IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-6, Issue-11, Nov 2018 E-ISSN: 2347-2693

Behavioural Analysis of Handover Mechanism in Heterogeneous Wi-Li-Fi Environment

P. Sivananaintha peruma[1]*, S. Arunmozhi Selvi[2], John K Joel[3], R.S. Rajesh[4]

[1,2,3,4]Dept. of Computer Science and Engineering Manonmanium Sundaranar University Tirunelveli, India

Available online at: www.ijcseonline.org

Accepted: 22/Nov/2018, Published: 30/Nov/2018

Abstract—Light-fidelity (Li-Fi) is a dominant technology for wireless networking working on the principle of visible light communication (VLC). Li-Fi has wide-bandwidth, licence-free characteristics enables communication in radio frequency (RF) sensitive environments, realizes energy-efficient data transmission, and has the potential to boost the capacity of wireless access network through divergence. The new network environment called hybrid Wi-Li-Fi system developed, utilizing unidirectional Li-Fi channel as downlink and Wi-Fi channel as both uplink and downlink. The handover in traditional heterogeneous RF based wireless network has already been analyzing. However integration of Li-Fi network with heterogeneous RF network will create a hybrid Het-Net and the handover method also become highly conjugate. In this paper, we analysed hybrid heterogeneous handover schemes while user equipment (UE) rotate and roam and novel insights are analysed. Experimental results revealed that the hybrid system out performs the conventional Wi-Fi, and Li-Fi environment for the crowded environments in terms of throughput, delay time and handover rate.

Keywords:— VLC, Li-Fi, Het-Net, Handover,Wi-Li-Fi

I. INTRODUCTION

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices can be said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other. Computer networks differ in the transmission medium used to carry their signals, communications protocols to organize network traffic, the network's size, topology and organizational intent. A wired network is a common type of wired configuration. Most wired networks use Ethernet cables to transfer data between connected PCs. In a small wired network, a single router may be used to connect all the computers. Larger networks often involve multiple routers or switches that connect to each other. One of these devices typically connects to a cable modem, T1 line, or other type of Internet connection that provides Internet access to all devices connected to the network. A wireless network using wireless data connections between access point (AP) and UE. The main purpose of Wireless networking is avoiding the costly process of deploying cables into a building, or as a connection between various UE locations. Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level of the OSI model network structure.

WI-FI SYSTEM:

Wi-Fi stands for Wireless Fidelity includes IEEE 802.11a/b/g standard. It is used for Wireless Local Area Networks (WLAN). It is used for broadcast the internet with high speed when connected to an access point (AP) or an ad-hoc mode. The IEEE 802.11 LAN is called a basic service set (BSS). If a BSS moves out from the station, it can't directly communicate. It is less secure than wired connections, such as Ethernet or physical connection. This technique of the signal range depends on the frequency band, radio power output, and modulation techniques. Wi-Fi performance continues to achieve more and it's one of the most pervasive wireless communications technologies in use today world. Deployment of Wi-Fi is easy, simple to use and economical too. Wi-Fi Access Points are now set up at home and in public hotspots, giving convenient internet access to every user from laptops to smart phones. Efficient encryption algorithms make Wi-Fi more secure, keeping away unwanted intruders from this wireless environment.

LI-FI SYSTEM:

Li-Fi stands for Light-Fidelity includes IEEE 802.15.7 standard. It is used for Wireless Personal Area Networks (PAN). It is implemented using Light Emitting Diode (LED). Normally these devices are used only for applying the constant current. Professor Harald Haas from University of Edinburgh, UK, has explained in very simple, "if the LED is switch ON, the transmitting of digital data is 1 and if it's OFF, the transmitting of digital data is 0". Likewise in this technique, the transmission of digital data is from the LED

