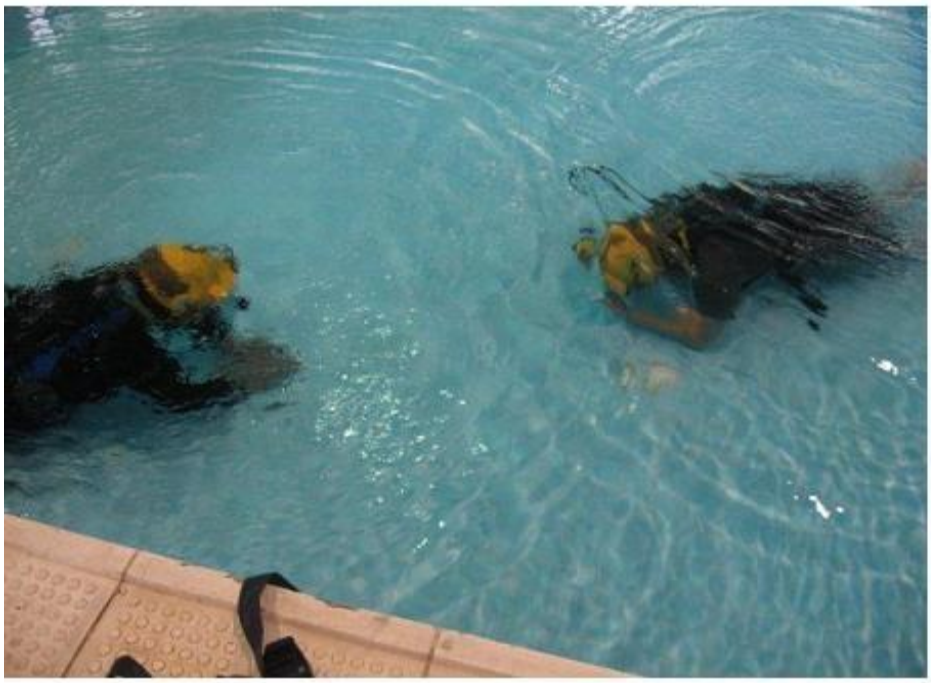
Applications based on LiFi (Visible Light Communication)

1. **Blind Indoor Navigation System**
   Indoor navigation is convenient for everyone, and it is especially indispensable for the visually impaired. We proposed such a navigation system for the visually impaired as shown in Figure. LED lights emit visible light with location data and embedded system or smartphone with a visible light receiver receives the data. The embedded system or smartphone calculates the optimal path to a designation and speaks to the visually impaired through a headphone.

2. **Under Water Communication System**

Information is transmitted from one point to another via modulation. Modulation, forming the basis of communication, is the process of transmission of low frequency data signal with high frequency carrier signal. As it could be understood from the description above, we need two signals for modulation process. These are data signal (voice, music, map, and video) to transmit and high frequency carrier signal. For three reasons modulation is a necessity. First, low frequency data signal has not that much energy to travel far distances. Second, if low frequency data signal were not imposed on carrier signal, in other words if not modulated, the dimension of the antenna would be inefficiently long. It is because the dimension of the antenna is inversely proportional to frequency. Third, data signal bandwidth is 20 Hz-20 KHz and assuming the frequency range of amplitude modulation is 5-10 KHz, there could be a few stations established. For these causes modulation as basis of communication is a demanding tool needed to be used.



3. **Vehicle Underground or Tunnel Navigation System**

The goal of this project is to develop a small, portable yet an intelligent and reliable system for everyone while roaming autonomously in indoor unlike malls. Now a days, places like malls consists of power driven LED's because they are available for cheap and power efficient and gives out long life. It supports LiFi Technology which is the emerging area of technology is also known as Visible Light Communication. In other words, it is also called as Wireless Optical Communication. VLC is a wireless communication technology that uses light that is visible to human. LiFi is transmission of data wirelessly through LED light that varies in intensity faster - door than human eye can follow. When the person moves in an in-door unit, the LiFi enabled devices receives the information about the location and directions. The navigation information can be seen on the LCD screen or any other display unit.

