**P802.15.7a**

Submitter Email: bheile@ieee.org
Type of Project: Amendment to IEEE Standard 802.15.7-2018
PAR Request Date: 19-Sep-2019
PAR Approval Date:PAR Expiration Date:Status: Unapproved PAR, PAR for an Amendment to an existing IEEE Standard

1.1 Project Number: P802.15.7a
1.2 Type of Document: Standard
1.3 Life Cycle: Full Use

2.1 Title: Draft Standard for Local and metropolitan area networks - Part 15.7: Short-Range Optical Wireless Communications

Amendment: High Data Rate Optical Camera Communications (OCC)

3.1 Working Group: Wireless Personal Area Network (WPAN) Working Group (C/LM/WG802.15)
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3.2 Sponsoring Society and Committee: IEEE Computer Society/LAN/MAN Standards Committee (C/LM)
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4.1 Type of Ballot: Individual
4.2 Expected Date of submission of draft to the IEEE-SA for Initial Sponsor Ballot: July 2022
4.3 Projected Completion Date for Submittal to RevComNote: Usual minimum time between initial sponsor ballot and submission to Revcom is 6 months.: Feb. 2023

5.1 Approximate number of people expected to be actively involved in the development of this project: 20
**5.2.a.** Scope of the complete standard: This standard defines a Physical (PHY) and Media Access Control (MAC) layer for short-range optical wireless communications in optically transparent media using light wavelengths from 10,000 nm to 190 nm. The standard is capable of delivering data rates sufficient to support audio and video multimedia services and also considers mobility of the optical link, compatibility with various light infrastructures, impairments due to noise and interference from sources like ambient light and a MAC layer that accommodates the unique needs of visible links as well as the other targeted light wavelengths. It also accommodates optical communications for cameras where transmitting devices incorporate light emitting sources and receivers are digital cameras with a lens and image sensor. The standard adheres to applicable eye safety regulations.

**5.2.b.** Scope of the project: This amendment specifies a high-rate Optical Camera Communications (OCC) Physical Layer (PHY) using light wavelengths from 10000 nm to 190 nm in optically transparent media. It is capable of delivering data rates up to 100 Mbit/s and is designed for point-to-point and point-to-multipoint communication. Adaptation to varying channel conditions and maintaining connectivity during high mobility (speeds up to 350 km/h), flicker mitigation, Radio Frequency (RF) co-existence, and a communication range of up to 200 m, are included. Multiple-Input-Multiple-Output (MIMO) (e.g. Multiple-Input-Multiple-Output Orthogonal frequency-division multiplexing (MIMO-OFDM)) is utilized to deal with high-levels of optical interference while maintaining high-rate data transmission. Relaying mechanisms are included enabling heterogeneous operation with existing RF wireless data communications standards. The Amendment adheres to applicable eye safety regulations.

5.3 Is the completion of this standard dependent upon the completion of another standard: No.

5.4 Purpose: This purpose of this standard is to utilize Optical Wireless Communication (OWC), to provide a global solution initially targeting vehicular applications requiring, secure, high data rate (up to 100Mbits/sec), and long range optical camera communication (up to 200m). The standard provides (i) access to unlicensed spectrum; (ii) inherent communication security due to inability to penetrate through optically opaque walls, (iii) data delivery without using RF spectrum; (iv) MIMO and Artificial intelligence (AI)-based PHY and MAC layers; and (v) communication augmenting and complementing existing services (such as illumination, indication, localization, etc.). These are also attributes that will be valuable in commercial and business settings, both of which are expected to be significant emerging markets.

5.5 Need for the Project: Given the growing expectation of ubiquitous wireless connectivity in high mobility environments, the rapid development of AI concept for PHY for effective and high-speed signal processing, the need for unlicensed, high bandwidth, easy-to-use wireless communications technology, immune to RF interference and which does not overload existing RF spectrum or necessarily require additional hardware, has never been greater. This standard specifically addresses these needs. Potential applications include Advanced driver-assistance systems (ADAS), Vehicle to Everything (V2X) communication, control of mobile robots in a personalized manufacturing cells or at an assembly lines, automated guided vehicular systems, collision avoidance in V2X network or drone network, small cell backhaul, patient monitoring in hospitals, security monitoring in manufacturing factories and petrochemical plants. In particular, optical wireless based solutions to this problem address a significant opportunity, extending to billions of existing communication devices where the OCC system can be implemented include Smartphone, CCTV, and other autonomous cars. Most of the smartphone cameras support new programmable applications and their firmware is upgradable. The camera2  application programming interfaces (APIs) (greater than android version 4.4) has additional features, such as manually-controlled exposure, focus, raw capture, etc. And nowadays almost (more than 87% in 2018) every smartphone camera is built with camera2 API. These features help to build an OCC application on a smartphone. Also, cameras should open on a secondary handler thread and the camera2 API makes thread management easier. It can be needed to collaborate with the manufacture companies to integrate the OCC protocol to the smartphones. Otherwise, we can develop OCC applications and users just need to install these applications to use OCC. OCC is incredibly potential in the intelligent transport services. Different types of communications using camera are possible in vehicular environments, e.g., vehicle-to-vehicle, vehicle-to-infrastructure, and vehicle-to-pedestrian and vice versa. Different applications, for example vehicle localization, can be performed using OCC which will be a great addition to the ADAS. Here, the OCC protocol is needed to be installed in the transmitter and receiver. In particular, a switching device and a Micro-controller Unit (MCU) in the transmitter is used to implement the OCC system.  It is also possible to design the autonomous cars and other infrastructures with the integration of OCC protocol by proper collaboration with them. Some members of ISO TC204 has been asked to update OCC standard for supporting high date rate transmission.

5.6 Stakeholders for the Standard: Automotive manufacturers, locomotive manufacturers, ship manufacturers, drone and aircraft manufacturers, robot manufacturers, logistics companies, industrial devices manufacturers, system integrators, medical equipment manufacturers, lighting manufacturers, silicon providers, chemical manufacturers, networking equipment manufacturers, and academic researchers.

Intellectual Property6.1.a. Is the Sponsor aware of any copyright permissions needed for this project?: No
6.1.b. Is the Sponsor aware of possible registration activity related to this project?: No

The RAC has requested routine review of PHY oriented projects, although no special registration activity is expected.

7.1 Are there other standards or projects with a similar scope?: No
7.2 Joint DevelopmentIs it the intent to develop this document jointly with another organization?: No

8.1 Additional Explanatory Notes: