LiFi is a Paradigm-Shifting 5G Technology

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LiFi is a Paradigm-Shifting 5G Technology

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Abstract *In this paper we will first explain what Light-Fidelity (LiFi) is and argue that it is a 5th Generation (5G) technology. Peak transmission speeds of 8 Gbps from a single light source have been demonstrated, and complete cellular networks based on LiFi have been created. We will discuss numerous misconceptions and illustrate the potential impact this technology can have across a number of existing and emerging industries. We also discuss new applications which LiFi can unlock in the future.*

Introduction

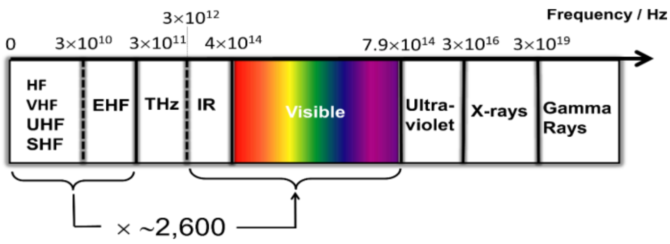

Figure 2. The radio frequency (RF) spectrum is only a fraction of the entire electromagnetic spectrum. The visible light spectrum and the infrared (IR) spectrum are unregulated, and offer 780 THz of bandwidth

LiFi is a wireless communication technology that uses the infrared and visible light spectrum for high speed data communication. LiFi, first coined in [1] extends the concept of visible light communication (VLC) to achieve high speed, secure, bi-directional and fully networked wireless communications [2]. It is important to note that LiFi supports user mobility and multiuser access. The size of the infrared and visible light spectrum together is approximately 2,600 times the size of the entire radio frequency spectrum of 300 GHz (see Figure 1). It is shown in [3] that the compound annual growth rate (CAGR) of wireless traffic has been 60% during the last 10 years. If this growth is sustained for the next 20 years, which is a reasonable assumption due to the advent of Internet-of-Things (IoT) and machine type communication (MTC), this would mean a demand of 12,000 times the current bandwidth assuming the same spectrum efficiency. As an example, the industrial, scientific and medical (ISM) RF band in the 5.4 GHz region is about 500 MHz, and this is primarily used by wireless fidelity (WiFi). This bandwidth is already becoming saturated, which is one reason for the introduction of Wireless Gigabit Alliance (WiGig). WiGig uses the unlicensed spectrum between 57 GHz – 66 GHz, i.e., a maximum bandwidth of 9 GHz. In 20 years from now, the bandwidth demand for future wireless systems would however, be 12,000 × 500 MHz which results in a demand for 6 THz of bandwidth. The entire RF spectrum is only 0.3 THz. This means a 20 times shortfall compared to the entire RF spectrum, and a 667 times shortfall compared to the currently allocated bandwidth for WiGig. In comparison, the 6 THz of bandwidth is only 0.8% of the entire IR and visible light spectrum. One could argue that a more aggressive spatial reuse of frequency resources could be adopted to overcome this looming spectrum crunch. This approach has been used very successfully in

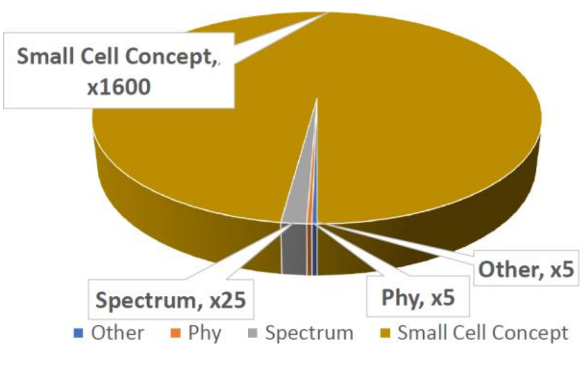

Figure 1: The main contributors that led to the factor 1,000,000 improvement of data rates in cellular communications during the last decades. The key factor has been the small cell concept, followed by the allocation of new spectrum. Interestingly, new physical layer technologies have only contributed by an overall factor of 5.