

**IEEE 802.11 Working Group Liaison Statement to ISO/IEC JTC1/SC6 in Response to the Request for IEEE 802.11 Working Group comments on document WG1 N289**

**TO:**

- Mr. Jungyup OH, Committee Manager ISO/IEC JTC1/SC6

**CC:**

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**SUBJECT: IEEE 802.11 Working Group Liaison Statement in Response to the Request for IEEE 802.11 Working Group comments on document WG1 N289**

**DATE: 2021-10-15**

Dear Mr. Jungyup OH,

The attachment below contains the IEEE 802/802.11 WG approved response to the request for IEEE 802.11 Working Group comments on document WG1 N289.

Thank you for providing the IEEE 802.11 Working Group with the opportunity to comment on document N289. Please contact me with any questions.

Yours sincerely,

/s/

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ATTACHMENT 1: Liaison statement containing the IEEE 802.11 Working Group response re: N289 review request

## **This Liaison Statement from IEEE 802.11 Wireless LAN Working Group (WG) responds to a request from an ISO/IEC JTC1/SC6/WG1 participant in relation to WG1 N289<sup>1</sup>**

During the recent virtual meeting of ISO/IEC JTC1/SC6/WG1, a document (WG1 N289) submitted by an expert appointed by the Innovation and Technology Commission of the Government of the Hong Kong Special Administrative Region (ITCHK SAR) was briefly addressed. The document was not discussed in any detail because it was submitted after the meeting deadlines. However, a request was made by the submitter for the IEEE 802.11 WG to review the document and provide comments for discussion at a future meeting of WG1.

### **SUMMARY**

WG1 N289 discusses a variety of topics, inspired by IEEE Std 802.11ax™-2021 and the next generation PHY being developed by the IEEE 802.11 WG as IEEE Project 802.11be, Extremely High Throughput (P802.11be). The focus of the first part of WG1 N289 is a challenge as to whether IEEE 802.11ax satisfies its label as a *High Efficiency WLAN*. The second part provides an analysis of the use of 1024 QAM in IEEE 802.11ax for high efficiency and the potential use of even higher modulations in IEEE 802.11be and beyond. Finally, WG1 N289 recommends that SC6 starts a research project *on the challenges of MCS schemes [Modulation and Coding Scheme] and the ways to continuously improve efficiencies of communication and network systems*.

An IEEE 802.11 WG expert has undertaken a detailed review of WG1 N289 on behalf of the WG. His comments are included below. They address various aspects of the analysis documented in WG1 N289.

From a high-level perspective, the expert's comments highlight that the challenge in WG1 N289 in relation to the high efficiency of IEEE 802.11ax-2021 is unsustainable by the evidence. IEEE 802.11ax-2021 provides a variety of features (including 1024 QAM) that can be leveraged in various use cases to achieve high efficiencies in multiple dimensions. Indeed, IEEE 802.11ax-2021 (certified by the Wi-Fi Alliance as Wi-Fi 6 and Wi-Fi 6E) is already very successfully satisfying the high efficiency needs of millions of diverse users. It is expected that IEEE 802.11be will specify a variety of new and refined features (the details have not yet been decided) that together will allow the next generation of IEEE 802.11 (probably marketed as Wi-Fi 7) to satisfy the expanding needs of even more use cases and users, including as an *Extremely High Throughput WLAN*.

The IEEE 802.11 WG agrees that research on new ways to improve the performance of WLANs is always interesting. However, we note the research project proposed in WG1 N289 related to MSC schemes is rather narrowly focused on a relatively minor feature. It is also not obvious that basic research of the type proposed is a suitable activity for a Standards Development Organisation like ISO/IEC JTC1/SC6, although that is a decision for SC6.

The IEEE 802.11 WG believes the most effective way for WG1 experts to contribute to the standardisation of the next generation of Wi-Fi is to participate in the standards activities currently underway in the IEEE 802.11 WG. We note that it is particularly easy for anyone to participate in IEEE 802.11 WG during the COVID disruptions. It is now confirmed that at least the next two WG sessions will operate in remote-only mode, which will allow easy participation by WG1 experts. The details of upcoming sessions are available at [https://grouper.ieee.org/groups/802/11/Meetings/Meeting\\_Plan.html](https://grouper.ieee.org/groups/802/11/Meetings/Meeting_Plan.html).

