Eminent Multimedia Communication using Li-Fi Cloud

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***Abstract*— The demand for wireless communication using Radio Frequency Technology is increasing day by day and by the course of few years the radio frequency spectrum will soon become exhausted. By Friis space equation at higher frequencies the path loss increases. Adding to that the obstructions in the path of propagation like high rise buildings and equatorial ellipticity of Earth it causes fading in terrestrial communication. So as a result systems must be designed to enhance the feature of Line of Sight propagation by using beam forming techniques which leads to the reduction in size of cells. This can provide increased capacity of the system. This is because the reduction in size of cells is a major contributor to the performance of cellular communication. On to the contrary the general understanding is that high frequencies are being used for terrestrial communication. The mainframe time sharing mechanism has effectively utilized the resources but has a limitation that it has poor scalability with networks due to high hardware expenses. The conventional Client-Server machines use acknowledgment for receiver to be considered as active and to start the communication process. When a data is stored it uses SQL commands for database storage and retrieval purposes. However Cloud Sever possesses great processing and storage capability since all the necessary data is being propagated through the network with less probability of traffic or congestion.**

***Keywords*— Data Transmission, Li-Fi technology, Cloud Storage, Remote Connectivity**

I. INTRODUCTION

Li-Fi is a ground breaking light – based communication technology which makes use of light waves instead of radio technology to transfer data [1]. The wide use of solid state lighting provides an opportunity for eminent dual use of lighting and communication devices. Drastic development in the field of photon and LED receiver technology has ensured the availability of suitable light transmitters and decoders [1]. The modulation of communication signals for such kinds of equipments has been developed through signal processing techniques such as multiple-input-multiple-output (MIMO) to become more practically available as in mobile communications [3].The capacity of MIMO systems is expressed as

$$C_{EP} = \log_2 [I_M + (P/M_T)HH^H] \text{ b/s/Hz.} \qquad 1$$

Li-Fi technology is being developed into a ubiquitous system enhancement, consisting of application specific combinations of light transmitters and receivers including solar cells and efficient computation algorithms with networking capabilities that can be implemented in a wide range of communication scenarios in a variety of platforms [5]. Li-Fi technology provides high data transmission rate which cannot be compensated by the existing technologies and more secure as data transmitted through light is resistant to security breaches [4]. Cloud computing proves itself as a very flexible technology that provides data storage more efficient than conventional server systems [8]. As the processed data is stored in the Cloud Sever it maintains a permanent storage of data and provides connectivity to users throughout the world [10]. The Internet obtained through Li-Fi is much faster as the light communicates with Line of Sight technology which requires a direct path between the transmitter and receiver. The concept of remote connectivity and light transmission will certainly be implanted in remote areas where installation of large base stations is difficult due to the unleveled surfaces. Mainly for commercial purposes and offices and residential areas each LED can be converted as a data transmission source which can possibly provide a user friendly environment for Internet usage and on to connection with the available highly user supportive Cloud servers [10]. Li-Fi Cloud technology will become an effective replacement for Internet access as it facilitates uplink and downlink communication at greater speeds.

II. EXISTING SYSTEM

The existing system for data transmission is through Radio frequency communication and Infrared communication. These technologies had been introduced many years ago however due to the increase in number of users in Radio frequency spectrum there is a huge traffic and congestion in the network and it will soon become exhausted. As of using radio waves to a great extent there is a great danger of extinction of very rare species of this ecosystem. The huge servers that we have can be easily influenced by security breaches with the help of IP technology. The Infrared light can transmit signals through light but it does not support for data and Internet transmission at higher data rates and requires no obstructions in the path of transmission.