4. **Monitor as transmitter for Data Communication**

The project is based on the next gen data transfer technique to enable transmission from the LED monitor to the devices. The conventional methods of data transfer are via wired, infrared, blue tooth and NFC. These technologies have their own limitations which is the main reason for us to come up with this novice technology.

The principle for communication here is - encoding and decoding data via black and white color display which will flicker at very high speed. Whenever a file needs to be transmitted, it is initially selected. A mini icon of the file will be created at the right side corner of the LCD screen. This image will constantly flicker between white and black colors. The device with sensor should

be brought near the mini folder of the LCD screen which will capture the encoded images and display data on hand held device.

5. **Preventing Phishing Attacks using One Time Password and User Machine Identification**

Phishing is a type of attack in which cyber criminals tricks the victims to steal their personal and financial data. It has become an organized criminal activity. Spoofed emails claiming to be from legitimate source are crafted in a way to lead victims to reveal their personal, financial data by misdirecting them to the counterfeit website. This research paper presents a novel approach to combat the Phishing attacks. An approach is proposed where user will retrieve the one time password by LiFi Device LCD screen. After receiving the one time password the application software will create an encrypted token for the user's computer/device for authentication. The encrypted token will be used for identification, any time user wishes to access the website he/she must request the new password. The one time password as name implies will expire after single use. The one time password and encrypted token is a smart way to tackle this problem.

6. **Super market navigation system and discount information based on location**

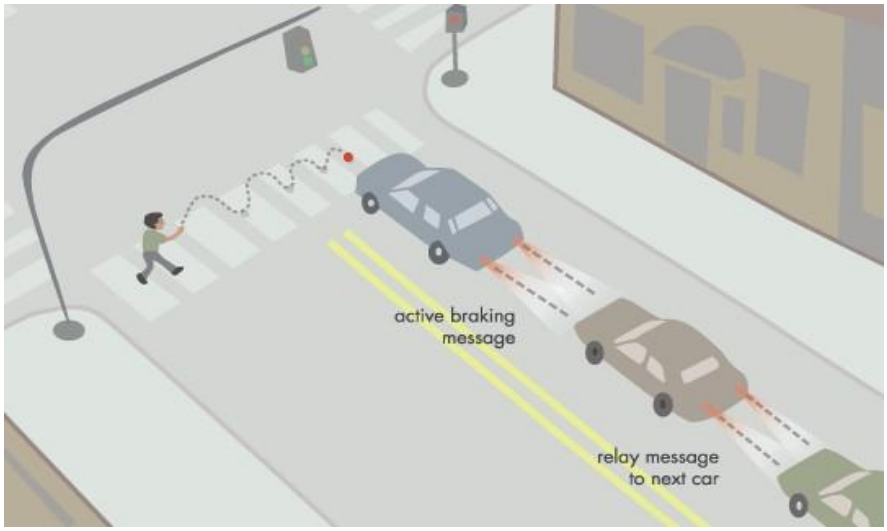
Positioning, also known as localization, is the process of determining the spatial position of an object or person. Accurate positioning is critical for numerous applications. The familiar Global Positioning System (GPS), originally a U.S. military system, is now in everyday use around the world, often in new and unexpected ways. Unfortunately, GPS is not suitable in many indoor situation. To obtain location information using GPS, a device must be able to receive signals from a number of GPS satellites, and this is

often not possible indoors. Even when GPS posi-tioning is available, it may not be accurate enough for many indoor applications. Despite decades of research into indoor positioning

using Technologies such as radio systems based on wireless local area networks (LANs), there is still no system that is cheap, accurate, and widely available. The fundamental problem in radio based systems is multipath propagation. Radio signals may reach a receiver by both direct line of sight and multiple reflected paths. This means that there is no simple and reliable way of deter mining the distance or direction of the transmitter from the received signal. The widespread introduction of white LEDs for illumination provides an unprecedented opportunity for visible light positioning (VLP) to fill this gap, and form the basis for a widely available, economical, and easy-to-use indoor system. Look up in almost any building and you will be able to see multiple light fittings, demon starting that at most indoor locations, a receiver could be designed to receive line-of-sight signals from multiple light sources. The introduction o LED lighting creates a new opportunity for creating an indoor positioning system. This was no possible with conventional lighting, but LEDs have a number of key advantages. First, LEDs can be modulated at much higher frequencies than conventional lighting, so the signals required for positioning can readily be transmitted at frequencies that do not cause visible flick-er. Second, although LED lights are initially more expensive, they have a much longer life-time, typically several years. This means that the added cost of constructing lights with the extra functionality required for positioning will be relatively smaller, and the benefits longer lasting.

