

Shedding Light on LiFi



Last updated August 2017

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For many of us Wi-Fi feels omnipresent. Wireless data has become an essential commodity in our daily life, synonymous with electricity and lighting. Wi-Fi is everywhere; our neighbours have it, it's free in shops, restaurants, trains and airports. We all know and understand the benefits of Wi-Fi, but what is LiFi and why is it so significant? connected future?

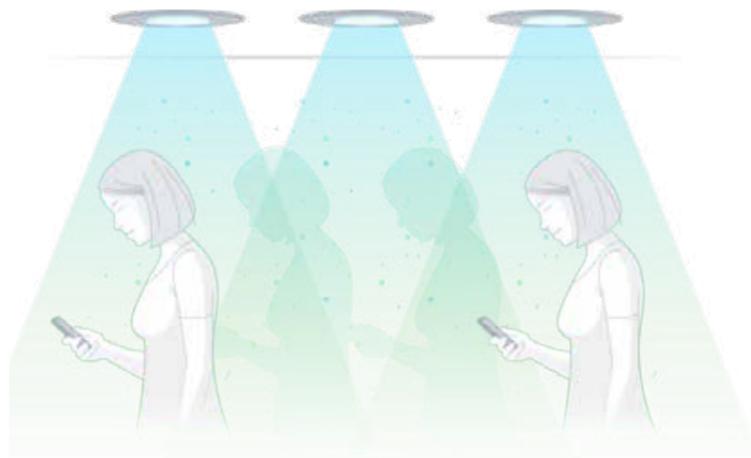
LiFi is important because it opens up a spectrum of connectivity that is 1000 times greater than Wi-Fi.



LiFi, like Wi-Fi, enables electronic devices like laptops, tablets, and smartphones to connect wirelessly to the internet. Wi-Fi achieves this using radio frequencies, but LiFi achieves this using the light spectrum which can enable unprecedented data and bandwidth.

It's important to consider that wireless data is required for more than just our traditional connected devices – today our televisions, speakers, headphones, printer's, VR goggles and even refrigerators use wireless data to connect and perform essential communications. In fact, it is predicted that by the year 2020 there will be 20 billion devices wirelessly connecting to the internet. Additionally, almost 80% of the wireless data is being consumed in the form of bandwidth intensive video that enables popular software and applications such as social media, video streaming services such as Netflix, virtual and augmented reality.

Radio frequency technology like Wi-Fi is running out of spectrum to support this digital revolution and LiFi can help power the next generation of immersive connectivity.



The difference between LiFi and Wi-Fi?

Congestion

Wi-Fi uses radio frequencies, and these are very limited. Devices computers, laptops, printers, smart TVs, smartphones and tablets must compete for bandwidth. The emergence of more and more Wi-Fi-enabled things e.g. refrigerators, watches, cameras, and offloading from cellular is causing congestion, and degrading data communications. Li-Fi uses the frequencies of light waves, which are 1000 times more plentiful than radio frequencies and do not interfere with radio frequencies.

Density

Imagine an office of 460 sq metres with 80 employees working on tablets and laptops wirelessly. Typically for every 200 square metre there would be one wireless Wi-Fi router providing approximately 1 Gbps. This would mean there would be a total of 2 Gbps for the entire office to share. However, imagine that the entire lighting structure of the office was LiFi enabled. Even if conservatively the office only had 100 lights in the ceiling that would provide more than 4 Gbps for the office to share and if that's not enough all you have to do is add more lights. However, you can't add more Wi-Fi routers as they interfere with each other. The amount of available data per square metre of space in a room will always be greater with LiFi.

Security

Radio waves pass through walls and ceilings. Light doesn't. Therein lies the difference in data security between Wi-Fi and LiFi. An intruder or hacker, outside a building can tap into the Wi-Fi data communications of computers inside the building. Data communicated via LiFi can only be accessed where the LED light illuminates.

Safety

Wi-Fi creates Electromagnetic Interference (EMI), known to interfere with airplanes' instruments and equipment in hospitals, and is potentially dangerous in hazardous operations, such as power/nuclear generation or oil and gas drilling. Li-Fi uses light instead of radio waves, which is intrinsically safe and does not create EMI.

Speed

The older versions of the Wi-Fi standard, like IEEE 802.11 a/g, specify data rates up to 54Mbps. However, the newer Wi-Fi standards, like the 802.11 ac provide technologies that can extend these data rates to 1Gbps and beyond. Indeed, the 802.11 ad can achieve data rates of up to 7 Gbps. The University of Edinburgh, pureLiFi's partner and home to Prof. Harald Haas – "the father of Li-Fi", have already demonstrated data rates over 3 Gbps with a single blue micro-LED. On a single light with three colour LEDs (R,G,B) this translates to theoretical data rates of up to 9 Gbps, showing great promise of this rapidly maturing technology.

How Does LiFi Work?

When a constant current of electricity is applied to an LED light bulb a constant stream of light is emitted from the bulb which is seen as visible light. If the current is varied slowly the output intensity of the light dims up and down. LEDs are semi-conductor devices, which means the current, and the visible light, can be modulated at extremely high speeds. This high-speed modulated signal is then be detected by a photo-detector and converted back to an electrical current. The intensity modulation is imperceptible to the human eye. LiFi communication is just as seamless as RF, however has many unique benefits, such as speed, density, security and enhanced location services.

Radio frequency communication requires radio circuits, antennas and complex receivers, whereas LiFi is much simpler and uses direct modulation methods and reflectors and diffusers for beam forming. Infra-red communication is limited in power due to eye safety requirements, whereas LED light bulbs have high intensities and can achieve very large data rates.

What is the difference between LiFi and VLC?