The following review represents the views of one IEEE 802.11 WG expert in relation to WG1 N289. While the views articulated in this review may not be aligned with all other IEEE 802.11 WG experts, the IEEE 802.11 WG believes they provide a valuable perspective for consideration by WG1.

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<sup>1</sup> This document solely represents the views of the IEEE 802 LMSC, and does not necessarily represent a position of the IEEE or the IEEE Standards Association.

## REVIEW COMMENTS from an IEEE 802.11 WG expert's review of WG1 N289

- 3.2 Lack Definition for “High-Efficiency”
  - “High-efficiency” is a descriptor, not a feature or function and as such it does not need a definition. The entire 802.11ax amendment is the “definition” of high-efficiency.
  - The descriptor language has precedence in 802.11n, described as “High Throughput”, and 802.11ac described as “Very High Throughput”.
- 3.3 Questions on “High-Efficiency”
  - Regarding, *““Because there is no definition for “HE”, it is not convincing to name 802.11ax-2021 as “High-Efficiency WLAN”.”* High Efficiency as a descriptive term as with the 11n and 11ac precedence completely counters this statement.
- 3.3.1 How to Define “High”?
  - Regarding, *“To call 802.11ax-2021 “High-Efficiency WLAN”, 6N17510 first needs to define the term “High” to answer questions like: What is “high”? How it is compared with ‘Low’? What kind of technical measurement to qualify as “high”? How high is the “High”?”* High Efficiency is a descriptive term as with the 11n and 11ac precedence completely counters this statement.
- 3.3.2 What is “Efficiency”?
  - *“An ideal improvement in communications system is the increase of efficiencies in both SE and PE. However, according to natural laws, there is a conflict between the two. An ideal improvement in communications system is the increase of efficiencies in both SE and PE. However, according to natural laws, there is a conflict between the two. A natural trend is that in order to send more information, the power consumption will also increase. Resolving this contradiction and achieving efficiency in both areas at the same time has been the most daunting challenge.”*

The author incorrectly assumes that all features will necessarily be used altogether and for single applications. 802.11ax provides a collection of features covering a range of high efficiency improvements (e.g., average throughput per station, power, and network). These features may be used to target specific applications. For example, power efficiency features will benefit IOT, throughput features will benefit streaming, and network improvements would benefit large scale deployments.
  - *“Therefore, 6N17510 needs to clarify whether it has higher efficiency in SE or PE.”* No such clarification is needed as higher efficiency is provided via one or more of the defined features in all of the identified areas as described.
- 3.4.1 High-Efficiency mechanism, individual or combined?
  - *“Separately, these four types of “high-efficiency” mechanisms each can indeed enhance some efficiency, but combined do not qualify a comprehensive “high-efficiency” system.”* The mechanisms provide a toolbox of high efficiency features that the user applies to their desired need and application.
- 3.4.2 High-Efficiency mechanism power consumption
  - *“Other three mechanisms actually use more power in order to achieve higher throughput. OFDMA+MMIMO aggregates network throughput, but in the meantime also aggregates power consumptions of sub-channels. MCS 10~11 can increase single channel throughput, but unfortunately also requires more energy to operate.”* This is not necessarily true. In order to transmit a fixed amount of data (e.g., 1 GB of data), using a lower data (e.g., single user operation or lower MCS) requires longer time on air. Longer time on air consumes more power at the transmitter (e.g., the power amplifier is active for longer). Similarly, the receiver consumes more power being active. Using high throughput modes with a fixed amount of data can drastically reduce active transmission and reception time, thereby reducing overall power consumption.

