IEEE P802.11
Wireless LANs

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| IEEE 802.11 UHR Proposed CSD |
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Abstract

CSD document for UHR

Rev 1: slight wording change to 1.2.5 d)

Rev 2: inclusion of industrial automation use case and reference to RTA report.

Rev 3: Aligned section 1.2.3 with PAR document

Rev 4: fixing editorial

Rev5: final version

Rev6: Incorporating changes for comments received from other WGs

Rev7: Incorporating changes for comments received from other WGs

# 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.

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## 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.

Wireless LAN (WLAN) continues to gain momentum, demonstrating that it has become an important and sometimes indispensable aspect of people's daily lives. The global pandemic has shown the crucial role of Wi-Fi in strengthening social and economic resilience by enabling remote work and learning, telemedicine, and maintaining connections among people and things across the globe. Below are illustrations of broad sets of applicability for the improvements that are envisioned for the 802.11bn project.

A study conducted by the Wi-Fi Alliance® [1] predicts that the global Wi-Fi economy will reach almost $5 trillion by 2025, a 150% rise from 2018. Residential Wi-Fi providing Internet access and connecting devices at home are estimated to be worth $2.2 trillion. Enterprise Wi-Fi deployments that support a significant portion of enterprise broadband traffic and improve operational efficiency are estimated at a value of $1.6 trillion. Furthermore, the availability of up to 1200 MHz of spectrum in the 6 GHz in many regions of the world is expected to drive technological competitiveness and pave the way to devices and services of the future.

The demand for wireless broadband access continues to increase, and over half of mobile data traffic is offloaded to WLAN networks, from coffee shops and healthcare facilities to public venues and stadiums. Wi-Fi access has become ubiquitous in many parts of the world, with over 540 million public access points now available globally [2].

The role of WLAN technology expands into many industry sectors and supports digital transformation initiatives, offering benefits such as quicker time-to-market, more efficient operations, and an improved customer experience. These market sectors include retail and e-commerce, education, government, transportation, agricultural, manufacturing, and healthcare. An example of a new market entry is seen in the automobile sector. Connected cars generate about 25 gigabytes (GB) of data each hour [3]. A large portion of this data needs to be uploaded to the cloud and Wi-Fi is a compelling technology to address such a use case. An example of WLAN market is industrial automation, with hard real-time cyclic control, machine tools, and production lines requiring 10 ms to 1 ms [9] one-way latency.

The emergence of the metaverse is on the horizon. Augmented and virtual reality (AR/VR) hardware are key user interfaces to access the metaverse. The AR/VR hardware, and the metaverse in general rely on the WLAN technology to connect users to servers that provide the essential services and/or to offload the demanding computation to nearby compute devices or cloud computation resources. The stringent motion-to-photon latency requirement (< 20 milliseconds [4]) and the throughput required to render immersive “reality” continue to raise challenges for the WLAN technology.

WLAN deployments are also expected to play a major role in addressing the digital divide. The Wireless Broadband Alliance (WBA) has shown that Wi-Fi is the most cost-effective and efficient technology for closing the digital divide in small towns, rural areas, and other sparsely populated locations, using the optimal backhaul solution available [5].

The annual shipment of WLAN devices was expected to reach 4.2 billion in 2022 and 18 billion Wi-Fi devices were expected to be in use that year [6]. These devices are becoming more and more diverse, from AR/VR headsets, laptops, smartphones, game consoles, smart speakers, security cameras to Mobile to Mobile (M2M) devices for the industry and agricultural sectors.

Reported by IDC [7], the worldwide VR hardware including consumer and commercial tethered and stand-alone VR headset shipments increased ~5 times, from 2.1 MU in 2016 to 10.8 MU in 2021, with the corresponding revenue quadrupled from $1.1 billions to $4.4 billions. Further projected by the IDC Research [8], the worldwide AR/VR hardware shipment will grow from 9.7 MU in 2022 to 29.9 MU with a total 32.0% CAGR.

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.

The numbers of annual shipment and the diversity of devices and usages illustrate the number of users that are relying on continued progress of WLAN technology.

## 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 will focus on increasing throughput at different Signal to Interference and Noise Ratio (SINR) levels of WLAN in scenarios of an isolated Basic Service Set (BSS) and of overlapping BSSs.

This project will reduce latency in 95th percentile of the latency distribution of WLAN.

The project will provide mechanisms to reduce power consumption for APs (including mobile APs) and improved P2P operation.

There is no other WLAN standard focusing on improving WLAN throughput at different SINR levels in scenarios of an isolated BSS and overlapping BSSs, improving the latency of 95th percentile of the latency distribution, enhancing mobility between BSSs, and providing mechanisms to reduce power consumption for APs (including mobile APs) 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 and UHR SG has reviewed many presentations listing candidate features and many of them indicated that the proposed solutions are technically feasible. Based on these presentations (for instance on multi-AP coordination, low latency channel access, …), the study group membership is confident that there are technical features that are feasible and that allow to meet the target threshold for different requirements.

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.

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 UHR APs.

In cases with lesser backhaul capacity, for lower end APs compliant with UHR 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 UHR 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] <https://www.wi-fi.org/download.php?file=/sites/default/files/private/The_Economic_Value_of_Wi-Fi-A_Global_View_2021-2025_202109.pdf>

[2] [https://www.wi-fi.org/discover-wi-fi/value-of-wi-fi.](https://www.wi-fi.org/discover-wi-fi/value-of-wi-fi.%20)

[3] <https://www.wi-fi.org/beacon/kevin-tang/wi-fi-is-essential-for-driving-automotive-transformation>

[4] <https://danluu.com/latency-mitigation/>

[5] [Rural Wi-Fi Connectivity: Challenges, Use Cases and Case Studies](https://wballiance.com/rural-wi-fi-connectivity/)

[6][https://www.wi-fi.org/members/downloads-members/Wi Fi\_Alliance\_Overview\_202207.pptx/245953/37160](https://www.wi-fi.org/members/downloads-members/Wi%20Fi_Alliance_Overview_202207.pptx/245953/37160)

[7] Worldwide Augmented and Virtual Reality Hardware Forecast, 2023–2027: CY 1Q23, Doc# US49996423

[8] The Consumer VR Metaverse and Its Emerging Cloud Connections, the 2022 World Conference On VR Industry (WCVRI), Lewis Ward, IDC.

[9] <https://mentor.ieee.org/802.11/dcn/18/11-18-2009-06-0rta-rta-report-draft.docx>