light can switch ON and OFF very frequently, which will give transmit high speeds for data's. In this method, the array of LEDs is transmitted data parallels, which speeds of data rate is 10Gbps and mixture of red, green and blue LEDs are used different light's frequency for security proposed. The main drawback of the light is it can't pass through any object; the signal will be instantaneously cut out. No doubt that, both Li-Fi and Wi-Fi networks could be fundamental building blocks of future 5G heterogeneous network. Chronic exposure of radio waves into human body would lead to health issue. Li-Fi is the best choice to mitigate this issue because of its void radiation. In Li-Fi, every LED source act as illuminating a room and also act as Li-Fi access point (AP) and serves downlink to multiple user equipment (UE) present in a room. Unlike Wi-Fi, characteristics of Li-Fi are line of sight (LOS) propagation. That means if there is any obstacle between transmitter and receiver then it abruptly stop transmitting data. So the coverage provided by a LED source is very minimum. So the authors in [1] coined new term called *attocells* like femtocells in cellular mobile networks. A attocell defined that is a coverage area provided by a single Li-Fi AP. So in order to cater all UE in a big room, multiple Li-Fi APs need to be deployed. Here horizontal handover required when a UE roam here and there within a room. UE always cannot vertically focusing straight top AP. Not only roaming, when a user rotating UE, then also it will miss LOS with current AP and it may get point of connection with neighbour Li-Fi AP. In this situation, horizontal handover is required within Li-Fi network.

HANDOVER PROCESS:

A handover is a process in telecommunications and mobile communications in which a connected cellular call or a data session is transferred from one cell site (base station) to another without disconnecting the session. Cellular services are based on mobility and handover, allowing the user to be moved from one cell site range to another or to be switched to the nearest cells site for better for better performance. Handovers are a core element in planning and deploying cellular networks. It allows users to create data sessions or connect phone calls on the move. This process keeps the calls and data sessions connected even if a user moves from one cell site to another. This papaer analysis the techniques of handover in downlink optical attocell networks, considering the effects of both mobility and rotation of the UE device.

II. RELATED WORK

Li-Fi networking technology and its integration with wireless heterogeneous networks have achieved substantive developments in recent years, including the structural design of a Li-Fi network, duplexing and multiplexing, a Li-Fi cell design, interference management and network handover techniques. Wentao Zhang et.al, [1] proposes a coalition formation for interference management in Li-Fi networks, where Li-Fi APs are designed to self-organize into cooperation coalitions based on the orthogonal time or frequency domain. M.Vladescuet.al,[2] Duplexing is still a challenge despite the many schemes that have been proposed. Establishing a bi-direction Li-Fi link is theoretically feasible, but remains impractical owing to excessive energy consumption at the user terminal devices and discomfort to the users' eyes. Wi-Fi used as uplink is a potential scheme , however, a co-channel transmission limits the throughput. LIU Yang et.al,[3] Another feasible scheme for achieving an uplink without electromagnetic interference is IR communication. Currently, the transmission rate of Fast Infrared is up to several tens of Mbit/s, whereas the power of an IR transceiver is only several tens of mW, and thus IR communication can satisfy the requirements of a high uplink rate and low consumption. Y.F.Liu et.al [5] compares various uplink options to demonstrate their advantages and disadvantages, and the use of near UV (Ultraviolet) and near IR LEDs for implementing a redundant uplink channel is recommended. However, similar to Li-Fi, IR communication has a strong directivity and an obvious transmission performance gap exists between the LI-FI and IR, necessitating a specific design. L. Chen et.al, [6] Communication (LI-FI) uses the unauthorized frequency LI-FI-preferred Uplink Scheme spectrum from 428 THz to 750 THz. And white Light This scheme requires a Li-Fi transmitter module be Emitting Diode (LED) is adopted to transmit data signals. Embedded into the existing mobile device such as smart phone Compared with existing wireless access scenarios such as IEEE 802.11 (Wi-Fi) and IEEE 802.15 (Bluetooth), Li-Fi or iPads. Due to the components and craftsmanship limit, the realizes the wireless data transmission in a more effective and Li-Fi transmitter modules may have a large size and high energy-saving way. Li-Fi has been widely recognized as one transmission power will be consumed, which may be a great of the important solutions for the future short distance wireless burden for the mobile devices. R. Zhanget.al, [7].when indoor Li-Fi users move around or the Li-Fi signals are obscured or interfered by indoor architecture and furniture, a reliable LI-FI network architecture and robust transmission scheme are indispensable. Naturally, if Li-Fi and existing short range wireless communication technology (such as 802.11 Wi-Fi) can be combined together, both the high-speed communication and good mobility supporting can be realized simultaneously. F. Wang et.al, [8] The Length of Sight (LoS) transmission features of Li-Fi, most indoor Li-Fi systems may suffer the signal obscured or interfered by some other obstacles, which makes Li-Fi unable to form a complete indoor access network independently. T. Komine et.al, Ref. [9]. LED-based indoor Li-Fi has gained great attention in recent years due to its innate physical properties such as energy efficiency and lower operational cost compared to conventional incandescent and fluorescent lighting. LiRa does not need uplink infrared transmission, and instead employs a radio uplink, coordinated with legacy

