help desk

Lust for LiFi | By Wayne Howell

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The launch of Art-Net 4 ethernet protocol added the ability to carry VLC data using Art-Net and DMX512. Unsurprisingly, our help desk has been full of questions. LiFi and VLC - what is it all about?

VLC (Visible Light Communication) is a method of using light for communication. While this is not a new concept per se - a TV remote uses infrared light to communicate with the TV set while fibre optic cables transmit high speed data via laser light - the use of visible light for communication is a fairly new technology and recent developments in LED has enhanced its application.

TECHNOLOGY

VLC works by switching the light source on and off very quickly in order to transmit binary data. The switching is done quicker than the human eye can register - there is no flicker. LED light sources can switch very quickly, which allows very high rates of data.

VLC has a number of benefits compared to radio networks such as WiFi. Most importantly, VLC is very directional and its range is limited by the extent of the visible light, which vastly reduces the potential for interference. There are also significant benefits for security as data transmission is contained within the walls of a room.

There are four key areas where VLC is evolving:
• Room-based lighting and remote control
• POI and POS information transfer
• Interior navigation
• Internet connection

Room lighting and remote control are the simplest uses of VLC and involve LED lights transmitting a low bandwidth beacon that identifies the room. This allows a mobile device to identify which room it's in and customise the user interface for control of features such as light levels, colour, heating and speaker volume.

Light dispersion can be easily controlled, which is particularly useful in point of information (PoI) and point of sale applications (PoS). Consider a museum display cabinet: the lights within the cabinet can be used to transmit VLC-containing information via text, graphics, audio or video depending on the bandwidth of the VLC. Current generation mobile devices can receive the VLC using the in-built camera, and next generation ones will accept higher speed VLC through sensors in the screen.

INTERIOR NAVIGATION

Using mobile devices for navigation has become commonplace, but it really only works outside. However, numerous companies have been developing GPS-style interior navigation with VLC-based technologies. Whilst there are a range of different implementations, the general concept is that the light bulbs transmit a unique beacon that allows your mobile device to triangulate position. This technology can be used for basic navigation - for example, in subway stations. It also has significant applications in retail, e.g. directing you to the relevant supermarket aisle. There are other technologies competing in this application space, such as Bluetooth Low Energy (also known as Bluetooth Smart) and ZigBee mesh networks.

INTERNET CONNECTION

LiFi is the term used to describe the use of VLC to replace or augment WiFi. It was coined by Professor Harold Haas who was the first to demonstrate high speed data transfer over VLC at TedGlobal 2011.

LiFi is generating huge interest and lots of companies are investing heavily in its development, because as the global quantity of active mobile devices increases, the radio spectrum for WiFi is becoming too saturated. LiFi can provide a WiFi-like internet connection by simply using the overhead LED lighting.

The direction of the data flow is a little trickier, however. The term 'downlink' is used to describe data flow from the internet to your device and 'uplink' is data flow from your device to the internet.

WiFi works in much the same way for both uplink and downlink - radio transmits in one direction or the other. LiFi excels at downlink because it modulates the overhead light to achieve its goal. Uplink requires a different solution, and two approaches are evolving. One is LiFi and WiFi working together, with LiFi providing the downlink and freeing up radio bandwidth for WiFi to provide the uplink. This has a huge benefit to the bandwidth saturation on WiFi, but still relies on radio signals. Another approach to the uplink issue is to use infrared to transmit the data back to the fixture. This is a less elegant approach as it requires an additional interface in the mobile device or laptop.

The first LED luminaire with LiFi was launched by Lucibel and pureLiFi at the recent Lux 2017 trade show. The product has a concentric ring which includes the required electronics and infrared receivers for the uplink. It provides downlink rates in excess of 40Mbps and can support up to 16 users per light.

INTERFACING

The process of getting data into and out of a VLC system varies depending on the type and speed of data. LiFi requires a high bandwidth data connection and the electronics used to modulate the LED must be very close (less than 100mm) to the LED. For this reason, a LiFi fixture will usually have a direct network connection at the fixture. The navigation and beacon type systems require much lower bandwidth, which make it viable for the data to be transferred via DMX512.

The saturation of the WiFi radio spectrum is likely to drive the acceleration of LiFi product development over the coming year. Many mobile devices already indirectly support VLC, with direct support expected very soon . . . ⊗

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