



Why Light Communications?

World-wide internet has been possible thanks to optical wireline communications, at the terrestrial level along with enabling connectivity between continents. Optical fiber is deployed everywhere, even for home subscribers, with the introduction of Fiber to The Home technology (FTTH). In parallel, wireless networks have been widely deployed almost everywhere with Wi-Fi® and cellular technologies from 1G to 5G offering wireless services and high-speed mobility at high performance. The growth of Industry 4.0 is also driving new constraints that requires the latest wireless technology and new innovative solutions.

Wireless connectivity is facing challenges

The world is quickly reaching a threshold in connectivity, and demand is quickly outpacing(?) supply of wireless bandwidth. Light Communications (LC) is the platform for a new digital age powered by billions of connections through light.

As more people, devices and services compete for limited radio spectrum—3G, 4G, 5G, Wi-Fi, Bluetooth, digital radio, and TV, we are quickly running out of spectrum which is becoming congested. Nokia Bell Labs predicts that the worlds demand for wireless data will be unmet by 30% by 2020.

According to Ericsson, mobile data is growing at 60% per year to 71 exabytes per month—or 71 billion, billion bytes—by 2021. Around 90% percent of mobile data will be consumed indoors by 2022, and connected devices in our homes are forecast to balloon from 10 today to 50 in just 5 years. This growth is leaving our radio spectrum congested and creating a risk of underserving our demand dramatically.

Privacy and security have also become a growing concern amongst consumers and enterprise customers alike. Those who operate these wireless networks manage a persistent challenge with ensuring its wide coverage can also be protected.

Light Communications as part of 5G and beyond

Light based wireless communication as part of future wireless networks like W-Fi and 5G technologies is an ideal candidate to enhance and augment the performance of existing 5G solutions. These new technologies will be at the convergence of wireless radio technologies and optical technologies to satisfy the Key Performance Indicators of the future, such as speed, bandwidth and latency.

We are entering into a new era where Light Communication technologies such as LiFi and OCC work in conjunction with other wireless technologies to facilitate and extend the access part of the network. LC operating alongside traditional wireless radio technologies to reduce the amount of radio emission while offering high data rates and greater data density. Additionally, light will help to achieve low energy consumption per bit and ultra-low latency.

The Opportunities for Light Communications

Global Market Insights predicts that the LiFi market will be worth \$75 billion by 2025, creating broad, far-reaching opportunities for the related industries to benefit from LC.

Initial applications defined by early adopters of LC technology to date, include sectors such as: transport, public and private buildings, hospitals, Defense and Industry 4.0. It is expected that once



the technology is standardized and miniaturized, LC will be a pervasive technology existing in every mobile handset and in consumer LEDs for both home and commercial use.

Benefits

- **Bandwidth & Speed**

Data consumption trends per user across the world is on an exponential rise with millions of terabytes of data exchanging hands and putting immense load on already congested RF spectrum every day. Spectral efficiency of wireless technologies is an inherent characteristic which cannot be improved and the same can only be optimized by proper planning & utilization of telecom infrastructure. Solution to spectral efficiency issues & meeting the ever-rising consumer demands is licensing of scarce & highly expensive additional spectrum. **Light Communication** proposes an additional free spectrum for wireless communication addressing the broad-spectrum congestion issues. The light spectrum is **1000** times wider than the usable RF spectrum. It is also feasible to achieve higher throughput per user (**multi gigabit**) in comparison to traditional RF solution which will cater the required demands of higher speeds. It also provides an option where efficient & cost-effective wireless backhaul connectivity can be built up for 4G/5G.

- **Latency**

Light Communication offers **sub millisecond latency** for wireless communication which will enable automation and enhances the AR/VR experience.

- **Security**

“Light cannot trespass through the physical environment, enabling secure data passage”. The inherent property of light is adding up an extra physical layer of security for data transmission.

- **Localization**

Li-Fi & OCC can enable precise localization of users as each light source has its own unique address which means advanced geofencing can be added in a Li-Fi network. With OCC, applications like precise asset tracking and indoor navigation can be enabled.

- **Energy Efficiency**

Li-Fi provides connectivity utilising the current lighting infra-structure with very low additional requirement of power for communication part. Which means we are saving more energy on data transmission side.

- **Reduce RF Emissions**

Light Communication reduces the RF emission as data is transmitted in visible and near infra-red part of electromagnetic spectrum.



Light Communications Adoption

Figure 1 outlines the expected adoption from industries most affected by enhanced wireless communications. A global LC Standard is currently being ratified under 802.11bb which is expected to complete in 2021. This milestone will represent an inflection point of consumer adoption.

