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The Lowdown on



LaserLiFi can now deliver >10Gbit/sec at 5 meter range from a 500 lumen spotlight. Image courtesy of SLD Laser

Along with IoT, Light+Health, and horticultural lighting, LiFi is one of the biggest tech trends to watch in the lighting industry.

BY DAVID SHILLER



In case you haven't heard of the term yet, "LiFi" is short for Light Fidelity and refers to the modulation of light in order to wirelessly stream data. It is similar to WiFi as the modulation of radio waves, which is light at an invisible wavelength. LiFi technology is also sometimes referred to as "Visible Light Communication" or VLC. What makes LiFi so important is its significant advantages over WiFi, including much faster data rates, increased bandwidth, enhanced cybersecurity within a built environment, plus it avoids the radio interference and constrained bandwidth that is limiting WiFi.

Recent market research estimates the LiFi market to reach USD \$75 billion by 2023, and according to Global Market Insights, Inc., the U.S. LiFi market will experience a 77-percent compound annual growth rate (CAGR) over that forecast timeframe.

To find out the latest on LiFi technology, I separately interviewed three leading experts:

Alistair Banham, CEO of pureLiFi, a leading manufacturer of LiFi components, Randy Reid, CEO of LumEfficient, an award-winning manufacturer of LiFi-enabled luminaires, and Paul Rudy, PhD, MBA, Cofounder, CMO and SVP BD for SLD Laser, the pioneer manufacturer in laser-phosphor, LaserLight sources for specialty lighting applications.

DAVID SHILLER: IN WHAT APPLICATIONS ARE YOU SEEING THE MOST EARLY POTENTIAL FOR LIFI?

ALISTAIR BANHAM: Early adopters include companies that want inherently secure, safe, interference-free wireless communications, such as industrial and industry 4.0 manufacturing environments and Defense. We also work closely with network operators such as O2 and Telefonica, who are interested in the benefits that massive available spectrum through light communications will open up. We have recently launched the world's first optical LiFi components that are capable of Gbps communications and small enough to be integrated into devices. The new optical LiFi components will, for the first time, allow for mobile device manufacturers to start designing LiFi into devices such as smartphones, tablets and laptops.

RANDY REID: In the U.S., the military seems to be the largest early adopter. We are in conversations

with a large city to do a beta site on some of their streetlights. We hope to have a beta site installed in a cobra head fixture this summer.

PAUL RUDY: All of these have potential. Early adoption is coming from customers involved in applications which require high data rates from safe visible light at range, typically outdoors to start, in some cases where either the source or the detector is in motion.

DS: WHICH LIFI BENEFITS DO YOU SEE DRIVING EARLY INTEREST IN LIFI ADOPTION?

AB: The key benefits of LiFi are:

- **Speed & Bandwidth:** LiFi can deliver multiple Gbps speeds in mobile devices. This next-generation technology will drive wireless beyond any current capability, opening up unprecedented bandwidth.
- **Reliability:** LiFi provides enhanced reliability enabling interference-free communications and 1,000 times the data density, dramatically improving the user experience.
- **Low Latency:** LiFi currently offers latency by a factor of three times lower than WiFi and can radically enable innovation, automation, and applications such as augmented reality and virtual reality.
- **Security:** Light can be contained. Light cannot travel through walls, which means a LiFi signal can be secured in a physical space. pureLiFi's technology also enables additional control as data can be directed from one device to another. Users can see where data is going.

➤ **No Interference:** Radio frequency technology such as WiFi is vulnerable to interference from a wide range of devices such as cordless phones, microwaves, and neighboring WiFi networks. LiFi signals can be defined by the area of illumination, which means interference is much simpler to avoid and even stop altogether. This also means LiFi can be used in RF hostile zones such as hospitals, power plants, and airplanes.

LiFi can achieve approximately 1,000 times the data density of WiFi, offering more data per square meter.

This new recessed downlight is equipped with LiFi capabilities from LumEfficient.



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► **Data Density:** Data density offers a greater user experience as it reduces the need to share the wireless bandwidth with other users. LiFi can achieve approximately 1,000 times the data density of WiFi, offering more data per square meter; this is an important factor for wireless efficiency.

► **Location Services:** LiFi systems are fully networked, and each LiFi-enabled light has a unique IP address, which means advanced geofencing can be deployed simply in a LiFi network.

RR: The main interest seems to be in security. One of the drawbacks to LiFi is that the user must connect a dongle to their laptop to send and receive data. The military actually likes this as it gives them another point of control.

PR: The most acute value proposition for early adoption now is high data transfer rates at a distance. Security is also a benefit, and is valued in future applications.

DS: ARE YOU HEARING ABOUT ANY RESIDENTIAL USES FOR LIFI YET?

AB: We see LiFi in every home in the future – this will be for many reasons including bandwidth, security, interference-free communications, and low

latency application for bandwidth and streaming. Currently, standardization efforts are happening under IEEE 802.11 to ensure LiFi is part of this wireless ecosystem.

