LiFi, and V2X - Safer 5G alternatives use visible light, not RF

Background

In the discourse of the “next step”, or “fifth generation” in wireless communications, talk has centered around so-called 5G and the very high-energy radio frequency spectrum assigned to it by the FCC. It should be understood however that there are nearly as many different technological approaches to exploiting this band of the RF spectrum as there are companies offering wireless services.

Some of these approaches are highly questionable, since there is no evidence that exposure to high intensities of these high-energy frequencies is harmless to humans and critical species such as pollinators or vegetation. Indeed, the millimeter wave portion of the spectrum granted for communication use has already been developed by the USAF as a crowd-control weapon capable of inflicting 1st and 2nd degree burns at a range greater than small-arms fire. (Active Denial System - https://www.globalsecurity.org/military/systems/ground/v-mads.htm and https://jnlwp.defense.gov/About/Frequently-Asked-Questions/Active-Denial-System-FAQs/#:~:text=The%20Airman%20received%20second-degree%20burns%20%28blisters%29%20from%20an,the%20training%20processes%20to%20Active%20Denial%20System%20controls.)

If millimeter wave RF were a chemical pharmaceutical, it would be required to pass through rigorous trials before roll-out to demonstrate its safety and effectiveness. No such trials have been required for RF exposure.

The argument for the necessity for high-intensity, high-energy, and high-frequency radio frequencies for communications systems like WiFi and cellular phones, is that higher frequencies allow for higher data rates. Why then wouldn’t we look at developing 5G using yet higher *optical* frequencies, using visible (or near-visible) light, that are well-known to be harmless to practically every organism on the surface of the planet?

Note: Data rates are largely proportional to carrier frequency. Frequency comparison: millimeter wave RF is 30-300GHz (billion hertz), while visible light is 400-800 THz (trillion hertz). The higher optical frequencies would yield data rates 1300 to 26,000 times faster than mm RF.

A safe, ultra-high speed local network

LiFi is a visible light technology capable of much higher data rates than RF-based WiFi. A typical application in say a classroom would interface the local data network with the room’s LED lighting fixtures. LED lights can be switched on and off (modulated) at extremely high frequencies, much higher than RF, making data speeds of ~100Gbps possible. (The modulation frequency of the flashing LED is far, far beyond human perception.) Students’ wireless devices such as laptops would be equipped with a small, low cost USB “stick” with its own LED and light sensor to connect with the local network at speeds up to 10Gbps (limited by current USB3.1 top speed). Since light from ceiling fixtures bounces off walls and other surfaces, data communication would not be strictly line-of-sight. Phones will be similarly equipped with a

built-in LED/light sensor. This technology has already been demonstrated in schools in Scotland and has been introduced commercially. (pureLiFi - https://purelifi.com/lifi-technology/)

A safer beam-forming technology

For some applications, “beam-forming” is desired because it offers very long range at lower power requirements than an unfocussed broadcast, and it offers greater security by directing the signal only at its intended recipient. Visible light lasers can form minutely-focussed beams over distances limited only by fog or dust scattering (ranging from 500m to 100s of kilometers, depending on conditions).

One such technology is V2X, which is being developed as a way for automobiles to send and receive data using laser-based headlights. (SLD Laser - https://www.sldlaser.com) The data exchange would enable “smart highways”, with improved traffic control and safety devices, as well as vehicle-to-vehicle communication and real-time freight dispatching. Once again, the V2X data rate is hundreds of times faster than any RF technology.

A similar laser technology is used to provide so-called “free-space optical communication”, which functions like fiber-optic networks, minus the physical fiber. Instead, the laser is beamed through “free-space” - transparent air, water or vacuum - to a receiver some distance away. This technology is promising for aircraft and satellite communication, as well as stationary land-based communications systems. Military technology already exists that can negate scattering and phase distortion of such signals passing through fog and dust.