II-B. DRAWBACKS OF EXISTING SYSTEM

- Requires base station installation
  To install a base station it requires large directional antennas and processing systems which are costly and utilizes more time.
- High data loss
  Due to fading and near far problem and handoff process creates a problem due to signal receive by mobile phone and network traffic.
- External security breaches
  If IP address and port number of a router is known it is possible to experience external data breaches.
- Considerably low data transmission speeds
  If the network is congested data is lost even some times call made is lost due to instability of network performance and consistent network coverage could not be provided.
- Loss of rare species
  Birds like humming birds are in the verge of extinction because of the radio waves and heat produced by the signals. SAR rate is very low for these species.
- Limited amount permanent data storage
  All the databases limit the amount of data storage and authenticate users.

To avoid all these limitations and make the working more accurately the system needs to be improved by using latest Li-Fi Cloud technology for providing more user friendly environment.

III. PROPOSED SYSTEM

The main objective of the proposed project is to develop a light based communication system, by replacing the traditional obsolete RF system. The hybrid Li-Fi computing system aims at providing high speed data access at confined areas. The Multimedia data is processed with digital modulation techniques and sent through the light transmitter. As it involves Line of Sight communication it provides high degree of electrical isolation and greatest security as data cannot be obtained through light energy. The Line of Sight propagation enhances the feature of secured data communication over the network since the communication is possible only within a confined area and it is similar to Fiber Optic transmission where a data is passed through the fiber and it is cut out for information only light will be seen. Different colors of LED's support for different data rates and field of application. But however red LED is used in the proposed system due to its longer wavelength and reasonable coverage capacity. The speed of transmission of data cannot be compensated by technologies like Wi-Fi and WiMax. Recent advancements in LED like gallium nitride, blue color LED was found and it is found to provide high intensity than other LED's due to its intensity [2]. Large data servers require high implementation cost and increase its size according the amount of data storage. But in case of Cloud server it does not require a large database system acting as a repository even a router used in homes and offices can be turned into cloud storage devices by configuring its settings and making it as a database cloud with help of a pen drive. The pen drive in the router acts a permanent storage and if the static IP address and Port Number is known then it is easier to access the information.

III-B. DESIRED RESULTS

The targeted parameters of this new system are

1. Data transmission as fast as possible:
   When Wi-Fi is used it provides a speed of 150Mbps while Li-Fi provides speed of 1Gbps
2. To provide remote connectivity to authenticated users:
   Being accessible by users all over the world
3. To act as a permanent storage:
   Cloud provides permanent storage
4. To avoid security breaches like hacking:
   Data through light cannot be hacked
5. To support large amount of data

The network supports large amounts of data without any congestion in it.

IV. SYSTEM DESIGN

The system has been designed to transmit multimedia data through the light transmitter module. As the analog data like Audio is passed through light it needs to encoded and then digitally given as an input to LED. The LED circuit as a transceiver such that it can facilitate communication in both ways. The data type Image needs to be converted into bits and encoded by digital modulation techniques such that the data rate is high and the speed of transmission is faster. The main concept of providing Quality of Service is through providing acknowledgments for each data type being sent. In case of video transmission each frame of a particular video stream is parsed and encoded separately. Individual acknowledgments ensure the accountability of the system. However the electrical energy to the LED diode is being converted into light energy as the LED acts as a transducer too.

The Light receiver circuit consists of photodiode which captures the light incident on it. It is mainly used to convert the light energy into electrical pulses. The main reason for using LED instead of Laser is due to the coverage area that can be provided with this equipment. The Intensity of the light determines the distance of link coverage and the data rate of each data type. As the information is passed through the light transmitter it flickers due to its inherent property which indicates that the LED on or off condition. But it is invisible to human eye as the flickering switch speed is about microseconds.

