NATIONAL INSTITUE OF TECHNOLOGY UTTARAKHAND

राष्ट्रीय प्रौद्योगिकी संस्थान ,उत्तराखण्ड

A PROJECT ON : NeoCommLight: A Visible Light Communication System for RF-Restricted NICUs

COURSE CODE –ECD351

Supervisor :

Dr. Sarika Pal

Name of Students:

BT21ECE034 Kumkum Upadhyay

BT21ECE032 Ankit Bisht

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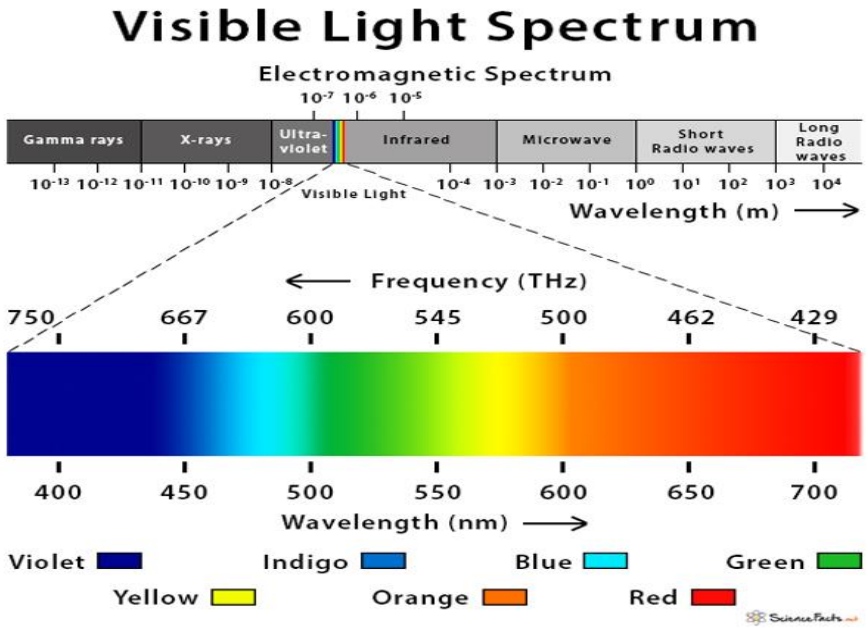
Visible light communication

- Its frequency is 750THz -429THz
- Wavelength for visible

light is 380nm -750nm

- It is a small portion of

electromagnetic spectrum



Motivation, why we are using visible light communication?

1. **High Bandwidth**: Leveraging the higher frequencies of visible light enables potentially faster data transfer rates compared to traditional radio frequencies.
2. **Limited Spectrum Congestion**: Utilizing a portion of the electromagnetic spectrum that is less crowded reduces interference and congestion issues commonly associated with radio frequency communication.
3. **Enhanced Security**: Light waves cannot penetrate through walls or solid objects, offering inherently more secure communication by minimizing the risk of interception or eavesdropping.
4. **Reduced Interference**: Light-based communication is ideal for environments where radio frequency signals may cause interference, such as hospitals, aircraft, or industrial facilities.
5. **Energy Efficiency**: Integrating data transmission capabilities into existing LED lighting infrastructure allows for dual-purpose functionality, providing both illumination and communication without significant additional energy consumption.
6. **Ubiquitous Infrastructure**: Takes advantage of the widespread deployment of light sources in indoor environments, facilitating easy and cost-effective implementation without the need for additional infrastructure.
7. **Diverse Applications**: Enables a wide range of applications including indoor positioning, smart lighting systems, wireless connectivity in sensitive environments, and emerging technologies like Li-Fi for high-speed internet access

ADVANTAGES AND DISADVANTAGES OF VLC

ADVANTAGES

- It supports large bandwidth and thus can overcome the bandwidth limitation of RF communication.
- It provides secure communication as data transmission cannot be interrupted by people staying at some other place which is a problem in RF communication.
- It is easy to install
- As it is a light-based communication system, it is not affected by electromagnetic radiations from RF systems.
- It does not pose any health risk.
- It does not cause any health problem(skin cancer etc.)

DISADVANTAGES

➡VLC based communication has interference issues from other ambient light sources.

➡VLC communication supports short coverage range.

➡There are challenges to integrate VLC with wifi system.

➡Other drawbacks with VLC system are atmospheric absorption, shadowing, beam dispersion etc.

➡It requires both source and receiver should be in LOS. Hence non-LOS communication is difficult to be achieved.