7. VLC based v2v (Vehicle to vehicle communication)

Vehicular Ad hoc NETworks (VANETs) belong to a subcategory of traditional Mobile Ad hoc NETworks (MANETs). The main feature of VANETs is that mobile nodes are vehicles endowed with sophisticated "on-board" equipments, traveling on constrained paths (*i.e.*, roads and lanes), and communicating each other for message exchange via Vehicle-to-Vehicle (V2V) communication protocols, as well as between vehicles and fixedroad-side Access Points (*i.e.*, wireless and cellular network infrastructure), in case of Vehicle-to-Infrastructure (V2I) communications .



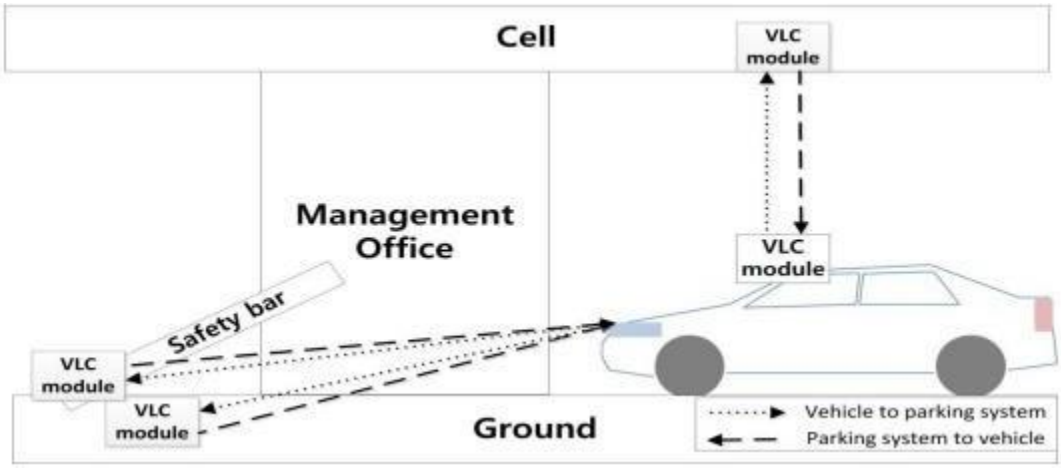
Future networked vehicles represent the future convergence of *computers*, *communications infrastructure*, and *automobiles* . Vehicular communication is considered as an enabler for driverless cars of the future. Presently, there is a strong need to enable vehicular communication for applications such as safety messaging, traffic and congestion monitoring and general purpose Internet access.

Visible Lighting Communications (VLC) can provide a valid technology for communication purposes in VANETs. The use of the visible spectrum provides service in densities exceeding femtocells for wireless access. It represents a viable alternative that can achieve high data rates, while alsoproviding illumination. This configuration minimizes packet collisions due to Line Of Sight (LOS) property of light and promises to alleviate the wireless bottleneck that exists when there is a high density of rich-media devices seeking to receive data from the wired network.

Possible applications of VLC impact the quality of life, including control of auto / traffic signaling for safety and enabling communications where high noise interferes with WiFi.

8. **Smart LIFI based Car Parking system**

Smart parking information system exploiting visible light communication (VLC) technology to help drivers getting the real-time parking information as well as direction guide. By providing accurate information on available parking spaces, drivers save time and fuel and increase efficiency of the parking process. Therefore, the proposed system not only gives the illumination function of LED but also the function of communicating in the manner of application based on the VLC. The effectiveness of the proposed scheme is validated through experiments in an indoor environment. In modern life, the shopping complexes always attract people for its good products and service. What's more, shopping complexes have begun providing services much more diverse than just pure selling and buying. Customers can use banking services, post offices, food courts, cinemas, children's play areas.