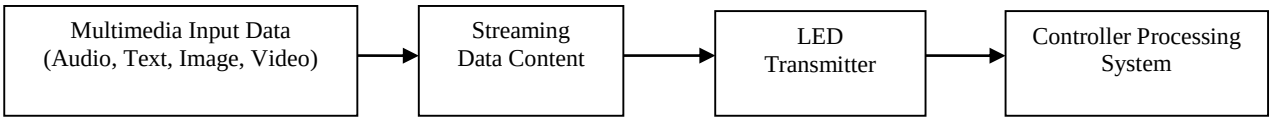
The conventional database systems provide authentication to users to data but it can highly risky due to the fact that the data can be misused by the person or an external hacker. The limited storage also provides restrictions the amount of data to be stored in the database systems. As the data is being accessed through the database the client looks for each and every data that is irrelevant to the data which is required. In order to minimize these limitations the Cloud technology provides a feasible way of storage where the main concept of repository is being MongoDB implementation wherein the data is being stored column wise such that the accessing is easier and provides much easier connectivity to even remote users to the network. Security systems also use Cloud computing servers to ensure high deal of security and confidentiality to data and other user related information like Bank Servers.

IV-B. MODULES

In order to provide data transmission through light, four modules namely – Light Transmitter Module, Processing Module, Light Receiver and Cloud Storage were developed.

IV-C. LIGHT TRANSMITTER MODULE

The Light transmitter accepts the four data types Audio, Image, Text and Video as its input and transmits it as light through air as medium. The module depends on the Intensity of light for coverage area and speed of transmission as the data is propagated. The flickering nature of LED determines the transmission process which provides a rough estimation on the bit rate and synchronization with the receiver.

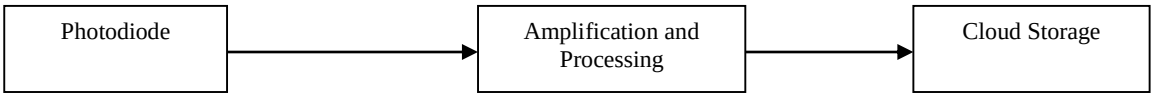


IV-D. PROCESSING MODULE

The processing system consists of two main functions such as converting the analog signal input into digital format and encoding of digital stream of bits. The main concept of digital modulation techniques plays a vital role in generating digital waveforms that can be supported by the transmitter equipment such that the different types of data formats can be recognized efficiently and noise is eliminated.

IV-E. LIGHT RECEIVER MODULE

The main job of the receiver is to capture the incident light energy and convert it into electrical energy. The Line of Sight propagation and synchronization with the transmitter are the major criteria that have to be satisfied for reliable demand of quality. The data once received has to be then reprocessed to differentiate different types such that it is easier for recognition in the user's perspective and avoids unwanted errors which degrade the performance of the system.



IV-C. CLOUD STORAGE MODULE

The Cloud Storage module is mainly used as data repository which provides efficient access to users throughout. The MongoDB based database system provides more quicker access to the core data area and lists out the required information with at most precision such that the time for retrieval of data is reduced to a greater extent. However same mechanisms of Client-Server database is used, that is by using the URL and the port number for accurately pinpointing the required information. The Cloud Storage provides virtualization support and each and every router used can be converted into a Cloud Storage by the use of Static IP Address and using a pen drive as storage even a hard disk can provide a successful means of backing up important data.

V. COMPONENTS

V-A. LED TRANSMITTER

The analog input is fed into the transmitter and the led switches on and off during the transmission. Concentrated LED provides more brightness and hence two concentrated LEDs can cover full room of average size. The distance of communication depends on the intensity of the LED. Before sending data to LED the data is being converted to digital format and by an encoder and undergoes modulation.

V-B. LED RECEIVER

Photo diode receiver circuit is used for data transmission. In Photo Diode Receiver circuit, LM339 is used as a comparator. LM339 has high gain and wide bandwidth. It is an open collector comparator. So it can be compatible to all logic levels like TTL, DTL, ECL, and CMOS Logic. If the light illumination varies photo diode current also changes. In receiver have two stages. First stage photo detector current converts to voltage level. In second stage inverting amplifier inverts once to get original information. The photodiode converts the incident light into electrical signals. The signals undergo appropriate decoding in order to obtain the original transmitted information with less probability of misconception and losses.

V-C. CLOUD SERVER

A cloud server is a logical server that is created, built and provides service through a cloud computing platform over the Internet. Cloud servers possess and exhibit similar capabilities and functionality to a traditional server but are accessed remotely from a cloud service provider. The main concept of remote connectivity is to support large number of users accessing the server. The concept of remote connectivity would attract many users because of increased functionalities and Amazon has started its Cloud Services in the name of Azure.

V. CONCLUSIONS

Parameters	**WIFI**	**LIFI**
Bit rate	54 Mbps	1 Gbps
Bit resolution	256 subcarriers	10^3
Receiver noise figure	7-10 dB	Less than 5dB
Coverage area	100 m	Depends on light intensity

The Light Fidelity concept will mark its destiny within 10-15 years as it is estimated to modify about 20 million LED bulbs to provide Internet in cities and remote areas throughout the world. . In the WI-FI we are aware of the fact that the speed and the congestion projects as today's problem because number of users are increasing. But this jamming problem get reduces to a great extent by the light fidelity concept.

The router that we use today will be replaced as Light Internet routers acting as transceivers and the underwater communication will be totally replaced by light. Further studies involve radical reduction in the size of cells of LED like gallium nitride providing reasonable coverage distance and illumination.

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REFERENCES

[1] H. Haas. (2011, Aug.). *Wireless data from every light bulb*. TED Website.[Online]. Available: http://bit.ly/tedvlc
[2] D. Tsonev, H. Chun, S. Rajbhandari, J. McKendry, S.Videv, E. Gu,M. Haji, S. Watson, A. Kelly, G.Faulkner, M.Dawson, H. Haas, and D. O'Brien*, "A 3-Gb/s single-LED OFDM-based wireless VLC link using a gallium nitride μLED,"* IEEE Photon. Technol. Lett., vol. 26, no. 7, pp. 637–640, Apr. 2014.
[3] S. Rajagopal, R. Roberts, and S.-K. Lim, *"IEEE 802.15.7 visible light communication: Modulation schemes and dimming support,"* IEEE Commun. Mag., vol. 50, no. 3, pp. 72–82, Mar. 2012.
[4] *Coexistence of Wifi and Lifi towards 5G:oppurtunities and challenges* Moussa Ayyash, Hany Egala, Abdallah Khreishah, Volker Jungnickel, Thomas Little, Sihua Shao, Micheal Rahaim, Dominic Schulz, Jonas Hilt, Ronald Freund IEE Communications Magazine Year:2016, Volume:54, Issue=2
[5*] Integrated LiFi(Light Fidelity) smart communication Through light illumination* R.Mahendran IEEE Conference on Advanced Communication and Control and Computing Technologies (ICACCCT)

[6] E. Sarbazi, M. Uysal, M. Abdallah, and K. Qaraqe, *"Ray tracing based channel modeling for visible light communications,"* in Proc.22nd Signal Process. Commun. Appl. Conf., Apr. 2014, pp. 702–705.
[7] A. Farid and S. Hranilovic, "Capacity *bounds for wireless optical intensity channels with Gaussian noise,"* IEEE Trans. Inf. Theory, vol. 56, no. 12,pp. 6066–6077, Dec. 2010.
[8] M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, and M. Zaharia, *"A view of cloud computing," Communications of the ACM, 2010.*
[9] G. Zhao, C. Rong, J. Li, F. Zhang, and Y. Tang, *"Trusted data sharing over untrusted cloud storage providers,"*in Proceedings of the 2010 IEEE Second International Conference on Cloud Computing Technology and Science (CLOUDCOM), 2010.
[10] R. A. Popa, J. R. Lorch, D. Molnar, H. J. Wang, and L. Zhuang, *"Enabling Security in Cloud Storage SLAs with Cloud Proof,"* in Proceedings of the USENIX Annual Technical Conference (USENIX ATC), 2011.
[11] R. Zhao, C. Yue, B. Tak, and C. Tang, *"SafeSky: A Secure Cloud Storage Middleware for End-User Applications,"*in IEEE 34th Symposium on Reliable Distributed Systems (SRDS), 2015.