiplexing (DCO-OFDM). The simulation comparisons between MP-OOK and DCO-OFDM verify these. VLC could also enable indoor as well as improve city canyon navigation where GPS signaling is weak or nonexistent. Due to the simplicity of its front-end hardware, it can play a significant role in enabling the Internet of Things and machine to- machine communications in general. Car-to car communications may be one of the first implementation scenarios as manufacturers are beginning to make a move toward solid-state lighting solutions. Other possible areas that stand to benefit from the practical implementation of VLC include museums, hospitals, and underwater communications.

KEY WORDS — *Multi-LED phase-shifted OOK (MP-OOK) modulation, KEIL, Light-emitting diode (LED), Intercell interference coordination (ICIC).*

I. INTRODUCTION

Since the introduction of mobile technologies over 30 years ago, wireless communications have evolved into a utility similar to water and electricity, fundamental to the socio-economic growth of modern society. To support the ever growing demand for mobile communications, cellular networks have had to evolve from simple local service providers to massively complex cooperative systems.

Indeed, meeting this exponentially growing demand of mobile communications services over the last few years and the corresponding network capacity evolution is the main challenge for wireless communications over the next decade(s).

Due to the large growth of mobile communications over the past two decades, cellular systems have resorted to fuller and denser reuse of bandwidth to cope with the growing demand. On one hand, this approach raises the achievable system capacity. On the other hand, however, the increased interference caused by the dense spatial reuse inherently limits the achievable network throughput. Therefore, the spectral efficiency gap between users' demand and network capabilities is ever growing.

Most recently, visible light communication has been identified as well equipped to provide additional bandwidth and system capacity without aggregating the interference in the mobile network. Furthermore, energy-efficient indoor lighting and the large amount of indoor traffic can be combined inherently. In this article, VLC is examined as a viable and ready complement to RF indoor communications, and advancement toward future communications.

Various application scenarios are discussed, presented with supporting simulation results, and the current technologies and challenges pertaining to VLC implementation are investigated. Discrepancy between traffic demand and network capacity as a result of the continued proliferation of mobile communications. From Shannon's initial work in information theory, it is clear that the capacity of a wireless link (and, by extension, of a network) is directly proportional to the available bandwidth. The increased frequency reuse introduces both inter- and intracell interference, which limits the achievable capacity of the network.

To this extent, the conventional methods for capacity improvement, enhanced spatial reuse and intercell interference coordination (ICIC), will be unable to support the growing demand for mobile communications. Therefore, a new radio frequency (RF)-orthogonal communication medium is required to fill the ever increasing capacity gap.

Visible light communication (VLC) relies on the visible light (VL) spectrum for communication rather than the cluttered, scarce, and expensive RF spectra used today for wireless communications. In fact, VL is not regulated, and can therefore be used freely for communication purposes, significantly reducing the costs for operators. Thus, VLC presents a viable alternative to traditional communication methods and may be used as a complement to current RF communications. Furthermore, recent studies indicate that a substantial portion (> 70 percent) of wireless traffic originates indoors.

Signal propagation through walls, however, severely inhibits the operation of indoor data services, which is attracting considerable interest in providing wireless communications directly indoors. Indeed, VLC is well suited to fill this function as:

- Most indoor environments are illuminated.
- VL cannot penetrate solid objects.
- VL can easily be directed through optics.
- As previously mentioned, it is interference orthogonal to the cellular network.

These characteristics permit very close spacing between VLC nodes, thereby increasing the spatial reuse of resources, providing higher data density, and resulting in increased network capacity. In addition, in an attempt to reduce the carbon footprint of the information and communication technology (ICT) industry, there has been a research drive for more energy-efficient networks. In this context, another advantage of VLC systems is that the energy used for communication in VLC is essentially free due to the lighting requirement(s) of indoor spaces; that is, no extra energy is required for information transmission, with minimal additional power to drive the necessary circuitry for communication.

Although both VL and RF communication employ electromagnetic radiation as the information medium, the two concepts differ significantly in their inherent properties. Waves in the visible region of the spectrum cannot penetrate through most surfaces that are present in everyday surroundings. Radio waves, on the other hand, are particularly apt at providing sufficient connectivity through the majority of commonly used materials.

As previously mentioned, this offers very interesting benefits. Information may be contained within the confined space of the specific premises where a VLC system is deployed. This practically eliminates the possibility of casual eavesdropping.

The wavelength of VL (380 nm to 750 nm) is much smaller than the typical area of a photo detector, which effectively removes multipath fading (as opposed to RF communication) from the system. In addition, signals in the optical domain do not interfere with the operation of sensitive electronic systems and can be used in a variety of applications where RF is not allowed, e.g., hospitals, aircraft, chemical lants).

