Fraunhofer
Heinrich Hertz Institute

FAQs Visible Light Communication

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What kind of LEDs can I use?

Data transfer by light uses perfectly ordinary, off the shelf LED modules. However, retrofit LED light bulbs of the kind you can buy in DIY stores are not so suitable as they have difficulty in providing the high transmission speeds needed by many applications.

Does data transfer work in both directions?

Yes, two-way transmission is possible. Generally speaking, however, infrared LEDs should be used for the back channel or reverse path to avoid signal interference.

In what kind of fields of application will Visible Light Communication be used?

VLC is suitable for all areas where radio cannot or should not be used – underwater, in hospitals, airplanes and production facilities. Data transfer by light is also possible in all places where the new LED technology is used – such as LED billboards, onboard car communication, as well as trade fair and exhibition stands.

What's the maximum transmission range?

Short range links of the kind typically found in indoor areas are the main target. This means we're talking about a typical transmission range of approx 30 cm to 5 meters. Yet if the light is bundled much greater distances would also be possible.

How does the data get into the LEDs?

Through a standard data transmission interface like an Ethernet or USB port. Depending on the application or transmission speed used, the signals are either relayed or the information is extracted and the data transmitted. In the latter case data is recompiled at the receiver end as foreseen by the transmission standard.

How is data transformed in optical signals?

By using a modulator which switches the LED lamp on and off. This happens so rapidly that it can not be perceived by the human eye. In this way data is transmitted bit by bit in the form of zeros and ones. A photodiode functions as receiver on the laptop. It captures the light and electronics decode the information and transform it into electrical impulses.

What data speeds (data rates) are possible at the moment?

- with RGB LEDs: 800 Mbit/s
- with white light LEDs: 500 Mbit/s

Can there be interference from other networks?

Absolutely not – and this is one of the major advantages of this technology. Radio networks operating in the same area can never impair the quality of transmission as the receiver in particular is only sensitive to optical signals. What's more, it is very simple to arrange operation of several optical WLANs all working at the same time. All you need is a simple optical screen – even rice paper would do the job!

Can there be interference from other light sources?

Yes and no. There's no problem if the same content is transferred over a number of lamps. But when different content is transferred over a number of lamps, you have to screen the lamps from one another. Sunlight can also be a possible source of interference but only if the sun is shining directly on the receiver, which doesn't happen all that often. Fluorescent light sources like fluorescent lamps can also be a problem. However, we expect that the vast majority of specific user situations will be lit exclusively by LED luminaries.

What happens if I want to dim the light or switch it off?

If the light's dimmed, the receiver experiences a loss of light intensity. Depending on the type of information being transmitted, this can lead to quality restrictions. Below a certain threshold, the light modulator can no longer connect with the receiver which means that transmission stops. If you switch off the light, transmission also becomes impossible. However, in terms of system technology it's relatively easy to switch over to infrared LEDs if you want to transfer data in a darkened room. Infrared light (the light TV remote controls operate with) cannot be seen by the human eye.

Can Visible Light Communication function even if there isn't a direct connection between sender and receiver?

Principally yes. Light signals are also reflected from walls, ceilings, table tops and so on, and can be picked up by the receiver. However, such reflected indirect signals lead to a lower data rate which means that only a much smaller volume of information can be transferred. Even so, data transfer by light also uses the same DMT and OFM modulation techniques that DSL and wireless technology does. Information flows over a number of separately modulated optical frequency channels and is reconstituted at the end into the main signal. This method ensures interference-free data transfer.

If the light is modulated, surely you get a flicker effect?

No, the human eye can only detect changes in intensity of up to around 100 Hz (as on the cinema or TV screen etc.). In VLC applications the light intensity is modulated at much higher frequencies (kHz to GHz) so the light doesn't flicker.

What kind of data can be transmitted?

The transfer technology doesn't differentiate between types of data as the administration side of data transfer is taken care of by other protocols (layers). Our demonstrators typically use Ethernet signals but other signal standards can equally be transmitted.

When will VLC be ready for use?

It's being used right now in a lab environment. Only the current receiver device is about the size of an A4 sheet of paper. The first VLC systems could appear in the shops in three to five years time. By that time a simple USB stick in the laptop or – in another vision – a dedicated chip in a Smartphone will be all that is needed to receive data from the ceiling light.

Why should I bother with VLC when there are already other transmission standards around like Bluetooth, IrDA, and Wi-Fi?

VLC isn't a new standard in itself, it's a new way of sending data. Actual administration of transmission can be dealt with by existing protocols - as is now being shown by our demonstrators which transmit Ethernet signals.

What advantages does an optical WLAN have? Does it have any downside?

One of the major advantages is the fact that data transmission is made possible just by making minor changes to the circuitry of a standard off the shelf LED. And all the other components of a VLC transfer system are relatively simple to realize.

Other advantages are the robustness of the system and its insensitivity to other wireless networks and the relative ease (in terms of choice of frequency, electromagnetic insulation etc.) with which several VLC networks can operate side by side in parallel.

Setting the right optical conditions is also simple as all you have to do is ensure that the receiver has a sufficient intensity of light. On the other hand, if the light beam is indirect via reflections only low data rates are possible which means that data-guzzling applications (like those involving parallel transmission of several HD video streams) could suffer from loss of quality.

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