IEEE P802.11
Wireless LANs

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| SENS SG Proposed CSD Draft |
| Date: 2020-07-10 |
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Abstract

This document contains the IEEE 802.11 WLAN sensing (SENS) study group’s (SG) proposed draft of Criteria for Standards Development (CSD).

This document includes content from the original template as presented in document IEEE 802.11-19-2105r0 and comments as presented in document IEEE 802.11-20-0036r0.

r1 – Added references to existing products, added interoperability as an enhancement, matched security features with PAR.

r2 – Changes to match the updates in PAR (11-19-2103r5) related to PHY enhancements, and some editorial updates.

r3 – Changes to match the updates in PAR (11-19-2103r8) and some editorial updates.

r4 – Editorial updates.

r5 – Incorporates changes proposed in 20/0726r2 that address comments submitted during the WG11 electronic ballot for the SENS CSD conducted from March 30th, 2020 to April 14th, 2020.

r6 – Incorporates changes discussed in 20/0989r1 that address comments submitted by the IEEE 802.3 WG on the SENS SG PAR.

1. IEEE 802 criteria for standards development (CSD)

The CSD documents an agreement between the WG and the Sponsor that provides a description of the project and the Sponsor's requirements more detailed than required in the PAR. The CSD consists of the project process requirements, [1.1](#RefHeading__5867_1944447809), and the 5C requirements, [1.2](#RefHeading__5883_1944447809).

## 1.1 Project process requirements

### 1.1.1 Managed objects

Describe the plan for developing a definition of managed objects. The plan shall specify one of the following:

1. The definitions will be part of this project.

**Yes**

1. The definitions will be part of a different project and provide the plan for that project or anticipated future project.
2. The definitions will not be developed and explain why such definitions are not needed.

### 1.1.2 Coexistence

A WG proposing a wireless project shall demonstrate coexistence through the preparation of a Coexistence Assurance (CA) document unless it is not applicable.

1. Will the WG create a CA document as part of the WG balloting process as described in Clause 13?

**Yes**

1. If not, explain why the CA document is not applicable.

## 1.2 5C requirements

### 1.2.1 Broad Market Potential

Each proposed IEEE 802 LMSC standard shall have broad market potential. At a minimum, address the following areas:

a) Broad sets of applicability.

According to the research in [1], the global estimation of Wi-Fi economy will increase from $1.96 trillion to $3.46 trillion. As of 2018, there are more than 340,846,887 Wi-Fi hotspots worldwide. Status of Wi-Fi market above can pave a broad way for Wireless Local Area Network (WLAN) sensing applications since the adoption of many applications are hindered by expensive dedicated hardware, such as indoor localization sensors, home security and motion sensor systems etc.

There are several market drivers for WLAN sensing, including:

* According to the report released by MarketsandMarkets [2], the indoor positioning market is expected to grow from $7.1 billion in 2017 to $41.0 billion by 2022, at a Compound Annual Growth Rate (CAGR) of 42.0% during the forecast period. Radio Frequency (RF)-based technology is also proposed as a key solution in this report.
* According to another report [3], the global market for home security system market was valued at $40.66 billion in 2017 and is expected to reach $74.75 billion by 2023, at a CAGR of 10.40% during the forecast period. Additionally, the report points out that the growth of the market can be attributed to the emergence of wireless technologies.
* According to another report [4], the gesture recognition market is expected to be worth $18.98 billion by 2022, growing at a CAGR of 29.63% and the touchless sensing market is expected to be worth $15.27 billion by 2022, growing at a CAGR of 17.44% during the forecast period.
* According to another report [5], the smart home market including lighting controls, home healthcare, entertainment and other controls is expected to grow from $76.6 billion in 2018 to $151.4 billion by 2024, at a CAGR of 12.02%.

b) Multiple vendors and numerous users.

A wide variety of vendors currently build numerous products for WLAN sensing marketplace. According to the same reports above [2-5], many of the current players in the sensing applications market are also vendors for the WLAN sensing and thus it is anticipated that a substantial proportion of those vendors, and others, will participate in subsequent commercialization activities for WLAN sensing.

### 1.2.2 Compatibility

Each proposed IEEE 802 LMSC standard should be in conformance with IEEE Std 802, IEEE 802.1AC, and IEEE 802.1Q. If any variances in conformance emerge, they shall be thoroughly disclosed and reviewed with IEEE 802.1 WG prior to submitting a PAR to the Sponsor.