Hence, more shop manager prefers to invest much money and time in designing the interior, store location, parking lots and so on to target more customers and increase revenue. Providing sufficient parking spaces for visitors is one of the most important issues in developing shopping complexes. Offering safe and conventional parking lots with a sufficient number of spaces is a few of the factors which can increase customer loyalty and attract customers to visit a shopping mall more frequently. However, until now, various parking information systems in our life are based on conventional radio communication system, which need specific industry standard

9. **Smart Location Aware of Services**

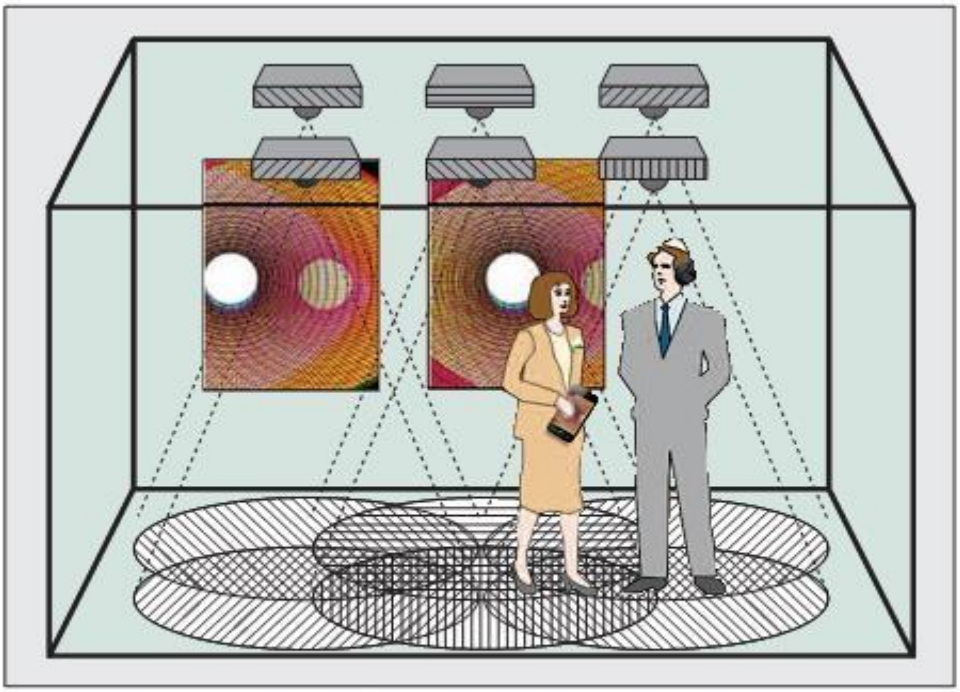


Figure 1. *Two uses of visible light positioning in an art gallery. The headset worn by the man detects its position and plays recorded information relevant to the picture in front of him. The woman is using a location-aware service on her tablet computer.*

Applications of indoor positioning, which have very different localization and communication requirements. Each figure shows a room of the future, where six light fittings are transmitting signals that can be used for localization. In Fig. 1, the man wearing headphones is listening to recorded information about the artwork in front of him. This is an automated version of the headsets currently provided by museums and other places of interest, which require a number to be entered by the user at each exhibit. In a VLP-based system, a receiver in the headset would detect the signal from the nearest LED and play the relevant commentary.