[1]

Requirement from the material to behave like optical fiber

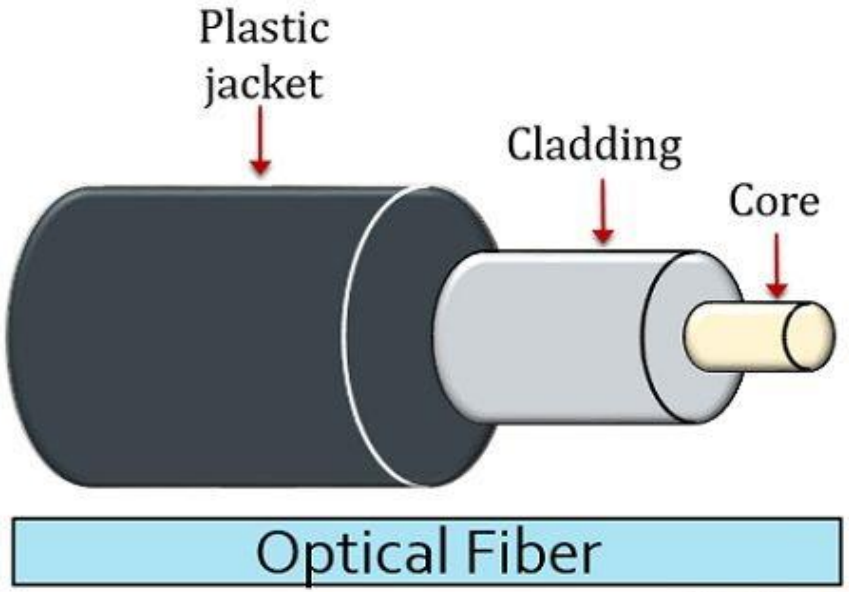
- 1. It should be long ,thin and flexible.
- 2.Transparent to the optical signal.
- 3. The refractive index of the core must be greater than the refractive index of the cladding (Core > Cladding) .
- 4. This is required to maintain total internal reflection(TIR).
- 5.Critical angle is the angle of incidence where the light refracts along the boundary between the two mediums.
- Critical Angle = $\emptyset = \sin^{-1}(n2/n1)$

[2]

Structure of optical fiber

1. **Core:** transparent to optical signal
2. **Cladding :** It is for providing mechanical strength and reflection losses also decreases in presence of cladding.

3.Protective layer : Use to protect the optical fiber as core is soft.



Types of optical fiber

- Optical fiber are of two types :-
- 1. Glass Optical fiber
- 2. Plastic optical fiber

Glass Optical fiber

ADVANTAGES

1. Glass fiber networks usually show fewer losses and have high data transmission capacity.
2. The glass that is used to make optical fibers is ultraclear. So, it has less attenuation and can be used for long-distance communications.
3. Some glass fibers are specially built to work with vacuum environments

DISADVANTAGES

1. Product cost and installation costs are more expensive.
2. The mechanical handling of glass optical fiber is difficult. It can break if not handled properly.
3. Highly trained technicians are required to install glass optical fibers, and tools and equipment are more expensive.

Plastic Optical fiber

ADVANTAGES

1. The material cost of plastic fiber is low, and its accessories, tools, and equipment are also not expensive.
2. There is no need for trained skills to install and use plastic optical fibers.
3. Plastic optical fiber is easy to handle and able to bend more without breaking.

DISADVANTAGES

1. Plastic optical fibers cannot be used for long distances because signal attenuation and dispersion increase when used over long distances.
2. POF can not be used in high-temperature environments.
3. They are not able to work in the vacuume environment

INNOVATIVE COMMUNICATION

- NeoCommLight is a cutting-edge communication system designed for Neonatal Intensive Care Units (NICUs). It utilizes visible light for data transmission, ensuring reliable communication in RF-restricted environments.

RF –Restricted Environment

- Operating in environments where radio frequency (RF) communication is restricted, NeoCommLight provides a secure and interference-free communication solution.

Improved Connectivity

Improved Connectivity

NeoCommLight enhances connectivity within RF-restricted NICUs, ensuring seamless communication between medical staff and equipment.

Data Transmission

It enables efficient transmission of critical data and information, supporting real-time decision-making and patient care.

Real-Time Monitoring

The system facilitates real-time monitoring of vital parameters, contributing to enhanced patient safety and care quality.

