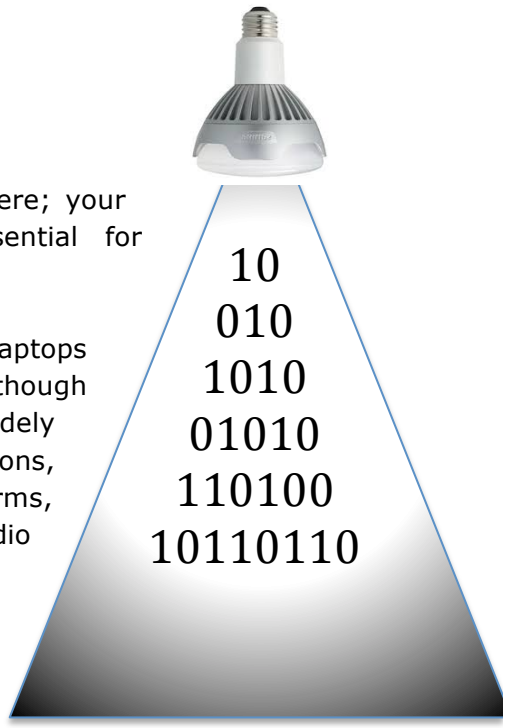
Shedding Light on Li-Fi



It's impossible to avoid Wi-Fi in today's world. It's everywhere; your neighbours have it, it's free in coffee shops, and essential for smartphones. We all know ***W****i-Fi*, but what is ***L****i-Fi*?

Li-Fi, like Wi-Fi, enables electronic devices like computers, laptops and smartphones to wirelessly connect to the Internet. Even though Wi-Fi was also originally intended for such devices, it is widely used today to connect all sorts of ***things***: printers, televisions, speakers, headphones, and even running shoes! In simple terms, Li-Fi is equivalent to Wi-Fi, but using light waves instead of radio signals.

Li-Fi uses the light waves from LED light bulbs – that are rapidly replacing incandescent light bulbs for their energy saving and safety - to transmit data so it provides illumination ***and*** wireless data communications.

Imagine a modern LED light bulb – fitted with Li-Fi technology – in your living room, or office, or in a lamp on your desk, or by your bedside. Anywhere that is illuminated by the Li-Fi enabled LED, can also communicate via Li-Fi.

The difference between Li-Fi and Wi-Fi is …?

Li-Fi can turn an LED lamp into a wireless access point similar to a Wi-Fi router, so apart from the added advantage of illumination, how do they differ?

"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 up to 10,000 times more plentiful than radio frequencies and do not compete with Wi-Fi.

"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.

"SECURITY"

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

"SPEED"

◆Wi-Fi standard, 802.11a/g, provides data communication rates up to 54Mbps. However, there are techniques available to extend this to 1Gbps. The University of Edinburgh, pureVLC's partner and home to Prof. Harald

Haas – "the father of Li-Fi" have already demonstrated 3Gbps on a single color. On a single LED with full color (R,G,B) this could communicate at speeds up to 9Gbps.

How Does It Work?

Standard LED light bulbs are controlled by a *driver* that turns the LED on and off, or dims and brightens it. With Li-Fi enabled LED light bulbs, the driver is used to *transmit* encoded data by controlling the LED light. An optical sensor is used to *receive* the data, which is then decoded. This is conceptually similar to Morse code – but at rates of many millions of times a second, which is imperceivable to the human eye.

The receiver has optics, and is fast enough to 'see' the light dimming and brightening, smart enough to decode the Li-Fi data, and then deliver it to the attached device such as a laptop computer.

Devices can include both a transmitter and receiver to enjoy two-way communications.

What is Visible Light Communications (VLC)?

Visible Light Communications is a very generic term that suggests ***any*** form of data communications via ***visible***, primarily white, light – in contrast to Infra Red (IR), the communication used on most consumer remote controls.

In addition to data communications, Li-Fi addresses advanced networking capabilities, including data roaming, hand over and multiple access.

Common Myths of Li-Fi

***Uni-Directional Only*.** No. Li-Fi can be implemented as a transceiver, providing both transmission and reception.

Visible Light Essential. No. Li-Fi enabled LEDs can be dimmed until no light is humanly visible, but data communications is still maintained reliably.

Line-Of-Sight Required. No – but desired. Li-Fi is perfectly capable of data communications from reflected light, but the signal will be stronger on direct light.

Requires Special LEDs. No.

The History of Li-Fi

Alexander Graham Bell Building - the birthplace of Li-Fi

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.