10. **Visible light positioning for asset tracking**

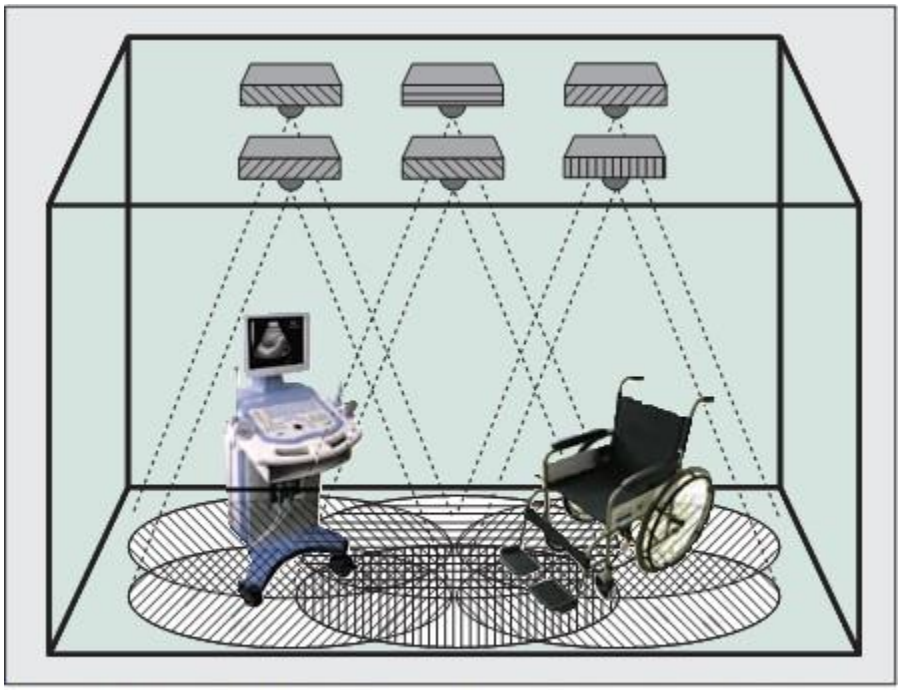


Figure 2. *Use of visible light positioning for asset tracking in a hospital to locate the positions of the trolley and the wheelchair.*

Very important use of the new systems will be in asset tracking. Figure 2 shows an example of a system being used to track the position of a wheelchair or a portable medical device, an application that is important in hospitals. The same concept could also be used for a host of other purposes such as tracking trolleys in airports or consignments in warehouses. The receiver on the wheelchair detects the identity of the nearest LED and transmits this information using a radio system such as ZigBee or a wire-less LAN to a central computer. The computer maintains a database of the identity of the LEDs and their locations. The receiver needs only to transmit information about its position intermittently, so it could be a low-power battery operated device. Note that in these first two applications, the receiver needs only to deter-mine the identity of the LED, not its position.

11. **POSITIONING TECHNIQUES FOR ACCURATE LOCALIZATION mobile robot navigation**

When accurate positioning is required, as in the mobile robot example of Fig. 3, the VLP receiver will use the received signals to determine the relative distance and/or direction of a number of LED transmitters. These measurements will then be combined using classical triangulation (using angle of arrival information) or tril alteration (using path length or time of arrival information) to determine the position of the receiver. We now discuss a range of positioning techniques and their suitability for use with light- ing LEDs. Many of the indoor positioning systems that are based on radio signals use received signal strength (RSS) to estimate the distance of the receiver from the transmitter. In general, as the distance between

