Visible Light Communication for 6G Technology : The Potential and Research Challenges

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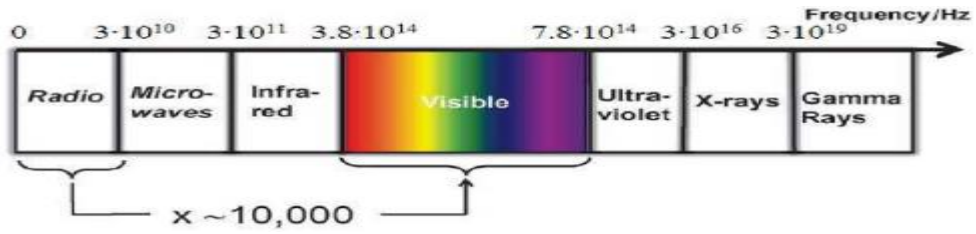
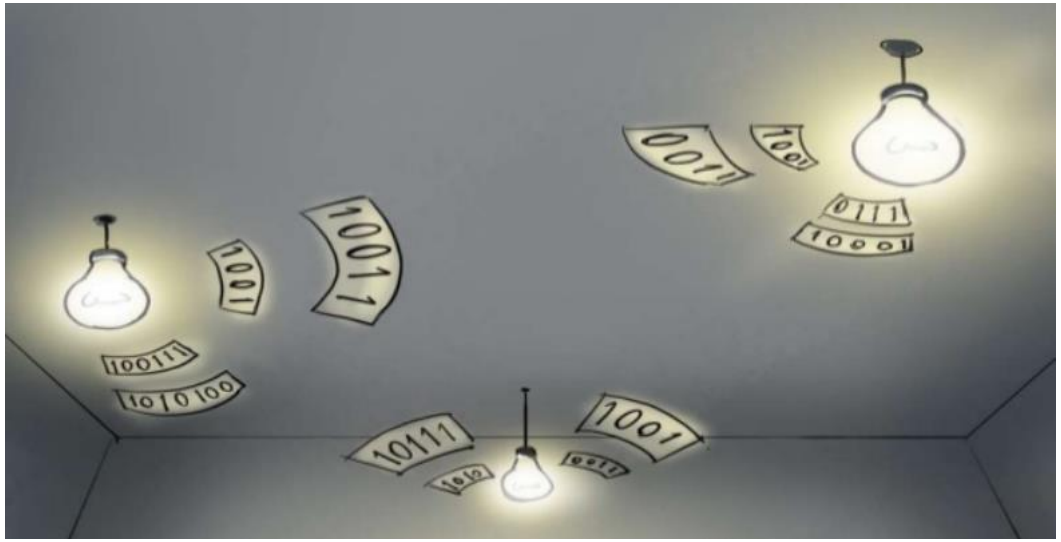
WHAT IS LI-FI

- LI-FI–”LIGHT FIDEALITY” is transmission of data through illumination, i.e. sending data through a LED light bulb that varies in intensity faster than human eye can follow.
- Visible Light Communication is a novel kind of optical wireless communication which uses visible light spectrum (400-790)THz

- Li-Fi is a light based Wi-Fi it uses light instead of radio waves to transmit information





Motivation

- Personal computers and personal digital assistants for indoor use are rapidly growing in offices, manufacturing floors, shopping areas and warehouses.

- This result in the need for flexible interconnection through the distributed or centralized data communication systems.

- Conventional way i.e. wired connection have number of limitations viz. space, time to setup, monetary investment in copper, maintenance etc.

- Wireless systems offer an attractive alternative. While the radio spectrum is limited, the demand for wireless data transmission keeps increasing.