Wi-Fi. A great difficulty in LiRa is realizing a radio feedback signal path through Wi-Fi for both acknowledgements of Li-Fi data transmissions and client transmission of control information such as RSS (Recieved Signal Sstrength), required for AP selection and adaptation of modulation and coding techniques. Thus, a legacy Wi-Fi ACK does not conflict with access to the medium and its transmission time is part of the duration coloumn that indicates the time for other UE to defer [10]. In order to handover within indoor Li-Fi networks, there are many published research articles. In [11], a handover procedure is designed based on a pre-handover idea to initiate broadcasting the UE details on the moving attocell. The procedure collecting information related to position of UE by visible light positioning and movement using the Kalman filter. In [12], a handover management approach is relay on the received signal intensity (RSI). The spatial distribution of downlink rate is analysed for both overlapping and non-overlapping coverage.

III. System Model and Design

The LI-FI-Wi-Fi hybrid network model, which consists of a central coordinator, Wi-Fi AP, and LI-FI AP is shown in Figure. Two types of APs are connected to the Internet through a central coordinator. As illustrated, user 1 accesses the LI-FI AP with a LI-FI downlink and IR uplink, user 2 accesses the LI-FI AP and Wi-Fi AP simultaneously with a LI-FI downlink and Wi-Fi uplink, user 3 accesses the Wi-Fi AP with a Wi-Fi uplink and downlink, and user 4 accesses the LI-FI AP and Wi-Fi AP simultaneously with a LI-FI+Wi-Fi downlink and an IR+Wi-Fi uplink.

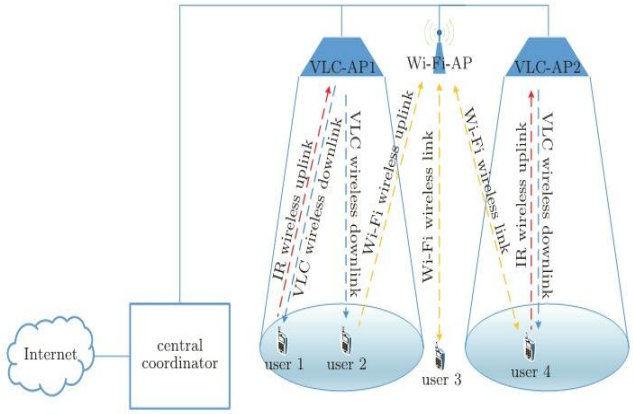

Fig. 1. General Wi-Li-Fi network model

P

roposed Technique:

A cell or sub-net handover is caused as a result of user movement. Because Wi-Fi continuously covers the users, a handover mainly takes place between LI-FI cells. A handover can be divided into three typical cases: when the user moves from one LI-FI cell to another; when the user moves from a LI-FI cell to outside the LI-FI cell; when a user moves from outside a LI-FI cell to inside the LI-FI cell. The first case is a horizontal handover between LI-FI cells, and the last two cases are a vertical handover between a LI-FI cell and a Wi-Fi cell. We designed a simple handover mechanism based on the user location for LI-FI cells with a horizontal handover in which the user terminal periodically transmits its access information through an uplink, and once the access information changes, the central coordinator immediately migrates the user data to a new cell. With a handover, the transmitter periodically transmits a beacon frame at the beginning of each super frame, and users receive and analyze this frame to obtain a cell-id. The user terminal then generates and transmits a CAP frame including the cell-id and user-id to the transmitter, and the central coordinator then records and updates the user's access information by analyzing the uplink CAP frame, and once the cell-id changes, the transmitter immediately migrates the data to a reallocated LI-FI link. A vertical network handover occurs when the user's feedback of the access information is lost or reappears at the central coordinator, and in practical terms, vertical handover is based on the path management of the MPTCP.

