IEEE P802.11
Wireless LANs

|  |
| --- |
| IEEE 802.11 IMMW Proposed CSD |
| Date: 2024-03-10 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Laurent Cariou | Intel |  |  | Laurent.cariou@intel.com |
| Abhishek Patil | Qualcomm |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Abstract

CSD document for IMMW

# 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, and the 5C requirements, 1.2.

## 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
2. The definitions will be part of a different project and provide the plan for that project or anticipated future project.
3. 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 prepare a Coexistence Assessment (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
2. 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:

1. Broad sets of applicability.

The digital era has witnessed an unprecedented surge in internet traffic, a trend that is expected to continue in the coming years. The explosive growth of internet traffic is primarily driven by the increasing number of connected devices and the widespread adoption of high-bandwidth applications such as video streaming and cloud services. In 2022, fixed-broadband traffic was estimated at 4,378 exabytes, nearly five times that of mobile-broadband traffic[1]. This growth has been fueled by a compound annual growth rate of 30% between 2019 and 2023, with a significant spike during the COVID-19 pandemic[1]. As of 2023, approximately 5.3 billion people worldwide are connected to the internet, which accounts for around two-thirds of the global population[2], and majority of the traffic comes over WLAN[3]. WLAN continues to play a pivotal role in managing this surge in internet traffic and connecting billions of devices to the internet. The evolution of WLAN technology promises to deliver higher speeds, wider bandwidths, and lower latencies[4].

As we look beyond the current advancements in WLAN technologies the future holds many emerging use cases that will push the boundaries of what's possible with wireless networks. The upcoming trends in WLAN technologies will need to gear up to address the increasing demands of indoor applications like AR/VR, peer-to-peer communication, cloud computing, and multi-player gaming[5].

Some of the emerging use cases that WLAN would need to support soon include:

* Immersive Communications: The leap into immersive AR/VR experiences is one of the most anticipated advancements. Moving from simple AR/VR glasses to holographic telepresence requires WLAN technologies to deliver ultra-high reliability and low latency to avoid motion sickness and provide life-like interactions[6, 9].
* Peer-to-Peer Communication: Direct device-to-device communication without the need for a central access point will enable a new level of collaboration, gaming, and sharing capabilities.
* Cloud Computing, AIML & Multi-Player Gaming: The rise of cloud-based services and gaming platforms demands WLANs that can support high throughput and low latency to provide seamless experiences.

Some of the challenges that WLAN would need to overcome include:

* Ultra-High Reliability: The future WLAN must prioritize reliability to support critical applications, especially in environments where communication between devices cannot afford interruptions[6].
* Latency: To avoid discomfort in AR/VR applications, end-to-end latency must not exceed 20 ms. Achieving this will be a significant hurdle for WLAN technologies[4, 7].
* Throughput: With the expected increase in connected devices, WLANs must provide substantial throughput to handle the data-intensive demands of applications like high-resolution video streaming and immersive gaming[8].
* Interference Resistance: Maintaining quality of service in dense environments will be crucial in future WLANs.

To support these emerging use cases and overcome these challenges, WLAN demands more spectrum. Millimeter-wave (mm-wave) band offers abundant spectrum and the convergence of existing technologies such as multi-link operation can reduce the complexity of supporting mm-wave band. Integrating the WLAN in mm-wave and sub7 GHz together can offer wider bandwidths, low interference, and higher data rates[10], while providing low latencies and improved resilience. The future of WLAN technologies is poised to revolutionize the way we interact with the digital world.

Sources:

1. Multiple vendors and numerous users.

A wide variety of vendors currently build numerous products for the Wireless Local Area Network (WLAN) marketplace. It is anticipated that most of those vendors, and others, will participate in the standards development process and subsequent commercialization activities.

## 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
2. 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.

This project focuses on allowing Wireless Local Area Network (WLAN) non-standalone operation in unlicensed bands between 42 GHz and 71 GHz using single-user (SU) OFDM based transmissions. The amendment requires that an 802.11 device supporting this amendment also supports at least one of the 2.4 GHz to 7.25 GHz (sub-7 GHz) unlicensed bands. The new amendment focuses on leveraging or reusing existing PHY and MAC specifications defined for the operation in sub-7 GHz bands, e.g. SU transmission PPDU format and MAC frames, and multi-link operation.