Visible Light Communications is a very generic term that suggests any form of data communications over light. Over the development of Light communications VLC has primarily been used to describe unidirectional, point-to-point light communication at low data rates.

LiFi technology addresses advanced networking capabilities, including data roaming, hand over and multiple access. Genuine LiFi is fully networked, bidirectional and high speed wireless communications using light.



Common Myths about LiFi?

LiFi in Sunlight

There is a misconception that LiFi doesn't work outdoors or in sunlight. LiFi can operate in daylight and even in direct sunlight conditions, as the modulated light can still be detected. LiFi relies on detecting the fast changes in light intensity and not on the absolute or slowly varying levels caused by natural disruptions in daylight or sunlight. LiFi technology modulates the light at very high rates and sunlight is constant light and therefore can be filtered out at the receiver. Our team at pureLiFi has tested our receivers outdoors under 77,000 Lux of sunlight.

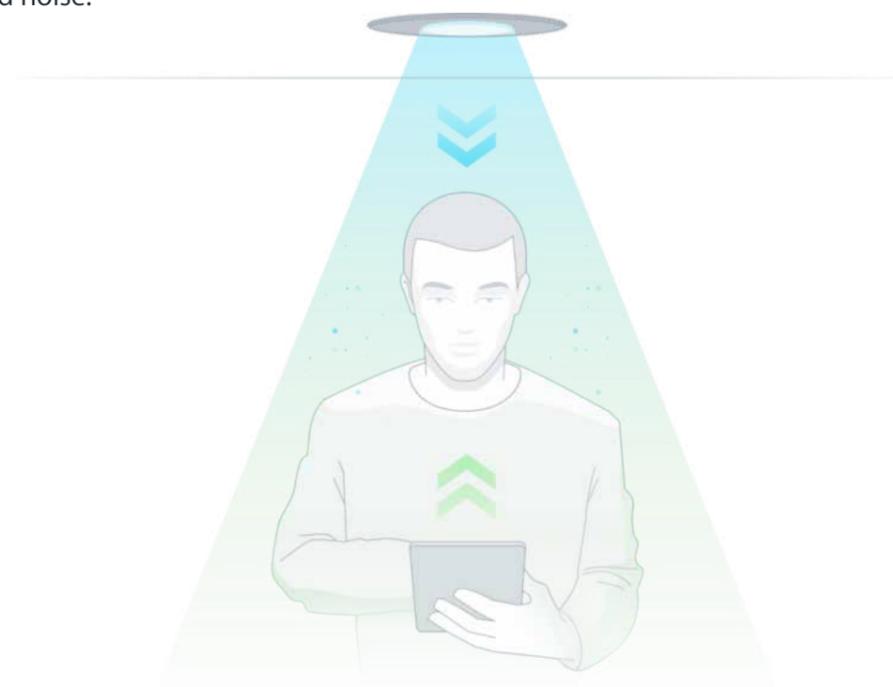
What happens to LiFi when I Turn off the Light?

If all power to a light is turned off then there is no LiFi. However, LiFi technology can be enabled to dim low enough that a room will appear dark and still transmit data. There are also other options for using invisible parts of the light spectrum such as infra-red, which is currently already being used for sending information back to the lightbulb (uplink).

Is LiFi a line of sight technology?

Light bounces off of surfaces and therefore LiFi is not strictly a line-of-sight technology, however it is strongest in line-of-sight conditions.

LiFi is a cellular communication system and the data rate is not dependent on the line of sight but on the signal quality at the device. Signal quality can be defined by the ratio of the desired data vs any interfering data and noise.



The History of LiFi

Alexander Graham Bell is most famous for inventing the telephone, but he also demonstrated the first VLC system in 1880. In fact, only 4 years after inventing the telephone, Bell demonstrated the world's first wireless telephone call. He did this with an apparatus called a Photophone that used light, not radio. Bell had to use daylight for transmission, which severely limited its practical use. Professor Harald Haas and his research team first developed the modern concept of Li-Fi at the University of Edinburgh, ironically in labs within the Alexander Graham Bell Building (Bell was born in Edinburgh and attended the University). Li-Fi was developed as a solution to the growing radio spectrum congestion problems. Haas demonstrated the technology by streaming live video for the first time at TED Global in July 2011, and the term 'Li-Fi' was coined by him during this talk. The company pureVLC (www.purevlc.com) was created in 2012, in order to commercialise Li-Fi.

pureLiFi Company Milestones



JULY 2011
Prof. Harald Haas coins "LiFi" at TEDGlobal 2011



SEPTEMBER 2013
First product launch of Li-1st. Innovate UK funded project with Cisco



DECEMBER 2014
Completed development of Second product: Li-Flame



NOVEMBER 2015
Prof. Haas demonstrates LiFi using Solar Cells at TEDGlobal 2015

JUNE 2016
Series A funding led by Temasek

JULY 2016
New CEO Alistair Banham Appointed

MARCH 2017
Win the digital trends "Cool Tech" award at Mobile World Congress

Q3 2017

JANUARY 2012
pureLiFi is found as VLC Ltd (pureVLC) with seed funding

DECEMBER 2012
Second round of seed funding
Innovate UK funded project with Rolls Royce

JANUARY 2014
Re-branding of company to pureLiFi



DEC 2015
Achieved Seed funding in two tranches totalling £4 million

MARCH 2016
Launch the LiFi-X, the world's first LiFi dongle at mobile world congress



SEPTEMBER 2016
Launch the world's first Integrated luminaire with partner Lucibel

NOVEMBER 2016
Established the IEEE 802.11 light communications Topic Interest Group (TIG)

JULY 2017
Established the IEEE 802.11 light communications Study Group (SG)