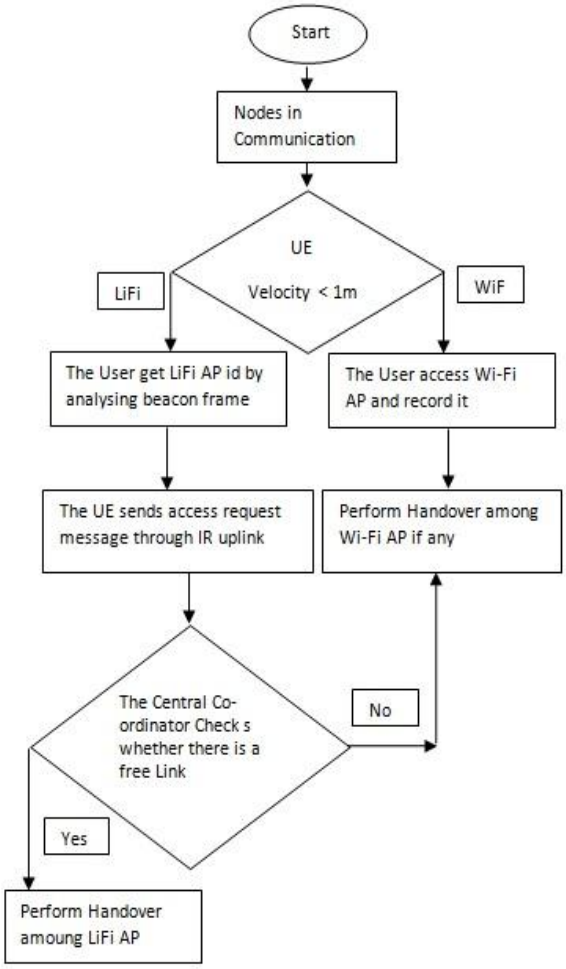

Fig. 2. Hybrid Wi- Li -Fi network model

IV. RESULTS OF WI-FI BASED HANDOVER DESIGN

The parameters are gives as the input to the Wi-Fi based handover system. The system generates the results for how much time taken for the data to send the handover of Wi-Fi to Wi-Fi process. The user moves to one place to another place, the handover performance will perform and find the data transfer time and the delay time. The input parameters are listed in the table 4.1. All the experiments are carried out using Matlab 2017a, with Intel Pentium® Dual Core processor on a 64-bit windows platform.

Table. 1.Parameters of Wi-Fi simulation

Parameter	Value
Area	800M × 800M
File size	100MB
No of nodes	20
No of bits per seconds	10^8bit/sec

The table 4.1 shows the input parameters of simulation in Wi-Fi based handover system. Different input and different parameters were given to both network systems. Results of the system were separately analyzed.