There is no other WLAN standard focusing on these objectives other than this amendment.

## 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.

The IEEE 802.11 WNG, UHR SG and IMMW SG have reviewed many presentations listing candidate features and many of them indicated that the proposed solutions are technically feasible. Based on these presentations, the study group membership is confident that there are technical features that are feasible and that allow to meet the requirements.

Here’s a list of contributions:

* <https://mentor.ieee.org/802.11/dcn/22/11-22-0030-01-0wng-look-ahead-to-next-generation.pptx>
* <https://mentor.ieee.org/802.11/dcn/22/11-22-0046-01-0wng-next-generation-after-802-11be.pptx>
* <https://mentor.ieee.org/802.11/dcn/22/11-22-1395-00-0uhr-thoughts-on-high-frequency-band.pptx>
* <https://mentor.ieee.org/802.11/dcn/22/11-22-1580-01-0uhr-aperspectiveonproposeduhrfeaturesforenterpriseusecases.pptx>
* <https://mentor.ieee.org/802.11/dcn/22/11-22-1872-00-0uhr-considerations-on-phy-designs-for-mmwave-band.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-0066-02-0uhr-thoughts-on-utiliizing-mmwave.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-1905-00-immw-high-level-thoughts-on-immw.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-1878-01-immw-high-level-design-considerations-of-immw.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-1819-01-immw-integrated-mmwave-design-considerations.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-1968-00-immw-discussion-on-general-direction-of-integrated-mmwave.pptx>
* <https://mentor.ieee.org/802.11/dcn/23/11-23-2004-00-immw-technical-scope-proposal.pptx>

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

IEEE 802.11 is a mature technology which has a wide variety of legacy devices and a proven track record, with several billion devices shipping each year. The increased capabilities envisioned for the MAC, baseband signal processing and RF technologies necessary to implement the proposed amendment are in line with the current progress of those technologies as demonstrated by lab testing, modeling and simulations."

**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) Known cost factors.

1. Support of the proposed standard will likely require a manufacturer to develop a modified radio, modem and firmware. This is similar in principle to the transition between IEEE 802.11ax and IEEE 802.11be as well as in previous iterations of IEEE Std. 802.11 enhancements. The cost factors for these transitions are well known and the data for this is well understood.
2. b) Balanced costs.
3. WLAN equipment is accepted as having balanced costs. The development of Wireless capabilities to enhance the throughput and improve latency of WLAN network deployments will not disrupt the established balance.

c) Consideration of installation costs.

Industry has recommended dual Cat6a cabling for APs for many years. The focus of this amendment is mostly on WLAN operation that requires no more than dual 10 Gbps full duplex for wired backhaul (i.e. 20 Gbps down and 20 Gbps up). Thus, for venues following this advice, the proposed amendment has no known impact on installation costs even for high end IMMW APs.

In cases with lesser backhaul capacity, for lower end APs compliant with IMMW or networks designed such that the bulk of the traffic originates or terminates at end-points cohosted with AP and non-AP STAs, the proposed amendment is not expected to impact installation costs either.

In some cases, new cabling infrastructure such as dual Cat6a is required for optimum IMMW AP performance. The cabling cost is balanced and comparable to the cost of an initial IEEE Std. 802.11 AP installation.

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 operational cost benefit. This amendment is not expected to change markedly today’s operation costs and indeed a goal is to improve the TCO via enabling reduced device power consumption.

e) Other areas, as appropriate.

None.

**References:**

[1] Facts and Figures 2023 - Internet traffic - ITU

[2] Internet usage worldwide - Statistics & Facts

[3] Facts and Figures 2023: Internet traffic

[4] The wireless future — ‘smarter, better, and faster’ - Cisco

[5] 5 Challenges for the Future of Wireless Networking

[6] What Will Wi-Fi 8 Be? A Primer on IEEE 802.11bn Ultra High Reliability

[7] 2022 Wireless Networks and Beyond, the Future of Connectivity

[8] Challenges in Networking to Support Augmented Reality and Virtual Reality

[9] Networked VR: State of the Art, Solutions, and Challenges - MDPI

[10] Wi-Fi 8: Embracing the Millimeter-Wave Era - arXiv.org