Practical Applications

- **01-Clinical Use Cases**
- NeoCommLight's applications in clinical settings for healthcare professionals, enabling seamless communication and data exchange during critical care procedures.
- **02 -Research and Development**
- Its potential for supporting research and development in neonatal care, facilitating data collection and analysis for medical studies and innovation.
- **03-Future Innovations**
- The scope for further innovations and advancements in VLC-based communication, paving the way for enhanced NICU communication and care delivery.

Technological Evolution

Technological Evolution

NeoCommLight represents a significant advancement in NICU communication technology, offering a paradigm shift in communication infrastructure for neonatal care.

Potential Impact

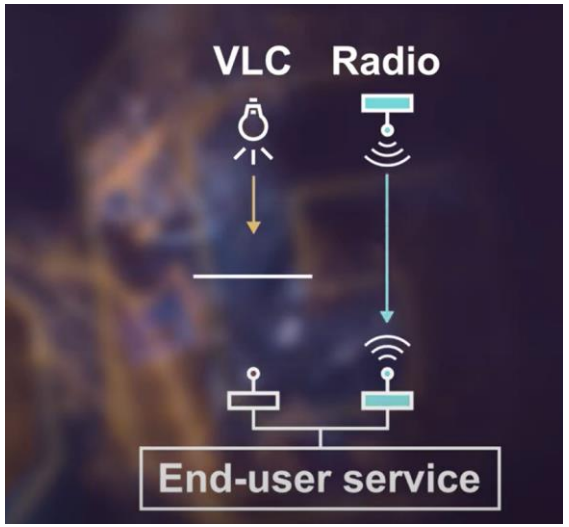
Its implications for improving patient care and medical outcomes, emphasizing the role of reliable communication in enhancing healthcare delivery.

Industry Adoption

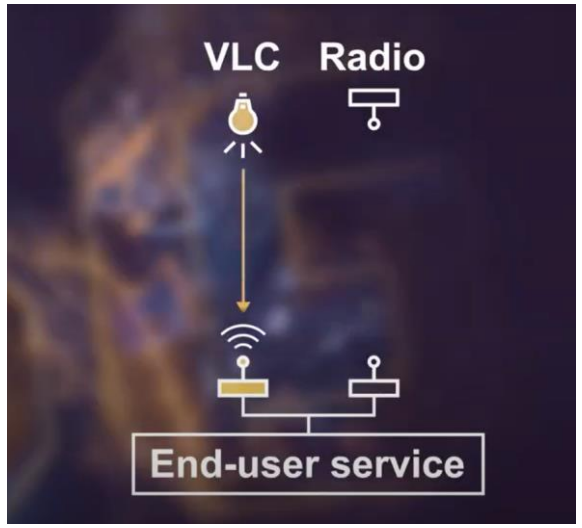
The potential for widespread adoption in NICUs and healthcare facilities, driving improvements in communication and care standards.

FUTURE VISION

- Our future vision is to use Visible light and Radio communication both simultaneously.



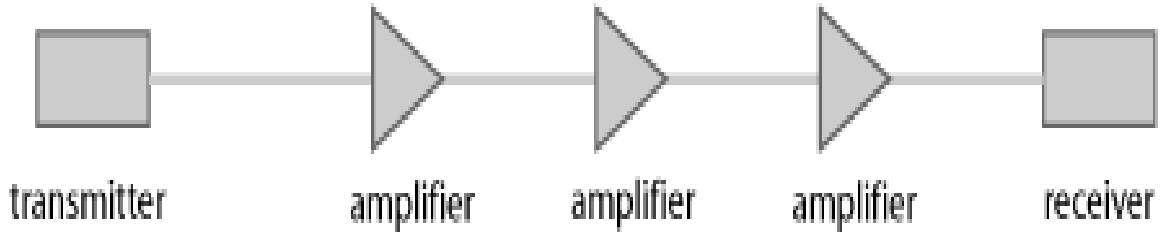
When device is in light restricted region.



*when device is in light presence region.

WHAT IS OPTICAL FIBER LINK SETUP

- A fiber-optic link (or *fiber channel*) is usually a part of an optical fiber communications system which provides a data connection between two points (*point-to-point connection*). It essentially consists of a data transmitter, a transmission fiber (in some cases with built-in fiber amplifiers), and a receiver. Even for very long transmission distances, extremely high data rates of many Gbit/s or even several Tbit/s can be achieved.
- The used components, which are mostly based on fiber optics, are explained in the following, beginning with a simple single-channel system. More sophisticated approaches are discussed thereafter.
- A special kind of fiber-optic links is used for timing distribution and synchronization, and is explained in the last paragraph of this article



[4]

OUTPUT WAVEFORMS

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