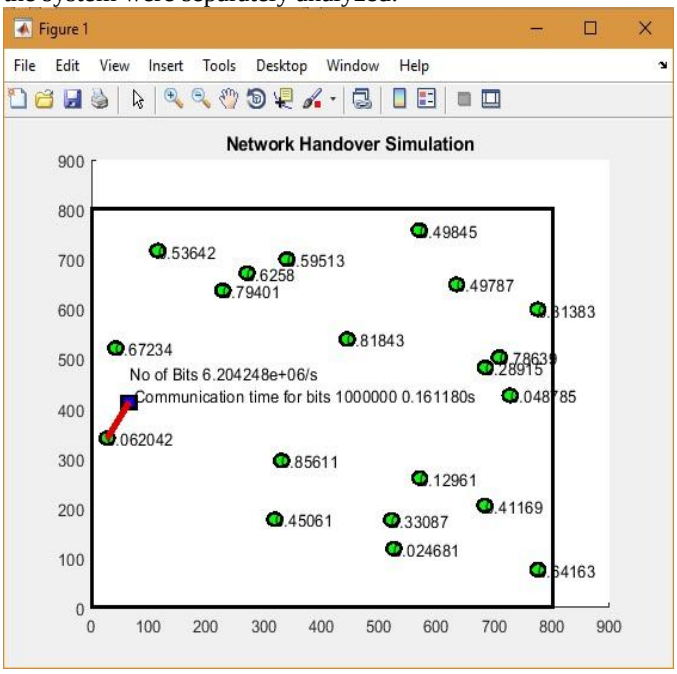

Fig. 3 Input image of Wi-Fi based handover system

Figure 3 shows a simulation system that has been given to the implemented Wi-Fi based handover system.

RESULTS OF LI-FI BASED HANDOVER DESIGN:

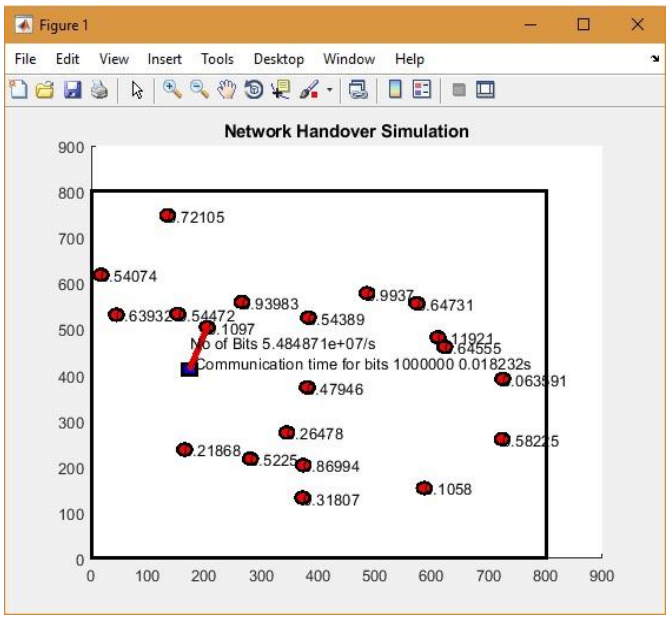

Fig. 4 Input image of LI-FI based handover system

Figure 4 shows a simulation system that has been given to the implemented Li-Fi based handover system.

RESULTS OF WI-LI-FI BASED HANDOVER DESIGN

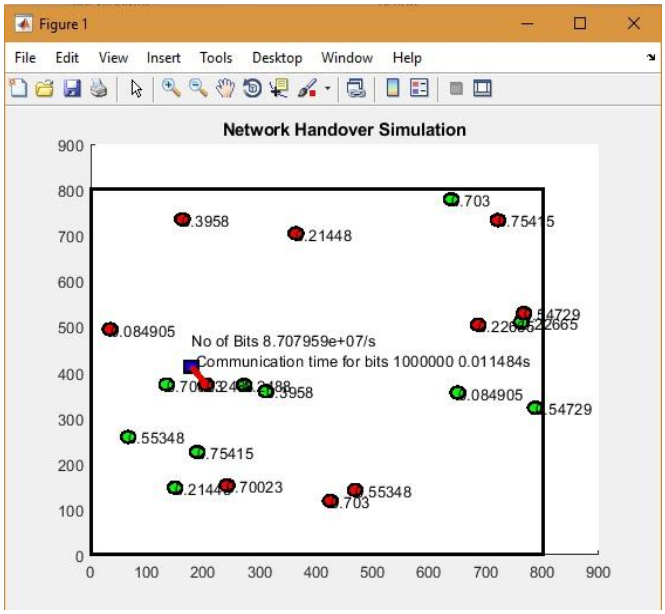

Fig. 5 Input image of Wi-LI-FI based handover system

Figure 5 shows a simulation system that has been given to the implemented Wi-LI-FI based handover system.