II. II.EXISTING METHOD

This system presents a new color shift keying (CSK) modulation format for wireless visible light communication (VLC), based on four colors instead of the three colors used in the existing IEEE 802.15.7 CSK physical layer standard. The new four color system uses a novel intensity modulation and direct detection approach to realize a four-dimensional signaling scheme that uses the available color and signal spaces efficiently. The bit error rate evaluation of both the existing and proposed system shows that the new four color scheme achieves a significant 4.4-dB electrical SNR gain over the three color scheme for an additive white Gaussian noise channel. The performance of existing and proposed CSK systems is examined over a range of dispersive optical wireless channels including the channel crosstalk and insertion losses, which reveals that the four color CSK scheme is more power efficient and reliable than the three color scheme for a particular amount of delay spread that the optical wireless channel may have.

III. PROPOSED METHOD

In existing method, there are multicolor can be used for communication. The error rate of the communication is high due to intensity switching modulation between different colors. So that we use single color light wave communication using color phase shift keying. In our system controls the error and operate efficient potential high data rate indoor communication using phase shifted OOK modulation.

Functional block diagram

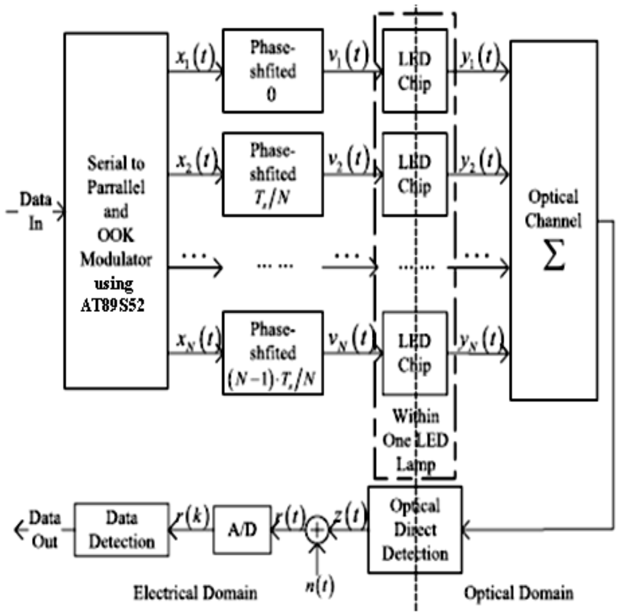

Fig.1.System model of the VLC system based on MP-OOK

System description

The VLC system model based on MP-OOK is depicted in Fig.1 It is composed of *N* LED chips and a PD. High speed bit stream is divided into *N* parallel bit streams. Then each bit stream is modulated into OOK signal *xi (t)* and the symbol period of OOK signal is *Ts.* Compared with the *(i*−1*)*th branch, the OOK signal of the *i* th branch has a shifted phase of *Ts/N*. The baseband signal *vi (t)* which is used to modulate the *i* th LED chip can be expressed as

$$v_i(t) = x_i\left(\mathrm{t} - \frac{i-1}{N} \times T_s\right)$$

In the system model, we assume that the nonlinearity of LED can be partly compensated by predistortion. Through predistortion, a linear response curve *f (·)* can be achieved over a certain range *(cl , cu):*

$$f(x) = \begin{cases} c_l, & x < c_l \\ \beta \cdot x, & c_l \le x \le c_u \\ c_u, & x > c_u \end{cases}$$

where *β* denotes optical source conversion factor. For the OOK signal, we can easily adjust *yi (t)* within the linear operating range. Then the intensity signal transmitted from the *i* th LED chip can be expressed as

yi(t)=β.(t)

The intensity signals from different LED chips are mixed when the light beam passes through the lampshade. Since the superposition of the intensity signals transmitted from different LED chips is linear, the received signal after optical direct detection can be given by

$$r\left(t\right)=\sum_{i=1}^{N}h_i\cdot y_i\left(t\right)+n\left(t\right)$$

where *hi* denote the channel gain from the *i* th LED chip to the receiver and *n (t)* is an additive white Gaussian noise (AWGN) where the main sources of noise are shot noise and amplifier thermal noise. In typical room configurations, the distance from the LED lamp to the receiver is 1 ∼ 3 (m), while the distance between different LED chips in one lamp is several centimeters. Therefore, we assume that the channel gains from different LED chips to the receiver are equal. Let the electro optical-electrical (EOE) channel gain be heoe,i = hi · β.