RR: At this point, I think LiFi is too expensive for homes, but prices are dropping dramatically. I think LiFi will begin to grow in residential use with the advent of 5G. Most homeowners won't connect each device directly to 5G because of cost. Rather there will be a 5G router in the home to receive the signal. Given that 5G is wildly fast, it doesn't make sense to slow things down using WiFi to get from the router to the devices, so this is where LiFi will come in – it will ensure high speed from 5G for that last 100 feet.

PR: Yes, for densely populated areas. Many early applications are more B2B.

DS: DO YOU SEE LIFI AS COMPLEMENTARY TO WIFI OR AS A POTENTIAL REPLACEMENT?

AB: LiFi and WiFi don't interfere with one another and can exist alongside each other happily. In the future, you will be able to hand over between WiFi and LiFi the same way you currently hand over between cellular and WiFi today.

RR: They're definitely complementary. Right now, I have WiFi and cellular on my iPad, but I always use WiFi because it is faster. However, some areas don't have WiFi, so in that case I use cellular. Now, we'll have a 3rd option. We'll always use LiFi because it is so much faster, but there will always be areas where LiFi is not available, and then we'll use WiFi. So think of LiFi as your first and best option.

PR: Complementary.

DS: DO YOU SEE THE FUTURE OF LIFI AS WHITE LIGHT, INFRARED, OR SOME OTHER PORTION OF THE ELECTROMAGNETIC SPECTRUM?

AB: We use both visible and infrared portions of the light spectrum for communications, and we expect to continue to use both.

RR: All of the above. This is the beauty of new technologies as different companies are experimenting

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pureLiFi offers a variety of new products, such as a POE-powered recessed light, a custom-built laptop with LiFi inside, a LiFi-enabled smart phone case, and a LiFi-enabled pendant lighting fixture using a GU10 bulb.



LiFi Integrated Down-light
PoE-powered light for LiFi networking.



LiFi Enabled Laptop
Custom built laptops with LiFi inside.



LiFi Phone Case
LiFi enabled phone case for mobile communications.



LiFi Lighting Fixture
LiFi-enabled fixture using a GU10 bulb.

with different technologies. Originally LiFi was envisioned to work with LED luminaires. Why? Lighting is typically uniform (even coverage) and each fixture has power coming to it, so it is very easy to simply add LiFi. At LumEfficient, we partner with several LiFi component companies, but one company is experimenting with IR. The theory is that they can simply offer 1 SKU to meet all of the needs whereas when LiFi is coupled with luminaires, companies will likely have to offer LiFi across the board in the majority of their indoor fixtures, doubling their SKU offering.

PR: Many applications desire the visible light to have a clear visibility of the optical link. For bandwidth, we expect to use the entire spectrum.

DS: WHAT IS THE MOST IMPORTANT ASPECT ABOUT LIFI THAT MOST PEOPLE MAY NOT CURRENTLY KNOW?

AB: The new optical LiFi components will, for the first time, allow for mobile device manufacturers to start designing LiFi into devices such as smartphones, tablets, and laptops. Our message to device manufacturers is that we are ready to get on your roadmap. We are developing the components that are necessary for LiFi integration into future generations of mobile devices.

RR: You must use a dongle today to send and receive data. Once the dongle is built into our phones, tablets, and laptops, LiFi will take off. Please be aware that one-way or mono-directional LiFi is available now using the camera in smartphones. One-way LiFi is great for museums, it is low cost and it is practical today.

PR: The amount of data that the emerging "Smart World" (autonomous vehicles, high-resolution video, 3D, IoT) requires is absolutely astonishing, and the existing RF-based WiFi is insufficient. It is important to understand that without LiFi, the data crunch cannot be solved with highly inefficient, expensive, and bulky RF. LiFi is an extremely elegant and high-speed solution to this issue, and LaserLiFi is the ultimate solution.

DS: WHAT INHERENT ADVANTAGES DOES LASER LIFI HAVE OVER LED LIFI?

PR: There are several benefits, and all of them relate to more than 10x the data rate and 10x the range:

Lasers can be modulated at >100x faster than LEDs; this is why telecom uses IR lasers and not LEDs. This is due to fundamental principles: lasers operate on stimulated emission, and LEDs operate on spontaneous emission. LED demos are in the 0.1 Gbit/sec range headed to 1 Gbit/sec, and laser LiFi already demos at >10Gbit/sec and headed to Tbit/sec.

Lasers have narrow spectrum (~1nm) and therefore, many wavelengths can be packed in to add bandwidth. LEDs are 10x broader in emission spectrum, and therefore have 1/10 capability to add bandwidth with spectrum in this respect.

Lasers also can be highly directional compared to LED, and therefore have more than 10x the range.

SLD has demonstrated >10Gbit/sec data rates across a room with our UL-listed 500 lumen, safe white light MicroSpot sources. We are working now with customers and strategic partners to deploy this capability into applications while also further developing the technology for higher data rates and extended range in the coming years. We have confidential partnerships developing applications in the fields of auto and specialty illumination. ❖



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