RESULT ANALYSIS EVALUATION RESULT

The following results as the evaluation results of the Wi-Fi based handover system for a same single input image.

Table 2 Parameters for performance calculation

Parameter	Value
Area	800M × 800M
File size	200 MB
No. of nodes	20
Source	0
Destination	400
No. of bits per second	10^8bit/sec

The table 2 shows the testing parameters of simulation to the Wi-Fi based handover system. Some testing parameters were given to both systems. Results of the system where separately analyzed for future improvement.

Fig. 6 Performance of Wi-Fi handover results for 200 MB in 800m × 800m

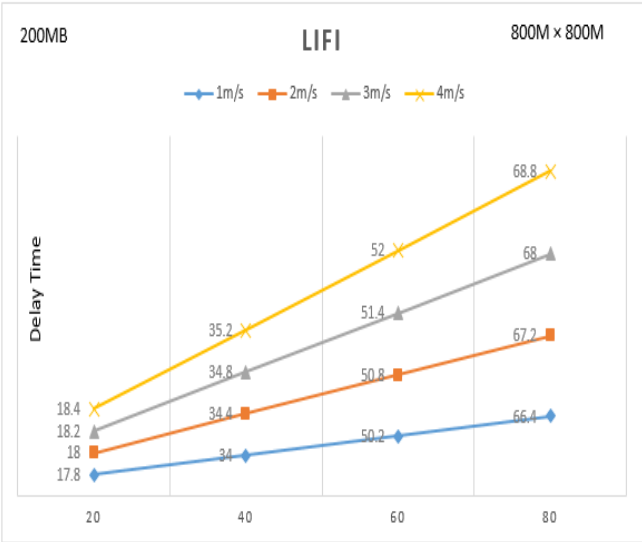

Fig. 7 Performance of Li-Fi handover results for 200 MB in 800m × 800m

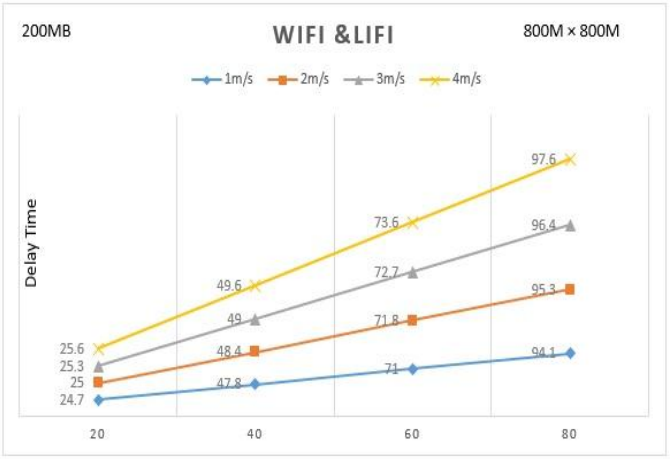

Fig. 8 Performance of Wi-Li-Fi handover results for 200 MB in 800m × 800m

OBSERVATION

The following bar chart depicts the Performance comparison of Wi-Fi, Li-Fi and Wi-Li-Fi.

Fig. 9 Performance of Wi-Fi, Li-Fi and Wi-Li-Fi

From the above bar chart we can conclude that Wi-Li-Fi is better than other two network models.

V. CONCLUSION AND FUTURE SCOPE

Both Wi-Fi and Li-Fi have its own merits and demerits. When we combine both Wi-Fi and Li-Fi we can get benefits of both Wi-Fi and Li-Fi. In this work we have implemented the handover mechanism in Wi-Fi network, Li-Fi network and integration of both Wi-Fi and Li-Fi network. From the experimental results we conclude that hybrid LI-FI-Wi-Fi network giving better performance than individual network.

In this work, we have only concentrated on handover mechanism in both Wi-Fi and Li-Fi. In feature work we are interested to include cellular network as well.

REFERENCES

[1]. Wentao Zhang, LiChen*, XiaohuiChen,ZihaoYu, ZhiyuanLi,Weidong Wang. Design and realization of indoor Li-Fi-wi-fi hybrid network,Journal of Communications and Information Networks,Vol.2,No.4,Dec. 2017,(78).