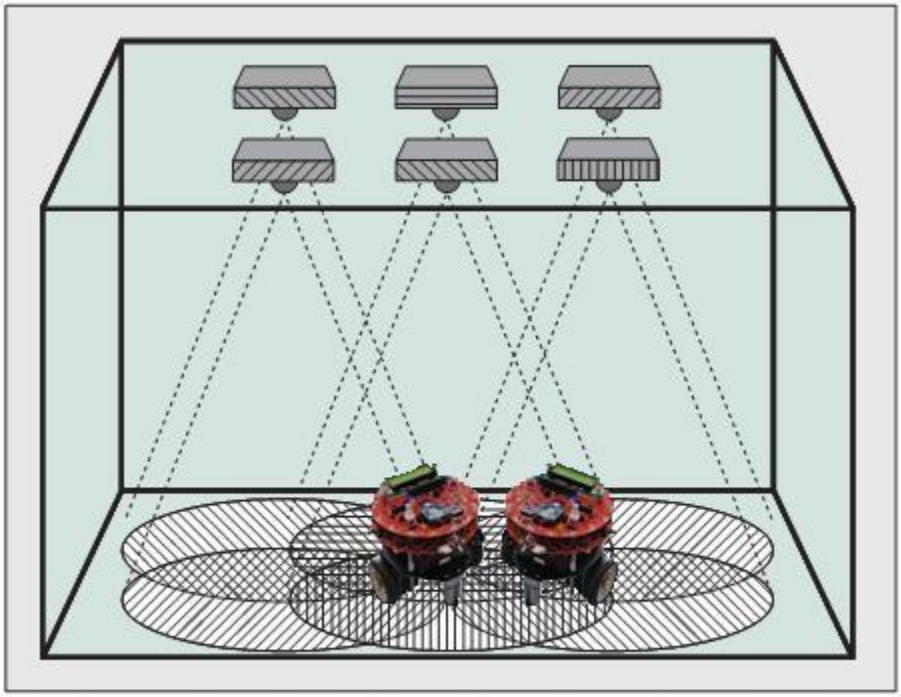
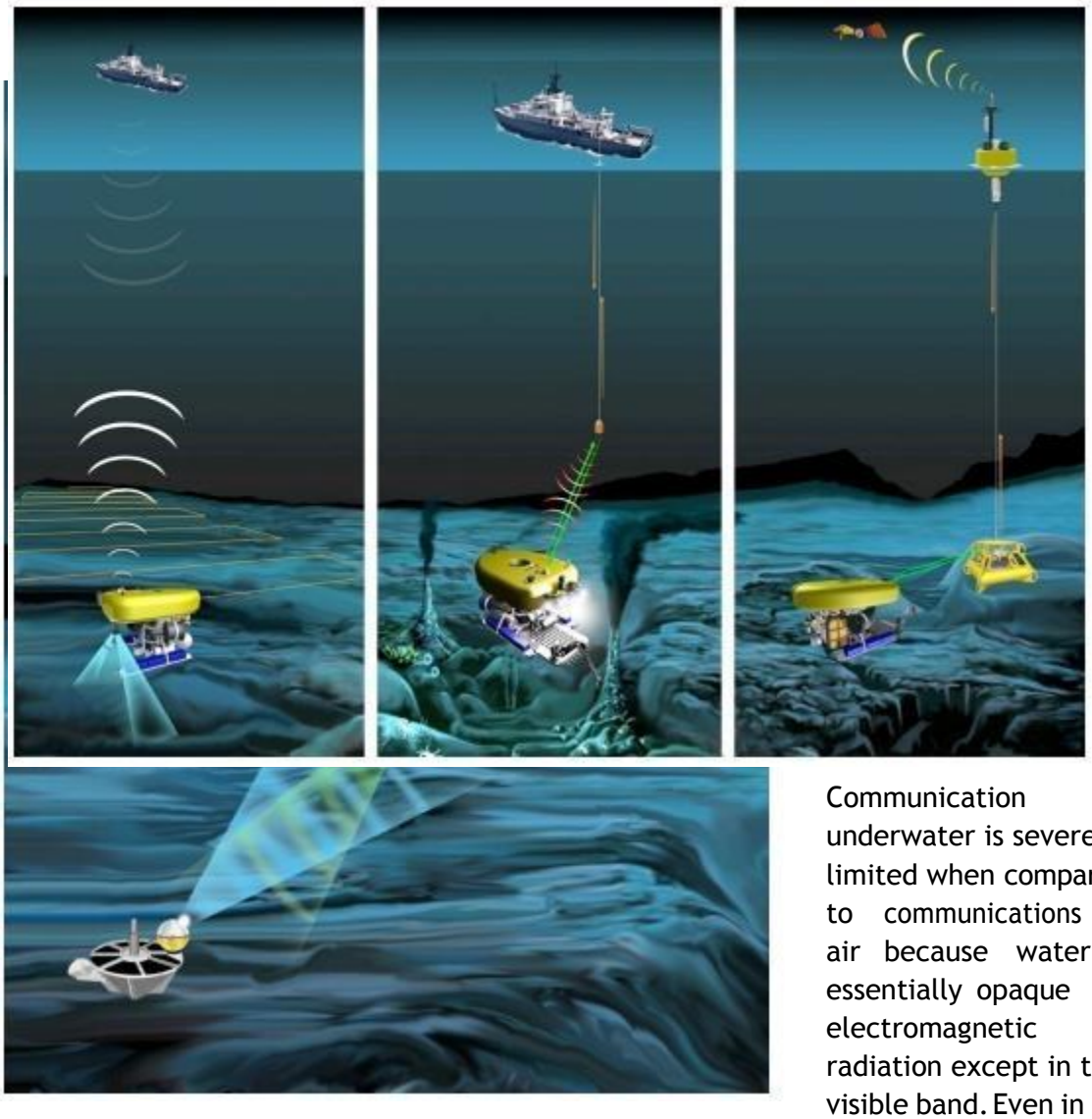