- *“Overall, even though 6N17510 contains TWT mechanism, the whole architecture does not find a way to reduce over-all power consumption in information transmission and does not qualify as a “high power efficiency” system.”* This is incorrect, see previous bullet.
- **3.5.1 General comments**
  - *“Among the four mechanisms, only modulation and coding scheme has a “HE” attached to its abbreviation (HE-MCS). This mechanism is the most direct contribution to SE (spectral efficiency) which is also the most important indicator of efficient use of frequency resources.”* This is incorrect. For example, for 80 MHz, one spatial stream, 800 nsec guard interval, the data rate for VHT-MCS 9 is 390.0 Mbps. However, for HE-MCS 9, the data rate is 480.4 Mbps. This is 23% increase in spectral efficiency. Therefore, there are other features in 802.11ax directly contributing to spectral efficiency.
- **3.5.2 Comparison of MCS 8~9 and MCS 10~11**
  - *“The most notable technical improvement in 802.11ax-2021 is its adoption of MCS 10-11 into its MCS schemes”.* While one could make this claim, there is a long list of “notable technical improvements” in 802.11ax, including OFDMA, and uplink MU-MIMO. One could equally argue that OFDMA is “the most notable technical improvement”.
  - *“Is this the reason for 802.11ax-2021 been called “High-Efficiency WLAN”? Does 2bps/Hz separate high-efficiency from the low?”* No. All the new features in the entire 802.11ax amendment contribute to the reason it is called High Efficiency.
- **3.5.3 MCS performance and High-Efficiency?**
  - *“Unless this problem of “unreliable performance” of higher order QAM MCS is resolved, the term “high-efficiency” should be used carefully.”* The author is focusing only on MCS 10/11 as high efficiency. In addition, the author also assumes “system can select “low order MCS” in harsh environment in which MCS 10~11 cannot provide reliable link”. However, all other features in the 802.11ax amendment will contribute to the complete system deployment and performance capabilities. As an example, let us assume a user is in the author’s condition of a “harsh environment” and MCS 11 is not possible. In this case, with uplink OFDMA, the user is assigned a narrower frequency resource unit. This assignment increases the power spectral density and reduces the noise bandwidth. Now the user is capable of supporting MCS 11 and achieves higher spectral efficiency.
- **4 Comments on 802.11be (6N17549)**
  - The development of P802.11be is in the relatively early stages, pre-initial approved Working Group draft, and thus is probably too early to comment definitively on 802.11be contents. That said, the current amendment name is “Extremely high throughput (EHT)”; the term “throughput” is used in the amendment title. There will be many new features that contribute to “extremely high throughput” besides an increase in QAM order.
- **5.1 MCS Road-Map**
  - The 802.11 community does not create an MCS roadmap. MCS increases are just one tool in the large toolbox of enhancements introduced from one amendment to a subsequent amendment as technical capabilities of the hardware components improve.
- **5.2 Power Efficiency Concerns over Future MCS Plans**
  - 802.11 covers a wide spectrum of application and device spaces. Some applications/devices will be tolerant of the necessity of increased power consumption of a specific feature, and some will not. Those that will not will benefit from other new features in the next amendment.
- **5.3 Spectral Efficiency Concerns over Future MCS Plans**
  - MCS evolution is one of many features which support an increase in spectral efficiency, e.g., MIMO.

- 5.4 Technical Concerns on Future MCS Plans
  - *“daunting challenges”*. It is fair to say that 20+ years ago, when an 11 Mbps specification was approved, that it was hard to imagine multi-gigabit WLAN speeds being achieved. Innovation in signal processing techniques, material science and algorithmic processing offer the possibility of continued performance improvements.
  
- 5.5 MCS in Other IEEE Standards
  - *“since QAM modulation has been the core MCS mechanism in the IEEE standard system with the major difference been that 802.11 is the first IEEE standard using the term “High-Efficiency-MCS”*. This is a very narrow view of IEEE standards. Specific to 802.11, each amendment has contained a breadth of features to address the scope of the problem.
  
- 6 Conclusions and Suggestions
  - *“One possible argument may be that 1024-QAM represents the state of the art in MCS and there is no other better technological solution.”* 1024-QAM is just one of many new features in 802.11ax that contributes to high efficiency.
  
  - *“From the two documents, serious concerns are raised about the future of MCS efficiency growth and prospect of continued WLAN technological advances.”* Modulation enhancements are just one of many new features contributing to enhancements in WLAN technology.
  
  - *“may face a dead end not far away”*, Modulation enhancements are just one of many new features contributing to enhancements in WLAN technology.
  
  - *“It is recommended that SC 6 starts a research project on the challenges of MCS schemes and the ways to continuously improve efficiencies of communication and network systems.”* Modulation enhancements are just one of many new features contributing to enhancements in WLAN technology to improve performance across throughput, power efficiency and spectral efficiency. It is also not obvious that basic research of the type proposed is a suitable activity for a Standards Development Organisation like ISO/IEC JTC1/SC6, although that is a decision for SC6. NB experts are welcome and invited to participate in IEEE 802.11 WG standards development.

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