[2]. M.Vladescu, D. T. Vuza. Redundant uplink optical channel for visible light communication systems[C]//Advanced Topics in Optoelectronics, Microelectronics, and Nano technologies VII, 2015: 92581J.

[3]. LIU Yang, ZHAO Hua, HUANG Kaizhi, et al. "Research on networking strategy of visible light indoor environment"[J], Telecommunication Science (in Chinese), 30(1): 8-14 , 2014.

[4]. Y. Q.Wang, Y. G.Wang, N. Chi, et al. Demonstration of 575-Mb/s downlink and 225-Mb/s uplink bi-directional SCM-WDM visible light communication using RGB LED and phosphor-based LED [J].Optics express, 2013, 21(1): 1203-1208.

[5]. Y.F.Liu, C.H.Yeh, C.W.Chow, et al. Demonstration of bi-directional LED visible light communication using TDD traffic with mitigation of reflection interference [J].Optics express, 2012, 20(21): 23019-23024.

[6]. L. Chen, W. D.Wang, C. Zhang. Coalition formation for interference management in visible light communication networks [J]. IEEE transactions on vehicular technology, 2017, 66(8): 7278-7285

[7]. X. Li, R. Zhang, and L. Hanzo. "Cooperative Load Balancing in Hybrid Visible Light Communications and WiFi"[J], IEEE Transactions on Communications, 63(4): 1319-1329, 2015.

[8]. F. Wang, Z. Wang, C. Qian, et al. "Efficient vertical handover scheme for heterogeneous LI-FI-RF systems"[J], IEEE/OSA Journal of Optical Communications and Networking, 7(12): 1172-1180, 2015.

[9]. T. Komineand, M. Nakagawa, "Fundamental analysis for visible-light communication system using led lights," Consumer Electronics, IEEE Transactions on, vol. 50, no. 1, pp. 100–107, 2004.

[10]. Mohammad Dehghani Soltani, Hossein Kazemi, Majid Safari, Harald Haas, "Handover Modeling for Indoor Li-Fi Cellular Network: The Effects of Receiver Mobility and Rotation",

[11]. IEEE Computer Society. IEEE Draft Standard for Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY). June 2012.

Authors Profile

P.Sivananaintha Perumal is an active Researcher in the field of heterogeneous wireless Networking . He has received his Bachelors degree of Engineering From Dr.Sivanthi Adithanar College of Engineering, Tiruchendur in 2004. He has received his Masters in Engineering from National Institute of Technology, Calicut, India in 2011. He is pursuing his Doctoral Degree from Manonmaniam Sundaranar University India. He has 4 years of teaching experience in Engineering Colleges. He has published 3 articles in leading international journals.

S.Arunmozhi Selvi is an active Researcher in the field of wireless Networking with Light Fidelity. She has received his Bachelors degree of Engineering From Dr.Sivanthi Adithanar College of Engineering, Tiruchendur in 2003. He has received his Masters in Engineering from Manonmaniam Sundaranar University India in 2011.She is pursuing her Doctrol Degree from Manonmaniam Sundaranar University India. She has more than 9 years of teaching experience in Engineering Colleges. she has published 7 articles in International conference proceedings and leading international journals.

John K Joel is a M.Phil scholar did research in the area of Wireless Networks. He has received his M.Sc Computer Science from Sundaranar University, Tirunelveli, India. His area of interest are Computer Networks, Heterogeneous Wireless Networks.

Dr. R. S. Rajesh received his B.E and M.E degrees in Electronics and Communication Engineering from Madurai Kamaraj University, Madurai, India in the year 1988 and 1989 respectively. He is currently the Professor and Head of Department of Computer Science and Engineering, Manonmaniam Sundaranar University where he earned his Doctorate degree in the field of Computer Science and Engineering in the year 2004. He has 22 years of PG teaching experience. He has published 100 articles in leading international journals. His research areas include Vehicular Adhoc Networks, Wireless networks, Digital image processing and Pervasive computing.