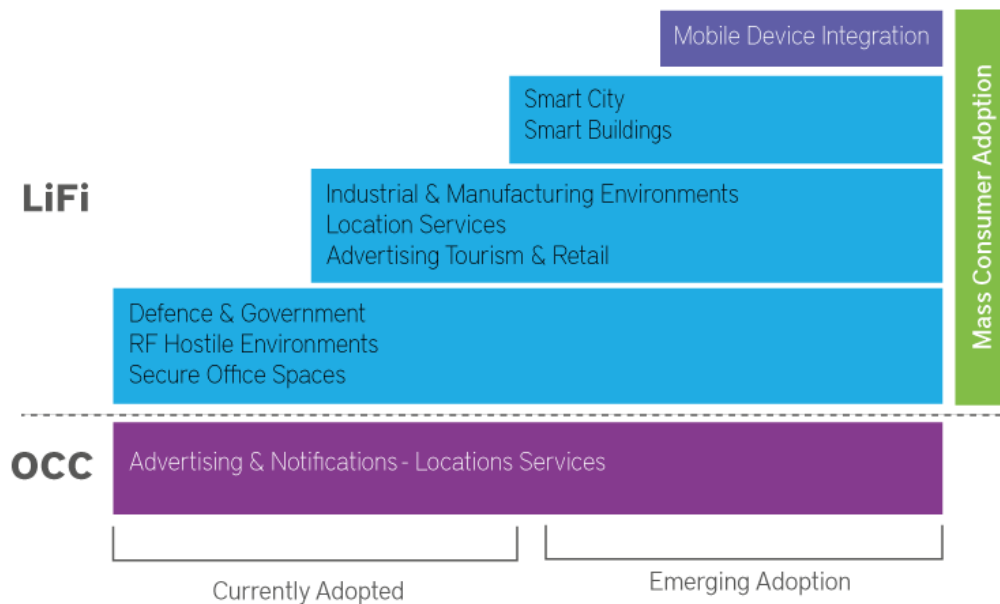


Figure 1: Sector adoption and use of LC

Early Adoption of Light Communications

The LC industry has seen enthusiastic early adoption from industries that have a long history of challenges with radio frequency technology.



Defence: LC, specifically LiFi, is inherently secure as light does not pass through walls. LC can enable additional control with precise localization for asset tracking and user authentication. These features make LiFi of interest to the defense and security sector, due to high bandwidth wireless communications which prevent interception and jamming of the signal in contested environments. For example, unlike radio signals, light-based wireless communication cannot be jammed.



Indoor Navigation: OCC is a low power way to enable interference free locations services with light. This enables off-the-shelf mobile phones to use their camera for LC. This could provide precise navigation through indoor spaces such as shopping malls, museums, even hospitals and more.



Industry 4.0: Mission critical communications within a busy industrial manufacturing environment can be complex and rife with interference and reliability challenges. As Light does not interfere with radio and radio does not interfere with ambient light, combinations of both LiFi and OCC can enable fast, secure and interference free wireless in Industry 4.0 environments.

Hospitals: Many hospitals have strict rules about the use of radio frequency technology including mobile phones, as sensitive medical equipment can be compromised by interfering radio technologies. LC can enable wireless communications for smart connected hospitals everywhere.



Smart Transport: Smart transportation requires complex sensors and receivers, where LC can provide simple connectivity by repurposing the lighting infrastructures.

Emerging Adoption of Light Communications

Public Hotspots: In busy public areas such as airports, stadiums and shopping centers it can be difficult to provide and sustain public wireless hotspots with traditional radio frequencies due to congestion and overloaded networks. LC can offer high bandwidth, secure and extremely dense networks that provide a better quality connection.



VR and Gaming: VR and AR technology has been limited by its requirement for complex processing and low latency connectivity. By using LC, low latency capabilities, processing can be offloaded to the lighting infrastructure making VR headsets more versatile.



Connected Vehicles: Lights can provide ultra-high speeds and low latency communications, making light an ideal candidate for repurposing the lights in the interiors and exteriors of our vehicles for communications. Light compliments other wireless technologies to enable Vehicle to Vehicle (V2V) and Vehicle to Everything (V2X) communications.



Smart Homes: Many homes experience overloaded networks. If multiple users in a single home are streaming video, online gaming and surfing the internet all at once, it is expected that each user is experiencing compromised bandwidth. Using LC in the home to augment and offload high bandwidth activity such as gaming and streaming, the users' experience can be greatly enhanced. LC also provides additional privacy as light does not pass through walls while also improving the privacy.

Optimistic Future for Light Communications

Light Communications has the ability to provide us with thousands of additional channels for communications, providing massive additional bandwidth for wireless connectivity. As the world's demand for wireless connectivity grows, with an explosion of high bandwidth services such as gaming, and video streaming, LC presents massive opportunities to service this demand, by augmenting and enhancing future wireless radio access networks such as Wi-Fi and 5G.