Without loss of generality, the EOE channel gain vector can be given by

$$\mathbf{h}=h_{eoe}\cdot\left[1,1,\ldots,1\right]_{N\times 1}^{T}$$

3.1.2 Demodulation Of MP-OOK Signals

From Equation, we can see that intensity signals from different LED chips are mixed together and we must separate the mixed signal to get each channel signal demodulated. Here the sampling period of the receiver is set as *Ts/N*. Then the receiver regards the symbol period of the transmitted signal as *Ts/N* (The actual symbol period is *Ts* as mentioned in part II). At the receiver, it seems that one symbol is repeatedly transmitted by *N* times, like Fig.2

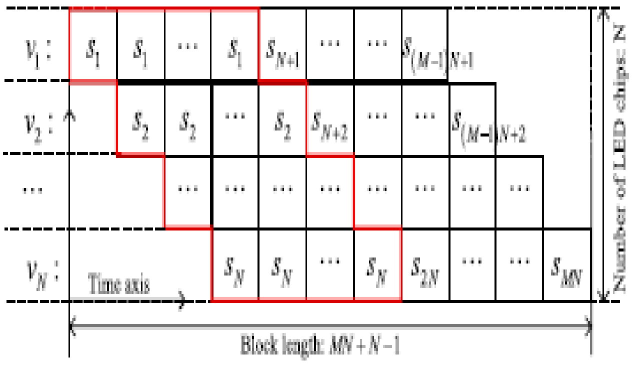

Fig.2 Structure of MP-OOK signals

As Fig.2, we define a sub-block as the part rounded up by the red line. Then, *M* sub-blocks compose a MPOOK block. The block length is $MN + N - 1$. Here we define a frame of the symbol sequence before serial to parallel conversion as $\mathbf{s} = [s1, s2, \ldots, sMN]^T_{NM\times 1}$. It is just the elements $\{si : 1 \le i \le MN\}$ of a frame that compose a MP-OOK block. The signal matrix can be expressed as

$$T\left(\mathrm{s},M,N\right)=\left\{\tau_{i,j}\right\}_{(MN+N-1)\times N},$$

$$\tau_{i,j}=\begin{cases}0, & j>i\ or\ i>j+(M-1)\cdot N\\ s_{j+\lfloor i/N\rfloor\cdot N}, & else,\end{cases}$$

Where [·] denotes floor function. The row indexes of *T* (**s**, *M, N)* represent different time slots, and the columns represent different LED chips. In time slot *t*, the elements on the t^{th} row of *T* (**s**, *M, N)* are respectively fed into the *N* different LED chips. According to Fig.2, a MP-OOK block duration *w* is given by

$\boldsymbol{\omega=(M+(N-1)/N)T_s}$

Then the duty cycle δ for pulse width modulation (PWM) is where T is the PWM symbol duration. Hence, dimming control can be easily achieved by changing the number of sub-blocks M in a MP-OOK block.