Figure 3. *Visible light positioning to give accurate positioning information for mobile robot navigation.*

transmitter and receiver increases, the power of the received signal falls. However, the effects of objects blocking and reflecting the radio signal mean that the relationship between distance and RSS is unpredictable, limiting the accuracy of an RSS approach in radio-based systems.

12. Integrated, underwater optical /acoustic communications system



Communication underwater is severely limited when compared to communications in air because water is essentially opaque to electromagnetic radiation except in the visible band. Even in the visible band, light penetrates only a few hundred meters in the clearest waters and much less in waters made turbid by suspended sediment or high concentrations of marine life. Consequently, acoustic techniques have been developed for underwater communication systems and now represent a relatively mature and robust technology. Acoustic systems are capable of long range communication, but offer limited data rates and significant latency (due to the speed of sound in water). We are developing an optical communication system that complements and integrates with existing acoustic systems resulting in an underwater communications capability offering high data rates and low latency when within optical range combined with long range and robustness of acoustics when outside of optical range. Amongst a wide array of applications, this combination of capabilities will make it possible to operate self-powered ROVs from support vessels or platforms without requiring a physical connection to the ROV. Such a capability will help simplify operations and potentially reduce costs through the use of less capable surface vessels.

New deployment strategies may offer game-changing opportunities within all areas of undersea activities. For example, rapid event response will be enhanced and repair and maintenance of the emerging ocean observatory infrastructure will become more cost effective. Such through-water communications will likewise enable exchange of large data files from fixed sensors using AUVs (or ROVs) as data mules, shuttling real-time video from untethered vehicles for inspection, identification, and other related operations. Interconnectivity for dense arrays of underwater sensors without the need for expensive and difficult to install undersea cables is also possible. An unmanned battery operated vehicle, dedicated to a subsea node, that can be wirelessly operated through a combination of acoustic and optical communications, will be an important asset for both scientific exploration and commercial applications.

13. Visible Light Communication Based Traffic Information Broadcasting Systems

Traffic safety information broadcast from traffic lights using Visible Light Communication (VLC) is a new cost effective technology which can draw attention to drivers to take necessary safety measures. This paper presents a VLC broadcast system considering LED-based traffic lights. It discusses the conceptual methodology for integrating traffic light road side unit (RSUs) with impending intelligent transportation systems (ITS) architecture.

Results from a case study of VLC system for information broadcast are also presented.