1. Will the proposed standard comply with IEEE Std 802, IEEE Std 802.1AC and IEEE Std 802.1Q?

Yes

1. If the answer to a) is no, supply the response from the IEEE 802.1 WG.

The review and response is not required if the proposed standard is an amendment or revision to an existing standard for which it has been previously determined that compliance with the above IEEE 802 standards is not possible. In this case, the CSD statement shall state that this is the case.

### 1.2.3 Distinct Identity

Each proposed IEEE 802 LMSC standard shall provide evidence of a distinct identity. Identify standards and standards projects with similar scopes and for each one, describe why the proposed project is substantially different.

WLAN sensing is the use of PHY and MAC features of IEEE 802.11 stations to obtain channel measurements that characterize the environment in which the stations operate. Measurements obtained with WLAN sensing are used to enable applications such as presence detection and gesture classification, among others. The specification of such applications is beyond the scope of the project.

This amendment defines modifications to the medium access control layer (MAC); the Directional Multi-Gigabit (DMG) and enhanced DMG (EDMG) physical layer (PHY) specifications; and the PHY service interface of High Throughput (HT), Very High Throughput (VHT), High Efficiency (HE) and Extremely High Throughput (EHT) PHYs that enhance WLAN sensing operation in license-exempt frequency bands between 1 GHz and 7.125 GHz and above 45 GHz.

WLAN sensing enhancements will be developed by enabling stations (STAs) to perform one or more of the following: To inform other STAs of their WLAN sensing capabilities, to request and setup transmissions that allow for WLAN sensing measurements to be performed, to indicate that a transmission can be used for WLAN sensing, and to exchange WLAN sensing feedback and information. The developed WLAN sensing enhancements will enable WLAN sensing measurements to be obtained using transmissions that are requested, unsolicited, or both. The developed WLAN sensing enhancements will also enable a MAC service interface for layers above the MAC to request and retrieve WLAN sensing measurements.

There is no other WLAN standard focusing on enhancing WLAN sensing compared to what can be achieved with IEEE 802.11 and, consequently, on enabling WLAN sensing applications and services other than this amendment.

This amendment will ensure coexistence and backward compatibility with legacy IEEE 802.11 devices.

### 1.2.4 Technical Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence that the project is technically feasible within the time frame of the project. At a minimum, address the following items to demonstrate technical feasibility:

a) Demonstrated system feasibility.

There are already proprietary WLAN sensing products available in the market [6-8]. Under many test scenarios these solutions are able to perform WLAN sensing actions reliably. However, there are a number of areas where standard support can enhance WLAN sensing performance, including reducing WLAN sensing overhead, increasing reliability of WLAN sensing periodicity, control and/or indication of link adaptations that affect WLAN sensing accuracy, improving interoperability and improving WLAN sensing privacy, etc.

The IEEE 802.11 Wireless Next Generation (WNG) Standing Committee (SC) and WLAN Sensing Topic Interest Group (TIG)/Study Group (SG) have reviewed many presentations indicating that the proposed enhancements are technically feasible. These contributions outline techniques [9-21] related to WLAN sensing efficiency, privacy, interoperability and accuracy to enhance current use cases and enable new ones.

b) Proven similar technology via testing, modeling, simulation, etc.

IEEE Std. 802.11 technology is very mature and has a wide variety of legacy devices and a proven track record, with several billions of devices shipping each year. The principle of extending the IEEE 802.11 PHYs and MAC with new capabilities is also well established by previous amendments within IEEE 802.11, e.g., adding sounding enhancements.

The increased capabilities envisioned for the MAC, baseband, RF parts and channel estimation computation engine necessary to implement the proposed amendment are in line with the current progress in technology and not expected to impinge testability.

### 1.2.5 Economic Feasibility

Each proposed IEEE 802 LMSC standard shall provide evidence of economic feasibility. Demonstrate, as far as can reasonably be estimated, the economic feasibility of the proposed project for its intended applications. Among the areas that may be addressed in the cost for performance analysis are the following:

a) Balanced costs (infrastructure versus attached stations).

WLAN equipment is accepted as having balanced costs. The development of features to support WLAN sensing capabilities of WLAN network deployments will not disrupt the established balance.

b) Known cost factors.