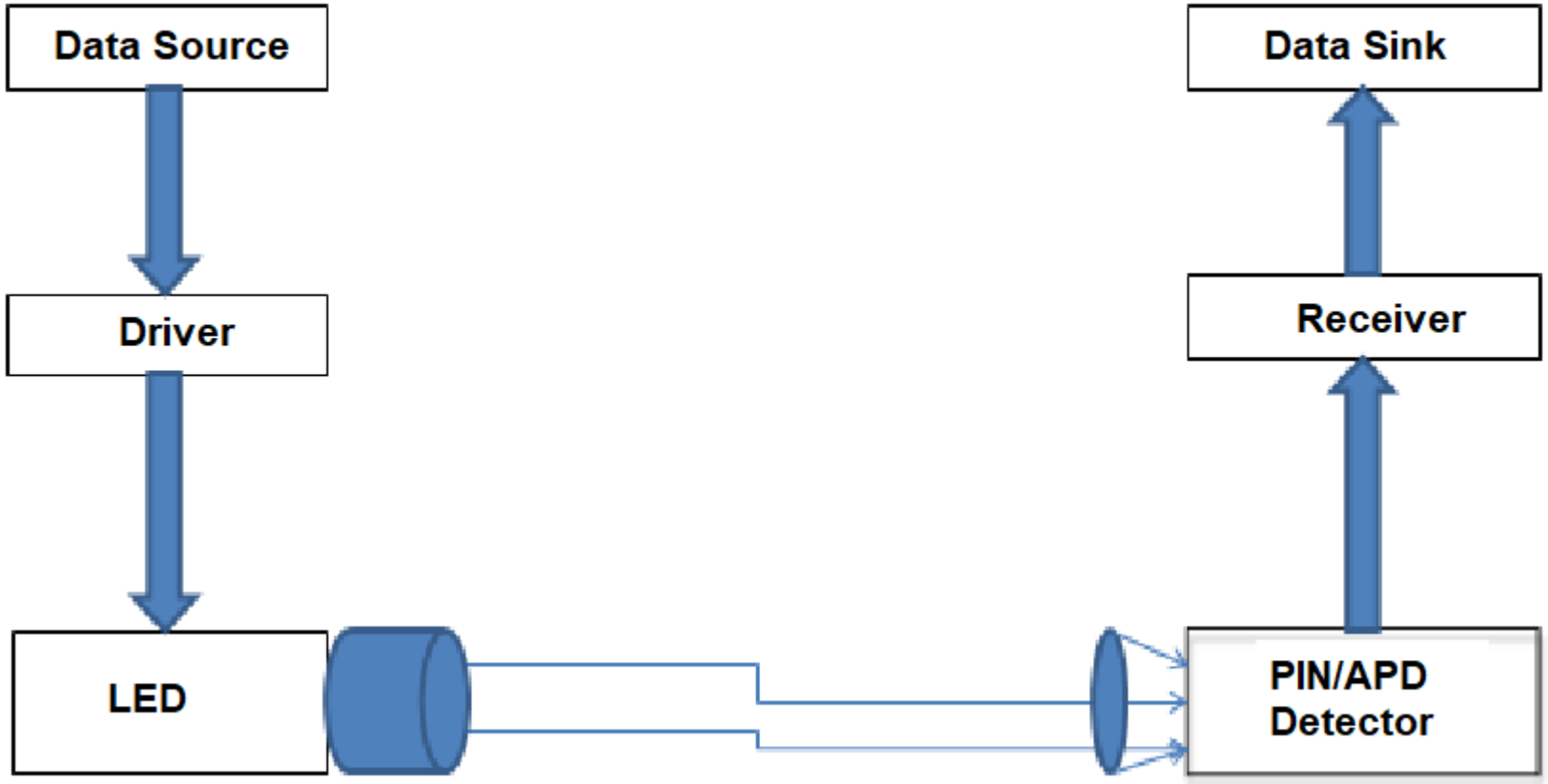
Brief History of VLC

- The VLC first developed by Dr. Alexander Graham Bell on 21st June, 1880.

- Graham had demonstrated a system which is capable of transmitting voice signals using sun light as a carrier and it was named as Photo-phone, The distance between the transmitter and receiver was around 213 meters in this demonstration.

- More new work started in 2003 at Nakagawa Laboratory, in Keio University, Japan

Block Diagram of Indoor VLC



APPLICATIONS

- Used for modern medical instruments.
- In aircrafts, it can be used for data transmission.
- Used in petroleum or chemical plants where other transmission or frequencies can be hazardous.
- In traffic signals, LI-FI can be used which will communicate with the LED lights of the car and number of accidents can be decreased.
- Location based services:-GPS
- Underwater communication.
- RF Spectrum relief.

ADVANTAGES

- Visible light's large frequency spectrum bandwidth
- There is no EMI. • Visible light communication requires much less power compared to RF communication
- Visible light cannot penetrate through the walls, so Indoor Visible light communication is comparatively secure.
- Visible light usually poses no health hazards to human body and eyes.
- Light sources are everywhere and can be more efficiently used by increasing its simultaneous functionality by transmitting data in addition to lighting an area.

Visible Light Communication for 6G Technology

- On continuing the consecutive development of mobile wireless technology, 6G technology is predicted to emerge in 2025.

- The new technology will be driven to give solution for any 5G technological limitations.

- 6G is expected to be able to provide a more perfect used case than what 5G may offer, in particular for dealing with exaggerate traffic growth and efficiency of indoor network performance.

- Meanwhile, in the effort to construct new technological platform for 6G, researchers have begun to study the potential use of radio communications over Terahertz spectrum, in which VLC is the primary technology working on it

Visible Light Communication for 6G Technology

5G aims to enhanced mobile broadband (eMBB), massive machine type communications (mMTC) and ultra-reliable and low latency (uRLLC) the , 6G provided :

- Mobile Broadband Reliable Low Latency Communication (mBRLLC), which is not only provides low latency communication, but also offers efficiency, reliability and pace

- Massive ultra reliable low latency communications (mURLLC), which is a combination of URLC and mMTC providing higher quality and reliable services

- Human centric-service, in which the realization of use case is targeted by the quality-of-physical experience (QoPE). Such a new term is a combination of the physical-facts-experience of the human itself with quality of services (QoS) and quality of experience (QoE)

- Multi-Purpose 3CLS and Energy Services. This use case will provide convergence of communications, computing, control, localization, sensing (3CLS) service and energy of small device through wireless energy transfer.

The Potential Use of VLC for 6G

- Heterogeneous network Similar as 5G platform, 6G should also supports heterogeneous networks, including macro cells, metro cells, micro cells Pico cell, and femtocell for an indoor area.

- A much higher data rate (bandwidth range of about 360 THz). At the end, this considerable bandwidth shall give a very high data rate which is expected to be 1 Tbsp.

- Security The physical-layer of 6G technological security thrives on providing a layer-defense. VLC is argued to have better security than other wireless technologies.

Research Challenges of VLC Technology

- Integration of VLC with another communication standard .
- Interference issues with ambient light sources
- Handover
- Inter-cell interference mitigation.
- Backbone network design
- Increasing data rate

Conclusion

- There is a potential to use of VLC for 6G technological platform and to come over its research challenges.

- Some technical aspects which make VLC to be considered as 6G technology are due to supporting heterogeneous network, having higher data rate, promising reliable security, and may offer service applications underlying the 6G used case.

- However, the VLC standard has not been mature. Some research challenges include interference issues with ambient light sources, handover issue, inter-cell interference mitigation, backbone network design, and developing method to increase the data rate.

Thank you