IEEE P802.11  
Wireless LANs

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| Light Communications (LC) for 802.11:  Use Cases and Functional Requirements:  Guidelines for PAR and CSD Development | | | | |
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Abstract

This document contains the output of the Light Communications TIG, intended to describe the use cases, requirements, and technical feasibility of Light Communications in 802.11.

**Chair**

Nikola Serafimovski

**Editors**

**Introduction**

We live in an increasingly connected world. The demand for mobile wireless communications is increasing at over 50% per year according to the Cisco Visual Networking Index. This demand is expected to continue to increase as the Internet of Things (IoT) becomes a reality, and the number of connected devices grows from 5 billion to over 20 billion by 2020. Unsurprisingly, in 2016, over 50% of all wireless data went through a Wi-Fi access point. This enormous utilisation results in a need for a continued increase in capacity of wireless networks, depending directly on the availability of additional unlicensed spectrum.

Undeniably, there are multiple solutions that can provide an increase in the available spectrum and increased confinement of the RF signal. As an example, WiGig solutions, defined in IEEE 802.11ad, .11mc, .11aj and being revised in 802.11ay. However, the continued deployment and growth of 802.11 technology relies on accessing unlicenses spectrum satisfying complementary use-cases.

The light spectrum, for the most part, has been underutilised. The visible light spectrum alone stretches from approximately 430 THz to 770 THz, which means that there is potentially more than 1000x the bandwidth of the entire RF spectrum of approx. 300 GHz. Both the visible light spectrum and the infrared spectrum are unlicensed. The TIG looks at the need and feasibility of expanding 802.11 protocols to efficiently access the light spectrum and satisfy various use-cases.

**LC use cases**

1. Enterprise
2. Home
   1. Fast setup
3. Retail
   1. Location-based connectivity and services
4. IoT
   1. Home
   2. Smart cities
   3. Factories of the future - Industrial and manufacturing
   4. Healthcare

**LC Metrics**

1. Data rate
2. SNR Link Margin (for PIN/APD detectors under illumination constraints)
   1. Provide typical Transmission range examples
3. Latency – average range
   1. PHY and MAC
4. Channel access fairness
5. Area capacity (area spectral density (bit/s/sqm))
6. Considerations for the MAC efficiency on the capacity – measured at the MAC SAP

**LC requirements**

1. Integration and backward compatibility with legacy 802.11
2. low-latency data delivery
3. Asymetric device capability support (power, directivity, wavelength, sensitivity, etc.)

**LC Technical Feasibility**

1. General Questions
   1. How does LC work?
   2. How does LC work in a bright room with sunlight?
   3. How does LC work when you turn off the lights?
   4. Can we see LC lights flicker?
   5. Is the in flicker created by modulation safe?
   6. Is LC a line of sight technology?
   7. If LC is a non-line-of-sight technology then how is it more secure than other wireless technologies?
   8. Will LC work in my pocket?
   9. Can we enable LC to be Full-Duplex in 802.11?
   10. Are LC systems subject to multipath fading?
   11. How does the backhaul work?
2. System Architecture
   1. Stand alone?
   2. Sub-strandard (802.11.3) or amendment (802.11xx)?
3. Reuse of 802.11 MAC – which MAC (ah/ad?)?
   1. Assumptions that are potentially not valid in the LC context
4. Compatibility with other 802 wireless protocols
5. Difference with on-going 802 light communication standards (eg., 802.15.7m)
6. Demonstrated Systems

**LC Economic Feasibility**

1. Balanced costs
2. Known cost factors
3. Consideration of installation costs
4. Consideration of operation costs
5. Market size/opportunity

**LC Regulatory perspective (spectrum and health)**

**Recommendations**