Support of the proposed standard will likely require a manufacturer to develop a modified radio, modem and firmware. The cost factors for these transitions are well known and the data for this is well understood.

c) Consideration of installation costs.

The proposed amendment has no known impact on installation costs.

d) Consideration of operational costs (e.g., energy consumption).

There are billions of WLAN systems in operation around the world. WLAN systems are recognized to provide a total cost of ownership (TCO) that provides a significant operation cost benefits. This amendment is not expected to change today’s operation costs.

e) Other areas, as appropriate.

None.

**References:**

[1] The Economic Value of Wi-Fi: A Global View (2018 and 2023), October 2018, [https://www.wi-fi.org/downloads-registered-guest/Economic%2BValue%2Bof%2BWi-Fi%2B2018.pdf/35675](https://www.wi-fi.org/downloads-registered-guest/Economic%252BValue%252Bof%252BWi-Fi%252B2018.pdf/35675)

[2] Indoor Location Market – Global Forecast to 2022, <https://www.marketsandmarkets.com/Market-Reports/indoor-location-market-989.html>

[3] Home Security System Market – Global Forecast to 2023, <https://www.marketsandmarkets.com/Market-Reports/home-security-system-market-205573901.html>

[4] Gesture Recognition and Touchless Sensing Market – Global Forecast to 2022, <https://www.marketsandmarkets.com/Market-Reports/touchless-sensing-gesturing-market-369.html>

[5] The smart home market – Global Forecast to 2024, <https://www.marketsandmarkets.com/Market-Reports/smart-homes-and-assisted-living-advanced-technologie-and-global-market-121.html>

[6] Aerial motion capture plug, https://www.prnewswire.com/news-releases/aerial-technologies-announces-the-motion-capture-plug--the-industrys-first-dedicated-wifi-motion-detection-device-300977509.html

[7] Origin Wireless breathing monitoring, <https://gizmodo.com/soon-linksys-wifi-will-be-able-to-detect-every-breath-y-1840794006>

[8] Cognitive Systems motion detection, <https://blog.plume.com/detecting-motion-through-wi-fi-expanding-smart-home-2.0-services-instantly>

[9] <https://mentor.ieee.org/802.11/dcn/19/11-19-1293-00-0wng-wi-fi-sensing-usages-requirements-technical-feasibility-and-standards-gaps.pptx>

[10] <https://mentor.ieee.org/802.11/dcn/19/11-19-1500-00-0wng-wi-fi-sensing-follow-up.pptx>

[11] <https://mentor.ieee.org/802.11/dcn/19/11-19-1416-00-0wng-wi-fi-sensing-cooperation-and-standard-support.pptx>

[12] <https://mentor.ieee.org/802.11/dcn/19/11-19-1551-01-0wng-wi-fi-sensing-in-60ghz-band.pptx>

[13] <https://mentor.ieee.org/802.11/dcn/19/11-19-1745-00-SENS-wireless-sensing-use-cases-feasibility-and-standardization.pptx>

[14] <https://mentor.ieee.org/802.11/dcn/19/11-19-1726-00-SENS-discussion-of-market-potential-and-technical-feasibility-about-wlan-sensing.pptx>

[15] <https://mentor.ieee.org/802.11/dcn/19/11-19-1769-01-SENS-csi-based-wi-fi-sensing-results-and-standardization-challenges.pptx>

[16] <https://mentor.ieee.org/802.11/dcn/19/11-19-1850-00-SENS-wi-fi-sensing-technical-feasibility-standardization-gaps.pptx>

[17] <https://mentor.ieee.org/802.11/dcn/19/11-19-1852-00-SENS-in-car-sensing-a-60ghz-usage-example.pptx>

[18] <https://mentor.ieee.org/802.11/dcn/19/11-19-1854-00-SENS-wlan-based-radars-in-the-60ghz-band.pptx>

[19] <https://mentor.ieee.org/802.11/dcn/19/11-19-1885-00-SENS-passive-radar-a-potential-solution-for-wlan-sensing.pptx>

[20] <https://mentor.ieee.org/802.11/dcn/19/11-19-1886-00-SENS-indoor-sensing-with-fmcw-radar.pptx>

[21] <https://mentor.ieee.org/802.11/dcn/19/11-19-1897-00-SENS-wi-fi-sensing-with-doppler-measurement-in-60ghz-band.pptx>