$$\delta = \omega / T$$

3.1.3 PRACTICAL MODEL

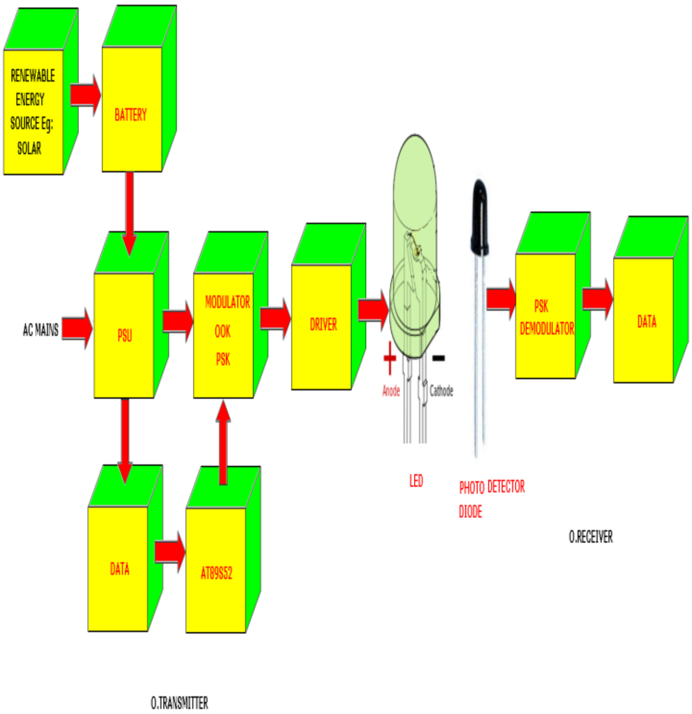

Fig. 3 Practical design of the system

In this system consists of two sections one is transmitter and receiver. The transmitter contains data source, AT89S52 microcontroller, on-off Keying PSK modulator, transistor driver and LED. The transmitting information is obtained from data source and it applied to the input of controller which is used to switching the modulator depends upon the time period of the information. The PSK modulator can be used to shifted or modulate the information into two phase level according to their data sign. The modulated signals are applied to the input of LED through transistor. The LED is act as a optical transmitter which is used to convert the modulated electrical signal into visual light. The visual light transmits from LED. In receiver side the light signals are fall on photo diode which is used to convert the light signals into electrical signal. This electrical signal is applied to the input of demodulator. The demodulator separates phase of data sign and finally we get original data output.

Intensity Modulation

In optical communications, **intensity modulation** (**IM**) is a form of modulation in which the optical power output of a source is varied in accordance with some characteristic of the modulating signal. The envelope of the modulated optical signal is an analog of the modulating signal in the sense that the instantaneous power of the envelope is an analog of the characteristic of interest in the modulating signal. Recovery of the modulating signal is usually by direct detection, not heterodyning. Heterodyne and homodyne systems are of interest because they are expected to produce an increase in sensitivity of up to 20 dB allowing longer hops between islands for instance. Such systems also have the important advantage of very narrow channel spacing in optical frequency-division multiplexing (OFDM) systems. OFDM is a step beyond wavelength-division multiplexing (WDM). Normal WDM using direct detection does not achieve anything like the close channel spacing of radio frequency FDM. The process transmitting information via light carrier (or any carrier signal) is called modulation.

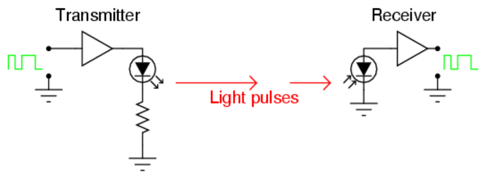

Fig: 4 simple circuit diagram of VLC

RESULT

We demonstrated the optical wireless transmission using LED based visible light source and photo-receptors. The data communication is done at indoor scenario at an ambient light using 5600K warm white LEDs with level of 600 lux and with a average distance of 2meters. The data rate of communication is 9600bps and can be communicated successfully with a higher tolerance angle with receiver.

IV CONCLUSION

The scientists emphasize that VLC is not intended to replace regular WLAN, Power LAN or UMTS. It is best suited as an additional option for data transfer where radio transmission networks are not desired or not possible? Without needing new cables or equipment in the house. Combinations are also possible, such as optical WLAN in one direction and Power LAN for the return channel. Films can be transferred to the PC like this and also played there, or they can be sent on to another computer. The new transmission technology is suitable for hospitals, for example, because radio transmissions are not allowed there. Despite this fact, high data rates must be transmitted without losses and unzipped, according to the experts. If part of the communication occurs via the light in the surgical room, this would make it possible to control wireless surgical robots or transmit x-ray images. In airplanes, each passenger could view his own entertainment program on a display, saving aircraft manufacturers miles of cables. Another possible venue for the application of this technologies are production facilities, where radio transmissions very often interfere with the processes. Currently the scientists are developing their systems toward higher bit rates.Using red-blue-green-white light LEDs, we were able to transmit 800 Mbit/s in the lab, said Klaus-Dieter Langer. “That is a world record for the VLC method”.

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REFERENCES

[1]. Eric Monteiro, Member, IEEE, and Steve Hranilovic, Senior Member, IEEE
[2]. Giorgio Corbellini, Kaan Aks¸it, Stefan Schmid, Stefan Mangold, and Thomas R. Gross
[3]. Irfanud Din and Hoon Kim, Member, IEEE
[4]. Ravinder Singh, Student Member, IEEE, Timothy O’Farrell, Member, IEEE, and John P. R. David, Fellow, IEEE
[5]. Robert J. Drost, Member, IEEE, and Brian M. Sadler, Fellow, IEEE
[6]. Takaya Yamazato, Isamu Takai, Hiraku Okada, Toshiaki Fujii, Tomohiro Yendo, Shintaro Arai,Michinori Andoh, Tomohisa Harada, Keita Yasutomi, Keiichiro Kagawa, and Shoji Kawahito
[7]. Toshiki Kishi, Member, IEEE, Hiroyuki Tanaka, Yohtaro Umeda, Member, IEEE, and Osamu Takyu, Member, IEEE
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