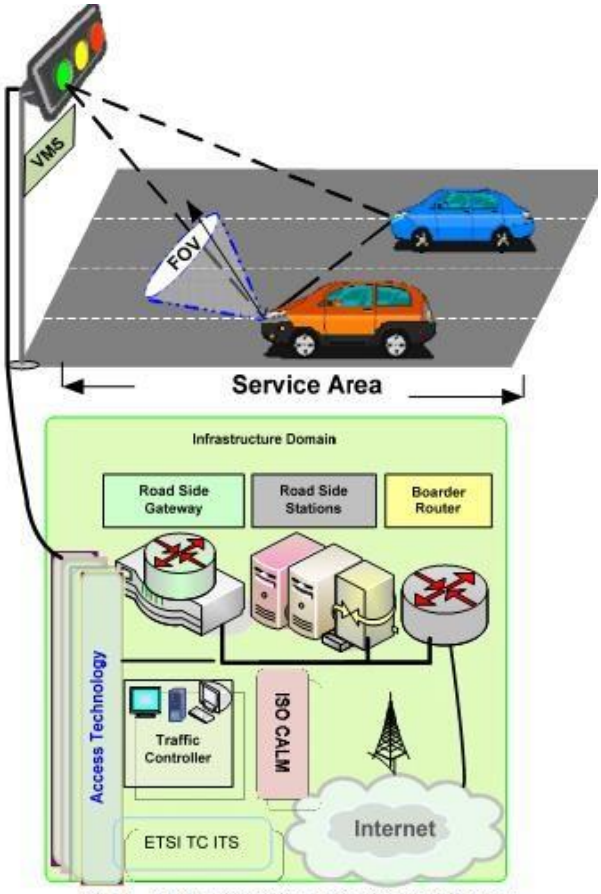
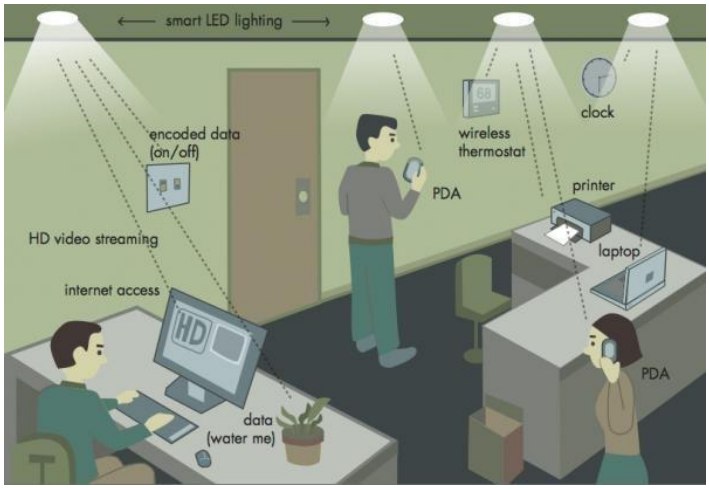


Fig. 1. VLC Integration with ITS architecture.

Road accidents which cause loss of material and most importantly human lives are becoming severe even with the deployment of many intelligent communication devices on board vehicle and alongside the road. According to world health organization report [1] road crashes are the second leading cause of death globally among young people aged five to 29 and the third leading cause of death among people aged 30 to 44 years. Over 1.2 million people are killed annually because of road accidents. The study predicted that road accidents would become the sixth largest cause of death in the world in 2020 whereas it was the ninth largest cause of death in 1990

14. Li-Fi wireless optical communication

Visible Light Communication (VLC) technology, one of the advanced optical wireless communication technologies, in which light in the visible region (375nm-780nm) is used as a medium for data transmission is more secure and achieves high data rates as compared to conventional wireless technologies like Wi-Fi, Bluetooth, Wi-max etc., which use radio waves for communication. While using wireless internet, when more than one device is tapped into the network, then bandwidth got frustrated at the slow speeds. To overcome the shortage of bandwidth we can use light to transfer the data which can be known as "DATA THROUGH ILLUMINATION". The idea behind is that, infra-red remote is slightly modified i.e., LED light bulb that varies in intensity which cannot be followed by the naked eye. It is possible to encode the data in the light by varying the light at which the LEDs flicker on and off to give different strings of 1s and 0s.While using mixtures of red, green and blue LEDs to alter the light frequency encoding a different data channel. If you can"t see the light then you cannot access the data so the security would be snapped.



Other Application

- Lifi Based Tunnel Navigation
- Lifi Based Mining worker communication, tracking and navigation system
- Lifi Based speaker hosting guide system
- Lifi based sticky note management system for work flow control
- Lifi based object tracking system
- Lifi based baby monitoring system
- Lifi based Advertisement and announcement system in aircraft
- Lifi based communication system in nuclear reactor
- Lifi Based indoor location proof password authentication system for server
- Lifi based intercom system